AIP Conference Proceedings

AIP Publishing

Volume 3148

The 2nd International Conference of Mathematics Education, Learning, and Application

Jember, Indonesia • 23–24 September 2023

Editors • Dian Kurniati, Rafiantika Megahnia Prihandini, Ridho Alfarisi and Robiatul Adawiyah

Available Online: pubs.aip.org/aip/acp

AIP Conference Proceedings

Volume 3148

ISBN: 978-0-7354-5088-2

ISSN: 0094-243X

pubs.aip.org/aip/acp

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All papers have been peer reviewed.

AIP Publishing
Melville, New York, 2024
AIP Conference Proceedings
Volume 3148

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ISBN 978-0-7354-5088-2
ISSN 0094-243X
Printed in the United States of America

AIP Conference Proceedings, Volume 3148
The 2nd International Conference of Mathematics Education, Learning, and Application

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EDUCATION

Preface: The 2nd International Conference of Mathematics Education, Learning, and Application

The 2nd ICOMELA (International Conference of Mathematics Education, Learning, and Application) is an annual conference organized by the Department of Mathematics Education University of Jember. This conference is held from 23rd-24th September 2023 in Jember University, East Java, Indonesia via online platform. The conference is held to welcome participants from many countries, with broad and diverse research interests on mathematics and learning. The aim of the second international conference is to present and discuss the latest research that contributes to the sharing of new theoretical, methodological and empirical knowledge and a better understanding in the area of mathematics and learning.

This conference permits the engagement of several notable keynote speaker from inside and outside Indonesia. The 2nd International Conference of Mathematics Education, Learning, and Application are focused on problems related to (1) Mathematics Learning, (2) Mathematics Learning Technology, (3) Mathematics, (4) Statistics, (5) Geometry, (6) Discrete Mathematics, (7) Algebra, (8) Mahematics Analysist, (9) Mathematics Education, (10) Applied Mathematics, (11) Math Computation, (12) Ethnomathematics. All accepted papers will be published in AIP conference proceeding indexed by Scopus.

The participants of the 2nd ICOMELA consisted of research students, academics and researchers, scholars, scientists, teachers and practitioners from many countries. The plenary session was conducted using Zoom Cloud Meeting with the invited speakers from many countries such as from Malaysia, South Africa, and Korea and Indonesia. After parallel session, all the participants of the 2nd ICOMELA were splitted into parallel session room using zoom cloud meeting breakout to disseminate and discuss their research finding.

On behalf of the organizing committee, finally we gratefully acknowledge the support from the Faculty of Teacher Training ad Edycation, University of Jember of this conference. This conference contributes to the sharing of new theoretical, methodological, and empirical knowledge and a better understanding in the area of mathematics and learning. We would also like to extend our thanks to all lovely participants who attended this unforgettable and valuable event.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 010001-1–010001-1; https://doi.org/10.1063/12.0030387

The Banking Credit Risk Behavior in Indonesia: The Axiom of Expected Utility Theory

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Abstract The financial system's vulnerability to the behavior patterns of financial system actors, especially banks, to risk-taking, is an important factor that must be considered to maintain financial system stability. The tendency of behavior patterns of actors that lead to adverse selection actions and moral hazard due to information asymmetry between borrowers and bank financial institutions as lenders cause friction in the financial system and can potentially cause a financial crisis**.** This study aims to investigate the axioms of expected utility theory in identifying the risk behavior patterns of bank borrowers. The analytical approach employed in this research is the experimental method. The study location was deliberately chosen using purposive sampling, specifically targeting Jember Regency. Experimental techniques were applied to financial actors, selecting 19 commercial bank customers in Jember Regency as the research sample. The study utilizes both primary and secondary data, encompassing perceptions as well as pre-existing data. The findings indicate that respondents generally prefer options that offer certainty, even if those options are disadvantageous. Respondents exhibit an asymmetric response to risk anticipation, reflecting their expectations when confronting the uncertainty of a prospect.

INTRODUCTION

Financial institutions or banks as financial intermediaries substantially reduce transaction costs where banks can generate economies of scale. Low transaction costs enable financial intermediaries to perform risk sharing at minimal expense, allowing them to profit from the spread between the returns generated by riskier assets and the payments made on sold assets. This process, often referred to as asset transformation, involves converting higher-risk assets into safer assets for investors. The primary issue in capital allocation within banking activities, functioning as an intermediary between fund owners and borrowers, is information asymmetry [4]. Fund owners lack complete information regarding the characteristics of borrowers. This asymmetry complicates decision-making, particularly given the scarcity and limited availability of resources. Consequently, the provision of accurate and reliable information is crucial for making sound decisions, maximizing profitability, and ensuring the optimal use of these scarce resources [5].

The primary issue in capital allocation within banking activities, which functions as an intermediary between fund owners and borrowers, is information asymmetry [4]. Fund owners lack complete information about the characteristics of borrowers. This asymmetry complicates decision-making, especially given that resources are relatively scarce and limited. Therefore, accurate and reliable information is crucial for making appropriate decisions, maximizing profitability, and optimizing the use of scarce resources [5].

Information asymmetry between lenders and borrowers is a key factor in the financial system, contributing to financial friction. Lenders often lack information about borrowers' creditworthiness and cannot detect inefficient behavior. The ex-ante theory addresses this information gap, known as adverse selection, where collateral is used to

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020001-1–020001-7; https://doi.org/10.1063/5.0244784
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

distinguish between good and bad borrowers. The ex-post theory focuses on incentive friction, or moral hazard, suggesting that lenders use collateral to encourage borrowers to adopt more efficient behaviors.

Risk behavior in decision-making is based on the characteristics of individual rationality. In the realm of economic theory, it is assumed that rational individuals follow the von Neumann-Morgenstern expected utility function (EU). EU is an axiomatic approach, which is an effort to understand the workings of the human mind with a mathematical modeling approach. However, at the empirical level, human rationality often does not follow the characteristics of rationality in the EU. This gives rise to alternative theories such as Generalized Expected Utility (GEU) which include Regret Theory [9], Disappointment Aversion, Expected utility without independent axiom [10], and cumulative prospect theory [15]. Outside of GEU, there is another EU alternative, namely Prospect Theory [8].

The experimental method is a systematic method of establishing causal relationships between phenomena. This method is to determine the effect of giving treatment to research subjects by conducting a contingent valuation of a decision so that ordering information is obtained. Expected Utility Theory is a model that explains decision analysis under risk, serving as a normative model of rational choice. It has also been widely used as a descriptive model of economic behavior. This study aims to investigate the axioms of expected utility theory in the behavior patterns of bank borrowers, specifically regarding their tendency to engage in risk-taking actions that could pose risks to the financial system.

LITERATUR REVIEW

In economic theory, it is assumed that rational individuals adhere to the von Neumann-Morgenstern expected utility function (EU). The EU is an axiomatic approach that seeks to understand decision-making through mathematical modeling. In economics, game theory, and decision theory, the expected utility hypothesis serves as a utility theory to determine "betting preferences" for uncertain outcomes or gambles, as indicated by the payout function, which may involve money or other goods, the probability of occurrence, risk aversion, and utility differing from the payout. This theory is crucial for explaining choices that contradict the expected value criterion, which only considers the size of the payout and the probability of occurrence. Daniel Bernoulli developed this theory in 1738. Until the mid-twentieth century, the standard term for expected utility was moral expectation, distinct from mathematical expectation.

Von Neumann and Morgenstern (1947) developed a utility theorem that underscores the significance of the rationality axiom if the expected utility hypothesis is satisfied. Expected utility theory is founded on four axioms of rational decision-making: completeness, transitivity, independence, and continuity. Completeness assumes that individuals can make the best choice between two alternatives. Transitivity implies that individual decisions are consistent, aligning with the completeness axiom. Independence suggests that combining two possibilities with a third one will not alter the preference order of the first two choices. Continuity posits that if there are three options, A, B, and C, and the individual prefers A over B and B over C, there exists a combination of A and C where the individual is indifferent between this combination and option B. If these axioms are fulfilled, the individual is deemed rational, and their choice is represented by a utility function. This is known as the von Neumann-Morgenstern utility representation theorem.

The expected utility model developed by John von Neumann and Oskar Morgenstern dominated decision theory from 1944 to the 1970s, serving as both a prescriptive and descriptive model. However, it faced criticism from Maurice Allais and Daniel Ellsberg, who highlighted inconsistencies in decision-making with the axiom of expected utility through their respective paradoxes. To address these issues, Daniel Kahneman and Amos Tversky developed prospect theory in 1979. While generalized expected utility falls within the realm of behavioral theory, it remains largely within the mainstream of economic theory.

Prospect theory, developed by Daniel Kahneman and Amos Tversky in 1979, is a behavioral economic theory that explains how individuals make choices among probabilistic alternatives involving known risks. The theory posits that decisions are based on the perceived value of potential losses and gains, which are evaluated using specific heuristics. This model provides a more accurate description of real-life decision-making compared to models based on optimal decisions.

RESEARCH METHOD

This research employs an experimental approach to identify the behavior patterns of agents in risk-taking. The study location was deliberately chosen using purposive sampling in Jember Regency, where experimental techniques were applied to financial actors, resulting in a sample of 19 commercial bank customers from Jember Regency. The study utilized both primary and secondary data, including perceptions and existing data. A quantitative approach, specifically the Experimental Method, was employed for analysis. Qualitative data analysis involves data reduction, data presentation, and conclusion drawing [12,4,7]. The sampling technique included in-depth interviews to capture the behavior and perceptions of the subjects. Regarding the rationality of subjects in making risky choices, Expected Utility Theory was used to explain decision-making based on risk. This theory serves as a normative model of rational choice and is widely utilized as a descriptive model of economic behavior.

Von Neumann and Morgenstern outline the implications of expected utility theory in choosing a prospect, based on three fundamental principles:

1. *Expectation* U*(x1 ,p1 ;...; xn, ,pn) =* p1 u(x1) +...+ *pn* u(xn). An expectation of utility is the sum of the utility's possible outcomes, xi, *multiplied by the utility's probability of coming, u(*xi*)*
2. *Asset Integration*: *(x1,p1 ;...; xn, ,pn) can be accepted into a wealth position* w, *if U(*w+x1,p1 ;...; *w+ xn, ,pn*) > u(*w*). A person will receive a prospect if the prospect brings more benefits than not receiving it.
3. *Risk aversion*: u has a *concave*, (u''<0). A person's preference will decrease when dealing with the prospect of higher risk.

According to [8], observation of individual behavior in making risky choices by giving direct questions to research subjects. The use of this method relies on the assumption that a person knows how they will behave in the actual situation of choice. Another assumption used is that the subject has no reason to hide or disguise the true choice. If a subject is accurate enough to predict choices, a general and systematic violation of the theory of *expected utility* in the experiment can provide evidence to question the theory. Some of the phenomena found to violate the axiom of expected *utility theory* are:

1. *Certainty Effect*. In *expected* utility theory, the utility of a possible outcome is weighted by the probability of that utility. This explains a series of choice problems where people's preferences systematically violate this principle. This research shows that many people tend more towards a prospect that gives a more definite possible outcome than another prospect that gives the same U(x1,*p1 ;...; xn, ,pn*) value. This is a violation of axiom 1. This condition suggests that one's expectations are not enough with the *expected utility theory*.
2. *Reflection Effect.* Most people prefer prospects that offer the possibility of a more definite outcome. However, this does not apply to a prospect that gives a negative possible outcome (*x1 <0*). There is a pattern where individuals avoid negative prospects so that the pattern will be the opposite of the observation of the *certainty effect*.
3. *Probabilistic Insurance*. This is an example of a violation of the axiom of *asset integration*, where if a prospect is given a certain weight, then individual preferences will not change. In the perspective of *expected utility theory*, probabilistic insurance products *will be considered more attractive than standard insurance products, because mathematically* probabilistic insurance products *provide* a higher U(x1 ,*p1 ;...; xn, ,pn*) value. However, most people prefer standard insurance over *probabilistic insurance*. This is a violation of *asset integration*, axiom 2.
4. *Isolation Effect*. In simplifying the choice between alternatives, individuals often overlook the components of alternative prospects and focus on the components that set them apart. This study observed that people can make mistakes in making assessments because individuals cannot see the choice of prospects. A pair of leads can be broken down into general and specific components in more ways than one, and different (general and specific) decomposition approaches will lead to different preferences.

RESULTS

Subject's Preference to Risk

A prospect is considered at risk if the probability associated with it is known. This stage comprises six parts that demonstrate the failure of Expected Utility Theory in explaining subject behavior. The first part involves preference misalignment, as described by Allais (1953). The second part addresses a violation of the substitution axiom, where subjects tend to choose options that provide certainty in the acquisition value (payoff). The third part examines subjects' preferences concerning probability perturbations. The fourth section tests the loss aversion hypothesis, suggesting that utility is based on changes in wealth rather than its final position. The fifth part assesses the consistency of subjects' preferences concerning perturbations in the acquisition value. The final part of the experiment evaluates subjects' preferences when faced with very small probabilities.

Part I: Preference Inconsistency Test

The stages in testing the discrepancy of the subject's preferences apply to questions number 1 until 6 in the simulation shows that 80% chose B in question number 1. This shows U(80,000) > (0.33). U(100,000) + (0.66). U (80,000) assuming U(0) = 0.

Table 1. Preference Inconsistency Test

No.1.			
A :	Rp.100.000,- probability 33% Rp. 80.000,- probability 66%	B :	Rp. 80.000,- probability 100%
N = 19	20%		80%
No. 2.			
A :	Rp.100.000,- probability 33%	B :	Rp. 80.000,- probability 34%
N = 19	60%		40%

In question 2, the probability of receiving Rp. 80,000,- was reduced by 0.66 for both choice A and choice B. The experimental results show that 60% of participants chose option A, indicating no violation of the expected utility theory as described by Allais (1953). According to this theory, expected utility is the sum of the utility of possible outcomes multiplied by their probabilities.

Question 3 is a modification of question 1, reducing the probability of earning Rp. 80,000,- by 0.33 for both choices A and B. The experimental results show that 95% of participants chose option B. This pattern does not indicate a violation of the expected utility theory, which asserts that changes in the probabilities of choices A and B should not alter individual preferences in making risky decisions.

No. 3.			
A :	Rp.100.000,- probability 33% Rp. 80.000,- probability 33%	B :	Rp. 80.000,- probability 67%
N = 19	5%		95%

The experimental results from questions 1 to 3 indicate that subjects generally prefer prospects that offer a more certain outcome. Questions 4, 5, and 6 are modifications of questions 1, 2, and 3, with the acquisition value changed from Rp. 100,000,- to Rp. 50,000,-. The experimental data reveal that subjects still favor the prospect with a more certain outcome, with choice B being selected more frequently than option A.

No. 4.			
A :	Rp.50.000,- probability 33% Rp. 40.000,- probability 66%	B :	Rp. 40.000,- probability 100%
N = 19	30%		70%
No. 5			
A :	Rp.50.000,- probability 33% Rp. 40.000,- probability 33%	B :	Rp. 40.000,- probability 67%
N = 19	5%		95%
No. 6.			
A :	Rp.50.000,- probability 33%	B :	Rp. 40.000,- probability 34%
N = 19	50%		50%

Questions 7, 8, and 9 are modifications of questions 4, 5, and 6, where the acquisition value is replaced with a loss value of Rp. 50,000,- and Rp. 40,000,-. The experimental results show that the majority of subjects preferred choice B over choice A. This aligns with the results from questions 4, 5, and 6, where subjects consistently chose the prospect with a definite possible value.

No. 7.			
A :	(Rp.50.000,-) probability 33% (Rp. 40.000,-) probability 66%	B :	(Rp. 40.000,-) probability 100%
N = 19	5%		95%

No. 8.			
A :	(Rp.50.000,-) probability 33% (Rp. 40.000,-) probability 33%	B :	(Rp. 40.000,-) probability 67%
N = 19	10%		90%

No. 9.			
A :	(Rp.50.000,-) probability 33%	B :	(Rp. 40.000,-) probability 34%
N = 40	10%		90%

Part II: Axiom Substitution Violation Testing

The second part examines potential violations of the substitution axiom, where subjects typically choose options that provide certainty in the acquisition value (payoff). Question 10 reveals that subjects prefer option B, demonstrating the preference (0.80)U(100,000) < (1.00)U(70,000). Question 11 modifies question 10 by multiplying the probabilities of choices A and B by 0.25, yet subjects still prefer option B, showing the preference (0.25)(0.80)U(100,000) < (0.25)(1.00)U(70,000). This preference for certainty ($p = 1.00$) in the acquisition value is known as the certainty effect. Questions 10 to 15 further illustrate that subjects generally choose the option providing certainty in their acquisition value, with only questions 14 and 15 favoring option A. Additionally, subjects continue to choose the option offering greater certainty even when neither option has a probability of 1. These findings support the certainty effect hypothesis proposed by [8].

No. 10.			
A :	Rp.100.000,- probability 80%	B :	Rp. 70.000,- probability 100%
N = 19	25%		75%

Part III: Testing Subject Preferences Relative to Perturbation Probability

The third part investigates subjects' preferences in response to probability perturbation. Questions 19 to 24, except for question 20, reveal a tendency for subjects to choose the option with a higher probability of a favorable outcome.

No. 19.			
A :	Rp.100.000,- probability 45%	B :	Rp. 50.000,- probability 90%
N = 19	0%		100%

Part IV: Loss Aversion Hypothesis Testing

This section examines the loss aversion hypothesis, which posits that utility is based on changes in wealth rather than its final position. The experiment investigates subjects' behavior concerning loss aversion. The experimental results indicate that subjects chose option B, demonstrating loss-averse behavior in their decision-making.

No. 25.			
A :	(Rp.50.000,-) probability 50%	B :	(Rp. 25.000,-) probability 100%
N = 19	5%		95%

Part V: Testing the Consistency of Preferences on Perturbation of Acquired Values

The fifth part of the study examines the consistency of subjects' preferences regarding the perturbation of acquisition value. Questions 28 to 36 are designed to test this consistency. Most respondents preferred option B over A, indicating that the perturbation of the acquisition value does not influence their preference. Subjects consistently choose the option with a definite probability of obtaining it. Consequently, in this context, the utility function does not become convex in adverse choices, which contradicts the findings of Kahneman and Tversky (1979) and Markowitz (1952).

No. 28.			
A :	(Rp.40.000,-) probability 25%	B :	(Rp. 10.000,-) probability 100%
N = 19	5%		95%

In the final part of this experiment, subjects' preferences were assessed under conditions of very low probability. Questions 37 to 41 reveal that most subjects are risk-averse when making choices. The majority preferred option B over A, as option B provided a probability of 1 (p=1.00). This finding aligns with previous experiments, where subjects favored the prospect of a more certain acquisition.

No. 37.			
A :	Rp.100.000,- probability 1%	B :	Rp. 1.000,- probability 100%
N = 19	5%		95%

DISCUSSION

The study of [8] found an opposite pattern between gains and losses. When a prospect provides a favorable choice, individuals tend to choose the option that provides a higher probability, and certainty effects so that individual behavior is risk averse. On the other hand, Kahneman finds risk-seeking behavior when a prospect gives a negative (adverse) acquisition value. This is a consequence of the certainty effect because if a negative choice is given greater weight because of the degree of certainty, the subjective value of the prospect will be smaller (negative) than the uncertain negative prospect. On the other hand, the discussion on preference concludes that the subject's response is asymmetric and closely linked to their risk preference. Ideally, the mirroring effect results from loss-averse behavior. In favorable conditions, individuals are risk-averse, while in adverse conditions, they become risk-seekers. Respondents tend to select the option offering certainty, even if it is detrimental, indicating that their anticipation of risk is asymmetric. This asymmetric response to risk reflects what the subject expects when dealing with the uncertainty of a prospect.

CONCLUSION

The results indicate that respondents prefer options that offer certainty, even if those options are detrimental. This suggests that respondents exhibit an asymmetric response to risk, reflecting their expectations when confronting uncertain prospects. Moreover, probability distortion generally disappears when a prospect has a probability of one.

ACKNOWLEDGMENT

We would like to thank the University of Jember for supporting this research through the Research Group Grant provided by LP2M University of Jember. Any errors or omissions in this paper are the sole responsibility of the authors and do not reflect the views of the institution.

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On Projective Presentation of the Generalized Transpose of a Module

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Abstract. Let K be an algebraically closed field and A be a finite dimensional K-algebra. If M is a finitely generated right A-module then M admits minimal projective presentation that induces the transpose of M, denoted by Tr M. This concept was generalized into the transpose of M relative to U where U is a nonzero submodule of M. As in the construction of Tr M we also obtain its minimal projective presentation, in this paper we will investigate the projective presentation of the generalized transpose.

INTRODUCTION

The definition of the transpose of a module can be seen in [1]. The construction involved the minimal projective presentation which consists of some initial terms of the minimal projective resolution of the considered module. As the concept of projective resolution was generalized in [2], in 2002 Mahatma et al. introduced the generalized concept of the transpose of a module [3], called the relative transpose. They gave the necessary and sufficient conditions for the relative transpose to be zero. As in the construction of the transpose of a module we also obtain its minimal projective presentation, in this research we will investigate the projective presentation of the relative transpose of a module. The fundamental concept required for this discussion can be found in [4] and [5].

Theoretical Study

Throughout this article, K denotes an algebraically closed field and A denotes a finite dimensional K-algebra. It was shown in Section I.5. of [1] (Theorem 5.8. page 28) that any finitely generated right A-module M admits a *projective cover*, that is an epimorphism $P \xrightarrow{d} M$ where P is projective and d is minimal, i.e. $\ker(d)$ is *superfluous*. As a consequence, any right A-module M admits a *minimal projective resolution*, that is the sequence $\cdots \xrightarrow{d_3} P_2 \xrightarrow{d_2} P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ where $P_0 \xrightarrow{d_0} M$, $P_1 \xrightarrow{d_1} \ker(d_0)$, $P_2 \xrightarrow{d_2} \ker(d_1)$, and so on, all are projective covers. The sequence $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ taken from the minimal projective resolution is called a *minimal projective presentation of* M.

Consider the contravariant functor $\mathrm{Hom}_A(-,A)$ which maps every right A-module M to the left A-module $\mathrm{Hom}_A(M,A)$ and maps every homomorphism $M \xrightarrow{f} N$ to the homomorphism $\mathrm{Hom}_A(N,A) \xrightarrow{\bar{f}} \mathrm{Hom}_A(M,A)$ where $\bar{f}(\varphi) = \varphi \circ f$ for every $\varphi \in \mathrm{Hom}_A(N,A)$. For simplicity, let us denote $\mathrm{Hom}_A(X,A)$ by X^t for every right A-module X.

Let M be a right A-module and $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ be a minimal projective presentation of M. If we apply the functor $\mathrm{Hom}_A(-,A)$ to this presentation, then we have the sequence $0 \to M^t \xrightarrow{d_0^t} P_0^t \xrightarrow{d_1^t} P_1^t$. We denote the $\mathrm{Coker}\, P_1^t = P_1^t / \mathrm{Im}(d_1^t)$ by $\mathrm{Tr}\, M$, called the *transpose of* M. The basic properties of the transpose of a module M is given in the following proposition.

Proposition 1 Let M be an indecomposable right A-module.

(a) M is projective if and only if $\mathrm{Tr}\, M = 0$.

AIP Conf. Proc. 3148, 020002-1–020002-4; https://doi.org/10.1063/5.0242513
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(b) If M is not projective then $\operatorname{Tr}(\operatorname{Tr} M) \cong M$. Further, if N is a right A-module then $M \cong N$ if and only if $\operatorname{Tr} M \cong \operatorname{Tr} N$.

(c) If M is not projective then $P_0^t \xrightarrow{d_1^t} P_1^t \to \operatorname{Tr} M \to 0$ is a minimal projective presentation of $\operatorname{Tr} M$.

The proof of this proposition can be found in Section IV.2. of [1] (Proposition 2.1. page 107).

Motivation

Inspired by [6] and [7], Mahatma and Muchtadi-Alamsyah in [2] introduced the generalization of the projective resolution, named the *U-projective resolution*. If M is a right A-module and U is a submodule of M then the U-projective resolution of M is the sequence $\ldots \xrightarrow{d_3} P_2 \xrightarrow{d_2} P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ satisfying:

1. All P_i s are projective.
2. $\operatorname{Im}(d_0) = M$.
3. $\operatorname{Im}(d_1) = d_0^{-1}(U)$.
4. For every $k \in \bullet$, $\operatorname{Im}(d_{k+1}) = d_k^{-1}(U_{k-1})$ where U_j is a submodule of P_j, $j = 0,1,2,\ldots$.

In the same article, they proposed a method of constructing the U-projective resolution of M so that the resolution is unique up to a kind of homotopy, called the (U,U)-homotopy which is introduced in [7]. For another reference, see [8].

Trivially, this notion bring us to the concept of the *minimal U-projective resolution of M* and also the *minimal U-projective presentation of M* as well, where the last is obviously given by the sequence $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ with $P_0 \xrightarrow{d_0} M$ and $P_1 \xrightarrow{d_1} d_0^{-1}(U)$ are all projective covers. As the minimal projective presentation of M be the material for constructing the module $\operatorname{Tr} M$, Mahatma et al. in 2022 utilized this sequence to define the transpose of M relative to the submodule U, denoted by $\operatorname{Tr} M[U]$. They showed in [3] that $\operatorname{Tr} M[U] = 0$ if and only if $d_0^{-1}(U)$ is projective.

METHODS OF RESEARCH

In this paper, we shall restrict the discussion only for case $U \neq 0$. The method of constructing the minimal U-projective presentation can be seen in [2].

Now suppose that M is a right A-module, U is a nonzero submodule of M, and $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ is a minimal U-projective presentation of M. Apply the functor $\operatorname{Hom}_A(-,A) = (-)^t$ to this sequence to obtain the sequence $0 \to M^t \xrightarrow{d_0^t} P_0^t \xrightarrow{d_1^t} P_1^t$. The module $\operatorname{Coker} P_1^t = P_1^t / \operatorname{Im}(d_1^t)$ is called the *transpose of M relative to submodule U* denoted by $\operatorname{Tr} M[U]$.

Here, we have the sequence $P_0^t \xrightarrow{d_1^t} P_1^t \xrightarrow{\pi} \operatorname{Tr} M[U]$ which is obviously exact. We will show that the left A-modules P_0^t and P_1^t are projective.

RESULTS AND DISCUSSION

Before we go, consider the following lemma. The proof can be found in Section I.5. of [1] (Lemma 5.3. (b) page 26).

Lemma 1 Suppose that $\{e_1, e_2, \ldots, e_n\}$ is a complete set of primitive orthogonal idempotents of A and $A = e_1A + e_2A + \ldots + e_nA$ is an indecomposable decomposition of A as a right A-module. If a right A-module P is projective then $P = Q_1 \oplus Q_2 \oplus \ldots \oplus Q_m$ where every Q_i is indecomposable and isomorphic to some e_jA.

We know that the module P_0 and P_1 in the sequence $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ are projective. Let $\{e_1, e_2, \ldots, e_n\}$ be a complete set of primitive orthogonal idempotents of A. According to Lemma 1, we may regard P_0 as $e_{s(1)}A \oplus e_{s(2)}A \oplus \ldots \oplus e_{s(m)}A$. Hence, every homomorphism $f \in \mathrm{Hom}_A(P_0, A)$ can be considered as $[f_1 \quad f_2 \quad \ldots \quad f_m]$ where $f_i : e_{s(i)}A \to A$ for $i = 1, 2, \ldots, m$. Now, define the map $\phi : \mathrm{Hom}_A(P_0, A) \to Ae_{s(1)} \oplus Ae_{s(2)} \oplus \ldots \oplus Ae_{s(m)}$ by $\phi([f_1 \quad f_2 \quad \ldots \quad f_m]) = f_1(e_{s(1)})e_{s(1)} \oplus f_2(e_{s(2)})e_{s(2)} \oplus \ldots \oplus f_m(e_{s(m)})e_{s(m)}$.

It is easy to verify that ϕ is a left A-module homomorphism. Now notice that if $\phi([f_1 \quad f_2 \quad \ldots \quad f_m]) = 0 \oplus 0 \oplus \ldots \oplus 0$ then we have $f_i(e_{s(i)})e_{s(i)} = 0$ for $i = 1, 2, \ldots, m$. Hence, for every $a \in A$,

$$\begin{aligned}
f_i(e_{s(i)}a) &= f_i(e_{s(i)})a \\
&= f_i(e_{s(i)})1a \\
&= f_i(e_{s(i)})(e_1 + e_2 + \ldots + e_n)a \\
&= \left(f_i(e_{s(i)})e_1 + f_i(e_{s(i)})e_2 + \ldots + f_i(e_{s(i)})e_{s(i)} + \ldots + f_i(e_{s(i)})e_n\right)a \\
&= \left(f_i(e_{s(i)})e_{s(i)}e_1 + f_i(e_{s(i)})e_{s(i)}e_2 + \ldots + f_i(e_{s(i)})e_{s(i)}e_{s(i)} + \ldots + f_i(e_{s(i)})e_{s(i)}e_n\right)a \\
&= f_i(e_{s(i)})e_{s(i)}a \\
&= 0
\end{aligned}$$

since

$$e_u e_v = \begin{cases} e_u & \text{if} \quad u = v \\ 0 & \text{if} \quad u \neq v \end{cases}$$

Thus, $f_i = 0$ for $i = 1, 2, \ldots, m$. This shows that ϕ is injective.

Next, if $b_1 e_{s(1)} \oplus b_2 e_{s(2)} \oplus \ldots \oplus b_m e_{s(m)} \in Ae_{s(1)} \oplus Ae_{s(2)} \oplus \ldots \oplus Ae_{s(m)}$ define the homomorphism $[g_1 \quad g_2 \quad \ldots \quad g_m] \in \mathrm{Hom}_A(P_0, A)$ by $g_i(e_{s(i)}) = b_i$ for $i = 1, 2, \ldots, m$. Clearly, $\phi([g_1 \quad g_2 \quad \ldots \quad g_m]) = b_1 e_{s(1)} \oplus b_2 e_{s(2)} \oplus \ldots \oplus b_m e_{s(m)}$. We have just shown that ϕ is surjective. Thus, ϕ is an isomorphism.

We see that $P_0^t = \mathrm{Hom}_A(P_0, A) \cong Ae_{s(1)} \oplus Ae_{s(2)} \oplus \ldots \oplus Ae_{s(m)}$ which is projective as desired. Of course, we can conclude the same for the module P_1^t. We summarize this result in the following lemma.

Lemma 2 Suppose that M is a right A-module, U is a nonzero submodule of M, and $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$ is a minimal U-projective presentation of M. If $\mathrm{Tr}\, M[U] \neq 0$ then $P_0^t \xrightarrow{d_1^t} P_1^t \xrightarrow{\pi} \mathrm{Tr}\, M[U]$ is a projective presentation of $\mathrm{Tr}\, M[U]$.

REMARK In the classic version, the sequence $P_0^t \xrightarrow{d_1^t} P_1^t \xrightarrow{\pi} \mathrm{Tr}\, M$ obtained in the construction process, is a minimal projective presentation of $\mathrm{Tr}\, M$. It is still open whether the projective presentation $P_0^t \xrightarrow{d_1^t} P_1^t \xrightarrow{\pi} \mathrm{Tr}\, M[U]$ is minimal.

CONCLUSION

Let K be an algebraically closed field and A be a finite dimensional K-algebra. For any right A-module M and any nonzero submodule U of M there exists the transpose of M relative to U. Such module is denoted by

$\operatorname{Tr} M[U]$. If $\operatorname{Tr} M[U] \neq 0$ then the sequence $P_0^t \xrightarrow{d_1^t} P_1^t \xrightarrow{\pi} \operatorname{Tr} M[U]$ induced from the minimal U -projective presentation of M , $P_1 \xrightarrow{d_1} P_0 \xrightarrow{d_0} M \to 0$, is a projective presentation of $\operatorname{Tr} M[U]$.

Next researchers are welcome to proof or disproof that such sequence is minimal.

ACKNOWLEDGMENTS

This research is fully funded and supported by Lembaga Penelitian dan Pengabdian Masyarakat Universitas Negeri Jakarta with contract number 24 /SPK PENELITIAN/5.FMIPA/2023. We would like to thank Fakhry Asad Agusfrianto, Firdaus Luthfi Kurniawan, and Natalie Efrata Susanti from Program Studi Matematika UNJ for their assistance during the research.

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Dimensional Reduction Using Principal Component Analysis by Alternating Least Squares on Fuzzy Possibilistic C-Means for New Student Economic Data

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Abstract. Cluster analysis on datasets that have outlier data is very influential on the quality of clustering.. Clustering methods for dealing with outlier data are Fuzzy C-Means (FCM), Possibilistic C Means (PCM) and Fuzzy Possibilistic C-Means (FPCM). Weakness in FCM that it still sensitive to outlier. PCM has the ability to cluster on outlier data but has the potential to produce identical clusters if the distance between cluster centers is close to others. In this study, a mixed scale dataset was used, namely ratio, nominal and ordinal. Outlier detection was carried out on the dataset using Mahalanobis Distance, it was found that 6.5% of the dataset had outliers. Principal Component Analysis was by Alternating Least Squares (PRINCALS) method to reduce the dimensions of the mixed scale. Based on the ratio Between Sum of Squares (BSS) and Total Sum of Squares (TSS), the performance results of FPCM with PRINCALS were 70.71%, better than FPCM without PRINCALS of 56.37%. FCM performance with PRINCALS is 68.16% and without PRINCALS is 52.82%. The PCM method has very poor performance, that is 0% because many cluster center values were similar. In this research, the FPCM cluster results are then used to determine the classification of Single Tuition Fee (STF).

INTRODUCTION

Data analysis is needed in producing knowledge discovery in databases or knowledge discovery in databases (KDD). Some data in the database are labeled and some are not labeled. Unlabeled data requires clustering method. The clustering method is the process of partitioning a data set into subgroups according to the closeness of the data. Clustering methods are divided into two categories, namely hierarchical clustering and non-hierarchical clustering [1].

The non-hierarchical clustering method has been widely used in research to group datasets with large amounts of data. The methods that are often used are Fuzzy C-Means (FCM) and K-Means clustering. FCM and K-Means clustering have been applied in research to detect breast cancer at an early stage by segmenting the Breast Cancer Wisconsin (BCW) dataset into two groups. The computational results show that the FCM algorithm is able to classify BCW datasets with better and more consistent accuracy than the K-Means algorithm [2]. FCM in other studies is used to group data that has noise or outliers. The results of this study indicated that FCM has several weaknesses, namely long computation time, the initial cluster center obtained randomly can cause local optimum and has sensitivity to outlier data or noise data [3].

One of the developments of the FCM algorithm is the Possibilistic C Means (PCM) method which has the ability to group data that has noise or outliers. PCM has a weakness, namely the distance between the centers of groups that are close together, resulting in a large number of clusters. not different or identical clusters [4]. Another research that

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020003-1–020003-10; https://doi.org/10.1063/5.0242144
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

has been done is the combination of FCM and PCM which produces the Fuzzy Possibilistic C-Means (FPCM) algorithm [5][6][7]. Apart from using random initial cluster centers, FPCM also uses typical or unique values in the grouped data. The FPCM algorithm resolves the weaknesses in the outlier data sensitivity in FCM and overcomes the identical cluster problem in the PCM algorithm [6]. Comparing the performance of FCM and PCM fuzzy clustering in the grouping distribution of contraceptive users in the province of Nusa Tenggara Barat (NTB) obtained better quality results FCM but computationally PCM is much more effective [7]. Fuzzy clustering research using FCM and FPCM is also used to classify Twitter social media data based on tweet content that is retweeted and liked by followers [8]. The FPCM method is capable of producing good quality performance in grouping districts/cities in Indonesia based on human development index indicators [9].

The performance of the fuzzy clustering method can be improved using dimension reduction, namely producing clusters with the same accuracy but with higher speed and lower computational costs [10]. This problem can be overcome by dimension reduction on variables that do not contribute significantly to the cluster information. The method used to reduce dataset dimensions is the Principal Component Analysis (PCA) method [11]. PCA reduces the number of variables (p) to $k < p$, often $k < 10$, so that data analysis can be carried out in k-dimensional space for the sake of better data interpretation if $k \leq 3$, so that it can be interpreted better [12]. PCA can reduce high dimensional data to lower dimensional data with a very small risk of losing information [13]. PCA to reduce non-linear data requires the Nonlinear Principal Component Analysis (NLPCA) method. In previous research, Principal Component Analysis by Alternating Least Squares (PRINCALS) was used to reduce mixed-scale non-linear data. PRINCALS was obtained using the Alternating Least Squares method approach. The Alternating Least Squares (ALS) algorithm is used to calculate nonlinear PCA for mixed scale data. The ALS algorithm is stable in convergence and simple in implementation [14].

The development of FPCM in this study aimed to use PRINCALS to solve high-dimensional problems on a mixed scale. The PRINCALS method was reduce the dimensions that do not have a contribution so that the data used in the FPCM analysis is expected to produce better cluster quality. This study uses a family economic dataset of new students at the Politeknik Elektronika Negeri Surabaya (PENS) which are entered independently when registering online. These participants filled in the form consisting of 12 family economic variables that have the potential for outlier data in a multivariate manner. Whether this research dataset has multivariate outlier data can be detected using the Mahalanobis Distance [15][16]. This dataset is very much needed in tertiary policy making to determine the amount of tuition fees which is called Single Tuition Fee (STF). Determination of STF is an assessment of student tuition fees that are paid each semester based on the student's financial ability. It is hoped that professional STF determination can help students with low financial capabilities be able to continue to higher education [17].

MATERIAL AND METHOD

Dataset

This research used data filled in from college entrance exam participants who were accepted in the selection for new student admissions through the independent route at Politeknik Elektronika Negeri Surabaya (PENS) in 2021. The dataset used was 431 records in mixed scale variables as follows:

- Personal identification includes: participant's name, address, date of birth, city of origin and province.
- Data related to the economy of new students consists of 12 variables with weight values determined based on economic priority values as follows:
  X_1: parents' income (ratio scale)
  X_2: number of family dependents (ratio scale)
  X_3: home ownership (ordinal scale)
  X_4: number of houses (ratio scale)
  X_5: land ownership (nominal scale)
  X_6: ownership of ponds/rice fields (nominal scale)
  X_7: apartment ownership (nominal scale)
  X_8: building ownership (nominal scale)
  X_9: number of cars owned (ratio scale)
  X_{10}: number of motorbikes owned (ratio scale)

X_{11}: electric power (ordinal scale: 450 Watt; 900 Watt; 1300 Watt and over 1300 Watt)
X_{12}: Institutional Development Contribution (IDC) (ratio scale).

Methods

This research has several stages as in fig. 1. The dataset used was obtained through the Extraction Transformation Loading (ETL) process by preprocessing data from the new student registration database via the independent route at PENS. The next step is to analyze the dataset in a multivariate way using the Mahalanobis Distance method to detect outlier. The mixed scale dataset was dimensionally reduced using PRINCALS to ensure the number of dimensions of quality variables in the cluster. PRINCALS also carries out transformations on the dataset based on the resulting dimension reduction. The results of the dataset transformation then use the Fuzzy partition coefficient to determine the number of clusters in FPCM. The performance of FPCM results with PRINCALS in this research was also compared with the FCM and PCM methods which are often used in cluster analysis for outlier data. The cluster method that maximizes better performance will be used to determine the STF classification of each resulting cluster.

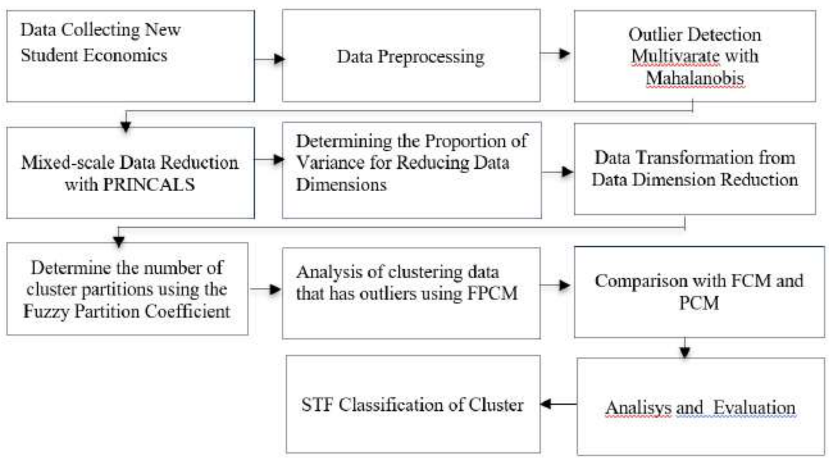

FIGURE 1. Methodology

Outlier Multivariate Detection

This research dataset has the potential to have outlier data because the data entered by new students is done independently. Datasets related to student economics need to be subjected to multivariate outlier analysis. The outlier detection method used in this research is Mahalanobis Distance. Mahalanobis Distance is obtained by calculating the distance of each observation to the data center based on the following equation (1):

$$d_i^2 = (\boldsymbol{x}_i - \mu)^T \Sigma^{-1} (\boldsymbol{x}_i - \mu), \qquad i = 1,2, \dots, p \tag{1}$$

Mahalanobis distance algorithm can be seen as follows:

1. Determine the average vector value (μ)
2. Determine the value of the variance covariance matrix (Σ)
3. Determine the Mahalanobis Distance value for each observation with the average vector using the equation (1).
4. Sort values d_i^2 from small to large $d_1^2 \leq d_2^2 \dots . \leq d_n^2$
5. Evaluate the Mahalanobis Distance value by using χ^2 on degrees of freedom (df) based on the number of variables used in the research. Identify outlier data in the second observation -i defined as an outlier if $d_i^2 \geq \chi^2_{p,1-\alpha}$.

Mixed-scale Dimension Reduction

The PRINCALS method was used to reduce the dimensions of data on a mixed scale by selecting which variables can explain the large variability of the data to be used in the new student economics dataset. The PRINCALS method was reduced variable dimensions by transforming new variables based on the proportion of the variance of the PRINCALS eigenvalues which are considered sufficient to represent a total cumulative variance of 80 percent. The PRINCALS method algorithm is as follows [14]:

1. Convert to a category scale by determining the number of class intervals.

2. Carry out qualitative data analysis by forming a matrix $\boldsymbol{H}$ which is $n \times m$ size. Matrix $\boldsymbol{H}$ can be broken down into $h_{\boldsymbol{ij}}$**.** The $h_{\boldsymbol{ij}}$ vector is then transformed using quantification. Quantification technique for the $\boldsymbol{H}$ matrix into $\boldsymbol{G}_j$ matrix of size $n \times k_j$ can be calculated using equation (3):

$$\boldsymbol{G}_j = \left(g_{ijk}\right) = \begin{pmatrix} g_{j11} & \cdots & g_{j1k_j} \\ \vdots & \vdots & \vdots \\ g_{jn1} & \cdots & g_{jnk_j} \end{pmatrix} = (g_{j1} \quad \cdots \quad g_{jk_j}), \tag{2}$$

$$g_{ijk=}\begin{cases} 1, & \text{if the } i\text{th object in the } j\text{th variable is not in the } k\text{th category} \\ 0, & \text{if the } i\text{th object in the } j\text{th variable is in the } k\text{th category} \end{cases}$$

where: $\boldsymbol{G}_j$ is indicator matrix of $\boldsymbol{h_{ij}}$ and $\mathbf{g_{ijk}}$ is matrix column Gj

3. Determine the object score matrix ($\boldsymbol{X}$) and quantify the $\boldsymbol{Y}_j$ category by minimizing meet loss as in equation (3).

$$\sigma_M(\boldsymbol{X};\boldsymbol{Y}) = \frac{1}{m}\sum_{j-1}^{m} tr(\boldsymbol{X}-\boldsymbol{G}_j\boldsymbol{Y}_j)'\,\boldsymbol{M}_j(\boldsymbol{X}-\boldsymbol{G}_j\boldsymbol{Y}_{\boldsymbol{j}})\ , \tag{3}$$

where:

tr : *trace* (summation of main diagonal elements),
$\boldsymbol{X}$: ordered object component score matrix $n \times p$,
$\boldsymbol{Y}$: a collection of multiple and single category quantification,
$\boldsymbol{G}_j$: indicator matrix for the jth variable of size $n \times k_j$,
$\boldsymbol{Y}_j$: quantification of multiple ordered categories $k_j \times p$,
$\boldsymbol{M}_j$: sized identity matrix $n \times n$.

4. Determining the number of main components selected by using total diversity, eigen value, scree plot and hypothesis testing. Eigen values ($\boldsymbol{\lambda}$) can be searched using PRINCALS from the correlation matrix $m^{-1}\underline{\boldsymbol{R}}(\underline{\boldsymbol{Q}})$ with equation (4).

$$|m^{-1}\boldsymbol{R}(\boldsymbol{Q}) - \lambda\boldsymbol{I}| = 0, \tag{4}$$

where:

m : the number of variables used,
$\boldsymbol{R}(\boldsymbol{Q})$: correlation matrix between the combined linear scores of all sets of $\boldsymbol{Q}$ matrices,
$\boldsymbol{Q}$: transformation data matrix of order n×m with column q_j where $q_j = \boldsymbol{G}_j y_j$,
q_j : transformation data.

5. Determine the main component score or loading component using equation (5).

$$\boldsymbol{a}_j = (\boldsymbol{y}_j'\boldsymbol{D}_j\boldsymbol{y}_j)^{-1}(\boldsymbol{Y}_j'\boldsymbol{D}_j\boldsymbol{y}_j) \tag{5}$$

where*:*

$\boldsymbol{a}_j$: component weight (component loading) of the order $p \times 1$,
$\boldsymbol{D}_j$: diagonal matrix $k_j \times k_j$ with the relative frequency of the jth variable on the main diagonal,
$\boldsymbol{y}_j$: Single category quantification.

6. The optimal linear combination model can calculate component scores using a formula like equation (6).

$$K = \sum_{j=1}^{m} \boldsymbol{a}_j\boldsymbol{G}_j\boldsymbol{Y}_j\ , K = \sum_{j=1}^{m} \boldsymbol{a}_j\boldsymbol{q}_j, \tag{6}$$

where :

K_{ij} : is the main component score on the ith object of the jth variabl with i=1,2,3,..., n and j=1,2,3,...,m,
$\boldsymbol{a}_j$: component weights of order $p \times 1$,

$\boldsymbol{q}_j$: j th transformation data.

Clustering Method

This research uses the FPCM method to classify a dataset of new economics students who have outlier data. Other cluster methods used as a comparison of FPCM performance after dimension reduction using PRINCALS are the FCM and PCM methods.

Fuzzy C-Means (FCM) Algorithm

The FCM clustering algorithm on data samples is divided into c categories, and an initial central clustering $\boldsymbol{C}$ or membership matrix $\boldsymbol{U}$ [18]. Each element in the membership matrix $\boldsymbol{U}$, namely u_{ij}, can be expressed in equation (7).

$$\sum_{i=1}^{c} u_{ij} = 1, \qquad \forall j = 1, \dots, n. \tag{7}$$

At the same time, the objective function (J) of the dissimilarity index can be expressed in equation (8).

$$J(\boldsymbol{U}, \boldsymbol{C}) = \sum_{i=1}^{c} J_i = \sum_{i=1}^{c} \sum_{j=1}^{n} u_{ij}^{w} d_{ij}^{2}, \tag{8}$$

where n is the number of data points and C is the number of clusters obtained by calculating the difference between the current objective function (J) and the previous objective function to match the error tolerance. Furthermore, the u_{ij} value is within (0,1) and w is the weighting value greater than 1.

The FCM algorithm is as follows:

1. The membership matrix $\boldsymbol{U}$ is obtained randomly with values between 0 and 1, while the conditional constraints of formula (7) must be met.
2. C_i cluster center is calculated by formula (9):
$$C_i = \frac{\sum_j^n u_{ij}^{w} x_{\boldsymbol{j}}}{\sum_{j=1}^{n} u_{ij}^{w}} \tag{9}$$
3. The objective function value in equation (8) determines the optimal cluster center. The algorithm stops if the difference between the objective function value and the previous value is smaller than the threshold.
4. The new membership matrix u_{ij} is calculated by formula (10), then returns to 2.
$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{d_{ij}}{d_{kj}}\right)^{2/w-1}} \tag{10}$$

Possibilistic Fuzzy C-Means (PCM) Algorithm

PCM has the main power, namely membership values are an absolute measure of class membership [18]. The PCM method has advantages in grouping outlier data compared to FCM. PCM has weaknesses, namely good initialization and produces similar clusters because the columns and rows are not clear enough so that they can cause the same clusters. The PCM objective function value is obtained by equation (11).

$$P_{\boldsymbol{t}} = \sum_{i=1}^{n} \sum_{k=1}^{c} t_{ik}^{w} d_{ik}^{2} + \sum\nolimits_{i=1}^{n} \eta_i \sum_{k=1}^{c} (1 - t_{ik})^{w}, \; t_{ik} = \left[1 + \left(\frac{d_{ik}}{\eta_i}\right)^{\frac{1}{w-1}}\right]^{-1}, \eta_i = K \frac{\sum_{i-1}^{n} \mu_{ik}^{w} d_{ik}^{2}}{\sum_{i=1}^{n} \mu_{ik}^{w}}; K > 0 \tag{11}$$

t_{ik} is the absolute distinctiveness matrix and d_{ik} is the distance from the i data to the k cluster center.

Fuzzy Possibilistics C Means (FPCM) Algorithm

FPCM is a development algorithm from FCM and PCM. The μ_{ik} value in the FCM algorithm is influenced by x_k and all cluster centers [18]. Meanwhile, in the PCM algorithm, the value of t_{ik} is only affected by x_k, the center of the ith cluster and γ_i. FPCM has the advantage of ignoring outlier data sensitivity deficiencies such as FCM and overcoming cluster problems such as PCM [6] [7]. The FPCM algorithm steps are as follows:

1. Enter the data to be clustered into a matrix **X**, where the matrix is $n \times m$, where n is the amount of data to be clustered and m is the number of attributes or variables.
2. Determine the number of clusters$(c \geq 2)$, rank/weight $(w > 1)$ and $(\eta > 1)$, maximum iteration (M), expected error (ξ), initial objective function $(P_0 = 0)$ and initial iteration $(t = 1)$.
3. Call the final result in the form of a uniqueness matrix (μ_{ik}) and cluster center (v_{kj}) in the FCM algorithm to calculate the absolute uniqueness matrix $(\boldsymbol{t}_{ik})$ with equation (12).

$$t_{ik} = \frac{\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/\eta-1}}{\sum_{i=1}^{n}\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/\eta-1}}, \tag{12}$$

4. Fixed the cluster center (v_{kj}) with equation (13).

$$v_{kj} = \frac{\left[\sum_{i=1}^{n}(\mu_{ik}^{w} - t_{ik}^{\eta})X_{ij}\right.}{\sum_{i=1}^{n}(\mu_{ik}^{w} - t_{ik}^{\eta})}, \tag{13}$$

5. Improve the distinctiveness matrix with equation (14).

$$\mu_{ik} = \frac{\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/w-1}}{\sum_{i=1}^{c}\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/w-1}}, \tag{14}$$

with $i = 1, 2, \ldots, n; k = 1, 2, \ldots, c; j = 1, 2 \ldots, m$.

6. Improve the absolute distinctiveness matrix with equation (15).

$$t_{ik} = \frac{\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/\eta-1}}{\sum_{i=1}^{n}\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right]^{-1/\eta-1}} \tag{15}$$

7. Checking the stop condition against the objective function P_t with equation (16).

$$P_t = \sum_{i=1}^{n}\sum_{k=1}^{c}\left(\left[\sum_{j=1}^{m}(X_{ij} - v_{kj})^2\right](\mu_{ik}^{w} + t_{ik}^{\eta})\right), \tag{16}$$

where : if $(|P_t - P_{t-1}| < \xi)$ or $(t > M)$ then stop; else: $t = t + 1$, repeat 4.

RESULT AND DISCUSSION

The result of using the Mahalanobis Distance method to detect outlier data in a multivariate manner is shown in Fig. 2.

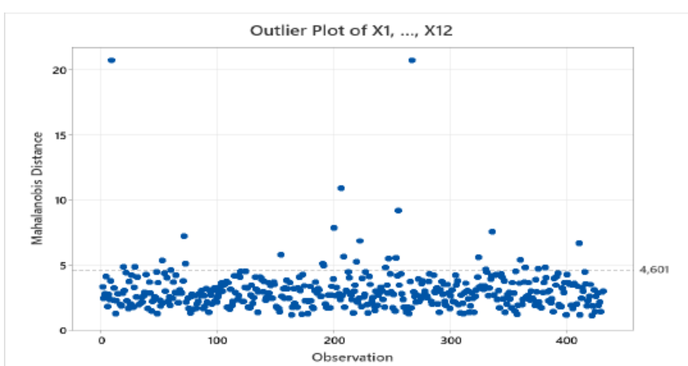

FIGURE 2. Outlier detection with Mahalanobis Distance

As shown at Figure 2, there are 28 (6.5%) outlier data from 431 data records because the data distance value exceeds or is equal to the value $\chi^2_{12,1-0.03}$=4.601.

Then mixed scale datasets must be converted to a categorical scale using PRINCALS algorithm. Computational calculations obtained the cumulative proportion value of the eigenvalue as in Table 1. Based on the Eigenvalue, there are 8 dimensions that are considered to fulfill the main components of the 12 dimensions because the cumulative proportion value of the Eigenvalue is 81.64% exceeding 80%. Based on the component loadings the dataset was reduced to 8 dimensions by transforming the data from 12 dimensions to 8 dimensions using equation (6). The results of the dataset reduction using PRINCALS are then entered into the clustering algorithm with the hope of being able to improve the quality of the clusters.

TABLE 1. Cumulative Proportion of Eigenvalue

Dimension	Eigenvalue	Cumulative Proportion
1	0.2186	21.86
2	0.1191	33.77
3	0.0949	43.26
4	0.0919	52.45
5	0.0846	60.91
6	0.0773	68.64
7	0.0687	75.51
8	0.0613	81.64
9	0.0529	86.93
10	0.0509	92.02
11	0.0434	96.36
12	0.0364	100

Cluster Analysis

This research uses the fuzzy partition coefficient method to determine the number of clusters. The computational results of the fuzzy partition coefficient are as follows:

k = 2 fuzzy partition coefficients = 0.588147104630066

…..

k = 8 fuzzy partition coefficient = 0.28181992062009226

k = 10 fuzzy partition coefficients = 0.285375049441900

Based on the fuzzy partition coefficient values and Fig. 3 at k = 8, there are significant differences in values changing and patterns so that the number of clusters used in this study is 8 clusters.

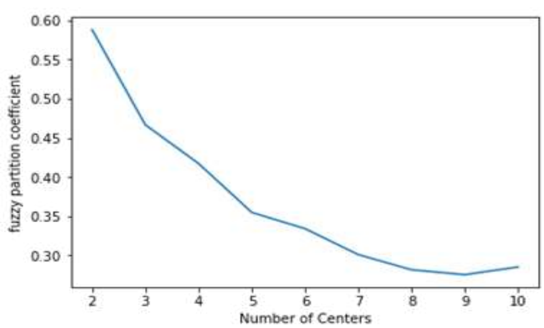

FIGURE 3. Fuzzy partition coefficient

Based on a partition of 8 clusters from the Fuzzy partition coefficient with the FCM, PCM and FPCM algorithms, it produces cluster quality as in Fig. 4. Based on the ratio Between Sum of Squares (BSS) and Total Sum of Squares (TSS), the cluster performance results in the FCM method using PRINCALS have a better cluster suitability of 68.16% when compared to without using PRINCALS which has a cluster suitability of 52.82%. The PCM method has a very poor cluster quality value, that is 0%, there is no increase in cluster quality even though PRINCALS has been carried out. The FPCM method with PRINCALS was produced better cluster quality, namely 70.1%, compared to without PRINCALS, where the cluster quality is 56.37%.

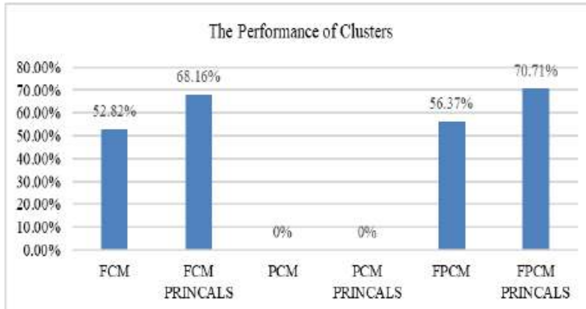

FIGURE 4. The performance of the cluster method

The results of the FPCM cluster method were carried out by data exploration by carrying out a descriptive analysis of each cluster and given a weight value for each economic variable to determine the STF level for each student. In Table 2 the results obtained for cluster 1 are 43 students, with an average parental salary (X_1) of Rp. 5,511,134, the average number of dependents (X_2) is 2 children and so on until the average value of Institutional Development Contributions (X_{12}) is Rp. 9,813,953.49. Cluster 2 consist of 56 students, with an average X_1 of Rp. 5,664,463; X_2 for 3 children and so on until the average value of X_{12} is Rp. 10,321,428.57. Likewise the average of all cluster is in Table below :

TABLE 2. The average value of each variable from each cluster

Cluster	N	Average												Score Y	Level STF
		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X9	X10	X11	X12		
		20%	5%	10%	10%	2.5%	2.5%	2.5%	2.5%	10%	10%	10%	15%		
1	43	5,5	2.3	2.9	1.1	1.1	1.0	1.0	1.0	3.3	0.1	2.2	9,8	0.58	4
2	56	5,7	2.6	2.7	0.9	1.1	1.1	1.0	1.0	2.1	0.8	2.6	10,3	0.61	5
3	36	16,7	2.4	2.9	1.2	1.4	1.1	1.0	1.0	1.9	1.1	3.3	33,9	0.93	8
4	43	4,0	4.3	2.4	0.8	1.1	1.0	1.0	1.0	1.7	0.1	2.2	8,1	0.50	2
5	48	7,8	2.2	3.0	1.1	1.3	1.1	1.0	1.0	1.9	0.7	2.6	19,0	0.69	6
6	39	10,8	2.9	3.0	1.2	1.4	1.2	1.0	1.0	3.1	1.0	3.0	19.9	0.81	7
7	79	2,9	2.5	2.5	0.8	1.1	1.0	1.0	1.0	1.2	0.0	1.8	7,5	0.43	1
8	87	3,8	2.1	2.5	0.9	1.1	1.1	1.0	1.0	2.0	0.0	2.2	8,9	0.48	3

This research also classified STF levels using weighting for each variable. The percentage weight value of each economic variable has a different score based on the economic potential of new students as in Table 2. This weight value is used to calculate the total economic score (Y) by adding the total of each weight value multiplied by the average of each variable X_1 to X_{12} by means of standardize the data first. The results of calculating the total economic score (Y) are sorted based on the score value to determine the classification. The classification results for each cluster are shown in Figure 5. The order of STF levels from the lowest (STF level 1) to the highest (STF level 8) is found in clusters 7,4,8,1,2,5,6,3 with the number of members as many as 79 (18%), 43 (10%), 87 (20%), 43 (10%), 56 (13%), 48 (11%), 39 (9%), and 36 (8%) students in each cluster.

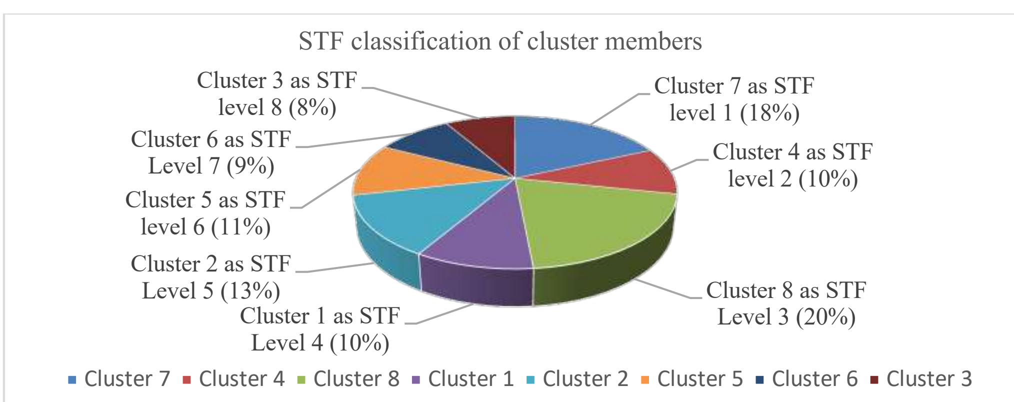

FIGURE 5. STF classification of cluster members

CONCLUSION

Based on the analysis results, it can be concluded that even though the dataset has a lot of outlier data, the FPCM method is able to produce good cluster quality. The FPCM method also has better performance compared to the FCM and PCM methods. The PRINCALS method in reducing the dimensions of mixed-scale datasets gives better performance. The PRINCALS method was able to increase the quality of FPCM and FCM clusters significantly. The PRINCALS method was not able to improve the performance of the PCM method. PCM cluster results are very poor because they produce similar or overlapping cluster center values. The FPCM cluster results are used to determine the SFT cost classification by assigning economic variable score weights to each cluster. The SFT classification to determine the lowest SFT (level 1) to the highest (Level 8) is determined based on the results of the total economic score of each cluster from the lowest economic score to the highest.

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Similarity Measure on Collection of Intuitionistic Fuzzy Sets

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Abstract. We are aware that intuitionistic fuzzy sets are one of generalization of fuzzy sets. To compare the similarity of information carried by intuitionistic fuzzy sets, similarity measures are constructed. Researchers have explored similarity measure as part of developing intuitionistic fuzzy sets. The similarity measures on intuitionistic fuzzy sets cannot fully answer the problems of measuring similarity that incorporates more complicated characterizations in collection sets. Therefore, we provide a novelty similarity measure. We provide a similarity measure for intuitionistic fuzzy set collections. In this article, first, we propose similarity measure's definition in the collection of intuitionistic fuzzy sets, then new formula of similarity measure with membership value and non-membership value. Moreover, we give proof of a new formula of similarity measure, so it is well defined, and examples to illustrate the proposed similarity measure are given too.

INTRODUCTION

The goal of studying intuitionistic fuzzy sets was to better manage uncertainty issues than fuzzy sets [1]. In various disciplines, including uncertainty reasoning and uncertain decision-making, intuitionistic fuzzy set theories have been applied in many fields. The discussion of similarity measures is a topic in intuitionistic fuzzy sets.

Topic about similarity measure in intuitionistic fuzzy sets was created as a tool for comparing the data carried by these sets. Similarity measure can be created by Hamming and Euclidean distances [2], which is later developed for pattern recognition [3]. Then, by using the Hausdorff distance, new similarity measures had been proposed by [4], [5], [6]. In addition, membership, and non-membership value can be used to build similarity measures on intuitionistic fuzzy sets. Several studies on aplications of similarity measures have been known in algebra structures, medical fields, and pattern recognition (see [7], [8], [9])

Problems arise when we want to see the similarity in collections of objects by considering their more complex characteristics. The solution for these problem cannot be resolved completely by the similarity measures among intuitionistic fuzzy sets. Hence, authors research in developing novelty of similarity measure.

Here, we present a new similarity measure which is a generalization of intuitionistic fuzzy sets. We define the generalization as collection in the intuitionistic fuzzy sets whose elements of the universe set are intuitionistic fuzzy sets. Using the proposed similarity measure, we can determine whether two collections in intuitionistic fuzzy sets are consistent with one another. We present the proposed similarity measure formed by membership and non membership value. Additionally, the examples are provided to show the proposed similarity measure.

The outlines of this article are presented as following: First, section preliminaries give reviews about definition, relations, and operations of intuitionistic fuzzy sets. The preliminary concept of similarity measure and several existing similarity measures are given in section preliminaries. Second, the presented similarity measure and illustrative examples as its interpretation are presented in section results. Third, the final section in this paper is conclusion for the paper.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020004-1–020004-6; https://doi.org/10.1063/5.0242143
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

PRELIMINARIES

In this part, we write again preliminary definitions for intuitionistic fuzzy sets that include similarity measure as basic theory.

Definition 1 [1]. Given U is nonempty and the universe set. A set P is intuitionistic fuzzy set of U if only if P state as

$$\{(u, \alpha_P(u), \beta_P(u)) : u \in U\}$$

with α_P is membership function and β_P is non- membership functions on P. The other side, $\alpha_P(u), \beta_P(u)$ are membership degree and non-membership value of u in U respectively where both of them in interval [0,1] and also sum of $\alpha_P(u)$ and $\beta_P(u)$ belong to [0,1]

Furthermore, $\gamma_P(u)$ is $1 - \alpha_P(u) - \beta_P(u)$ as the hesitant degree for $u \in U$.

The basic concept of relations and operations between two intuitionistic fuzzy sets have been described by [1].

Definition 2 [1]. Suppose P, Q are intuitionistic fuzzy sets respectively with the universe set U. The following relations and operations in intuitionistic fuzzy sets for all $u \in U$ are

1. $P \subseteq Q$ if only if $\alpha_P(u) \leq \alpha_Q(u)$, and $\beta_P(u) \geq \beta_Q(u)$
2. $P = Q$ if only if $\alpha_P(u) = \alpha_Q(u)$, and $\beta_P(u) = \beta_Q(u)$
3. $P^c = \{(u, \alpha_{P^c}(u), \beta_{P^c}(u)) : u \in U\} = \{(s, \beta_P(u), \alpha_P(u)) : u \in U\}$.
4. $P \cap Q = \{(u, \min\{\alpha_P(u), \alpha_Q(u)\}, \max\{\beta_P(u), \beta_Q(u)\}) : u \in U\}$,
5. $P \cap Q = \{(u, \max\{\alpha_P(u), \alpha_Q(u)\}, \min\{\beta_P(u), \beta_Q(u)\}) : u \in U\}$,

Definition 3 have been presented by [10].

Definition 3 [10]. Suppose P, Q are intuitionistic fuzzy sets respectively on the universe set U.

A function $SM: \mathbb{F} \times \mathbb{F} \to [0,1]$ is similarity measure in intuitionistic fuzzy sets if :

1) $0 \leq SM(P, Q) \leq 1$ for all $P, Q \in \mathbb{F}$.
2) $SM(P, Q) = 1$ if only if $P = Q$ for all $P, Q \in \mathbb{F}$
3) For every $P, Q \in \mathbb{F}$, $SM(P, Q) = SM(Q, P)$
4) For every $P, Q, R \in \mathbb{F}$, if $P \subseteq Q \subseteq R$, then $SM(P, R) \leq SM(Q, R)$, also $SM(P, R) \leq SM(P, Q)$

In next part, we give several similarity measures of intuitionistic fuzzy sets that have been studied.

Example 1. Several similarity measures that have been developed by previous researchers are:

1. $SM_{HY}(P, Q) = 1 - \frac{1}{m}\sum_{i=1}^{m} \max\{|\alpha_P(s_i) - \alpha_Q(s_i)|, |\beta_P(s_i) - \beta_Q(s_i)|\}$
   is similarity measure in [4].
2. $SM_C(P, Q) = 1 - \frac{1}{2m}\sum_{i=1}^{m} |\alpha_P(s_i) - \beta_P(s_i)) - \left(\alpha_Q(s_i) - \beta_Q(s)\right)|$ is similarity measure in [11].
3. $SM_{LX}(P, Q) = 1 - \frac{1}{4m}\sum_{i=1}^{m}|\alpha_P(s_i) - \alpha_Q(s_i)| + |\beta_P(s_i) - \beta_Q(s_i)| + |\alpha_P(s_i) - \beta_P(s_i) - \left(\alpha_Q(s_i) - \beta_Q(s_i)\right)|$ is similarity measure in [12].
4. $SM_{LZD}(A, B) = 1 - \sqrt{\frac{1}{2m}\sum_{i=1}^{m}\left(\alpha_P(s_i) - \alpha_Q(s_i)\right)^2 + \left(\beta_P(s_i) - \beta_Q(s_i)\right)^2}$ is similarity measure in [12]
5. $SM_M(P, Q) = 1 - \frac{1}{2}\left\{\sqrt[p]{\frac{1}{m}\sum_{i=1}^{m}|\alpha_P(s_i) - \alpha_Q(s_i)|^p} + \sqrt[p]{\frac{1}{m}\sum_{i=1}^{m}|\beta_P(s_i) - \beta_Q(s_i)|^p}\right\}$ is similarity measure in [13].
6. $SM_{HK}(A, B) = 1 - \frac{1}{2m}\sum_{i=1}^{m}|\alpha_P(s_i) - \alpha_Q(s_i)| + |\beta_P(s_i) - \beta_Q(s_i)|$ is similarity measure in [14].

METHODS

Methods of this research are literature review for articles related to intuitionistuc fuzzy sets, operations, and similarity measures, then develop collection of intuitionistic fuzzy sets as new concept of intuitionistic fuzzy sets. The new definitions are constructed based on the ordinary definitions of intuitionistic fuzzy sets and the operations. The results of this research are contained in the next section.

RESULTS

In this part, we give results of research related to novelty of similarity measure. Firstly, we give definition and basic properties on collection of intuitionistic fuzzy sets.

Definition 4. Let P_i is non empty intuitionistic fuzzy sets and $\mathcal{X}$ be universe set of discourse. Then a collection of intuitionistic fuzzy sets in $\mathcal{X}$ is

$$\mathcal{P} = \{(P_i, \alpha_{\mathcal{P}}(P_i), \beta_{\mathcal{P}}(P_i)) : P_i \in \mathcal{X}\}$$

with $\alpha_{\mathcal{P}} : \mathcal{X} \to [0,1]$ is membership function of $\mathcal{P}$, whereas $\beta_{\mathcal{P}} : \mathcal{X} \to [0,1]$ is non-membership function of $\mathcal{P}$. Furthermore, $\alpha_{\mathcal{P}}(P_i)$ is determined by membership value of P_i in $\mathcal{P}$, whereas $\beta_{\mathcal{P}}(P_i)$ is determined by non membership value of P_i in $\mathcal{P}$ with $\alpha_{\mathcal{P}}(P_i) + \beta_{\mathcal{P}}(P_i) \in [0,1]$.

$\gamma_{\mathcal{P}}(P_i)$ is the hesitant degree of P_i in $\mathcal{P}$ where $\gamma_{\mathcal{P}}(P_i) = 1 - \alpha_{\mathcal{P}}(P_i) - \beta_{\mathcal{P}}(P_i)$.

The following example is given to clearly about the Definition 4.

Example 2. A beautician want to provide the best recommendation of three skincares for consumers based on data represented by intuitionistic fuzzy sets. Let S is criteria set $\{p', q', r'\}$ with p' is price, q' is ingredients, and r' is product variations.

Three skincare with the criterias assumed by intuitionistic fuzzy sets in S are P_1, P_2, P_3 where

$P_1 = \{(p', 0.75, 0.2), (q', 0.85, 0.1), (r', 0.85, 0.1)\}$,

$P_2 = \{(p', 0.15, 0.6), (q', 0.25, 0.5), (r', 0.3,5\ 0.6)\}$, and

$P_3 = \{(p', 0.55,0.2), (q', 0.65, 0.1), (r', 0.75, 0.1)\}$

Based on the intuitionistic fuzzy sets, a recomended beautician of three skincares can be represented as a collection of intuitionistic fuzzy sets $\mathcal{P}$ in $\mathcal{X}$ which is the universe set $\{P_1, P_2, P_3\}$ where

$$\mathcal{P} = \{(P_1, 0.9, 0.2), (P_2, 0.2, 0.6), (P_3, 0.75, 0.3)\}.$$

Beautician gives membership value of P_1 is 0.9 because membership values from every criterias in P_1 is greater than every criterion in P_2, P_3. Clearly the best recommendation on skincare is P_1.

Definition 5. Given $\mathcal{P}, \mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$. The definition subset $\mathcal{P}$ of $\mathcal{Q}$, or we write $\mathcal{P} \subseteq \mathcal{Q}$ if

$$\alpha_{\mathcal{P}}(P_i) \leq \alpha_{\mathcal{Q}}(P_i), \text{ and } \beta_{\mathcal{P}}(P_i) \geq \beta_{\mathcal{Q}}(P_i), \forall P_i \in \mathcal{X}.$$

Definition 6. Given $\mathcal{P}, \mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$. The definition equality between two collection of intuitionistic fuzzy set or $\mathcal{P} = \mathcal{Q}$ is for all $P_i \in \mathcal{X}$ hold

$$\alpha_{\mathcal{P}}(P_i) = \alpha_{\mathcal{Q}}(P_i) \text{ and } \beta_{\mathcal{P}}(P_i) = \beta_{\mathcal{Q}}(P_i).$$

The similarity measure, which is defined here, is a technique for determining how similar two collection of objects are to one another.

Definition 7. Given $\mathcal{P}, \mathcal{Q}, \mathcal{R}$ are collections of intuitionistic fuzzy set in $\mathcal{X}$.

Let $\mathcal{S}$ denote a funtion $\mathcal{S}: \mathcal{E} \times \mathcal{E} \to [0,1]$. We can say $\mathcal{S}$ is similarity measure between collection of intuitionistic fuzzy sets if it holds

1) Every $\mathcal{P}, \mathcal{Q} \in \mathcal{E}$ so $0 \leq \mathcal{S}(\mathcal{P}, \mathcal{Q}) \leq 1$
2) Every $\mathcal{P}, \mathcal{Q} \in \mathcal{E}$ so $\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1$ if only if $\mathcal{P} = \mathcal{Q}$.
3) Every $\mathcal{P}, \mathcal{Q} \in \mathcal{E}$ so $\mathcal{S}(\mathcal{P}, \mathcal{Q}) = \mathcal{S}(\mathcal{Q}, \mathcal{P})$.
4) Every $\mathcal{P}, \mathcal{Q}, \mathcal{R} \in \mathcal{E}$ so if $\mathcal{P} \subseteq \mathcal{Q} \subseteq \mathcal{R}$, then $\mathcal{S}(\mathcal{P}, \mathcal{Q}) \geq \mathcal{S}(\mathcal{P}, \mathcal{R})$, and $\mathcal{S}(\mathcal{Q}, \mathcal{R}) \geq \mathcal{S}(\mathcal{P}, \mathcal{R})$.

A new similarity measure is given here. We state

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}\left(\sum_{i=1}^{m}\left(\left|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)\right| + \left|\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)\right|\right)\right)$$

with $\mathcal{P}, \mathcal{Q}$ are collection of intuitionistic fuzzy set in $\mathcal{X}$respectively. Then, the following theorems are presented.

Theorem 1. Let $\mathcal{P}, \mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$.
If

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|))$$

then $0 \leq \mathcal{S}(\mathcal{P}, \mathcal{Q}) \leq 1$.

Proof :

Obviously that $0 \leq \alpha_{\mathcal{P}}(P_i) \leq 1$ and $-1 \leq -\alpha_{\mathcal{Q}}(P_i) \leq 0$, so $-1 \leq \alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i) \leq 1$ or $0 \leq |\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| \leq 1$.

Same on the way, we get $0 \leq |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)| \leq 1$.

Next, we have

$$0 \leq \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|)) \leq 1$$

By multiplying minus one and adding by 1, we can see that

$$0 \leq 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|)) \leq 1$$

Therefore $0 \leq \mathcal{S}(\mathcal{P}, \mathcal{Q}) \leq 1$.

Theorem 2. Given $\mathcal{P}, \mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$. $\mathcal{P} = \mathcal{Q}$ if only if $\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1$ where

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|))$$

Proof :

If $\mathcal{P}$ is equal to $\mathcal{Q}$ then $\alpha_{\mathcal{P}}(P_i) = \alpha_{\mathcal{Q}}(P_i)$ also $\beta_{\mathcal{P}}(P_i) = \beta_{\mathcal{Q}}(P_i)$.

Obviously,

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|)) = 1.$$

The other side, let $\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1$ or

$$1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|)) = 1$$

We have for every $i = 1,2,.,m$ so $|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| = 0$ and $|\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)| = 0$.

Therefore $\alpha_{\mathcal{P}}(P_i) = \alpha_{\mathcal{Q}}(P_i)$ and $\beta_{\mathcal{P}}(P_i) = \beta_{\mathcal{Q}}(P_i)$ for every i. So $\mathcal{P} = \mathcal{Q}$.

Theorem 3. Given $\mathcal{P}, \mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$.
If

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|))$$

then $\mathcal{S}(\mathcal{P}, \mathcal{Q}) = \mathcal{S}(\mathcal{Q}, \mathcal{P})$.

Proof :

Because $|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| = |\alpha_{\mathcal{Q}}(P_i) - \alpha_{\mathcal{P}}(P_i)|$ and $|\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)| = |\beta_{\mathcal{Q}}(P_i) - \beta_{\mathcal{P}}(P_i)|$ then we get $\mathcal{S}(\mathcal{P}, \mathcal{Q})$ is equal to $\mathcal{S}(\mathcal{Q}, \mathcal{P})$.

Theorem 4. Given $\mathcal{P}, \mathcal{Q}, \mathcal{R}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$ respectively and $\mathcal{P} \subseteq \mathcal{Q} \subseteq \mathcal{R}$.
If

$$\mathcal{S}(\mathcal{P}, \mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{Q}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{Q}}(P_i)|))$$

then $\mathcal{S}(\mathcal{P}, \mathcal{Q}) \geq \mathcal{S}(\mathcal{P}, \mathcal{R})$, and $\mathcal{S}(\mathcal{Q}, \mathcal{R}) \geq \mathcal{S}(\mathcal{P}, \mathcal{R})$.

Proof :
Supposed that $\mathcal{P} \subseteq \mathcal{Q} \subseteq \mathcal{R}$, so $\alpha_{\mathcal{P}}(P_i) \leq \alpha_Q(P_i) \leq \alpha_R(P_i)$ and $\beta_{\mathcal{P}}(P_i) \geq \beta_Q(P_i) \geq \beta_R(P_i)$
Clearly that $|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| \leq |\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{R}}(P_i)|$ and $|\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)| \leq |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{R}}(P_i)|$.
So we have

$$|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)| \leq |\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{R}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{R}}(P_i)|$$

and then we get

$$[-\frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)|))] + 1$$
$$\geq [-\frac{1}{2m}\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{R}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{R}}(P_i)|))] + 1$$

or $\mathcal{S}(\mathcal{P},\mathcal{Q}) \geq \mathcal{S}(\mathcal{P},\mathcal{R})$
Using the similar way, we get $\mathcal{S}(\mathcal{Q},\mathcal{R}) \geq \mathcal{S}(\mathcal{P},\mathcal{R})$.

Theorem 5. Let $\mathcal{P},\mathcal{Q}$ are collections of intuitionistic fuzzy sets in $\mathcal{X}$.
If

$$\mathcal{S}(\mathcal{P},\mathcal{Q}) = 1 - \frac{1}{2m}(\sum_{i=1}^{m}(|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)|))$$

then $\mathcal{S}(\mathcal{P},\mathcal{Q})$ is a similarity measure between $\mathcal{P}$ and $\mathcal{Q}$.
Proof :
The proof of this theorem is based on Theorem 1 until 4, therefore $\mathcal{S}(\mathcal{P},\mathcal{Q})$ satisfies axioms of Definition 7.
So, $\mathcal{S}(\mathcal{P},\mathcal{Q})$ is the proposed similarity measure on collection of intuitionistic fuzzy sets $\mathcal{P}$ and $\mathcal{Q}$.

Next, we give some examples of calculation of the similarity measure.
Example 3. Suppose $\mathcal{P},\mathcal{Q}$ are two collections of intuitionistic fuzzy sets where
$\mathcal{P} = \{(A, 0.7,0.2), (B, 0.8, 0.1), (C, 0.6, 0.4), (D, 0.4, 0.3)\}$ and
$\mathcal{Q} = \{(A, 0, 0.8), (B, 1, 0), (C, 0.3, 0.6), (D, 0.2, 0.8)\}$.
So, the similarity measure of $\mathcal{A}_1$ and $\mathcal{A}_2$ is

$$\mathcal{S}(\mathcal{P},\mathcal{Q}) = 1 - \frac{1}{2.4}(\sum_{i=1}^{4}(|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)|) = 0.65.$$

Example 4. Suppose $\mathcal{P},\mathcal{R}$ are two collections of intuitionistic fuzzy sets where
$\mathcal{P} = \{(A, 0.7, 0.2), (B, 0.8, 0.1), (C, 0.6, 0.4), (D, 0.4, 0.3)\}$ and
$\mathcal{R} = \{(A, 0.7,0.1), (B, 0.8, 0.1), (C, 0.6, 0.4), (D, 0.5, 0.3)\}$.
So, the similarity measure of $\mathcal{A}_1$ and $\mathcal{A}_2$ is

$$\mathcal{S}(\mathcal{P},\mathcal{R}) = 1 - \frac{1}{2.4}(\sum_{i=1}^{4}(|\alpha_{\mathcal{P}}(P_i) - \alpha_{\mathcal{R}}(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_{\mathcal{R}}(P_i)|) = 0.975.$$

We can observe of Example 3 and 4 that $\mathcal{P}$ is more similar to $\mathcal{R}$ than $\mathcal{Q}$ because the value of similarity between $\mathcal{P}$ and $\mathcal{R}$ approach to 1.

Example 5. Suppose $\mathcal{P},\mathcal{Q}$ are two collections of intuitionistic fuzzy sets where
$\mathcal{P} = \{(A, 0.7, 0.2), (B, 0.8, 0.1), (C, 0.6, 0.4), (D, 0.4, 0.3)\}$ and
$\mathcal{Q} = \{(A, 0.7,0.2), (B, 0.8, 0.1), (C, 0.6, 0.4), (D, 0.4, 0.3)\}$.
So, the similarity measure of $\mathcal{A}$ and $\mathcal{B}$ is

$$\mathcal{S}(\mathcal{P},\mathcal{Q}) = 1 - \frac{1}{2.4}(\sum_{i=1}^{4}(|\alpha_{\mathcal{P}}(P_i) - \alpha_Q(P_i)| + |\beta_{\mathcal{P}}(P_i) - \beta_Q(P_i)|) = 1$$

From Example 5, we say that $\mathcal{P}$ is the same as $\mathcal{Q}$.

The similarity measure that presented can be implemented to pattern recognition. The following example gives illustration in pattern recognition.

Example 6. An urban planning expert $\mathcal{B}$ wants to classify his opinion about four regions based on the opinions of three urban planning experts. Assume A, B, C, D are four regions and $\mathcal{P}, \mathcal{Q}, \mathcal{R}$ are three urban planning experts. If their opinions are represented by collections of intuitionistic fuzzy sets in $\mathcal{X} = \{A, B, C, D\}$ where
$\mathcal{P} = \{(A, 0.1, 0.8), (B, 0.8, 0.1), (C, 0.5, 0.5), (D, 0.4, 0.3)\}$,
$\mathcal{Q} = \{(A, 0.5,0.2), (B, 0.2, 0.1), (C, 0.3, 0.4), (D, 0.5, 0.3)\}$,
$\mathcal{R} = \{(A, 0.35, 0.6), (B, 0.35, 0.6), (C, 0,1, 0.8), (D, 0, 1)\}$.
Let opinion of $\mathcal{B}$ is $\{(A, 0.25,0.5), (B, 0.3, 0.3), (C, 0.2, 0.8), (D, 1, 0)\}$ be an opinion that needs to be classified.
The degrees of similarity measures are calculated by the presented similarity measure as
$\mathcal{S}(\mathcal{P}, \mathcal{B}) = 0.66875$
$\mathcal{S}(\mathcal{Q}, \mathcal{B}) = 0.73125$
$\mathcal{S}(\mathcal{R}, \mathcal{B}) = 0.76875$
We can see obviously that opinion of $\mathcal{B}$ belong to opinion of $\mathcal{R}$ cbecause the value of similarity of $\mathcal{R}$ and $\mathcal{B}$ is higher than the others.

CONCLUSION

By adopting definition of similarity measure on intuitionistic fuzzy sets, the definition similarity measure in the collection of intuitionistic fuzzy sets is given. The new similarity measure is presented by membership and non-membership value. Besides, the authors provide several theorems to show that the presented similarity measure satisfies the axioms of the definition. We give examples as an illustration of the use of similarity measures in measuring similarity between objects. Moreover, research about the similarity measure can be implemented for pattern recognition and the other fields.

ACKNOWLEDGMENTS

The authors say thank you to Department of Mathematics, Brawijaya University, which supported this research.

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Modeling of Home Ownership Loan Fraud Risk Using Binary Logistic Regression and Multivariate Adaptive Regression Spline

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Abstract. *Home Ownership loan (KPR) is one of the best products in every banking industry. That is because housing is part of basic needs. The Covid-19 pandemic that hit Indonesia in 2020 had impact on increasing credit fraud ratio. Therefore, a method is needed to overcome the risk of fraud on home ownership loans. The purpose of this study is to modeling of home ownership loan fraud risk with a binary response variable (faud and no fraud) so that binary logistic regression model is used and by using Multivariate Adaptive Regression Spline (MARS) that can accommodate the interactions between preditor's variables. Data collection was taken from data sample of PT Bank Mandiri Retail Credit Center Surabaya unit for the 2020-2022 period. The result of this study shows that significant relationship with the risk of KPR fraud are credit limit, collateral values, debtor salaries and employee status, while the credit period and interest rate have no significant on the risk of KPR fraud. Moreover, by using MARS approach gives better performance than binary logistic regression with an accuracy of 89% and sensitivity of 95.7%. Meanwhile the binary logistic regression approach gives an accuracy of 87% and sensitivity of 91%.*

INTRODUCTION

As population growth continues to increase, the need for housing also continues to grow. because the house is the basic needs of everyone. Not everyone could buy a house in cash, so home ownership credit are a solution to the housing problem. Home ownership credit (KPR) is consumer credit for ownership of a residential home in the form of a landed house or apartment (excluding office houses and shop houses) with collateral in the form of a residence provided by the bank to individual debtor with the maximum loan amount determined based on the value of the collateral [1].

In this digital era economy, we cannot be separated from banking activities. The main activities of the bank include lending, credit cards, investments, mortgages, and others. Home ownership loan (KPR) is one of mortgages loan. Bank is a financial institution that has the main function of collecting and channeling public funds. This of course poses a risk to the credit provided by the bank. Home ownership loan itself does not rule out the possibility of having various kinds of credit risk. According to BI regulation no 23/2/PBI/2021, a bank is considered healthy condition if its bad debt ratio is no more than 5% [2]. The tendency for KPR customers to fraud in the banking industry is increasing due to the impact of the Covid-19 pandemic which hit the world, including Indonesia, in 2020. Uncertain economic conditions, makes banking institutions create decisions on every problem that occurs precisely and quickly. This makes the problem of loan fraud becoming very important to avoid bank losses.

Statistical modeling can be divided into parametric and non-parametric approaches [3-4]. In this case the response variable is categorical (such as fraud dan no fraud), so Logistic Regression and Multivariate Adaptive Regression Spline (MARS) can handle the case. Logistic Regression is a parametric approach by choosing a logistic distribution where the estimating method of parameters used is Maximum Likelihood Estimation [5]. There are two primary reasons for choosing the logistic distribution. First, from a mathematical point of view, it is an extremely flexible and easily used function. Second, its model parameters provide the basis for clinically meaningful estimates of effect [6]. On the other hand, Multivariate Adaptive Regression Spline (MARS) is a nonparametric regression

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020005-1–020005-8; https://doi.org/10.1063/5.0241477
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

approach that is more flexible because it has dependent variable not only continue type but also binary type. MARS can examine all possible levels of interaction between independent variables [7].

There are many previous research about modelling the risk of fraud loan using statistical model approach. A research on Credit Card Fraud Detection Using Linear Discriminant Analysis (LDA), Random Forest, And Binary Logistic Regression by [8]. Another research on modelling Loan repayment performance of micro and small-scale enterprise with And Binary Logistic Regression has been done by [9]. There are also several previous studies that compare two methods namely logistic regression and MARS such as conducted by [10-12]. According to those several previous studies, MARS gives better performance than Binary Logistic Regression in terms of accuracy. MARS as one of nonparametric regression approaches can provide greater flexibility because the form of the estimation of the regression function will adjust to the pattern of the data without being influenced by the subjectivity of the researcher.

Based on the explanation above, it means that there is no previous research that compares these two methods, Logistic Regression and MARS, for predicting risk of home ownership loan fraud. Therefore in this study, we modelled the risk of home ownership loan fraud by using those two methods. The comparison of those two methods was examined by the number of significant variables, accuracy, sensitivity, and specificity values.

RESEARCH METHOD

1. Dataset Description

In this study, we used a dataset from secondary data in PT Bank Mandiri, Retail Credit Center unit on 2020-2022. The total of records was 100 which there were 30 transactions are labeled as fraud. We used R Software to analyze all methods in this research. Table 1 provides variables of the models used in this study

TABLE 1. Variables of Home Ownership loan Fraud Dataset

Feature	Description
y = Fraud KPR	0 = No Fraud and 1 = Fraud
x_1 = Credit Limit	Credit limit given to debtors
x_2 = Interest Rate	Interest rate given by the bank
x_3 = Credit Periode	Credit Period given to debtors
x_4 = Collateral Values	The price of a house that was accept by the bank
x_5 = Debtor Salaries	Debtor’s salary that was accept by the bank
x_6 = Employee Status	0 = Employee and 1 = Not Employee

2. Performance of Classification Model

The accuracy of a classifier can be stated as the ratio of accurately predicting the class (positive and negative class) in the dataset. Accuracy measures for binary problem classification can be described in terms of four terms: True Positive (TP), False Positive (FP), True Negative (TN), and False Negative (FN) [8]. These terms can be arranged in a 2 × 2 matrix called confusion matrix as tabulated in Table 2.

TABLE 2. Confusion Matrix of Binary Classification

Actual	Prediction	
	Positive	**Negative**
Positive	TP (True Positive)	FN (False Negative)
Negative	FP (False Positive)	TN (True Negative)

The sensitivity can be explained as the ratio of TP over the total sample of the positive class. The specificity can be explained as the ratio of TN over the total sample of the negative class. And Accuracy is an evaluation metric that measures how well the model makes correct predictions out of the total predictions made. Therefore, the values of accuracy, sensitivity, and specificity, respectively is defined as follows [8]

$$\text{Sensitivity} = \frac{\text{TP}}{\text{TP+FN}} \times 100\%\text{; and}$$

$$\text{Specificity} = \frac{\text{TN}}{\text{TN+FP}} \times 100\%\text{; and}$$

$$\text{Accuracy} = \frac{\text{TP+TN}}{\text{TP+TN+FP+FN}} \times 100\%$$

3. Analysis Step

The analysis steps carried out in this paper are presented as follows.

- Determining statistical descriptive of the predictor variables associated with the incidence of KPR Fraud.
- Modelling KPR Fraud risk factors by using Logistic Regression with the following steps:
  1. Defining data in R software
  2. Performing the binary logistic regression model using the glm() function
  3. Interpretating the obtained model based on the following equations:

     $$\pi(\mathbf{x}) = \frac{e^{\beta_0+\beta_1\mathbf{x}}}{1+e^{\beta_0+\beta_1\mathbf{x}}} = \frac{1}{1+e^{-(\beta_0+\beta_1\mathbf{x})}} \quad \text{and}$$

     $$\text{g}(\mathbf{x}) = \text{logit}(\pi(\mathbf{x})) = \ln\left(\frac{\pi(\mathbf{x})}{1-\pi(\mathbf{x})}\right) = \beta_0 + \beta_1\mathbf{x}\,.$$
  4. Calculating the odds value according to the following equation:

     $$\psi = \frac{exp\ (\beta_0+\beta_1)}{exp(\beta_0)} = exp\ \beta_1$$
  5. Constructing the Diagnostic Confusion Matrix for Table 2X2 as Table 2
  6. Calculating the values of accuracy, sensitivity, and specificity
- Modelling the risk of KPR Fraud events using the MARS model approach with the following steps:
  1. Defining data in R software
  2. Analyzing the obtained MARS model based on the following equation:

     $$\log it\pi(x) = \ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = a_0 + \sum_{m=1}^{M} a_m \prod_{k=1}^{k_m} S_{Km}.\left(x_{v(k,m)} - t_{Km}\right).$$
  3. Determining the best model based on the minimum GCV values:

     $$GCV(M) = \frac{\frac{1}{n}\sum_{i=1}^{N}\left[y_i - \hat{f}_M(x_1)\right]^2}{\left[1-\frac{C(M)}{n}\right]^2}.$$
  4. Constructing the Confusion Matrix for Table 2X2 as Table 2
  5. Calculating the values of accuracy, sensitivity, and specificity
- Comparing the obtained results of Logistic Regression and MARS models approach.
- Providing conclusions about which model approach has the best performance for modelling the risk of KPR Fraud.

RESULT AND DISCUSSION

In this section, we give results of this study, description of variables and modeling of KPR Fraud risk factors using logistic regression model and MARS model approaches

Modeling Risk of KPR Fraud Using Binary Logistic Regression (Binary LR)

The regression method is data analysis that describes a response variable and one or more variables explanatory or predictor variables [6]. Binary logistic regression analysis is a statistical method that is useful for seeing the relationship between a response variable (y) which has a categorical scale with two or more predictor variables (x) with the aim of forming a regression model [13]. In this case binary logistic regression has two categories of "fraud" and "no fraud".

First we will input data of KPR Fraud in R software to find significant predictor variables, whose results are as follows :

TABLE 3. Estimation Results Using Logistic Regression Model Approach

	β	SE	Z(Wald)	P
(Intercept)	1.973	2.026	0.948	
Credit Limit (x_1)	-0.003	0.001	5.761	0.016
Interest rate (x_2)	-48.095	23.490	4.192	0.041
Credit Period (x_3)	-0.009	0.007	1.858	0.173
Collateral Value (x_4)	0.003	0.001	8.070	0.005
Debtor Salaries (x_5)	0.000	0.000	4.873	0.027
Employee Status (x_6)	3.285	0.746	19.377	0.000
Likelihood Ratio Test (G)			122.220	
P Value G			0.000	

Based on the simultaneously Likelihood Ratio Test has value of **G** with a significance level (sig) of 0.000 (P-value<0,005). Hence, we conclude that there is at least one component that affects the response variable. The Wald testing (Z) tests the unique contribution of each predictor.Based on partial test, we can conclude that predictor variables that significant KPR fraud risk are credit limit, interest rates, collateral values, debtor salaries and employee status, while the credit period has no significant on the KPR fraud (p-value < 0.05).

The results of the Binary Logistic Regression model approach are given by the following equation:

$$\pi(\mathbf{x}) = \frac{e^{(1.973-0.03x_1-48.095x_2-0.09x_3+0.003x_4+0.000x_5+3.285x_6)}}{1+e^{(1.973-0.03x_1-48.095x_2-0.09x_3+0.03x_4+0.000x_5+3.285x_6)}}$$

In particular, we transform the model into a natural log from $\pi(\mathbf{x})$ as follows

$$ln\left[\frac{\pi(\mathbf{x})}{1-\pi(\mathbf{x})}\right] = 1.973 - 0.03x_1 - 48.095x_2 - 0.09x_3 + 0.003x_4 + 0.000x_5 + 3.285x_6$$

The next step, we can construct the Confusion Matrix and Calculating the values of accuracy, sensitivity, and specificity as bellow

TABLE 4. Confusion Matrix for Logistic Regression Model

Actual	Prediction	
	Positive	Negative
Positive	64	6
Negative	7	23
	Accuracy	87%
	Sensitivity	91.4%
	Specificity	76.7%

Modeling Risk of KPR Fraud Using MARS

Multivariate Adaptive Regression Spline (MARS) is one of the nonparametric regression methods that was first popularized by [14]. The MARS method can overcome the shortcomings of recursive partitioning regression (RPR) by producing a continuous model at knots and identifying the presence of an additive linear function. The working system of the MARS method is a two-stage algorithm, namely the forward stepwise model and the backward stepwise model [15]. The first stage is the forward stepwise algorithm which is used to combine the basis of function (BF), maximum interaction (MI), and minimum observation (MO) to find the relationship between the respond variable and the predictor variable. Furthermore, the second stage of the Backward Stepwise model is used as a simplification of the basis function (BF) obtained from the Forward Stepwise stage.

Modeling the risk of KPR fraud events using the MARS approach begins with combining the number of basic functions (BF), maximum interaction (MI), and a minimum number of observations (MO). The number of BF used is 2 to 4 times the number of independent variables. In this case, we determined the maximum number of basic functions (BF) is 12, 18, 24. MI is the number of interactions that can occur in the model. MI used is 1,2 or 3. MO is the minimum number of observations between knots. The minimum distance between nodes or the minimum observation (MO) between nodes used is 0, 1, 2, and 3. The selection of the best model is based on the smallest GCV value, the smallest MSE and maximum R^2 (see Table 5)

TABLE 5. Summary of MARS Model

Model	BF	MI	MO	R^2	MSE	GCV
1	12	1	0	0.347	0.122	0.140
2	12	1	1	0.354	0.104	0.138
3	12	1	2	0.354	0.104	0.138
4	12	1	3	0.347	0.122	0.140
5	12	2	0	0.304	0.108	0.149
6	12	2	1	0.384	0.106	0.132
7	12	2	2	0.349	0.118	0.140
8	12	2	3	0.296	0.135	0.151
9	12	3	0	0.296	0.108	0.151
10	12	3	1	0.384	0.106	0.132
11	12	3	2	0.349	0.118	0.140
12	12	3	3	0.296	0.135	0.151
13	18	1	0	0.339	0.121	0.142
14	18	1	1	0.335	0.122	0.142
15	18	1	2	0.335	0.122	0.142
16	18	1	3	0.342	0.122	0.141

Model	BF	MI	MO	R^2	MSE	GCV
17	18	2	0	0.290	0.136	0.152
18	18	2	1	0.379	0.106	0.133
19*	18	2	2	0.377	0.100	0.133
20	18	2	3	0.343	0.112	0.141
21	18	3	0	0.338	0.118	0.142
22	18	3	1	0.379	0.106	0.133
23	18	3	2	0.350	0.118	0.139
24	18	3	3	0.350	0.112	0.139
25	24	1	0	0.337	0.121	0.142
26	24	1	1	0.334	0.128	0.143
27	24	1	2	0.334	0.128	0.143
28	24	1	3	0.342	0.122	0.141
29	24	2	0	0.290	0.136	0.152
30	24	2	1	0.332	0.127	0.143
31	24	2	2	0.354	0.105	0.138
32	24	2	3	0.346	0.112	0.140
33	24	3	0	0.281	0.136	0.154
34	24	3	1	0.332	0.127	0.143
35	24	3	2	0.355	0.118	0.138
36	24	3	3	0.346	0.112	0.140

*Best model

The results of the best MARS model with minimum GCV value is given by the following equation:

$$Y = 0.891 - 0.731888 \cdot 10^{-3} * BF4 - 0.213991 \cdot 10^{-9} * BF5 - 0.389891 \cdot 10^{-3} * BF12 + 0.001 * BF13 - 0.855056 \cdot 10^{-3} * BF15$$

BF1 = (Employee status = 0);
BF2 = (Employee status = 1);
BF4 = max (0, 1526 – Collateral value);
BF5 = max (0, Salaries – $0.2 \cdot 10^9$) $* BF2$;
BF12 = max (0, Collateral value – 151) $* BF1$;
BF13 = max (0, Collateral value – 1966) $* BF1$;
BF15 = max (0, Credit limit – 1500) $* BF1$;

The following is the Interpretation of model based on basis functions are:

1. BF1 = (Employee status = 0);
   It means that BF1 coefficient is significant if employee status is Employee, but if the employee status is not employee, the BF1 coefficient is not significant.
2. BF2 = (Employee status = 1);
   It means that BF2 coefficient is significant if employee status is not employee, but if the employee status is employee, then BF2 coefficient is not significant.
3. BF4 = max (0, 1526 – Collateral value); with coefficient $-0.731888 \cdot 10^{-3}$
   It means that every one unit increase in BF4 will reduce the risk of KPR fraud by $0.731888 \cdot 10^{-3}$ with other basis functions constant. If collateral value < 1526, it will reduce the risk of KPR fraud by $0.731888 \cdot 10^{-3}$.
4. BF5 = max (0, Salaries – $0.2 \cdot 10^9$) $* BF2$; with coefficient $-0.213991 \cdot 10^{-9}$
   It means that every one unit increase in BF5 will reduce the risk of KPR fraud by 0.001 with other basis functions constant. If salaries $> 0.2 \cdot 10^9$ and employee status is not employee, it will reduce the risk of KPR fraud by $-0.213991 \cdot 10^{-9}$.
5. BF12 = max (0, Collateral value – 151) $* BF1$; with coefficient $-0.389891 \cdot 10^{-3}$

It means that every one unit increase in BF12 will reduce the risk of KPR fraud by $0.389891 \cdot 10^{-3}$ with other basis functions constant. If collateral value > 151 and employee status is employee, it will reduce the risk of KPR fraud by $-0.389891 \cdot 10^{-3}$.

6. BF13 = max (0, Collateral value – $1966) * BF1$; with coefficient 0.001
   It means that every one unit increase in BF13 will increase the risk of KPR fraud by 0.001 with other basis functions constant. If collateral value > 1966 and employee status is employee, it will increase the risk of KPR fraud by 0.001.
7. BF15 = max (0, Credit limit – $1500) * BF1$; with coefficient $-0.855056 \cdot 10^{-3}$
   It means that every one unit increase in BF15 will reduce the risk of KPR fraud by $0.855056 \cdot 10^{-3}$ with other basis functions constant. If credit limit > 1500 and employee status is employee, it will reduce the risk of KPR fraud by $-0.855056 \cdot 10^{-3}$.

The importance variables are variables that highly have impact regarding response variable. The most important predictor variables successively are credit limit, salaries, collateral values, and employee status.

Furthermore, to measure the performance of the MARS model, the accuracy, sensitivity and specificity values of the best model are calculated form confusion matrix. The classification accuracy of stroke status based on the MARS model is calculated using the classification accuracy value which can be seen in Table 6

TABLE 6. Confusion Matrix of MARS Model

Actual	Prediction	
	Positive	Negative
Positive	67	3
Negative	8	22
	Accuracy	89%
	Sensitivity	95.7%
	Specificity	73,3%

Based on Table 6, the accuracy of the MARS model classification for training data is 88%, and sensitivity value is 97,1%. The accuracy value is 76.47% and sensitivity value is 95.5%. Table 7 shows comparison the accuracy, sensitivity, and specificity values for training and testing data between Binary LR and MARS models.

TABLE 7. Comparison of performance of the Binary LR and MARS models

Performance Criteria	Prediction	
	Binary LR	MARS
Accuracy	87%	**89%**
Sensitivity	91%	**95.7%**
Specificity	76,7%	73.3%

Based on Table 7, the two criteria of the MARS model for data have the higher value compared with Binary LR in data. Also, the comparison of variables that significant or important can be seen in Table 8.

TABLE 8. Comparison of Significance Variable in Binary LR and MARS

	Binary LR	**MARS**
Credit Limit	√	√
Interest Rate	√	-
Credit Period	-	-
Collateral Values	√	√
Debtor Salaries	√	√
Employee Status	√	√
Interaction	-	√

Table 8 shows that MARS has higher number of significance variable than binary logistic regression. Also, MARS can examine interaction between independent variables, while binary logistic regression cannot accommodate it. Based on these comparison results, it means that the MARS model has more appropriate performance of home ownership loan (KPR) fraud risk than binary logistic regression.

CONCLUSIONS

MARS model in predicting the risk of home ownership loan (KPR) Fraud gives accuracy and sensitivity values are 89% and 95.7%, respectively while binary logistic regression gives accuracy and sensitivity values are 87% and 91%, respectively it means that MARS model is better than binary logistic regression in predicting the risk of home ownership loan (KPR) fraud.

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Forecasting Seasonal Rainfall Levels Using the Convolution Neural Network (CNN) Method

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Abstract. The rainy season is a condition of the region where the intensity of rainfall increases measurably and remains at a specific time. The weather is often unpredictable, and rainfall can increase or decrease drastically so that many sectors are affected, and various disasters can threaten life, such as droughts, floods, landslides, etc. So, a solution is needed to determine the level of rainfall in an area to overcome existing problems. Therefore, rainfall forecasts are needed to determine the level of rainfall that will be experienced in the future. Data pre-processing is done to fill in the blanks and normalize the data. This research proposed an efficient forecasting technique for seasonal rainfall. Technical tuning parameters create the best model solution. CNN architecture is focused on producing fitness solutions that meet high accuracy. This algorithm tries to fulfill the requirements until optimal analysis is carried out to contribute maximum accuracy in rainfall predictions. The results of rainfall intensity testing used data starting from 1 year with RMSE 0.18009 and MAPE 9.04321%, data from April to September with RMSE 0.00130 and MAPE 6.43897%, and data from October to March with RMSE 0.00255 and MAPE 3.47579%. Grid search is carried out to tune momentum, learning rate, kernel, and epoch parameters. Grid search is carried out to optimize the variable size. This process aims to gradually find optimal values for hyperparameters with high-dimensional space evaluation of the model resulting from optimum hyperparameters at an error rate. The best results from model occurred when using data from April to September with the best with Grid Search on CNN with 3 convolution layers, 3 Max Pooling layers, 30 shape inputs in 1 convolution; 15 in convolution 2; 7 on convolution 3, filter 64, padding 1, activation Relu, Size Pooling 2, Stride Pooling 2, Flatten 192, Dense 100, and Output Layer 1 which gets RMSE 0.00130 and MAPE 6.43897%. This research can impact the prediction of disasters, planting seasons in the agricultural sector, and production times in the industrial sector. Development techniques for selecting appropriate parameters significantly influence the method's performance to produce high accuracy.

INTRODUCTION

Indonesia has a humid tropical climate with only two seasons, namely the dry and rainy season [1]. The rainy season is a regional condition in which the intensity of rainfall increases steadily and regularly a period of time [2]. However, rainfall varies from gelion to region depending on the geographical and topographical conditions of each region [3]. Rainfall can be interpreted as the amount of rain that is intertwined in a period where the water is concentrated in units of millimeters per hour [4]. Unstable weather causes rainfall to increase or decrease drastically, so many problems can arise due to the influence of the level of rainfall [5]. Flood is a natural disaster that occurs when excessive water inundates normally dry land or can lead to flash floods [6]. Landslides can arise due to prolonged rainfall, so the soil in less stable areas moves. Rainfall can also affect the agricultural, trade, and industrial sectors [7].

Based on existing problems, a solution is needed to determine the level of rainfall in an area. So, rainfall levels can be used to estimate the influence of rainfall, such as landslides, floods, and droughts. Apart from disasters, rainfall can be utilized in the agricultural, industrial, commercial, or economic sectors to carry out actions or policies that benefit these sectors [8].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020006-1–020006-9; https://doi.org/10.1063/5.0242738

Methods that can be used to predict rainfall levels include Artificial Neural Network (ANN), Backpropagation Neural Network (BP-NN), Convolutional Neural Network (CNN), and etc. Artificial Neural Network is a method that has the same simple architecture as in human neural networks [9] [10]. The development of ANN is a Backpropagation Neural Network that has calculations to update weights directly so that it can get the smallest error value between the prediction value and the target value, but it can cause computational time to become unstable and waste time in the process of finding the weight value [11] [12]. Convolutional Neural Network provides a solution from the previous method by adding a Feature Learning stage that contains a Convolution Layer, Activation Layer, and Pooling Layer to get important features and reduce the input but still maintain important features [13] [14].

Various types of forecasting are based on Multilayer Perceptron (MLP), Convolutional Neural Network (CNN), Deep Belief Network (DBN), Long Short-Term Memory (LSTM), and Recurrent Neural Network (RNN). CNN can prevent the loss of essential features and increase accuracy. Since, CNN capabilities that use convolution and sub-sampling layers, as well as training methods that can learn features directly from training data [15]. The author uses the CNN method to classify heart disease based on this argument. In the research, the author used a grid search algorithm. Grid search can optimize parameters in improving classification performance and perform generalizations to obtain conclusions about parameter combinations with better performance [16]. Grid Search is a traditional method for finding the best parameter values within a predetermined range. However, this algorithm will take a long time to execute because this algorithm works by combining all the previously determined parameter ranges [17] [18]. The use of the CNN method is due to CNN is a flexible and proprietary approach adaptive architecture. CNN is said to be flexible and adaptive because hidden units are only added on the network so that in the end produces flowing architecture [19] [20].

This study tried to use the Convolutional Neural Network (CNN), which reduce features from high dimensions to lower dimensions. The convolution layer on the CNN reduces dimensionality, but the existing features have not changed and are still retained. Architectural adjustments are used to minimize the RMSE value of the CNN method to obtain accurate or near-accurate prediction results. This research aims to conduct optimized CNN modeling with Grid Search for predict the start of the rainy season and evaluate performance of the prediction results that have been produced. The research can find out the initial predictions rainy season to help provide better information in agricultural management, especially related to determining planting time to avoid failure harvest.

RESEARCH METHODOLOGY

In this session, a theoretical basis was used to compile this study, which contains an explanation of several theories used. Description of forecasting theory in general and using daily climate data provided by the Meteorology, Climatology, and Geophysics Agency (BMKG) [21]. The next step was pre-processing the data to enter it into the Convolutional Neural Network method. The accuracy of the results that have been obtained will be calculated using RMSE and MAPE [22].

The dataset will be processed for data pre-processing, which includes processes such as data interpolation and data normalization. After the data has been processed perfectly, the next step is to model the forecast using the Convoluniotal Neural Network method. The CNN method will produce a predicted value that can be entered into the next step, using error with the RMSE and MAPE values. The RMSE and MAPE values can be known so that the accuracy value of the CNN model is for calculating rainfall levels and predicting subsequent rainfall levels [22].
The following are the main contributions of this paper:

- We use interpolation techniques with before and after data values to fill in missing weather values.
- We designed hyper parameters with Grid Search on CNN to produce the best parameters as the best model for predicting future seasonal weather traffic conditions.
- We examined some additional rainy weather data in specific periods to determine the level of short-term traffic variable prediction accuracy of the deep learning model.
- The model compared using several architectures of the proposed model results to test the best deep learning model for traffic prediction below upcoming weather conditions.

Forecasting

Forecasting is an attempt to predict the future using existing or previously recorded data and using two popular methods: quantitative (numerical scale) and qualitative (descriptive) [16]. Forecasting is an important key in holding a company to carry out or plan a production activity or company operational activities. After this forecasting, the company can minimize expenses so that the facilities provided are adequate for employees [17]. The majority of authors use CNN to predict weather conditions. The rainfall variable is a point value, considering the current traffic speed, wind speed, traffic volume, road capacity, wind direction, rainfall intensity, and visibility. Different deep learning models were assessed to validate the speed prediction accuracy, and the results concluded that the proposed one-dimensional CNN network model outperformed other models in terms of least root mean square error and least mean absolute error [20]. CNN hyper parameters to predict in a time- and weather-aware manner, large amounts of data such as weather forecast data, road network information, as well as speed and traffic flow data are collected to train the system. The improved Deep Neural Network (DNN) architecture, the basic structure of which is to learn features for hourly rainfall weather forecasting. Rainfall data was used as point data in their research. They consider the temporal dependencies of traffic and weather data [21]. Rainfall values from the nearest station are interpolated to the target road segment. Research using CNN spatiotemporal input data predicts traffic flow in lousy weather conditions. When making predictions, they consider the spatiotemporal dependencies of weather data and adjacent road traffic [25].

Meteorological, Climatological, and Geophysical Agency (BMKG)

BMKG is a national agency that manages and analyzes the fields of Meteorology, Climatology, and Geophysics throughout Indonesia. The station that studies climate and weather in Indonesia is the Meteorological Station, and for Surabaya and surrounding areas, the station is called the Perak II Surabaya Maritime Meteorological Station. The data provided by the Perak II Surabaya Maritime Meteorological Station is daily climate data from the Surabaya area, which has several parameters, there are Tn (Minimum temperature (°C)), Tx (Maximum temperature (°C)), Tavg (Average temperature (°C)), RH_avg (Average humidity (%)), RR (Rainfall (mm)), ss (Duration of solar radiation (hours)), ff_x (Maximum wind speed (m/s)), ddd_x (Wind direction at maximum speed (°)), ff_avg (Average wind speed (m/s)), and ddd_car (Most wind direction (°)) [3].

Pre-processing

In this session, a theoretical basis is used to compile this study, which contains an explanation of several theories used. Description of forecasting theory in general and using daily climate data provided by the Meteorology, Climatology, and Geophysics Agency (BMKG). The next step is pre-processing the data to enter it into the CNN. The accuracy of the results that have been obtained will be calculated using RMSE and MAPE. Pre-processing is a step or action before data processing that is used so that the data is ready to enter the data modeling stage [10][11][18].

a) Data Interpolation

Data Interpolation is an action that occurs in the pre-processing stage. This stage fills in the blank data by using the average value of the data before and after the blank data [14]. Equation 1 below is for data interpolation calculations [26].

$$x_n = \frac{x_{n-1} + x_{n+1}}{2} \tag{1}$$

X : Missing value parameter
n : Missing value index

b) Data Normalization

Data normalization is the treatment of data using the min-max method to obtain data with a smaller size and represent the original data without losing its characteristics [14][25]. Equation 2 below is for data normalization calculations.

$$x' = \frac{x - x_{min}}{x_{max} - x_{min}} \tag{2}$$

x' : New data values after normalization

x : Old data values before normalization
x_{min} : Minimum value of data
x_{max} : Maximum value of data

Convolutional Neural Network

A convolutional Neural Network is an algorithm of neural networks that can provide information processed or carry out calculation operations with connected neurons [11][19]. CNN is a development of an Artificial Neural Network that carries Deep Learning architecture inspired by the human ability to identify objects or things quickly [20]. The Supervised Learning method includes the CNN method, which aims to classify data with labels [21]. Supervised Learning is a way of processing data that has been determined with an algorithm and has variables to be used for the next target [22]. The architecture of a Convolutional Neural Network (CNN) is shown in Figure 1 below:

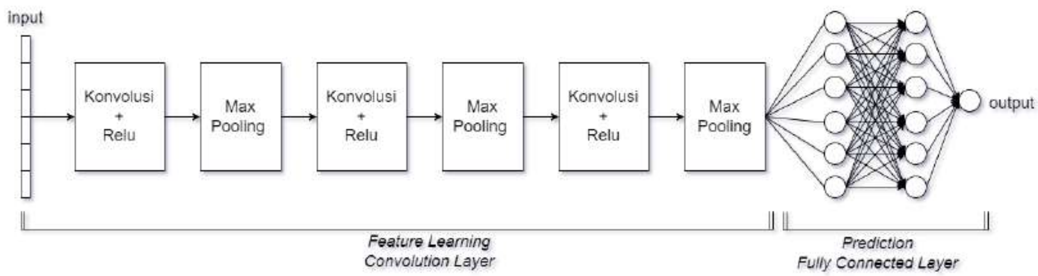

FIGURE 1. Convolutional Neural Network Architecture [22]

There are several layers in the CNN architecture, and some can also be called Feature Extraction, which is useful for the encoding process to get some features needed for the next step [23]. The convolution layer must perform dot matrix multiplication between the specified kernel and the input data without destroying the input data to obtain results. The convolution function in this layer is useful for training models [24]. The activation layer is useful to eliminate irrelevant data so that it does not interfere with the modeling process [25]. Pooling reduces the size of the Feature Map using a down sampling process to speed up computation and reduce overfitting. This layer is a layer for classifying certain classes. Neurons in this layer are interconnected with other layers or are called fully connected layers [26].

Grid Search

Hyperparameter tuning has a significant role in optimizing the performance of any machine learning (ML) algorithm [7][23]. Grid search is a brute-force method for finding hyperparameter values by defining lower and upper limits at certain stages [10]. The approach is quite simple: evaluating each model and returning the best combination. This method aims to get the best combination to be used as a prediction model [9]. However, due to its detailed nature, it will only be effective for small searches [24]. The name "grid" comes from experiments on grid-shaped model spaces [16]. This research uses the Grid Search technique to find optimal hyperparameter values in the model. Grid Search is a comprehensive search algorithm for a subset of hyperparameter space based on the number of numbers, minimum value (lower bound), and maximum value (upper bound) in the subset space, as shown in Figure 3.

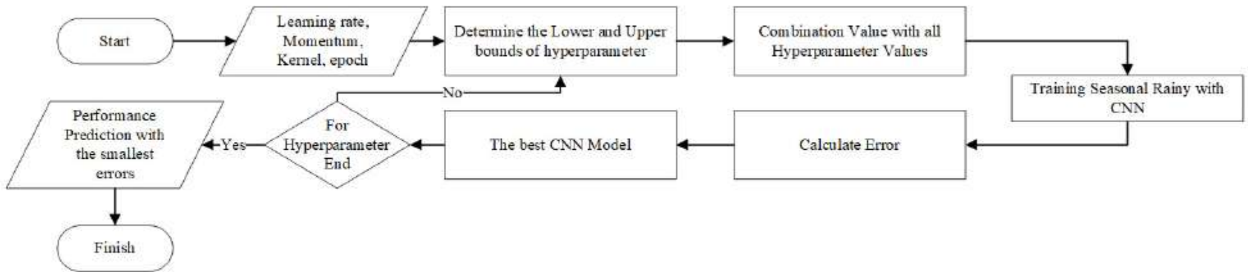

FIGURE 2. System Architecture hyperparameter

The Measurement of Forecasting Performance

a) Root Mean Square Error (RMSE)

RMSE uses calculations with the square root of the average error value between the actual and predicted values. RMSE values that are almost close to zero or low, then the calculation of prediction results is by actual data and can be used for future predictions [1]. The RMSE equation is shown in equation 3 below:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y'_i - Y_i)} \tag{3}$$

Y'_i : Actual value of index
Y_i : Predicted value
n : Number of samples

b) Mean Average Percentage Error (MAPE)

Mean average percentage error is a method used to calculate errors in a model. The absolute value of each period is divided by the value in the actual calculation result for that period. After obtaining the results, the absolute error results are averaged [12]. The MAPE equation is shown in equation 4 below:

$$MAPE = \frac{\sum_{t=1}^{n}\left|\frac{xt - ft}{xt}\right|}{n} \times 100\% \tag{4}$$

xt : Actual value in the *t*-th period
ft : Predicted value in the *t*-th period
t : Period

System Architecture Proposed Method

In Figure 2 below, there are the steps in forecasting rainfall levels by collecting daily climate data from the BMKG website, which is downloaded manually on the website.

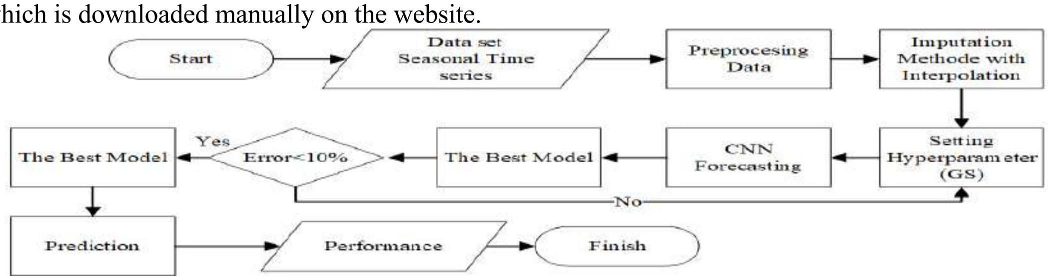

FIGURE 3. System Architecture Forecasting

After the required data has been obtained, pre-processing will be carried out, including processes such as data interpolation and normalization. After the data is ready and can be processed by the method perfectly, the next step is to model the forecast using the Convolutional Neural Network method. The CNN method will generate a predicted value to be entered into the next step: calculate the RMSE and MAPE error values. Based on the RMSE and MAPE values, the accuracy value of the CNN model can be known to calculate rainfall levels and predict future rainfall levels.

RESULT DAN DISCUSSION

The hyperparameters used to optimize CNN by getting optimal values are learning rate, momentum, number of epochs, and layers. The grid search method is used to fine-tune the hyperparameters of ResNet50, VGG16, GoogleNet to achieve performance improvements. Table 2 shows the hyperparameter ranges used to obtain optimal values.

TABLE 1. Hyperparameter range test values to get the optimal CNN

Hyperparameter	Range Value
Learning Rate	0.01-0.9
Momentum	0.1- 0.9
Epochs	5 - 1000
Kernel	1 - 10

Forecasting trials are conducted on the CNN model to get the best model. The CNN model can be called the best if it has the smallest error value. The way to get the best model can be done by testing the existing model in Table 2., which is a table for CNN Model Scenarios that uses 3 test scenarios, with each scenario having a different number of convolution layers and Pooling layers to form a different architecture.

TABLE 2. CNN Model Experiment

Parameter	ResNet50	VGG16	GoogleNet
Convolution 1	input = (30,4), filter = 12, kernel = 2, Padding = 1, Relu	input = (30,4), filter = 24, kernel = 3, Padding = 1, Relu	input = (30,4), filter = 64, kernel = 3, Padding = 1, Relu
Pooling 1	Max Pooling, size pooling = 2, Stride = 2		
Convolution 2	-	input = (15,4), filter = 64, kernel = 3, Padding = 1, Relu	input = (15,4), filter = 64, kernel = 3, Padding = 1, Relu
Pooling 2	-	Max Pooling, size pooling = 2, Stride = 2	
Convolution 3	-	-	input = (7,4), filter = 64, kernel = 3, Padding = 1, Relu
Pooling 3	-	-	Max Pooling, size pooling = 2, Stride = 2
Flatten	15 x 64 = 960	7 x 64 = 448	3 x 64 = 192
Learning Rate	0.1	0.1	0.3
Dense	100	100	100
Epoch	909	863	884
Momentum	0.3	0.6	0.3

Forecasting uses training data divided into two periods. The first period uses data with low-intensity rainfall. Low-intensity data includes data recorded during the dry season because rainfall parameters are relatively low in the dry season. The dry season occurs from April to September of that year. Training data used data in 2021, and testing data used data in 2022. The second period used data with high-intensity rainfall. High-intensity data includes data recorded during the rainy season because some rainfall parameters are classified as high in this rainy season. The rainy season occurs in October of that year until March of the following year. Training data used data from 2021 to 2022, and testing data uses data from 2022 to 2023.

After describing some of the scenarios used for Convolutional Neural Network modeling and data testing scenario will produce training results data shown in Table 3. below which explains some of the experiments that have been carried out:

TABLE 3. Training results due to the influence of changes in parameters and architecture

Architecture	Data	Number of Convolution	Number of Pooling	RMSE	MAPE
ResNet50	High-intensity	1 layer	1 layer	0.00873	12.49278%
	Low-intensity	1 layer	1 layer	0.00221	16.23740%
VGG16	High-intensity	2 layer	2 layer	0.00628	9.62060%
	Low-intensity	2 layer	2 layer	0.00194	11.98254%
GoogleNet	High-intensity	3 layer	3 layer	0.00255	3.47579%
	Low-intensity	3 layer	3 layer	0.00130	6.43897%

Table 3. shows a graph of CNN training results obtaining scenario evaluation values using RMSE error values. RMSE measures the extent to which CNN architecture predictions vary from actual values on the same scale as the target. In the results of this training, the RMSE value obtained in the scenario 1 experiment was 0.00873 for high-intensity data and 0.00221 for low-intensity data. The result in RMSE error values gets smaller from ResNet50, VGG16, GoogleNet, which increases the number of layers in GoogleNet with RMSE 0.00255 for high-intensity data and 0.00130 for low-intensity data. The lower the RMSE value, the better CNN's architecture is at making accurate predictions.

This result shows CNN training, which obtained scenario evaluation values using MAPE error values. MAPE measures the average error percentage relative to the actual value. The usage of MAPE values obtained for experiment scenario 1 are 12.49278% of high-intensity data and 16.23740% of low-intensity data. The results of the MAPE value also get smaller if the convolution layer used for training increases, and GoogleNet using 3 layers gets a MAPE value of 3.47579% for high-intensity data and 6.43897% for low-intensity data. MAPE reflects the average percentage error of CNN predictions to the actual value. A lower MAPE value will get a good CNN scenario result in making relatively accurate predictions. From these results, with changes in the number of convolution layers and pooling layers, CNN can reduce the error value for forecasting. In GoogleNet, using 3 convolution layers and 3 pooling layers gets small RMSE and MAPE values compared to the other two scenarios, so it is the best scenario and can be used for forecasting. GoogleNet gets RMSE values of 0.00255 for high-intensity data and 0.00130 for low-intensity data and MAPE values of 3.47579% for High-intensity data and 6.43897% for low-intensity data.

The results of the scenario obtained come from the CNN can be used for the data testing process using 1 year of flat data with the data time range used from 1 January 2022 to 31 December 2022. Table 3 shows the results from testing 1 year of data.

TABLE 4. Comparison of rainfall data test performance

Data	RMSE	MAPE
1 Year	0.18009	9.04321%

The results in Table 4. show that the RMSE error value is 0.18230, followed by the MAPE value of 9.04321%, so the Convolutional Neural Network scenario can be carried out for forecasting rainfall levels. It can be seen that Figure 5 shows the comparison of prediction results with targets from data that are close to each other, but there are data anomalies so that the data cannot be predicted accurately. The prediction results are low at index 0 to 7, but the target value goes up and down.

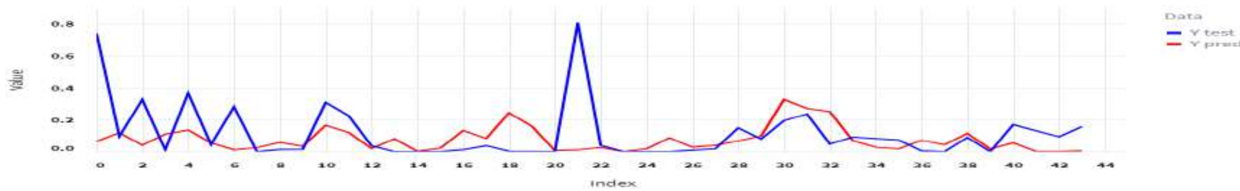

FIGURE 4. Graph of Test Results

This study created a Graphical User Interface (GUI) containing displays and features for running the forecasting system. This Graphical User Interface (GUI) was created using a Python library called Streamlit. The Graphical User Interface (GUI) has five pages: the homepage, dataset page, interpolation page, normalization page, and CNN scenario page. Figure 6 shows the appearance of this study's Graphical User Interface (GUI).

CONCLUSION

Based on the results of the tests that have been carried out, it can be concluded that the Convolutional Neural Network (CNN) can forecast rainfall data provided by the Meteorology, Climatology, and Geophysics Agency (BMKG), and architectural changes can affect the results of forecasting by reducing the error value of the results. The results obtained at the training stage are in the form of a Root Mean Square Error (RMSE) of 0.00873 and Mean Absolute Percentage Error (MAPE) of 12.49278% in model 1, which can decrease the error value up to RMSE to 0.00255 and MAPE to 3.47579% in model 3. The parameters used to train using model 3 include layer parameters: 3 Convolution Layers and 1 Max Pooling Layer. Input Parameters 30 for 1st convolution, 15 for 2nd convolution, and 7 for 3rd convolution. Filter Parameters: 64, Padding: 1, Acitavion: Relu, Size Pooling: 2, Stride Pooling: 2, Flatten: 192, Dense: 100, Epoch: 1000, and Output Layer: 1.

The results of testing data using high-intensity and low-intensity data get error value results that decrease with architectural changes in the model used. Model 1 with 1 layer gets an RMSE of 0.00873 for high-intensity data and 0.00221 for low-intensity data. After increasing the layer in model 3 with 3 layers, the RMSE value decreases to 0.00255 for high-intensity data and 0.00130 for low-intensity data. The MAPE value also decreased, previously 12.49278% for high-intensity data and 16.23740% for low-intensity data, which could decrease to 3.47579% for high-intensity data and 6.43897% for low-intensity data. The error value results differ for each data used, ranging from high to low-intensity data, indicating that the data used can affect the error value results from the forecasting.

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The Inverse of Interval Matrix by Elementary Row Operations Modification

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Abstract. Algebra for interval numbers has been developed by various authors. For the operations of addition, subtraction, and scalar multiplication, there aren't many differences among the numerous algebras for interval numbers. However, other algebraic alternatives are offered by various authors for division/inverse operations and multiplication. All of the provided algebra, however, $\tilde{a}(r) \otimes \frac{1}{\tilde{a}(r)}$ is irrelevant. As a result, the author of this article will modify interval number algebra so that it applies$\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1} = \widetilde{\boldsymbol{I}}$ to Interval Matrices. Initially, the midpoint of an interval number $\left(m(\tilde{a})\right)$ is provided in order to accomplish this purpose. Afterwards, the interval matrix's basic row operations will be modified to determine the inverse of the interval matrix.

INTRODUCTION

An interval matrix is the same as a regular matrix that has algebra operations to solve questions on the matrix. Algebra operations on interval matrices are based on algebra operations in a number of intervals.

There are several methods used by various authors to determine algebra operations of interval numbers, including the authors of [1, 2, 3, 7, 11-12, and 16]. However, some a specs of these definitions do not follow the rule of real numbers. For example, if $\tilde{O} \in \tilde{a}(r) = [a_l, a_r]$ and $a_l \leq O \leq a_r$, then $\frac{1}{\tilde{a}(r)} = \left[\frac{1}{a_r}, \frac{1}{a_l}\right]$ does not always imply $\frac{1}{\tilde{a}(r)} \in IR$. Then $\frac{\tilde{a}(r)}{\tilde{a}(r)}$ is also not necessarily the same as $\tilde{\imath}(r) = [1,1]$. For example. If $\tilde{a}(r) = [-3,5]$, then $\frac{\tilde{a}(r)}{\tilde{a}(r)} = \left[-\frac{5}{3}, 1\right] \neq \tilde{\imath}(r)$.

The midpoint $m(\tilde{a})$ is defined by several authors [1, 2, 8, 12-15, and 17] for solving linear systems in the form of interval numbers, especially for finding the determinant and inverse of the matrix in the linear system $\widetilde{\boldsymbol{A}} \otimes \tilde{x}(r) = \tilde{b}(r)$. Additionally, some people use it to see the singularity of the matrix $\tilde{A}$ [18] or other things related to interval matrices, such as interval matrix multiplication [19]. As with previous algebraic operations, the algebraic operations used are still incomplete in the concepts of multiplication and division.

Based on the conditions above, we need to present the concept of algebraic operations on interval numbers, especially on multiplication and division so that $\tilde{a}(r) \otimes \frac{1}{\tilde{a}(r)} = \tilde{\imath}(r) = [1,1]$.

In this research, the author will determine the inverse of the interval matrix by first making algebraic modifications to the interval numbers. Starting by defining the midpoint $m(\tilde{a})$, multiplying the interval number and dividing the interval number and the inverse of the interval number. So it applies $\tilde{a}(r) \otimes \tilde{a}(r)^{-1} = \tilde{\imath}(r)$ and is developed for interval matrices that also apply $\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1} = \widetilde{\boldsymbol{I}}$.

LITERATURE REVIEW

The concepts and theories that guide and support this study are listed below.

A. Interval Numbers

Interval numbers are an interesting part of algebra. The interval arithmetic number has been proposed by several authors in different ways. The interval arithmetic number presented in [1,2,3,7-8,10-16,20 and 21] is as follows.

AIP Conf. Proc. 3148, 020007-1–020007-8; https://doi.org/10.1063/5.0242031
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For example, for two interval numbers $\tilde{a}(r) = [a_l, a_r]$ and $\tilde{b}(r) = [b_l, b_r]$ with $a_l \leq a_r$ and $b_l \leq b_r$ it defines $IR = \{\tilde{a}(r) = [a_l, a_r] | a_l \leq a_r \text{ dan } a_l, a_r \in \mathbb{R}\}$, applies:

(i) $\tilde{a}(r) \oplus \tilde{b}(r) = [a_l + b_l, a_r + b_r]$.

(ii) $\tilde{a}(r) \ominus \tilde{b}(r) = [a_l - b_r, a_r - b_l]$.

(iii) $\tilde{a}(r) \otimes \tilde{b}(r) = [\min\{a_l b_l, a_l b_r, a_r b_l, a_r b_r\}, \max\{a_l b_l, a_l b_r, a_r b_l, a_r b_r\}]$

(iv) $\alpha\tilde{a}(r) = \begin{cases} [\alpha a_l, \alpha a_r], \text{ jika } \alpha \geq 0, \\ [\alpha a_r, \alpha a_l], \text{ jika } \alpha < 0. \end{cases}$

(v) $\frac{\tilde{a}(r)}{\tilde{b}(r)} = [a_l, a_r] \otimes \left[\frac{1}{b_r}, \frac{1}{b_l}\right]$.

Furthermore, for $\tilde{a}(r) = [a_l, a_r]$ and $\tilde{b}(r) = [b_l, b_r]$ in [8,13-15] it defines $m(\tilde{a}) = (a_l + a_r)/2$ dan $m(\tilde{b}) = (b_l + b_r)/2$. So the following operations apply:

i. $\tilde{a}(r) \oplus \tilde{b}(r) = \left[m(\tilde{a}) + m(\tilde{b}) - k, m(\tilde{a}) + m(\tilde{b}) + k\right]$.

ii. $\tilde{a}(r) \ominus \tilde{b}(r) = \left[m(\tilde{a}) - m(\tilde{b}) - k, m(\tilde{a}) - m(\tilde{b}) + k\right]$,
with $k = \left\{\frac{(a_r+b_r)-(a_l+b_l)}{2}\right\}$.

iii. $\tilde{a}(r) \otimes \tilde{b}(r) = \left[m(\tilde{a})m(\tilde{b}) - k, m(\tilde{a})m(\tilde{b}) + k\right]$,
with $k = \min\{m(\tilde{a})m(\tilde{b}) - \alpha, \beta - m(\tilde{a})m(\tilde{b})\}$ and
$\alpha = \min\{a_l b_l, a_l b_r, a_r b_l, a_r b_r\}$, $\beta = \max\{a_l b_l, a_l b_r, a_r b_l, a_r b_r\}$.

iv. $1{:}\,\tilde{a}(r) = \frac{1}{\tilde{a}(r)} = \frac{1}{[a_l, a_r]} = \left[\frac{1}{m(\tilde{a})} - \delta, m(\tilde{a}) + \delta\right]$,
with $\delta = \min\left\{\frac{1}{a_r}\left(\frac{a_r - a_l}{a_l + a_r}\right), \frac{1}{a_l}\left(\frac{a_r - a_l}{a_l + a_r}\right)\right\}$ and $0 \neq \tilde{a}(r)$.

It is obvious that the given formula cannot determine $1/\tilde{a}\,(r)$ if $0 \neq \tilde{a}(r)$, as a result, another solution must be found to determine $1/\tilde{a}(r)$ for any $\tilde{a}$(r)=0.

B. Interval Matrix

The interval matrix's explanation is actually identical to that of a regular matrix; the only distinction is in the elements, which are represented by intervals in [18]. The interval matrix is defined in detail as follows.

Definition 1. If $\underline{A}, \overline{A}$ are two matrices in $\mathbb{R}_{m\times n}$, with $\underline{A} \leq \overline{A}$ which is part of a matrix: $\widetilde{\boldsymbol{A}} = [\underline{A}, \overline{A}] = \{\widetilde{\boldsymbol{A}}; \underline{A} \leq \tilde{A} \leq \overline{A}\}$. This is called as an interval matrix, and the matrix $\underline{A}, \overline{A}$ is a finite matrix.

As an illustration, consider these two matrices $\underline{A}$ and $\overline{A}$ as follows

$$\underline{\boldsymbol{A}} = \begin{bmatrix} b_{11} & b_{12} & \dots & b_{1n} \\ b_{21} & b_{22} & \dots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{m1} & b_{m2} & \dots & b_{mn} \end{bmatrix} \quad \text{and} \quad \overline{\boldsymbol{A}} = \begin{bmatrix} c_{11} & c_{12} & \dots & c_{1n} \\ c_{21} & c_{22} & \dots & c_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m2} & \dots & c_{mn} \end{bmatrix}$$

Next, the matrix $\tilde{A}$ is defined as:

$$\widetilde{\boldsymbol{A}} = \begin{bmatrix} [b_{11}, c_{11}] & [b_{12}, c_{12}] & \dots & [b_{1n}, c_{1n}] \\ [b_{21}, c_{21}] & [b_{22}, c_{22}] & \dots & [b_{2n}, c_{2n}] \\ \vdots & \vdots & \ddots & \vdots \\ [b_{m1}, c_{m1}] & [b_{m2}, c_{m2}] & \dots & [b_{mn}, c_{mn}] \end{bmatrix} \quad \text{with } b_{ij} \leq c_{ij}$$

$i = 1,2, \dots, n$ and $j = 1,2, \dots, m$.

Next, if $b_{ij} = \underline{a}_{ij}$ and $c_{ij} = \overline{a}_{ij}$, then the interval matrix $\widetilde{\boldsymbol{A}}$ can be written as follows:

$$\widetilde{\boldsymbol{A}} = \begin{bmatrix} \tilde{a}_{11} & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{a}_{22} & \dots & \tilde{a}_{2n} \\ \vdots & \vdots & \dots & \vdots \\ \tilde{a}_{i1} & \tilde{a}_{i2} & \dots & \tilde{a}_{in} \\ \vdots & \vdots & \dots & \vdots \\ \tilde{a}m_1 & \tilde{a}_{m2} & \dots & \tilde{a}_{mn} \end{bmatrix}$$

with $\tilde{a}_{ij} = [\underline{a}_{ij}, \overline{a}_{ij}]$.

The symbol $\boldsymbol{O}$ is used as a symbol of the zero matrix, while in the interval matrix, the zero matrix is symbolized by $\widetilde{\boldsymbol{O}}$, namely an interval matrix whose element is zero.

$$\tilde{\boldsymbol{O}} = \begin{bmatrix} \tilde{0} & \dots & \tilde{0} \\ \vdots & \ddots & \vdots \\ \tilde{0} & \dots & \tilde{0} \end{bmatrix} = \begin{bmatrix} [0,0] & \dots & [0,0] \\ \vdots & \ddots & \vdots \\ [0,0] & \dots & [0,0] \end{bmatrix}$$

The identity matrix in the interval matrix is symbolized by $\tilde{\boldsymbol{I}}$ which is defined as follows:

$$\tilde{\boldsymbol{I}} = \begin{bmatrix} \tilde{1} & \dots & \tilde{0} \\ \vdots & \tilde{1} & \vdots \\ \tilde{0} & \dots & \tilde{1} \end{bmatrix} = \begin{bmatrix} [1,1] & \dots & [0,0] \\ \vdots & [1,1] & \vdots \\ [0,0] & \dots & [1,1] \end{bmatrix}$$

ARITHMETIC AND INTERVAL NUMBER ALGEBRA

To compile the arithmetic for multiplication, division and inverse of interval numbers, first define the median value as follows:

Definition 2. The median of the interval number $\tilde{a}(r) = [a_r, a_l]$ is defined as follows:

$$m(\tilde{a}) = \frac{(a_l + a_r)}{2} \tag{1}$$

The following multiplicative arithmetic can be created using Definition 3.1:

$$\tilde{a}(r) \otimes \tilde{b}(r) = \left[a_l m(\tilde{b}) + b_l m(\tilde{a}) - m(\tilde{a})m(\tilde{b}), a_r m(\tilde{b}) + b_r m(\tilde{a}) - m(\tilde{a})m(\tilde{b})\right] \tag{2}$$

In addition, each interval number can be represented by equation (2), which will obtain the inverse $\frac{1}{\tilde{a}(r)}$.

$$\tilde{a}(r) \otimes \tilde{x}(r) = \tilde{\imath}(r) = [1,1] \tag{3}$$

Then the evidence of the following theorem is presented as an example of (3).

Theorem 1. For each interval number $\tilde{a}(r) = [a_l, a_r]$ with $m(\tilde{a}) \neq 0$, and $\tilde{x}(r) = \frac{1}{\tilde{a}(r)} = \left[\frac{2m(\tilde{a})-a_l}{(m(\tilde{a}))^2}, \frac{2m(\tilde{a})-a_r}{(m(\tilde{a}))^2}\right]$, then based on the multiplication in (2), we obtain:

$$\tilde{a}(r) \otimes \tilde{x}(r) = \tilde{\imath}(r) = [1,1].$$

Proof. First we will calculate $m(\tilde{x})$.

$$m(\tilde{x}) = \frac{\left(\left(\frac{2m(\tilde{a}) - a_l}{(m(\tilde{a}))^2}\right) \oplus \left(\frac{2m(\tilde{a}) - a_r}{(m(\tilde{a}))^2}\right)\right)}{2}$$

$$= \frac{\frac{4m(\tilde{a}) - (a_l + a_r)}{(m(\tilde{a}))^2}}{2}$$

$$m(\tilde{x}) = \frac{1}{m(\tilde{a})} \tag{4}$$

Then, we can determine $\tilde{a}(r) \otimes \tilde{x}(r)$ using (4)

$$\begin{aligned}
\tilde{a}(r) \otimes \tilde{x}(r) &= [a_l m(\tilde{x}) + x_l m(\tilde{a}) - m(\tilde{a})m(\tilde{x}), a_r m(\tilde{x}) + x_r m(\tilde{a}) - m(\tilde{a})m(\tilde{x})] \\
&= \left[a_l\left(\tfrac{1}{m(\tilde{a})}\right) + \left(\tfrac{2m(\tilde{a})-a_l}{(m(\tilde{a}))^2}\right)m(\tilde{a}) - m(\tilde{a})\left(\tfrac{1}{m(\tilde{a})}\right), a_r\left(\tfrac{1}{m(\tilde{a})}\right) + \left(\tfrac{2m(\tilde{a})-a_r}{(m(\tilde{a}))^2}\right)m(\tilde{a}) - m(\tilde{a})\left(\tfrac{1}{m(\tilde{a})}\right)\right] \\
&= \left[\frac{a_l}{m(\tilde{a})} + \frac{2m(\tilde{a}) - a_l}{m(\tilde{a})} - 1, \frac{a_r}{m(\tilde{a})} + \frac{2m(\tilde{a}) - a_r}{m(\tilde{a})} - 1\right] \\
&= [1,1] \\
\tilde{a}(r) \otimes \tilde{x}(r) &= \tilde{\imath}(r)
\end{aligned}$$

It is proven that $\tilde{a}(r) \otimes \tilde{x}(r) = \tilde{\imath}(r)$. ■

Similarly for $\tilde{b}(r) = [b_l, b_r]$,

$$\frac{1}{\tilde{b}(r)}=\left[\frac{2m(\tilde{b})-b_l}{\left(m(\tilde{b})\right)^2},\frac{2m(\tilde{b})-b_r}{\left(m(\tilde{b})\right)^2}\right]=\frac{1}{m(\tilde{b})}$$

Corollary 1. Every interval number $\tilde{a}(r)=[a_l,a_r]$ and $\tilde{b}(r)=[b_l,b_r]$, can be shown as $\frac{\tilde{a}(r)}{\tilde{b}(r)}$.

Proof.

$$\begin{aligned}
\frac{\tilde{a}(r)}{\tilde{b}(r)} &= \tilde{a}(r)\otimes\frac{1}{\tilde{b}(r)}\\
&= [a_l,a_r]\otimes\left[\frac{2m(\tilde{b})-b_l}{\left(m(\tilde{b})\right)^2},\frac{2m(\tilde{b})-b_r}{\left(m(\tilde{b})\right)^2}\right]\\
&= \left[a_l\left(\frac{1}{m(\tilde{b})}\right)+\left(\frac{2m(\tilde{b})-b_l}{\left(m(\tilde{b})\right)^2}\right)m(\tilde{a})-\frac{m(\tilde{a})}{m(\tilde{b})},a_r\left(\frac{1}{m(\tilde{b})}\right)+\left(\frac{2m(\tilde{b})-b_r}{\left(m(\tilde{b})\right)^2}\right)m(\tilde{a})-\frac{m(\tilde{a})}{m(\tilde{b})}\right]\\
&= \left[\frac{a_lm(\tilde{b})+2m(\tilde{b})m(\tilde{a})-b_lm(\tilde{a})-m(\tilde{a})m(\tilde{b})}{\left(m(\tilde{b})\right)^2},\frac{a_rm(\tilde{b})+2m(\tilde{b})m(\tilde{a})-b_rm(\tilde{a})-m(\tilde{a})m(\tilde{b})}{\left(m(\tilde{b})\right)^2}\right]\\
&= \left[\frac{a_lm(\tilde{b})-b_lm(\tilde{a})+m(\tilde{a})m(\tilde{b})}{\left(m(\tilde{b})\right)^2},\frac{a_rm(\tilde{b})+b_rm(\tilde{a})-m(\tilde{a})m(\tilde{b})}{\left(m(\tilde{b})\right)^2}\right]
\end{aligned}$$

Theorem 2. If there is an interval number $\tilde{a}(r)=[a_l,a_r]$ and $\tilde{b}(r)=[b_l,b_r]$, it will fulfill the following characteristics:

(a) $\tilde{a}(r)\otimes\tilde{0}(r)=\tilde{0}(r)$.
(b) $\tilde{a}(r)\otimes\tilde{\imath}(r)=\tilde{a}(r)$.
(c) $\tilde{a}(r)\otimes\tilde{b}(r)=\tilde{b}(r)\otimes\tilde{a}(r)$.
(d) $\left(\tilde{a}(r)\otimes\tilde{b}(r)\right)\otimes\tilde{c}(r)=\tilde{a}(r)\otimes\left(\tilde{b}(r)\otimes\tilde{c}(r)\right)$.
(e) $\left(\tilde{a}(r)\oplus\tilde{b}(r)\right)\otimes\tilde{c}(r)=(\tilde{a}(r)\otimes\tilde{c}(r))\oplus\left(\tilde{b}(r)\otimes\tilde{c}(r)\right)$.
(f) If $\tilde{a}(r)\otimes\tilde{x}(r)=\tilde{b}(r)$ with $\tilde{a}(r)\not\approx\tilde{0}(r)$, then $\tilde{x}(r)=\frac{\tilde{b}(r)}{\tilde{a}(r)}$.
(g) If $\tilde{a}(r)\otimes\tilde{b}(r)=\tilde{0}(r)$, then $\tilde{a}(r)\approx\tilde{0}(r)$, or $\tilde{b}(r)\approx\tilde{0}(r)$.
(h) If $\tilde{a}(r)\otimes\tilde{b}(r)=\tilde{a}(r)\otimes\tilde{c}(r)$ with $\tilde{a}\not\approx\tilde{0}$, then $\tilde{b}(r)=\tilde{c}(r)$.
(i) If $\tilde{a}(r)\not\approx\tilde{0}(r)$, then $\frac{1}{\tilde{a}(r)}\not\approx\tilde{0}(r)$ and $\frac{1}{\frac{1}{\tilde{a}(r)}}=\tilde{a}(r)$.
(j) If $\tilde{a}(r)\not\approx\tilde{0}(r)$ and $\tilde{b}(r)\not\approx\tilde{0}(r)$, then $\frac{1}{\tilde{a}(r)\otimes\tilde{b}(r)}=\frac{1}{\tilde{a}(r)}\otimes\frac{1}{\tilde{b}(r)}$.

Proof: Clearly.

THE INVERSE OF INTERVAL MATRIX BY ELEMENTARY ROW OPERATIONS MODIFICATION

The method used to determine the inverse of the interval matrix is the elementary row operation method with slight modifications. In principle, the operating steps used are the same as elementary row operations on real numbers, the difference is that in this modification of elementary row operations, the multiplier used is not a constant but an interval number.

Determining the inverse matrix by modifying elementary row operations is by reducing the matrix $\tilde{\boldsymbol{A}}$ to the matrix $\tilde{\boldsymbol{I}}$, so that the final matrix is in the form $\left[\tilde{\boldsymbol{I}}|\tilde{\boldsymbol{A}}^{-1}\right]$. The following are the steps for modifying elementary row operations for interval matrices:

1. Multiplying a row by an interval number.
2. Changing the positions of two lines.

3. Adding/ subtracting a row by multiplying the interval numbers to another row.

The following is an example of determining the inverse of a 3×3 interval matrix using modified elementary row operations by applying interval number algebraic arithmetic in Theorem 3.2. Then it will be proven that $\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1} = \widetilde{\boldsymbol{I}}$.

Example 1. The interval matrix is given as follows

$$\widetilde{\boldsymbol{A}} = \begin{bmatrix} [1,4] & [1,3] & [1,2] \\ [-2,4] & [2,5] & [-2,3] \\ [3,4] & [3,5] & [3,6] \end{bmatrix}$$

The interval matrix above will be converted into an enlarged matrix form as follows

$$\widetilde{\boldsymbol{A}}|\tilde{I} = \left[\begin{array}{ccc|ccc} [1,4] & [1,3] & [1,2] & [1,1] & [0,0] & [0,0] \\ [-2,4] & [2,5] & [-2,3] & [0,0] & [1,1] & [0,0] \\ [3,4] & [3,5] & [3,6] & [0,0] & [0,0] & [1,1] \end{array}\right]$$

To change [1,4] to [1,1] then [1,4] will be multiplied by the inverse of [1,4] with arithmetic as in equation (3) so that the first row will be multiplied by $\frac{1}{[1,4]}$, then it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & \left[\frac{22}{25},\frac{18}{25}\right] & \left[\frac{19}{25},\frac{11}{25}\right] & \left[\frac{16}{25},\frac{4}{25}\right] & [0,0] & [0,0] \\ [-2,4] & [2,5] & [-2,3] & [0,0] & [1,1] & [0,0] \\ [3,4] & [3,5] & [3,6] & [0,0] & [0,0] & [1,1] \end{array}\right]$$

Then $[-2,4]$ will be changed into [0,0] by multiplying $[2,-4]$ with the first line then the result is added to the second line and [3,4] will be changed to [0,0] by multiplying $[-3,-4]$ with the first row then the results are added to the third row, then it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & \left[\frac{22}{25},\frac{18}{25}\right] & \left[\frac{19}{25},\frac{11}{25}\right] & \left[\frac{16}{25},\frac{4}{25}\right] & [0,0] & [0,0] \\ [0,0] & \left[\frac{88}{25},\frac{47}{25}\right] & \left[-\frac{24}{25},\frac{19}{25}\right] & \left[\frac{14}{25},-\frac{34}{25}\right] & [1,1] & [0,0] \\ [0,0] & \left[\frac{8}{25},\frac{52}{25}\right] & \left[\frac{16}{25},\frac{104}{25}\right] & \left[-\frac{51}{25},-\frac{19}{25}\right] & [0,0] & [1,1] \end{array}\right]$$

Next, $\left[\frac{88}{25},\frac{47}{25}\right]$ will be changed [1,1] by multiplying the second row and $\frac{1}{\left[\frac{88}{25},\frac{47}{25}\right]}$ then it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & \left[\frac{22}{25},\frac{18}{25}\right] & \left[\frac{19}{25},\frac{11}{25}\right] & \left[\frac{16}{25},\frac{4}{25}\right] & [0,0] & [0,0] \\ [0,0] & [1,1] & \left[-\frac{251}{729},\frac{197}{729}\right] & \left[\frac{184}{729},-\frac{400}{729}\right] & \left[\frac{188}{729},\frac{352}{729}\right] & [0,0] \\ [0,0] & \left[\frac{8}{25},\frac{52}{25}\right] & \left[\frac{16}{25},\frac{104}{25}\right] & \left[-\frac{51}{25},-\frac{19}{25}\right] & [0,0] & [1,1] \end{array}\right]$$

Afterwards, $\left[\frac{22}{25},\frac{18}{25}\right]$ will be change into [0,0] by multiplying $\left[-\frac{22}{25},-\frac{18}{25}\right]$ and the second row then its result is added to the first row and $\left[\frac{8}{25},\frac{52}{25}\right]$ will be changed into [0,0] by multiplying $\left[-\frac{8}{25},-\frac{52}{25}\right]$ and the second row then its result is added to the third row, therefore it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & [0,0] & \left[\frac{757}{729},\frac{161}{729}\right] & \left[\frac{328}{729},\frac{428}{729}\right] & \left[-\frac{172}{729},-\frac{260}{729}\right] & [0,0] \\ [0,0] & [1,1] & \left[-\frac{251}{729},\frac{197}{729}\right] & \left[\frac{184}{729},-\frac{400}{729}\right] & \left[\frac{188}{729},\frac{352}{729}\right] & [0,0] \\ [0,0] & [0,0] & \left[\frac{248}{243},\frac{940}{243}\right] & \left[-\frac{601}{243},\frac{7}{243}\right] & \left[\frac{4}{243},-\frac{220}{243}\right] & [1,1] \end{array}\right]$$

Next, $\left[\frac{248}{243},\frac{940}{243}\right]$ will be changed into [1,1] by multiplying the third row and $\frac{1}{\left[\frac{248}{243},\frac{940}{243}\right]}$ so it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & [0,0] & \left[\frac{757}{729},\frac{161}{729}\right] & \left[\frac{328}{729},\frac{428}{729}\right] & \left[-\frac{172}{729},-\frac{260}{729}\right] & [0,0] \\ [0,0] & [1,1] & \left[-\frac{251}{729},\frac{197}{729}\right] & \left[\frac{184}{729},-\frac{400}{729}\right] & \left[\frac{188}{729},\frac{352}{729}\right] & [0,0] \\ [0,0] & [0,0] & [1,1] & \left[-\frac{43}{33},\frac{10}{33}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[\frac{235}{363},\frac{62}{363}\right] \end{array}\right]$$

Then, $\left[\frac{757}{729},\frac{161}{729}\right]$ will be changed into [0,0] by multiplying $\left[-\frac{757}{729},-\frac{161}{729}\right]$ and the third row, then its result is added to the first row, and $\left[-\frac{251}{729},\frac{197}{729}\right]$ will be changed into [0,0] by multiplying $\left[\frac{251}{729},-\frac{197}{729}\right]$ and the third row, then its result is added to the second row, so it obtains

$$\left[\begin{array}{ccc|ccc} [1,1] & [0,0] & [0,0] & \left[\frac{146}{99},\frac{19}{99}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[-\frac{626}{1089},\frac{65}{1089}\right] \\ [0,0] & [1,1] & [0,0] & \left[\frac{5}{99},-\frac{38}{99}\right] & \left[\frac{24}{121},\frac{64}{121}\right] & \left[\frac{163}{1089},-\frac{130}{1089}\right] \\ [0,0] & [0,0] & [1,1] & \left[-\frac{43}{33},\frac{10}{33}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[\frac{235}{363},\frac{62}{363}\right] \end{array}\right]$$

So it obtains the inverse matrix $\widetilde{\boldsymbol{A}}^{-1}$ as follows

$$\widetilde{\boldsymbol{A}}^{-1} = \begin{bmatrix} \left[\frac{146}{99},\frac{19}{99}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[-\frac{626}{1089},\frac{65}{1089}\right] \\ \left[\frac{5}{99},-\frac{38}{99}\right] & \left[\frac{24}{121},\frac{64}{121}\right] & \left[\frac{163}{1089},-\frac{130}{1089}\right] \\ \left[-\frac{43}{33},\frac{10}{33}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[\frac{235}{363},\frac{62}{363}\right] \end{bmatrix}$$

Then to prove that the $\widetilde{\boldsymbol{A}}^{-1}$ obtained is correct, it will be proven by calculating $\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1} = \widetilde{\boldsymbol{I}}$

The calculation of $\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1}$ is shown below.

$$\widetilde{\boldsymbol{A}} \otimes \widetilde{\boldsymbol{A}}^{-1} = \begin{bmatrix} [1,4] & [1,3] & [1,2] \\ [-2,4] & [2,5] & [-2,3] \\ [3,4] & [3,5] & [3,6] \end{bmatrix} \otimes \begin{bmatrix} \left[\frac{146}{99},\frac{19}{99}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[-\frac{626}{1089},\frac{65}{1089}\right] \\ \left[\frac{5}{99},-\frac{38}{99}\right] & \left[\frac{24}{121},\frac{64}{121}\right] & \left[\frac{163}{1089},-\frac{130}{1089}\right] \\ \left[-\frac{43}{33},\frac{10}{33}\right] & \left[-\frac{12}{121},-\frac{32}{121}\right] & \left[\frac{235}{363},\frac{62}{363}\right] \end{bmatrix}$$

1. For $\tilde{I}_{11}$

$$\begin{aligned} & [1,4] \otimes \left[\frac{146}{99},\frac{19}{99}\right] \oplus [1,3] \otimes \left[\frac{5}{99},-\frac{38}{99}\right] \oplus [1,2] \otimes \left[-\frac{43}{33},\frac{10}{33}\right] \\ = & \left[\frac{965}{396},\frac{685}{396}\right] \oplus \left[\frac{53}{198},-\frac{185}{198}\right] \oplus \left[-\frac{75}{44},\frac{9}{44}\right] \\ = & [1,1] \end{aligned}$$

2. For $\tilde{I}_{12}$

$$\begin{aligned} & [1,4] \otimes \left[-\frac{12}{121},-\frac{32}{121}\right] \oplus [1,3] \otimes \left[\frac{24}{121},\frac{64}{121}\right] \oplus [1,2] \otimes \left[-\frac{12}{121},-\frac{32}{121}\right] \\ = & \left[\frac{3}{121},-\frac{113}{121}\right] \oplus \left[\frac{4}{121},\frac{172}{121}\right] \oplus \left[-\frac{7}{121},-\frac{59}{121}\right] \\ = & [0,0] \end{aligned}$$

3. For $\tilde{I}_{13}$

$$\begin{aligned} & [1,4] \otimes \left[-\frac{626}{1089},\frac{65}{1089}\right] \oplus [1,3] \otimes \left[\frac{163}{1089},-\frac{130}{1089}\right] \oplus [1,2] \otimes \left[\frac{235}{363},\frac{62}{363}\right] \\ = & \left[-\frac{4577}{4356},-\frac{1033}{4356}\right] \oplus \left[\frac{619}{2178},-\frac{487}{2178}\right] \oplus \left[\frac{371}{484},\frac{223}{484}\right] \\ = & [0,0] \end{aligned}$$

4. For $\tilde{I}_{21}$

$$\begin{aligned} & [-2,4] \otimes \left[\frac{146}{99},\frac{19}{99}\right] \oplus [2,5] \otimes \left[\frac{5}{99},-\frac{38}{99}\right] \oplus [-2,3] \otimes \left[-\frac{43}{33},\frac{10}{33}\right] \\ = & \left[-\frac{203}{198},\frac{533}{198}\right] \oplus \left[\frac{169}{396},-\frac{631}{396}\right] \oplus \left[\frac{79}{132},-\frac{145}{132}\right] \\ = & [0,0] \end{aligned}$$

5. For $\tilde{I}_{22}$

$$[-2,4] \otimes \left[-\frac{12}{121},-\frac{32}{121}\right] \oplus [2,5] \otimes \left[\frac{24}{121},\frac{64}{121}\right] \oplus [-2,3] \otimes \left[-\frac{12}{121},-\frac{32}{121}\right]$$

$$= \left[\frac{54}{121}, -\frac{98}{121}\right] \oplus \left[\frac{18}{121}, \frac{290}{121}\right] \oplus \left[\frac{49}{121}, -\frac{71}{121}\right]$$
$$= [1,1]$$

6. For $\tilde{I}_{23}$

$$[-2,4] \otimes \left[-\frac{626}{1089}, \frac{65}{1089}\right] \oplus [2,5] \otimes \left[\frac{163}{1089}, -\frac{130}{1089}\right] \oplus [-2,3] \otimes \left[\frac{235}{363}, \frac{62}{363}\right]$$
$$= \left[\frac{431}{2178}, -\frac{1553}{2178}\right] \oplus \left[\frac{2183}{4356}, -\frac{1721}{4356}\right] \oplus \left[-\frac{1015}{1452}, \frac{1609}{1452}\right]$$
$$= [0,0]$$

7. For $\tilde{I}_{31}$

$$[3,4] \otimes \left[\frac{146}{99}, \frac{19}{99}\right] \oplus [3,5] \otimes \left[\frac{5}{99}, -\frac{38}{99}\right] \oplus [3,6] \otimes \left[-\frac{43}{33}, \frac{10}{33}\right]$$
$$= \left[\frac{1879}{396}, \frac{431}{396}\right] \oplus \left[\frac{73}{198}, -\frac{337}{198}\right] \oplus \left[-\frac{225}{44}, \frac{27}{44}\right]$$
$$= [0,0]$$

8. For $\tilde{I}_{32}$

$$[3,4] \otimes \left[-\frac{12}{121}, -\frac{32}{121}\right] \oplus [3,5] \otimes \left[\frac{24}{121}, \frac{64}{121}\right] \oplus [3,6] \otimes \left[-\frac{12}{121}, -\frac{32}{121}\right]$$
$$= \left[-\frac{31}{121}, -\frac{123}{121}\right] \oplus \left[\frac{52}{121}, \frac{300}{121}\right] \oplus \left[-\frac{21}{121}, -\frac{177}{121}\right]$$
$$= [0,0]$$

9. For $\tilde{I}_{33}$

$$[3,4] \otimes \left[-\frac{626}{1089}, \frac{65}{1089}\right] \oplus [3,5] \otimes \left[\frac{163}{1089}, -\frac{130}{1089}\right] \oplus [3,6] \otimes \left[\frac{235}{363}, \frac{62}{363}\right]$$
$$= \left[-\frac{8203}{4356}, \frac{349}{4356}\right] \oplus \left[\frac{1271}{2178}, -\frac{1007}{2178}\right] \oplus \left[\frac{1113}{484}, \frac{669}{484}\right]$$
$$= [1,1]$$

Based on the calculation, results 1 to 9 fulfill the requirements of an interval identity matrix, so it can be written in matrix form .

$$\tilde{\boldsymbol{I}} = \begin{bmatrix} [1,1] & [0,0] & [0,0] \\ [0,0] & [1,1] & [0,0] \\ [0,0] & [0,0] & [1,1] \end{bmatrix}$$

So, it is proven that $\tilde{\boldsymbol{A}} \otimes \tilde{\boldsymbol{A}}^{-1} = \tilde{\boldsymbol{I}}$.

CONCLUSION

Based on the multiplication arithmetic in Equation (2), the inverse number of the interval $\tilde{a}(r) = [a_l, a_r]$ can be determined which is $\tilde{a}(r)^{-1} = \left(\frac{2m(\tilde{a})-a_l}{(m(\tilde{a}))^2}, \frac{2m(\tilde{a})-a_r}{(m(\tilde{a}))^2}\right)$. Then the arithmetic can be used to determine the inverse of the interval matrix.

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The Geometric Product of Bivectors in Three-Dimensional Spaces

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Abstract. *In this paper, we present some properties of geometric product of bivectors in three-dimensional spaces. The geometric product is particularly conducted for two bivectors. In general, the geometric product is not commutative or anti-commutative. This product is commutative provided that the two bivectors are parallel. Meanwhile, the geometric product of two bivectors is anti-commutative when the bivectors are perpendicular. Furthermore, the geometric product of two bivectors is distributive over the addition.*

INTRODUCTION

In algebra, people study some symbols and operations such as addition, subtraction, multiplication, and division. Meanwhile, in geometry, people study concept of the shape of objects such as points, lines, circles, cubes, and so on. Further, the geometric algebra is established to study the concept of algebraic operation applied to the geometric shapes. Geometric algebra is introduced by William Kingdon Clifford in 1987. Now, we could see some researchers applying geometric algebra in many areas (such as physics, robotic, medical, and geometry), as we can see in [4, 8, 9, 5, 6, 11, 1, 2, 10].

Geometric algebra is a graded algebra having multivectors as its element. In $\mathbb{R}^3$, a multivector $\mathbf{M}$ is the the sum of scalar (or 0-blade), vector (or 1-blade), bivector (or 2-blade), and trivector (or 3-blade). In formula,

$$\mathbf{M} = s + \mathbf{v} + \mathbf{B} + \mathbf{T}$$

where s is a scalar, $\mathbf{v}$ is a vector, $\mathbf{B}$ is a bivector, and $\mathbf{T}$ is a trivector. Scalars are called grade-0 objects, vectors are grade-1, bivectors are grade-2, trivectors are grade-3. Geometrically, a scalar is visualized as a point, a vector is visualized as a directed line segment, a bivector is visualized as a directed parallelogram and a trivector is visualized as a directed parallelepiped.

In geometric algebra, we use the geometric product as an operation. This product is the sum of inner product and outer product of multivectors. As a multivectos in $\mathbb{R}^3$ is the sum of scalar, bivector, and trivector, then studying the geometric product of the elements contructing the mulivector could be an important issue. There are not many studies conducted in detail about the geometric product of two bivectors. Hence, in this paper, we present perspectively the bivectors in three-dimensional space ($\mathbb{R}^3$), and more importantly, we present in detail some properties of the geometric product of two bivectors.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020008-1–020008-12; https://doi.org/10.1063/5.0241965

METHODS

In this paper, we present firstly the definition and geometric interpretation (i.e. the magnitude) of bivectors based on some references. Secondly, we will present the geometric product of bivectors and their properties.

BIVECTORS IN THREE-DIMENSIONAL SPACE

For any vectors $\mathbf{a}$ and $\mathbf{b}$ in $\mathbb{R}^3$, we may write them in term of the basis vector $\mathbf{e}_1$, $\mathbf{e}_2$, dan $\mathbf{e}_3$, i.e.

$$\mathbf{a} = \mathrm{a}_1\mathbf{e_1} + \mathrm{a}_2\mathbf{e_2} + \mathrm{a}_3\mathbf{e_3} \text{ and } \mathbf{b} = \mathrm{b}_1\mathbf{e_1} + \mathrm{b}_2\mathbf{e_2} + \mathrm{b}_3\mathbf{e_3}$$

where $a_1, a_2, a_3, b_1, b_2, b_3 \in \mathbb{R}$. According to [7], the outer product of $\mathbf{a}$ and $\mathbf{b}$ is given by

$$\begin{aligned}
\mathbf{a} \wedge \mathbf{b} &= \begin{vmatrix} \mathbf{e_2} \wedge \mathbf{e_3} & \mathbf{e_3} \wedge \mathbf{e_1} & \mathbf{e_1} \wedge \mathbf{e_2} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} \\
&= \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} (\mathbf{e_1} \wedge \mathbf{e_2}) + \begin{vmatrix} a_1 & a_3 \\ b_1 & b_3 \end{vmatrix} (\mathbf{e_1} \wedge \mathbf{e_3}) + \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} (\mathbf{e_2} \wedge \mathbf{e_3}) \\
&= (a_1 b_2 - a_2 b_1)(\mathbf{e_1} \wedge \mathbf{e_2}) + (a_1 b_3 - a_3 b_1)(\mathbf{e_1} \wedge \mathbf{e_3}) + (a_2 b_3 - a_3 b_2)(\mathbf{e_2} \wedge \mathbf{e_3}).
\end{aligned}$$

The outer product $\mathbf{a} \wedge \mathbf{b}$ and $\mathbf{b} \wedge \mathbf{a}$ are called bivectors. Bivectors $\mathbf{e_1} \wedge \mathbf{e_2}, \mathbf{e_2} \wedge \mathbf{e_3}$, and $\mathbf{e_3} \wedge \mathbf{e_1}$ are known as basis unit bivectors, as illustrated in Figure 1. They satisfy the following properties:

$$\mathbf{e_1} \wedge \mathbf{e_2} = -\mathbf{e_2} \wedge \mathbf{e_1}, \qquad \mathbf{e_1} \wedge \mathbf{e_3} = -\mathbf{e_3} \wedge \mathbf{e_1}, \qquad \mathbf{e_2} \wedge \mathbf{e_3} = -\mathbf{e_3} \wedge \mathbf{e_2}$$
$$\mathbf{e_1} \wedge \mathbf{e_1} = \mathbf{e_2} \wedge \mathbf{e_2} = \mathbf{e_3} \wedge \mathbf{e_3} = \mathbf{B_0},$$

where $\mathbf{B_0}$ is the null bivector.

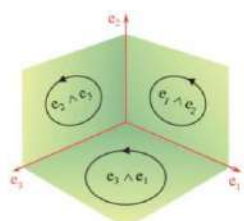

FIGURE 1 Unit bivectors in $\mathbb{R}^3$ (Vince, 2009)

Geometrically, the bivector $\mathbf{a} \wedge \mathbf{b}$ is represented as a directed parallelogram and has a positive direction, while the bivector $\mathbf{b} \wedge \mathbf{a}$ has a negative direction (see Figure 2).

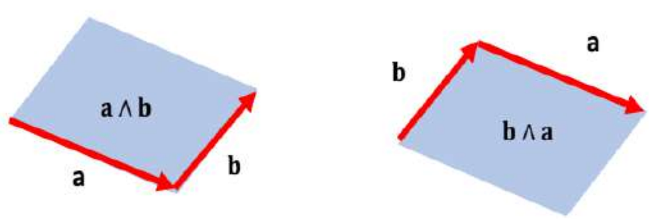

FIGURE 2 Geometric representation of bivectors $\mathbf{a} \wedge \mathbf{b}$ and $\mathbf{b} \wedge \mathbf{a}$

We notice that

$$\begin{aligned}
|\mathbf{B}|^2 = |\mathbf{a} \wedge \mathbf{b}|^2 &= |\mathbf{a}|^2|\mathbf{b}|^2|\sin\theta|^2 = |\mathbf{a}|^2|\mathbf{b}|^2(1 - \cos^2\theta) \\
&= |\mathbf{a}|^2|\mathbf{b}|^2\left(1 - \frac{(a_1 b_1 + a_2 b_2 + a_3 b_3)^2}{|\mathbf{a}|^2|\mathbf{b}|^2}\right) \\
&= |\mathbf{a}|^2|\mathbf{b}|^2 - (a_1 b_1 + a_2 b_2 + a_3 b_3)^2
\end{aligned}$$

$$
\begin{aligned}
&= ({a_1}^2 + {a_2}^2 + {a_3}^2)({b_1}^2 + {b_2}^2 + {b_3}^2) - (a_1b_1 + a_2b_2 + a_3b_3)^2 \\
&= ({a_1}^2 + {a_2}^2 + {a_3}^2)({b_1}^2 + {b_2}^2 + {b_3}^2) - (a_1b_1 + a_2b_2 + a_3b_3)^2 \\
&= ({a_1}^2{b_2}^2 - 2a_1a_2b_1b_2 + {a_1}^2{b_2}^2) + ({a_2}^2{b_3}^2 - 2a_2a_3b_2b_3 + {a_2}^2{b_3}^2) \\
&\quad + ({a_3}^2{b_1}^2 - 2a_3a_1b_3b_1 + {a_3}^2{b_1}^2) \\
&= (a_1b_2 - a_2b_1)^2 + (a_2b_3 - a_3b_2)^2 + (a_3b_1 - a_1b_3)^2
\end{aligned}
$$

where θ is the angle between the vector **a** and **b.** Hence, the magnitude of bivector $\mathbf{B} = \mathbf{a} \wedge \mathbf{b}$ is the area of parallelogram which is given by

$$|\mathbf{B}| = |\mathbf{a} \wedge \mathbf{b}| = |\mathbf{a}||\mathbf{b}||\sin\theta| = \sqrt{(a_1b_2 - a_2b_1)^2 + (a_2b_3 - a_3b_2)^2 + (a_3b_1 - a_1b_3)^2}.$$

GEOMETRIC PRODUCT OF BIVECTORS AND THEIR PROPERTIES

Geometric product of two bivectors is the sum of inner product and outer product of two bivectors. Therefore, before we discuss the geometric product of bivectors, we will discuss first the inner product of two bivectors and the outer product of two bivectors.

Inner Product of Two Bivectors

For any vectors **a** and **b** in $\mathbb{R}^3$, the geometric product of **a** and **b** is defined by

$$\mathbf{ab} = \mathbf{a} \bullet \mathbf{b} + \mathbf{a} \wedge \mathbf{b}, \tag{1}$$

$$\mathbf{ba} = \mathbf{a} \bullet \mathbf{b} - \mathbf{a} \wedge \mathbf{b}. \tag{2}$$

[7]. Equations (1) and (2) give us

$$\mathbf{ab} + \mathbf{ba} = 2(\mathbf{a} \bullet \mathbf{b}) \text{ and } \mathbf{ab} - \mathbf{ba} = 2(\mathbf{a} \wedge \mathbf{b})$$

Therefore, we get

$$\mathbf{a} \bullet \mathbf{b} = \frac{1}{2}(\mathbf{ab} + \mathbf{ba}) \tag{3}$$

$$\mathbf{a} \wedge \mathbf{b} = \frac{1}{2}(\mathbf{ab} - \mathbf{ba}). \tag{4}$$

Equation (3) dan (4) then provide us with

$$\mathbf{e_i} \bullet \mathbf{e_j} = \frac{1}{2}(\mathbf{e_i e_j} + \mathbf{e_j e_i}), \tag{5}$$

$$\mathbf{e_i} \wedge \mathbf{e_j} = \frac{1}{2}(\mathbf{e_i e_j} - \mathbf{e_j e_i}), \tag{6}$$

where $\mathbf{e_i e_j}$ is the geometric product of $\mathbf{e_i}$ and $\mathbf{e_j}$. By using equation (5), we have the following theorem which illustrates the relation between the geometric product and the inner product of two-unit vectors.

Theorem 1 *For unit vectors* $\boldsymbol{e_1}$, $\boldsymbol{e_2}$, *and* $\boldsymbol{e_3}$ *in* $\mathbb{R}^3$, *we have*

1. $\mathbf{e_1} \bullet \mathbf{e_1} = \mathbf{e_1 e_1}, \quad \mathbf{e_2} \bullet \mathbf{e_2} = \mathbf{e_2 e_2}, \quad \mathbf{e_3} \bullet \mathbf{e_3} = \mathbf{e_3 e_3};$ (7)
2. $\mathbf{e_1} \bullet \mathbf{e_2} = \mathbf{e_1} \bullet \mathbf{e_3} = \mathbf{e_2} \bullet \mathbf{e_1} = \mathbf{e_2} \bullet \mathbf{e_3} = \mathbf{e_3} \bullet \mathbf{e_1} = \mathbf{e_3} \bullet \mathbf{e_2} = 0.$

Proof.

1. For any $\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3} \in \mathbb{R}^3$, we have

$$
\begin{aligned}
\mathbf{e_1} \bullet \mathbf{e_1} &= \tfrac{1}{2}(\mathbf{e_1e_1} + \mathbf{e_1e_1}) = \tfrac{1}{2}(2)(\mathbf{e_1e_1}) = \mathbf{e_1e_1}; \\
\mathbf{e_2} \bullet \mathbf{e_2} &= \tfrac{1}{2}(\mathbf{e_2e_2} + \mathbf{e_2e_2}) = \tfrac{1}{2}(2)(\mathbf{e_2e_2}) = \mathbf{e_2e_2}; \\
\mathbf{e_3} \bullet \mathbf{e_3} &= \tfrac{1}{2}(\mathbf{e_3e_3} + \mathbf{e_3e_3}) = \tfrac{1}{2}(2)(\mathbf{e_3e_3}) = \mathbf{e_3e_3}.
\end{aligned}
$$

2. For any $\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3} \in \mathbb{R}^3$, we have

$$
\begin{aligned}
\mathbf{e_1} \bullet \mathbf{e_2} &= \tfrac{1}{2}(\mathbf{e_1e_2} + \mathbf{e_2e_1}) = \tfrac{1}{2}(\mathbf{e_1e_2} - \mathbf{e_1e_2}) = \tfrac{1}{2}(0) = 0; \\
\mathbf{e_2} \bullet \mathbf{e_3} &= \tfrac{1}{2}(\mathbf{e_2e_3} + \mathbf{e_3e_2}) = \tfrac{1}{2}(\mathbf{e_2e_3} - \mathbf{e_2e_3}) = \tfrac{1}{2}(0) = 0; \\
\mathbf{e_3} \bullet \mathbf{e_1} &= \tfrac{1}{2}(\mathbf{e_3e_1} + \mathbf{e_1e_3}) = \tfrac{1}{2}(\mathbf{e_3e_1} - \mathbf{e_3e_1}) = \tfrac{1}{2}(0) = 0.
\end{aligned}
$$

Then, by applying the commutative property of inner product for two vectors, we end up with

$$\mathbf{e_1} \bullet \mathbf{e_2} = \mathbf{e_2} \bullet \mathbf{e_1} = 0, \quad \mathbf{e_1} \bullet \mathbf{e_3} = \mathbf{e_3} \bullet \mathbf{e_1} = 0, \quad \mathbf{e_2} \bullet \mathbf{e_3} = \mathbf{e_3} \bullet \mathbf{e_2} = 0.$$

Therefore, our proof is complete. ■

By recalling the properties of inner product:

$$\mathbf{e_1} \bullet \mathbf{e_1} = |\mathbf{e_1}|^2 = 1, \quad \mathbf{e_2} \bullet \mathbf{e_2} = |\mathbf{e_2}|^2 = 1, \quad \mathbf{e_3} \bullet \mathbf{e_3} = |\mathbf{e_3}|^2 = 1. \tag{8}$$

and applying equation (7) in Theorem 1 as well as equation (8), we find the value of the geometric product of two unit vectors basis:

$$\mathbf{e}_1\mathbf{e}_1 = \mathbf{e}_1 \bullet \mathbf{e}_1 = 1, \quad \mathbf{e}_2\mathbf{e}_2 = \mathbf{e}_2 \bullet \mathbf{e}_2 = 1, \quad \mathbf{e}_3\mathbf{e}_3 = \mathbf{e}_3 \bullet \mathbf{e}_3 = 1.$$

Now, we apply equation (6) to get Theorem 2.

Theorem 2 *For unit vectors $\boldsymbol{e_1}$, $\boldsymbol{e_2}$, and $\boldsymbol{e_3}$ in $\mathbb{R}^3$, we have*
1. $\mathbf{e}_1 \wedge \mathbf{e}_1 = \mathbf{e}_2 \wedge \mathbf{e}_2 = \mathbf{e}_3 \wedge \mathbf{e}_3 = \mathbf{B}_0$,
2. $\mathbf{e}_1 \wedge \mathbf{e}_2 = \mathbf{e}_1\mathbf{e}_2, \quad \mathbf{e}_1 \wedge \mathbf{e}_3 = \mathbf{e}_1\mathbf{e}_3, \quad \mathbf{e}_2 \wedge \mathbf{e}_1 = \mathbf{e}_2\mathbf{e}_1,$ (9)
3. $\mathbf{e}_2 \wedge \mathbf{e}_3 = \mathbf{e}_2\mathbf{e}_3, \quad \mathbf{e}_3 \wedge \mathbf{e}_1 = \mathbf{e}_3\mathbf{e}_1, \quad \mathbf{e}_3 \wedge \mathbf{e}_2 = \mathbf{e}_3\mathbf{e}_2.$ (10)

Proof.
1. For any $\mathbf{e_1}$, $\mathbf{e_2}$, and $\mathbf{e_3} \in \mathbb{R}^3$, we have
$$\mathbf{e_1} \wedge \mathbf{e_1} = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_1} - \mathbf{e_1}\mathbf{e_1}) = \tfrac{1}{2}(\mathbf{B}_0) = \mathbf{B}_0;$$
$$\mathbf{e}_2 \wedge \mathbf{e}_2 = \tfrac{1}{2}(\mathbf{e}_2\mathbf{e}_2 - \mathbf{e}_2\mathbf{e}_2) = \tfrac{1}{2}(\mathbf{B}_0) = \mathbf{B}_0;$$
$$\mathbf{e}_3 \wedge \mathbf{e}_3 = \tfrac{1}{2}(\mathbf{e}_3\mathbf{e}_3 - \mathbf{e}_3\mathbf{e}_3) = \tfrac{1}{2}(\mathbf{B}_0) = \mathbf{B}_0.$$
2. For $\mathbf{e_1}$, $\mathbf{e_2}$, and $\mathbf{e_3} \in \mathbb{R}^3$, we get
$$\mathbf{e_1} \wedge \mathbf{e_2} = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_2} - \mathbf{e_2}\mathbf{e_1}) = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_2} + \mathbf{e_1}\mathbf{e_2}) = \tfrac{1}{2}(2)(\mathbf{e_1}\mathbf{e_2}) = \mathbf{e_1}\mathbf{e_2};$$
$$\mathbf{e_1} \wedge \mathbf{e_3} = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_3} - \mathbf{e_2}\mathbf{e_3}) = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_3} + \mathbf{e_1}\mathbf{e_3}) = \tfrac{1}{2}(2)(\mathbf{e_1}\mathbf{e_3}) = \mathbf{e_1}\mathbf{e_3};$$
$$\mathbf{e_2} \wedge \mathbf{e_1} = \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_1} - \mathbf{e_1}\mathbf{e_2}) = \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_1} + \mathbf{e_2}\mathbf{e_1}) = \tfrac{1}{2}(2)(\mathbf{e_2}\mathbf{e_1}) = \mathbf{e_2}\mathbf{e_1};$$
$$\mathbf{e}_2 \wedge \mathbf{e}_3 = \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_3} - \mathbf{e_3}\mathbf{e_2}) = \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_3} + \mathbf{e_2}\mathbf{e_3}) = \tfrac{1}{2}(2)(\mathbf{e_2}\mathbf{e_3}) = \mathbf{e_2}\mathbf{e_3};$$
$$\mathbf{e}_3 \wedge \mathbf{e}_1 = \tfrac{1}{2}(\mathbf{e}_3\mathbf{e}_1 - \mathbf{e}_3\mathbf{e}_1) = \tfrac{1}{2}(\mathbf{e}_3\mathbf{e}_1 + \mathbf{e}_3\mathbf{e}_1) = \tfrac{1}{2}(2)(\mathbf{e}_3\mathbf{e}_1) = \mathbf{e}_3\mathbf{e}_1;$$
$$\mathbf{e}_3 \wedge \mathbf{e}_2 = \tfrac{1}{2}(\mathbf{e}_3\mathbf{e}_2 - \mathbf{e_2}\mathbf{e_3}) = \tfrac{1}{2}(\mathbf{e}_3\mathbf{e}_2 + \mathbf{e}_3\mathbf{e}_2) = \tfrac{1}{2}(2)(\mathbf{e}_3\mathbf{e}_2) = \mathbf{e}_3\mathbf{e}_2. \qquad \blacksquare$$

Furthermore, the properties of outer product

$$\mathbf{e}_1 \wedge \mathbf{e}_2 = -\mathbf{e}_2 \wedge \mathbf{e}_1 = -\mathbf{e}_2\mathbf{e}_1,$$
$$\mathbf{e}_1 \wedge \mathbf{e}_3 = -\mathbf{e}_3 \wedge \mathbf{e}_1 = -\mathbf{e}_3\mathbf{e}_1,$$
$$\mathbf{e}_2 \wedge \mathbf{e}_1 = -\mathbf{e}_1 \wedge \mathbf{e}_2 = -\mathbf{e}_1\mathbf{e}_2,$$
$$\mathbf{e}_2 \wedge \mathbf{e}_3 = -\mathbf{e}_3 \wedge \mathbf{e}_2 = -\mathbf{e}_3\mathbf{e}_2,$$
$$\mathbf{e}_3 \wedge \mathbf{e}_1 = -\mathbf{e}_1 \wedge \mathbf{e}_3 = -\mathbf{e}_1\mathbf{e}_3,$$
$$\mathbf{e}_3 \wedge \mathbf{e}_2 = -\mathbf{e}_2 \wedge \mathbf{e}_3 = -\mathbf{e}_2\mathbf{e}_3.$$

together with equation (9) and (10) in Theorem 2 give us

$$\mathbf{e}_1\mathbf{e}_2 = \mathbf{e}_1 \wedge \mathbf{e}_2 = -\mathbf{e}_2 \wedge \mathbf{e}_1 = -\mathbf{e}_2\mathbf{e}_1,$$
$$\mathbf{e}_1\mathbf{e}_3 = \mathbf{e}_1 \wedge \mathbf{e}_3 = -\mathbf{e}_3 \wedge \mathbf{e}_1 = -\mathbf{e}_3\mathbf{e}_1,$$
$$\mathbf{e}_2\mathbf{e}_1 = \mathbf{e}_2 \wedge \mathbf{e}_1 = -\mathbf{e}_1 \wedge \mathbf{e}_2 = -\mathbf{e}_1\mathbf{e}_2,$$
$$\mathbf{e}_2\mathbf{e}_3 = \mathbf{e}_2 \wedge \mathbf{e}_3 = -\mathbf{e}_3 \wedge \mathbf{e}_2 = -\mathbf{e}_3\mathbf{e}_2,$$
$$\mathbf{e}_3\mathbf{e}_1 = \mathbf{e}_3 \wedge \mathbf{e}_1 = -\mathbf{e}_1 \wedge \mathbf{e}_3 = -\mathbf{e}_1\mathbf{e}_3,$$
$$\mathbf{e}_3\mathbf{e}_2 = \mathbf{e}_3 \wedge \mathbf{e}_2 = -\mathbf{e}_2 \wedge \mathbf{e}_3 = -\mathbf{e}_2\mathbf{e}_3.$$

The properties of inner product and outer product of unit vector basis $\mathbf{e_1}$, $\mathbf{e_2}$, dan $\mathbf{e_3}$ presented previously lead us to the following theorem.

Theorem 3 *For $\boldsymbol{e_1}$, $\boldsymbol{e_2}$, $\boldsymbol{e_3} \in \mathbb{R}^3$, we have inner product between basis bivector $(\boldsymbol{e_1} \wedge \boldsymbol{e_2})$, $(\boldsymbol{e_1} \wedge \boldsymbol{e_3})$, $(\boldsymbol{e_2} \wedge \boldsymbol{e_1})$, $(\boldsymbol{e_2} \wedge \boldsymbol{e_3})$, $(\boldsymbol{e_3} \wedge \boldsymbol{e_1})$, and $(\boldsymbol{e_3} \wedge \boldsymbol{e_2})$.*
1. $(\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2}) = (\mathbf{e_1} \wedge \mathbf{e_3}) \bullet (\mathbf{e_1} \wedge \mathbf{e_3}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \bullet (\mathbf{e_2} \wedge \mathbf{e_1}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})$
$= (\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \bullet (\mathbf{e_3} \wedge \mathbf{e_2}) = -1;$
2. $(\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_2} \wedge \mathbf{e_1}) = (\mathbf{e_1} \wedge \mathbf{e_3}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_3} \wedge \mathbf{e_2})$
$= (\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_1} \wedge \mathbf{e_3}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3}) = 1.$

Proof. By using equation (3), we could get the following results.

1. For $\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3} \in \mathbb{R}^3$, we have

$$\begin{aligned}
(\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2}) &= \frac{1}{2}\big((\mathbf{e_1} \wedge \mathbf{e_2})(\mathbf{e_1} \wedge \mathbf{e_2}) + (\mathbf{e_1} \wedge \mathbf{e_2})(\mathbf{e_1} \wedge \mathbf{e_2})\big) = \frac{1}{2}\big((\mathbf{e_1}\mathbf{e_2})(\mathbf{e_1}\mathbf{e_2}) + (\mathbf{e_1}\mathbf{e_2})(\mathbf{e_1}\mathbf{e_2})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_1}\mathbf{e_2})(\mathbf{e_1}\mathbf{e_2})\big) = (\mathbf{e_1}\mathbf{e_2})(\mathbf{e_1}\mathbf{e_2}) = (-\mathbf{e_2}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_2}) = -\mathbf{e_2}[(\mathbf{e_1}\mathbf{e_1})\mathbf{e_2}] \\
&= -\mathbf{e_2}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_2} = -\mathbf{e_2}(1)\mathbf{e_2} == -\mathbf{e_2}\mathbf{e_2} = -1; \\
(\mathbf{e_1} \wedge \mathbf{e_3}) \bullet (\mathbf{e_1} \wedge \mathbf{e_3}) &= \frac{1}{2}\big((\mathbf{e_1} \wedge \mathbf{e_3})(\mathbf{e_1} \wedge \mathbf{e_3}) + (\mathbf{e_1} \wedge \mathbf{e_3})(\mathbf{e_1} \wedge \mathbf{e_3})\big) = \frac{1}{2}\big((\mathbf{e_1}\mathbf{e_3})(\mathbf{e_1}\mathbf{e_3}) + (\mathbf{e_1}\mathbf{e_3})(\mathbf{e_1}\mathbf{e_3})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_1}\mathbf{e_3})(\mathbf{e_1}\mathbf{e_3})\big) = (\mathbf{e_1}\mathbf{e_3})(\mathbf{e_1}\mathbf{e_3}) = (-\mathbf{e_3}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_2}) = -\mathbf{e_3}[(\mathbf{e_1}\mathbf{e_1})\mathbf{e_3}] \\
&= -\mathbf{e_3}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_3} = -\mathbf{e_3}(1)\mathbf{e_3} = -\mathbf{e_3}\mathbf{e_3} = -1; \\
(\mathbf{e_2} \wedge \mathbf{e_1}) \bullet (\mathbf{e_2} \wedge \mathbf{e_1}) &= \frac{1}{2}\big((\mathbf{e_2} \wedge \mathbf{e_1})(\mathbf{e_2} \wedge \mathbf{e_1}) + (\mathbf{e_2} \wedge \mathbf{e_1})(\mathbf{e_2} \wedge \mathbf{e_1})\big) = \frac{1}{2}\big((\mathbf{e_2}\mathbf{e_1})(\mathbf{e_2}\mathbf{e_1}) + (\mathbf{e_2}\mathbf{e_1})(\mathbf{e_2}\mathbf{e_1})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_2}\mathbf{e_1})(\mathbf{e_2}\mathbf{e_1})\big) = (\mathbf{e_2}\mathbf{e_1})(\mathbf{e_2}\mathbf{e_1}) = (-\mathbf{e_1}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_1}) = -\mathbf{e_1}[(\mathbf{e_2}\mathbf{e_2})\mathbf{e_1}] \\
&= -\mathbf{e_1}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_1} = -\mathbf{e_1}(1)\mathbf{e_1} = -\mathbf{e_1}\mathbf{e_1} = -1; \\
(\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3}) &= \frac{1}{2}\big((\mathbf{e_2} \wedge \mathbf{e_3})(\mathbf{e_2} \wedge \mathbf{e_3}) + (\mathbf{e_2} \wedge \mathbf{e_3})(\mathbf{e_2} \wedge \mathbf{e_3})\big) = \frac{1}{2}\big((\mathbf{e_2}\mathbf{e_3})(\mathbf{e_2}\mathbf{e_3}) + (\mathbf{e_2}\mathbf{e_3})(\mathbf{e_2}\mathbf{e_3})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_2}\mathbf{e_3})(\mathbf{e_2}\mathbf{e_3})\big) = (\mathbf{e_2}\mathbf{e_3})(\mathbf{e_2}\mathbf{e_3}) = (-\mathbf{e_3}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_3}) = -\mathbf{e_3}[(\mathbf{e_2}\mathbf{e_2})\mathbf{e_3}] \\
&= -\mathbf{e_3}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_3} = -\mathbf{e_3}(1)\mathbf{e_3} = -\mathbf{e_3}\mathbf{e_3} = -1; \\
(\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1}) &= \frac{1}{2}\big((\mathbf{e_3} \wedge \mathbf{e_1})(\mathbf{e_3} \wedge \mathbf{e_1}) + (\mathbf{e_3} \wedge \mathbf{e_1})(\mathbf{e_3} \wedge \mathbf{e_1})\big) = \frac{1}{2}\big((\mathbf{e_3}\mathbf{e_1})(\mathbf{e_3}\mathbf{e_1}) + (\mathbf{e_3}\mathbf{e_1})(\mathbf{e_3}\mathbf{e_1})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_3}\mathbf{e_1})(\mathbf{e_3}\mathbf{e_1})\big) = (\mathbf{e_3}\mathbf{e_1})(\mathbf{e_3}\mathbf{e_1}) = (-\mathbf{e_1}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_1}) = -\mathbf{e_1}[(\mathbf{e_3}\mathbf{e_3})\mathbf{e_1}] \\
&= -\mathbf{e_1}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_1} = -\mathbf{e_1}(1)\mathbf{e_1} = -\mathbf{e_1}\mathbf{e_1} = -1; \\
(\mathbf{e_3} \wedge \mathbf{e_2}) \bullet (\mathbf{e_3} \wedge \mathbf{e_2}) &= \frac{1}{2}\big((\mathbf{e_3} \wedge \mathbf{e_2})(\mathbf{e_3} \wedge \mathbf{e_2}) + (\mathbf{e_3} \wedge \mathbf{e_2})(\mathbf{e_3} \wedge \mathbf{e_2})\big) = \frac{1}{2}\big((\mathbf{e_3}\mathbf{e_2})(\mathbf{e_3}\mathbf{e_2}) + (\mathbf{e_3}\mathbf{e_2})(\mathbf{e_3}\mathbf{e_2})\big) \\
&= \frac{1}{2}(2)\big((\mathbf{e_3}\mathbf{e_2})(\mathbf{e_3}\mathbf{e_2})\big) = (\mathbf{e_3}\mathbf{e_2})(\mathbf{e_3}\mathbf{e_2}) = (-\mathbf{e_2}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_2}) = -\mathbf{e_2}[(\mathbf{e_3}\mathbf{e_3})\mathbf{e_2}] \\
&= -\mathbf{e_2}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_2} = -\mathbf{e_2}(1)\mathbf{e_2} = -\mathbf{e_2}\mathbf{e_2} = -1.
\end{aligned}$$

2. For $\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3} \in \mathbb{R}^3$, we find that

$$\begin{aligned}
(\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_2} \wedge \mathbf{e_1}) &= \frac{1}{2}\big((\mathbf{e_1} \wedge \mathbf{e_2})(\mathbf{e_2} \wedge \mathbf{e_1}) + (\mathbf{e_2} \wedge \mathbf{e_1})(\mathbf{e_1} \wedge \mathbf{e_2})\big) = \frac{1}{2}\big((\mathbf{e_1}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_1}) + (\mathbf{e_2}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_2})\big) \\
&= \tfrac{1}{2}(\mathbf{e_1}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_1} + \mathbf{e_2}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_2}) = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_1} + \mathbf{e_2}\mathbf{e_2}) = \tfrac{1}{2}(1+1) = \tfrac{1}{2}(2) = 1; \\
(\mathbf{e_1} \wedge \mathbf{e_3}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1}) &= \frac{1}{2}\big((\mathbf{e_1} \wedge \mathbf{e_3})(\mathbf{e_3} \wedge \mathbf{e_1}) + (\mathbf{e_3} \wedge \mathbf{e_1})(\mathbf{e_1} \wedge \mathbf{e_3})\big) = \frac{1}{2}\big((\mathbf{e_1}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_1}) + (\mathbf{e_3}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_3})\big) \\
&= \tfrac{1}{2}\big((\mathbf{e_1}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_1} + \mathbf{e_3}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_3})\big) = \tfrac{1}{2}(\mathbf{e_1}\mathbf{e_1} + \mathbf{e_3}\mathbf{e_3}) = \tfrac{1}{2}(1+1) = \tfrac{1}{2}(2) = 1; \\
(\mathbf{e_2} \wedge \mathbf{e_1}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2}) &= \frac{1}{2}\big((\mathbf{e_2} \wedge \mathbf{e_1})(\mathbf{e_1} \wedge \mathbf{e_2}) + (\mathbf{e_1} \wedge \mathbf{e_2})(\mathbf{e_2} \wedge \mathbf{e_1})\big) = \frac{1}{2}\big((\mathbf{e_2}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_2}) + (\mathbf{e_1}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_1})\big) \\
&= \tfrac{1}{2}(\mathbf{e_2}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_2} + \mathbf{e_1}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_1}) = \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_2} + \mathbf{e_1}\mathbf{e_1}) = \tfrac{1}{2}(1+1) = \tfrac{1}{2}(2) = 1; \\
(\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_3} \wedge \mathbf{e_2}) &= \frac{1}{2}\big((\mathbf{e_2} \wedge \mathbf{e_3})(\mathbf{e_3} \wedge \mathbf{e_2}) + (\mathbf{e_3} \wedge \mathbf{e_2})(\mathbf{e_2} \wedge \mathbf{e_3})\big) \\
&= \frac{1}{2}\big((\mathbf{e_2}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_2}) + (\mathbf{e_3}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_3})\big) = \frac{1}{2}\big((\mathbf{e_2}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_2} + \mathbf{e_3}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_3})\big) \\
&= \tfrac{1}{2}(\mathbf{e_2}\mathbf{e_2} + \mathbf{e_3}\mathbf{e_3}) = \tfrac{1}{2}(2) = 1; \\
(\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_1} \wedge \mathbf{e_3}) &= \frac{1}{2}\big((\mathbf{e_3} \wedge \mathbf{e_1})(\mathbf{e_1} \wedge \mathbf{e_3}) + (\mathbf{e_1} \wedge \mathbf{e_3})(\mathbf{e_3} \wedge \mathbf{e_1})\big) \\
&= \frac{1}{2}\big((\mathbf{e_3}\mathbf{e_1})(\mathbf{e_1}\mathbf{e_3}) + (\mathbf{e_1}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_1})\big) = \frac{1}{2}(\mathbf{e_3}(\mathbf{e_1}\mathbf{e_1})\mathbf{e_3} + \mathbf{e_1}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_1}) \\
&= \frac{1}{2}(\mathbf{e_1}\mathbf{e_1} + \mathbf{e_3}\mathbf{e_3}) = \frac{1}{2}(1+1) = \frac{1}{2}(2) = 1; \\
(\mathbf{e_3} \wedge \mathbf{e_2}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3}) &= \frac{1}{2}\big((\mathbf{e_3} \wedge \mathbf{e_2})(\mathbf{e_2} \wedge \mathbf{e_3}) + (\mathbf{e_2} \wedge \mathbf{e_3})(\mathbf{e_3} \wedge \mathbf{e_2})\big)
\end{aligned}$$

$$= \frac{1}{2}\big((\mathbf{e_3}\mathbf{e_2})(\mathbf{e_2}\mathbf{e_3}) + (\mathbf{e_2}\mathbf{e_3})(\mathbf{e_3}\mathbf{e_2})\big) = \frac{1}{2}(\mathbf{e_3}(\mathbf{e_2}\mathbf{e_2})\mathbf{e_3} + \mathbf{e_2}(\mathbf{e_3}\mathbf{e_3})\mathbf{e_2})$$
$$= \tfrac{1}{2}(\mathbf{e_3}\mathbf{e_3} + \mathbf{e_2}\mathbf{e_2}) = \tfrac{1}{2}(1+1) = \tfrac{1}{2}(2) = 1. \qquad \blacksquare$$

Now, suppose we have any bivector **A** and **B** in $\mathbb{R}^3$, where

$$\mathbf{A} = a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{B} = b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$

and $a_1, a_2, a_3, b_1, b_2, b_3 \in \mathbb{R}$. By applying Theorem 3, we could see in some references, such as [3], the inner product of bivectors **A** and **B** is given by

$$\begin{aligned}
\mathbf{A} \bullet \mathbf{B} &= \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= a_1b_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_1b_2\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + \\
&\quad a_1b_3\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) + a_2b_1\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + \\
&\quad a_2b_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_2b_3\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) + \\
&\quad a_3b_1\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_3b_2\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_3b_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= a_1b_1(-1) + a_1b_2(0) + a_1b_3(0) + a_2b_1(0) + a_2b_2(-1) + \\
&\quad a_2b_3(0) + a_3b_1(0) + a_3b_2(0) + a_3b_3(-1) \\
&= a_1b_1(-1) + a_2b_2(-1) + a_3b_3(-1) \\
&= -a_1b_1 - a_2b_2 - a_3b_3.
\end{aligned}$$

The properties of the inner product of bivectors are presented in the following theorem.

Theorem 4 *If* **A**, **B**, *and* **C** *are any bivector in* $\mathbb{R}^3$, *then we have the following properties:*

1. *the inner product is commutative, that is* $\mathbf{A} \bullet \mathbf{B} = \mathbf{B} \bullet \mathbf{A}$;
2. *the inner product is distributive over the addition, that is* $\mathbf{A} \bullet (\mathbf{B} + \mathbf{C}) = \mathbf{A} \bullet \mathbf{B} + \mathbf{A} \bullet \mathbf{C}$;
3. *if the bivector* **A** *is perpendicular to bivector* **B**, *then* $|\mathbf{A} \bullet \mathbf{B}| = 0$.

Proof. Let **A**, **B** and **C** be bivectors in $\mathbb{R}^3$, where

$$\mathbf{A} = a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{B} = b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{C} = c_1(\mathbf{e_2} \wedge \mathbf{e_3}) + c_2(\mathbf{e_3} \wedge \mathbf{e_1}) + c_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$

and $a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3 \in \mathbb{R}$.

1. For bivectors **A** and **B**, we have

$$\begin{aligned}
\mathbf{A} \bullet \mathbf{B} &= \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= a_1b_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_2b_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_3b_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= b_1a_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + b_2a_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + b_3a_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= \big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= \mathbf{B} \bullet \mathbf{A};
\end{aligned}$$

2. For bivectors **A**, **B** and **C**, we get

$$\begin{aligned}
\mathbf{A} \bullet (\mathbf{B} + \mathbf{C}) &= \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \\
&\quad \Big(\big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) + \big(c_1(\mathbf{e_2} \wedge \mathbf{e_3}) + c_2(\mathbf{e_3} \wedge \mathbf{e_1}) + c_3(\mathbf{e_1} \wedge \mathbf{e_2})\big)\Big) \\
&= \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \\
&\quad \Big(\big(\mathrm{b}_1 + \mathrm{c}_1(\mathbf{e_2} \wedge \mathbf{e_3})\big) + \big(\mathrm{b}_2 + \mathrm{c}_2(\mathbf{e_3} \wedge \mathbf{e_1})\big) + \big(\mathrm{b}_3 + \mathrm{c}_3(\mathbf{e_1} \wedge \mathbf{e_2})\big)\Big) \\
&= a_1(b_1 + c_1)\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_2(b_2 + c_2)\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + \\
&\quad a_3(b_3 + c_3)\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= a_1b_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_1c_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_2b_2\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) \\
&\quad + a_2c_2\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_3b_3\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_3c_3\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) \\
&= \Big(a_1b_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_2b_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_3b_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big)\Big) \\
&\quad + \Big(a_1c_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \bullet (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_2c_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \bullet (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_3c_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \bullet (\mathbf{e_1} \wedge \mathbf{e_2})\big)\Big) \\
&= \big(a_1b_1(-1) + a_2b_2(-1) + a_3b_3(-1)\big) + \big(a_1c_1(-1) + a_2c_2(-1) + a_3c_3(-1)\big) \\
&= (-a_1b_1 - a_2b_2 - a_3b_3) + (-a_1c_1 - a_2c_2 - a_3c_3)
\end{aligned}$$

$= \mathbf{A} \bullet \mathbf{B} + \mathbf{A} \bullet \mathbf{C}$.

3. If bivector **A** is perpendicular to bivector **B**, then

$$\mathbf{A} \bullet \mathbf{B} = |\mathbf{A}||\mathbf{B}| \cos\theta = |\mathbf{A}||\mathbf{B}| \cos 90^\circ = 0. \qquad \blacksquare$$

Outer Product of Two Bivectors

Before discussing the outer product of any bivectors, we firstly present in Theorem 5 the outer product of bivector found from $\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3} \in \mathbb{R}^3$.

Theorem 5 *For $\boldsymbol{e_1}$, $\boldsymbol{e_2}$, $\boldsymbol{e_3}$ $\in \mathbb{R}^3$, the outer product of $(\boldsymbol{e_1} \wedge \boldsymbol{e_2})$, $(\boldsymbol{e_1} \wedge \boldsymbol{e_3})$, $(\boldsymbol{e_2} \wedge \boldsymbol{e_1})$, $(\boldsymbol{e_2} \wedge \boldsymbol{e_3})$, $(\boldsymbol{e_3} \wedge \boldsymbol{e_1})$, and $(\boldsymbol{e_3} \wedge \boldsymbol{e_2})$ is as follows:*

1. $(\mathbf{e_1} \wedge \mathbf{e_3}) \wedge (\mathbf{e_3} \wedge \mathbf{e_2}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_1} \wedge \mathbf{e_3}) = (\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1}) = \mathbf{e_1} \wedge \mathbf{e_2}$;
2. $(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \wedge (\mathbf{e_3} \wedge \mathbf{e_2}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_2} \wedge \mathbf{e_1}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2}) = \mathbf{e_1} \wedge \mathbf{e_3}$;
3. $(\mathbf{e_1} \wedge \mathbf{e_3}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1}) = (\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_3} \wedge \mathbf{e_2}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \wedge (\mathbf{e_1} \wedge \mathbf{e_3}) = \mathbf{e_2} \wedge \mathbf{e_1}$;
4. $(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1}) = (\mathbf{e_1} \wedge \mathbf{e_3}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \wedge (\mathbf{e_1} \wedge \mathbf{e_3}) = (\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_2} \wedge \mathbf{e_1}) = \mathbf{e_2} \wedge \mathbf{e_3}$;
5. $(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_3} \wedge \mathbf{e_2}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3}) = (\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \wedge (\mathbf{e_2} \wedge \mathbf{e_1}) = \mathbf{e_3} \wedge \mathbf{e_1}$;
6. $(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_1} \wedge \mathbf{e_3}) = (\mathbf{e_1} \wedge \mathbf{e_3}) \wedge (\mathbf{e_2} \wedge \mathbf{e_1}) = (\mathbf{e_2} \wedge \mathbf{e_1}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1}) = (\mathbf{e_3} \wedge \mathbf{e_2}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2}) = \mathbf{e_3} \wedge \mathbf{e_1}$.

Let **A** and **B** be bivectors in $\mathbb{R}^3$, where

$$\mathbf{A} = a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{B} = b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$

and $a_1, a_2, a_3, b_1, b_2, b_3 \in \mathbb{R}$. As in some refences, such as Vince (2009: 92), Theorem 5 provides us with the outer product of **A** and **B**, namely

$$\begin{aligned}
\mathbf{A} \wedge \mathbf{B} = &\ \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \wedge \ \big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
= &\ a_1b_1\big((\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_1b_2\big((\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1})\big) + \\
&\ a_1b_3\big((\mathbf{e_2} \wedge \mathbf{e_3}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2})\big) + a_2b_1\big((\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3})\big) + \\
&\ a_2b_2\big((\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_2b_3\big((\mathbf{e_3} \wedge \mathbf{e_1}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2})\big) + \\
&\ a_3b_1\big((\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_2} \wedge \mathbf{e_3})\big) + a_3b_2\big((\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_3} \wedge \mathbf{e_1})\big) + a_3b_3\big((\mathbf{e_1} \wedge \mathbf{e_2}) \wedge (\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
= &\ a_1b_2(\mathbf{e_2} \wedge \mathbf{e_1}) + a_1b_3(\mathbf{e_3} \wedge \mathbf{e_1}) + a_2b_1(\mathbf{e_1} \wedge \mathbf{e_2}) + \\
&\ a_2b_3(\mathbf{e_3} \wedge \mathbf{e_2}) + a_3b_1(\mathbf{e_1} \wedge \mathbf{e_3}) + a_3b_2(\mathbf{e_2} \wedge \mathbf{e_3}) \\
= &\ (a_2b_1 - a_1b_2)(\mathbf{e_1} \wedge \mathbf{e_2}) + (a_3b_2 - a_2b_3)(\mathbf{e_2} \wedge \mathbf{e_3}) + (a_1b_3 - a_3b_1)(\mathbf{e_3} \wedge \mathbf{e_1}).
\end{aligned}$$

The properties of outer product are given in the following theorem.

Theorem 6 *If* **A**, **B**, *and* **C** *are any bivectors in* $\mathbb{R}^3$, *then:*

1. *The outer product is anti-commutative, that is* $\mathbf{A} \wedge \mathbf{B} = \ -(\mathbf{B} \wedge \mathbf{A})$;
2. *The outer product is distributive, that is* $\mathbf{A} \wedge (\mathbf{B} + \mathbf{C}) = \mathbf{A} \wedge \mathbf{B} + \mathbf{A} \wedge \mathbf{C}$;
3. *If* **A** *and* **B** *are parallel, then* $|\mathbf{A} \wedge \mathbf{B}| = 0$.

Proof. Let **A**, **B** and **C** be any bivector in $\mathbb{R}^3$, where

$$\mathbf{A} = a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{B} = b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{C} = c_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ c_2(\mathbf{e_3} \wedge \mathbf{e_1}) + c_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$

and $a_1, a_2, a_3, b_1, b_2, b_3, c_1, c_2, c_3 \in \mathbb{R}$.

1. For bivector **A** and **B**, we have

$$\begin{aligned}
\mathbf{A} \wedge \mathbf{B} &= \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \wedge \big(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\
&= (a_3b_2 - a_2b_3)(\mathbf{e_2} \wedge \mathbf{e_3}) + (a_1b_3 - a_3b_1)(\mathbf{e_3} \wedge \mathbf{e_1}) + (a_2b_1 - a_1b_2)(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&= (b_2a_3 - b_3a_2)(\mathbf{e_2} \wedge \mathbf{e_3}) + (b_3a_1 - b_1a_3)(\mathbf{e_3} \wedge \mathbf{e_1}) + (b_1a_2 - b_2a_1)(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&= -(b_3a_2 - b_2a_3)(\mathbf{e_2} \wedge \mathbf{e_3}) - (b_1a_3 - b_3a_1)(\mathbf{e_3} \wedge \mathbf{e_1}) - (b_2a_1 - b_1a_2)(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&= \big(-b_1(\mathbf{e_2} \wedge \mathbf{e_3}) - \ b_2(\mathbf{e_3} \wedge \mathbf{e_1}) - b_3(\mathbf{e_1} \wedge \mathbf{e_2})\big) \wedge \big(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + \ a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\big)
\end{aligned}$$

$= (-[b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})]) \wedge \left(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\right)$
$= -(\mathbf{B} \wedge \mathbf{A})$.

2. For bivector **A**, **B** and **C**, we get

$$\begin{aligned}
\mathbf{A} \wedge (\mathbf{B} + \mathbf{C}) &= \left(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\right) \wedge \\
&\quad \left(\left(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\right) + \left(c_1(\mathbf{e_2} \wedge \mathbf{e_3}) + c_2(\mathbf{e_3} \wedge \mathbf{e_1}) + c_3(\mathbf{e_1} \wedge \mathbf{e_2})\right)\right) \\
&= \left(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2})\right) \wedge \\
&\quad \left((b_1 + c_1)(\mathbf{e_2} \wedge \mathbf{e_3}) + (b_2 + c_2)(\mathbf{e_3} \wedge \mathbf{e_1}) + (b_3 + c_3)(\mathbf{e_1} \wedge \mathbf{e_2})\right) \\
&= \left(a_3(b_2 + c_2) - a_2(b_3 + c_3)\right)(\mathbf{e_2} \wedge \mathbf{e_3}) + \left(a_1(b_3 + c_3) - a_3(b_1 + c_1)\right)(\mathbf{e_3} \wedge \mathbf{e_1}) \\
&\quad + (a_2(b_1 + c_1) - a_1(b_2 + c_2))(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&= a_3 b_2(\mathbf{e_2} \wedge \mathbf{e_3}) + a_3 c_2(\mathbf{e_2} \wedge \mathbf{e_3}) - a_2 b_3(\mathbf{e_2} \wedge \mathbf{e_3}) - a_2 c_3(\mathbf{e_2} \wedge \mathbf{e_3}) + a_1 b_3(\mathbf{e_3} \wedge \mathbf{e_1}) \\
&\quad + a_1 c_3(\mathbf{e_3} \wedge \mathbf{e_1}) - a_3 b_1(\mathbf{e_3} \wedge \mathbf{e_1}) - a_3 c_1(\mathbf{e_3} \wedge \mathbf{e_1}) + a_2 b_1(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&\quad + a_2 c_1(\mathbf{e_1} \wedge \mathbf{e_2}) - a_1 b_2(\mathbf{e_1} \wedge \mathbf{e_2}) - a_1 c_2(\mathbf{e_1} \wedge \mathbf{e_2}) \\
&= \left((a_3 b_2 - a_2 b_3)(\mathbf{e_2} \wedge \mathbf{e_3}) + (a_1 b_3 - a_3 b_1)(\mathbf{e_3} \wedge \mathbf{e_1}) + (a_2 b_1 - a_1 b_2)(\mathbf{e_1} \wedge \mathbf{e_2})\right) \\
&\quad + \left((a_3 c_2 - a_2 c_3)(\mathbf{e_2} \wedge \mathbf{e_3}) + (a_1 c_3 - a_3 c_1)(\mathbf{e_3} \wedge \mathbf{e_1}) + (a_2 c_1 - a_1 c_2)(\mathbf{e_1} \wedge \mathbf{e_2})\right) \\
&= \left(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge \left(b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2})\right)\right) \\
&\quad + \left(a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}) \wedge \left(c_1(\mathbf{e_2} \wedge \mathbf{e_3}) + c_2(\mathbf{e_3} \wedge \mathbf{e_1}) + c_3(\mathbf{e_1} \wedge \mathbf{e_2})\right)\right) \\
&= \mathbf{A} \wedge \mathbf{B} + \mathbf{A} \wedge \mathbf{C}.
\end{aligned}$$

3. If bivector **A** is parallel to **B**, then

$$|\mathbf{A} \wedge \mathbf{B}| = |\mathbf{A}||\mathbf{B}| \sin \theta = |\mathbf{A}||\mathbf{B}| \sin 0° = 0. \qquad \blacksquare$$

Geometric Product of Two Bivectors

Let **A** and **B** be any bivector in $\mathbb{R}^3$, where

$$\mathbf{A} = a_1(\mathbf{e_2} \wedge \mathbf{e_3}) + a_2(\mathbf{e_3} \wedge \mathbf{e_1}) + a_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$
$$\mathbf{B} = b_1(\mathbf{e_2} \wedge \mathbf{e_3}) + b_2(\mathbf{e_3} \wedge \mathbf{e_1}) + b_3(\mathbf{e_1} \wedge \mathbf{e_2}),$$

and $a_1, a_2, a_3, b_1, b_2, b_3 \in \mathbb{R}$. Vince (2009: 90) define the geometric product of **A** dan **B** by

$$\begin{aligned}
\mathbf{AB} &= \mathbf{A} \bullet \mathbf{B} + \mathbf{A} \wedge \mathbf{B} \\
&= (-a_1 b_1 - a_2 b_2 - a_3 b_3) + (a_2 b_1 - a_1 b_2)(\mathbf{e_1} \wedge \mathbf{e_2}) + (a_3 b_2 - a_2 b_3)(\mathbf{e_2} \wedge \mathbf{e_3}) + (a_1 b_3 - a_3 b_1)(\mathbf{e_3} \wedge \mathbf{e_1}).
\end{aligned}$$

In general, the geometric product of two bivectors is not either commutative or anti-commutative. However, for certain conditions, the geometric product of two bivectors is commutative or anti-commutative.

Theorem 7 *If the bivectors* **A** *and* **B** *are perpendicular, then*

$$\mathbf{AB} = \mathbf{A} \wedge \mathbf{B} \quad \textit{and} \quad \mathbf{AB} = -\mathbf{BA}.$$

Proof. Let **A** and **B** be perpendicular bivectors in $\mathbb{R}^3$. By applying Theorem 4, we find

$$\mathbf{AB} = \mathbf{A} \bullet \mathbf{B} + \mathbf{A} \wedge \mathbf{B} = 0 + \mathbf{A} \wedge \mathbf{B} = \mathbf{A} \wedge \mathbf{B}.$$

Furthermore, Theorem 6 enable us to get

$$\mathbf{AB} = \mathbf{A} \wedge \mathbf{B} = -\mathbf{B} \wedge \mathbf{A} = -\mathbf{BA}. \qquad \blacksquare$$

Example 1 Let **A** and **B** are bivectors in $\mathbb{R}^3$ where

$$\mathbf{A} = 6(\mathbf{e_2} \wedge \mathbf{e_3}) - 4(\mathbf{e_3} \wedge \mathbf{e_1}) + 8(\mathbf{e_1} \wedge \mathbf{e_2})$$

and

$$\mathbf{B} = 2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2}).$$

Since

$$\begin{aligned}
\mathbf{A} \bullet \mathbf{B} &= \left(6(\mathbf{e_2} \wedge \mathbf{e_3}) - 4(\mathbf{e_3} \wedge \mathbf{e_1}) + 8(\mathbf{e_1} \wedge \mathbf{e_2})\right) \bullet \left(2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2})\right) \\
&= -6(2) - (-4)(-5) - 8(-4) = -12 - 20 + 32 = 0
\end{aligned}$$

and

$$\begin{aligned}\mathbf{A}\wedge\mathbf{B} &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\wedge\big(2(\mathbf{e_2}\wedge\mathbf{e_3}) - 5(\mathbf{e_3}\wedge\mathbf{e_1}) - 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= \big((-4)(2) - 6(-5)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big(8(-5) - (-4)(-4)\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + \big(6(-4) - 8(2)\big)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= \big(-8 - (-30)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + (-40 - 16)(\mathbf{e_2}\wedge\mathbf{e_3}) + (-24 - 16)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= 22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1}),\end{aligned}$$

then we have the geometric product

$$\begin{aligned}\mathbf{AB} &= \mathbf{A}\bullet\mathbf{B} + \mathbf{A}\wedge\mathbf{B}\\ &= 0 + 22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= 22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1}).\end{aligned}$$

Furthermore,

$$\begin{aligned}\mathbf{BA} &= \mathbf{B}\bullet\mathbf{A} + \mathbf{B}\wedge\mathbf{A}\\ &= \mathbf{A}\bullet\mathbf{B} - \mathbf{A}\wedge\mathbf{B}\\ &= 0 - \big(22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1})\big)\\ &= -22(\mathbf{e_1}\wedge\mathbf{e_2}) + 56(\mathbf{e_2}\wedge\mathbf{e_3}) + 40(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= -\mathbf{AB}.\end{aligned}$$

■

Theorem 8 *If the bivectors* **A** *and* **B** *are parallel, then*

$$\mathbf{AB} = \mathbf{A}\bullet\mathbf{B} \quad \textit{and} \quad \mathbf{AB} = \mathbf{BA}.$$

Proof. Let **A** and **B** be parallel bivectors in $\mathbb{R}^3$. By applying Theorem 6, we get

$$\mathbf{AB} = \mathbf{A}\bullet\mathbf{B} + \mathbf{A}\wedge\mathbf{B} = \mathbf{A}\bullet\mathbf{B} + \mathbf{B}_0 = \mathbf{A}\bullet\mathbf{B}.$$

Now, Theorem 4 gives us

$$\mathbf{AB} = \mathbf{A}\bullet\mathbf{B} = \mathbf{B}\bullet\mathbf{A} = \mathbf{BA}.$$

■

Example 2 Let **A** and **B** are bivectors in $\mathbb{R}^3$ where

$$\mathbf{A} = 6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})$$

and

$$\mathbf{B} = 3(\mathbf{e_2}\wedge\mathbf{e_3}) - 2(\mathbf{e_3}\wedge\mathbf{e_1}) + 4(\mathbf{e_1}\wedge\mathbf{e_2}).$$

We have the outer product

$$\begin{aligned}\mathbf{A}\wedge\mathbf{B} &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\wedge\big(3(\mathbf{e_2}\wedge\mathbf{e_3}) - 2(\mathbf{e_3}\wedge\mathbf{e_1}) + 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= \big((-4)(3) - 6(-2)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big(8(-2) - (-4)(4)\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + \big(6(4) - 8(3)\big)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= \big(-12 - (-12)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big(-16 - (-16)\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + (24 - 24)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= 0(\mathbf{e_1}\wedge\mathbf{e_2}) + 0(\mathbf{e_2}\wedge\mathbf{e_3}) + 0(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= \mathbf{B}_0\end{aligned}$$

and the inner product

$$\begin{aligned}\mathbf{A}\bullet\mathbf{B} &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\bullet\big(3(\mathbf{e_2}\wedge\mathbf{e_3}) - 2(\mathbf{e_3}\wedge\mathbf{e_1}) + 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= -6(3) - (-4)(-2) - 8(4)\\ &= -18 - 8 - 32\\ &= -58.\end{aligned}$$

Therefore,

$$\mathbf{AB} = \mathbf{A}\bullet\mathbf{B} + \mathbf{A}\wedge\mathbf{B} = -58 + \mathbf{B}_0 = -58$$

and

$$\mathbf{BA} = \mathbf{B}\bullet\mathbf{A} + \mathbf{B}\wedge\mathbf{A} = \mathbf{A}\bullet\mathbf{B} - \mathbf{A}\wedge\mathbf{B} = -58 - \mathbf{B}_0 = -58 = \mathbf{AB}.$$

■

The geometric product of bivectors is distributive over the addition, as presented in the follwing theorem.

Theorem 9 *For the bivectors* **A**, **B**, *and* **C**, *we have*

$$\mathbf{A}(\mathbf{B}+\mathbf{C}) = \mathbf{AB}+\mathbf{AC};$$
$$(\mathbf{A}+\mathbf{B})\mathbf{C} = \mathbf{AC}+\mathbf{BC}.$$

Proof. For any **A**, **B**, and **C** in $\mathbb{R}^3$, we have

$$\begin{aligned}\mathbf{A}(\mathbf{B}+\mathbf{C}) &= \mathbf{A} \bullet (\mathbf{B}+\mathbf{C}) + \mathbf{A}\wedge(\mathbf{B}+\mathbf{C})\\ &= \mathbf{A}\bullet\mathbf{B} + \mathbf{A}\bullet\mathbf{C} + \mathbf{A}\wedge\mathbf{B} + \mathbf{A}\wedge\mathbf{C}\\ &= (\mathbf{A}\bullet\mathbf{B} + \mathbf{A}\wedge\mathbf{B}) + (\mathbf{A}\bullet\mathbf{C} + \mathbf{A}\wedge\mathbf{C})\\ &= \mathbf{AB}+\mathbf{AC}.\end{aligned}$$

and

$$\begin{aligned}(\mathbf{A}+\mathbf{B})\mathbf{C} &= (\mathbf{A}+\mathbf{B})\bullet\mathbf{C} + (\mathbf{A}+\mathbf{B})\wedge\mathbf{C}\\ &= \mathbf{A}\bullet\mathbf{C} + \mathbf{B}\bullet\mathbf{C} + \mathbf{A}\wedge\mathbf{C} + \mathbf{B}\wedge\mathbf{C}\\ &= (\mathbf{A}\bullet\mathbf{C} + \mathbf{A}\wedge\mathbf{C}) + (\mathbf{B}\bullet\mathbf{C} + \mathbf{B}\wedge\mathbf{C})\\ &= \mathbf{AC}+\mathbf{BC}.\end{aligned}$$

■

Example 3 Let **A**, **B**, dan **C** are bivectors in $\mathbb{R}^3$ where

$$\mathbf{A} = 6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2}),$$
$$\mathbf{B} = 3(\mathbf{e_2}\wedge\mathbf{e_3}) - 2(\mathbf{e_3}\wedge\mathbf{e_1}) + 4(\mathbf{e_1}\wedge\mathbf{e_2}),$$

and

$$\mathbf{C} = 2(\mathbf{e_2}\wedge\mathbf{e_3}) - 5(\mathbf{e_3}\wedge\mathbf{e_1}) - 4(\mathbf{e_1}\wedge\mathbf{e_2}).$$

Since

$$\begin{aligned}\mathbf{B}+\mathbf{C} &= \big(3(\mathbf{e_2}\wedge\mathbf{e_3}) - 2(\mathbf{e_3}\wedge\mathbf{e_1}) + 4(\mathbf{e_1}\wedge\mathbf{e_2})\big) + \big(2(\mathbf{e_2}\wedge\mathbf{e_3}) - 5(\mathbf{e_3}\wedge\mathbf{e_1}) - 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= \big(5(\mathbf{e_2}\wedge\mathbf{e_3}) - 7(\mathbf{e_3}\wedge\mathbf{e_1}) - 0(\mathbf{e_1}\wedge\mathbf{e_2})\big),\end{aligned}$$

$$\begin{aligned}\mathbf{A}\bullet(\mathbf{B}+\mathbf{C}) &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &\quad\bullet\big(5(\mathbf{e_2}\wedge\mathbf{e_3}) - 7(\mathbf{e_3}\wedge\mathbf{e_1}) - 0(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= -6(5) - (-4)(-7) - 8(0)\\ &= -30 - 28 - 0\\ &= -58,\end{aligned}$$

and

$$\begin{aligned}\mathbf{A}\wedge(\mathbf{B}+\mathbf{C}) &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\wedge\big(5(\mathbf{e_2}\wedge\mathbf{e_3}) - 7(\mathbf{e_3}\wedge\mathbf{e_1}) - 0(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= \big((-4)(5) - 6(-7)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big(8(-7) - (-4)(0)\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + \big(6(0) - 8(5)\big)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= \big(-20 - (-42)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big((-56) - 0\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + (0 - 40)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= 22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1}),\end{aligned}$$

then we get

$$\begin{aligned}\mathbf{A}(\mathbf{B}+\mathbf{C}) &= \mathbf{A}\bullet(\mathbf{B}+\mathbf{C}) + \mathbf{A}\wedge(\mathbf{B}+\mathbf{C})\\ &= -58 + 22(\mathbf{e_1}\wedge\mathbf{e_2}) - 56(\mathbf{e_2}\wedge\mathbf{e_3}) - 40(\mathbf{e_3}\wedge\mathbf{e_1}).\end{aligned}$$

Therefore,

$$\begin{aligned}\mathbf{AB} &= \mathbf{A}\bullet\mathbf{B} + \mathbf{A}\wedge\mathbf{B}\\ &= -58 + 0(\mathbf{e_1}\wedge\mathbf{e_2}) + 0(\mathbf{e_2}\wedge\mathbf{e_3}) + 0(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= -58.\end{aligned}$$

We also have

$$\begin{aligned}\mathbf{A}\bullet\mathbf{C} &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\bullet\big(2(\mathbf{e_2}\wedge\mathbf{e_3}) - 5(\mathbf{e_3}\wedge\mathbf{e_1}) - 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= -6(2) - (-4)(-5) - 8(-4)\\ &= -12 - 20 - (-32)\\ &= 0,\end{aligned}$$

$$\begin{aligned}\mathbf{A}\wedge\mathbf{C} &= \big(6(\mathbf{e_2}\wedge\mathbf{e_3}) - 4(\mathbf{e_3}\wedge\mathbf{e_1}) + 8(\mathbf{e_1}\wedge\mathbf{e_2})\big)\wedge\big(2(\mathbf{e_2}\wedge\mathbf{e_3}) - 5(\mathbf{e_3}\wedge\mathbf{e_1}) - 4(\mathbf{e_1}\wedge\mathbf{e_2})\big)\\ &= \big((-4)(2) - 6(-5)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + \big(8(-5) - (-4)(-4)\big)(\mathbf{e_2}\wedge\mathbf{e_3}) + \big(6(-4) - 8(2)\big)(\mathbf{e_3}\wedge\mathbf{e_1})\\ &= \big(-8 - (-30)\big)(\mathbf{e_1}\wedge\mathbf{e_2}) + (-40 - 16)(\mathbf{e_2}\wedge\mathbf{e_3}) + (-24 - 16)(\mathbf{e_3}\wedge\mathbf{e_1})\end{aligned}$$

$$= 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}).$$

$$\begin{aligned}\mathbf{AC} &= \mathbf{A} \bullet \mathbf{C} + \mathbf{A} \wedge \mathbf{C} \\ &= 0 + 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}).\end{aligned}$$

Therefore,

$$\begin{aligned}\mathbf{AB} + \mathbf{AC} &= -58 + 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= \mathbf{A}(\mathbf{B} + \mathbf{C}).\end{aligned}$$

We also have

$$\begin{aligned}\mathbf{A} + \mathbf{B} &= \big(6(\mathbf{e_2} \wedge \mathbf{e_3}) - 4(\mathbf{e_3} \wedge \mathbf{e_1}) + 8(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &\quad + \big(3(\mathbf{e_2} \wedge \mathbf{e_3}) - 2(\mathbf{e_3} \wedge \mathbf{e_1}) + 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &= \big(9(\mathbf{e_2} \wedge \mathbf{e_3}) - 6(\mathbf{e_3} \wedge \mathbf{e_1}) + 12(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ (\mathbf{A} + \mathbf{B}) \bullet \mathbf{C} &= \big(9(\mathbf{e_2} \wedge \mathbf{e_3}) - 6(\mathbf{e_3} \wedge \mathbf{e_1}) + 12(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &\quad \bullet \big(2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &= -9(2) - (-6)(-5) - 12(-4) \\ &= -18 - 30 - (-48) \\ &= 0,\end{aligned}$$

and

$$\begin{aligned}(\mathbf{A} + \mathbf{B}) \wedge \mathbf{C} &= \big(9(\mathbf{e_2} \wedge \mathbf{e_3}) - 6(\mathbf{e_3} \wedge \mathbf{e_1}) + 12(\mathbf{e_1} \wedge \mathbf{e_2})\big) \wedge \big(2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &= \big((-6)(2) - 9(-5)\big)(\mathbf{e_1} \wedge \mathbf{e_2}) + \big(12(-5) - (-6)(-4)\big)(\mathbf{e_2} \wedge \mathbf{e_3}) + \big(9(-4) - 12(2)\big)(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= \big(-12 - (-45)\big)(\mathbf{e_1} \wedge \mathbf{e_2}) + (-60 - 24)(\mathbf{e_2} \wedge \mathbf{e_3}) + (-36 - 24)(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 33(\mathbf{e_1} \wedge \mathbf{e_2}) - 84(\mathbf{e_2} \wedge \mathbf{e_3}) - 60(\mathbf{e_3} \wedge \mathbf{e_1}),\end{aligned}$$

which provide us with

$$\begin{aligned}(\mathbf{A} + \mathbf{B})\mathbf{C} &= (\mathbf{A} + \mathbf{B}) \bullet \mathbf{C} + (\mathbf{A} + \mathbf{B}) \wedge \mathbf{C} \\ &= 0 + 33(\mathbf{e_1} \wedge \mathbf{e_2}) - 84(\mathbf{e_2} \wedge \mathbf{e_3}) - 60(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 33(\mathbf{e_1} \wedge \mathbf{e_2}) - 84(\mathbf{e_2} \wedge \mathbf{e_3}) - 60(\mathbf{e_3} \wedge \mathbf{e_1}).\end{aligned}$$

Furthermore,

$$\begin{aligned}\mathbf{AC} &= \mathbf{A} \bullet \mathbf{C} + \mathbf{A} \wedge \mathbf{C} \\ &= 0 + 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 22(\mathbf{e_1} \wedge \mathbf{e_2}) - 56(\mathbf{e_2} \wedge \mathbf{e_3}) - 40(\mathbf{e_3} \wedge \mathbf{e_1}).\end{aligned}$$

Since

$$\begin{aligned}\mathbf{B} \bullet \mathbf{C} &= \big(3(\mathbf{e_2} \wedge \mathbf{e_3}) - 2(\mathbf{e_3} \wedge \mathbf{e_1}) + 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \bullet \big(2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &= -3(2) - (-2)(-5) - 4(-4) \\ &= -6 - 10 + 16 \\ &= 0, \\ \mathbf{B} \wedge \mathbf{C} &= \big(3(\mathbf{e_2} \wedge \mathbf{e_3}) - 2(\mathbf{e_3} \wedge \mathbf{e_1}) + 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \wedge \big(2(\mathbf{e_2} \wedge \mathbf{e_3}) - 5(\mathbf{e_3} \wedge \mathbf{e_1}) - 4(\mathbf{e_1} \wedge \mathbf{e_2})\big) \\ &= \big((-2)(2) - 3(-5)\big)(\mathbf{e_1} \wedge \mathbf{e_2}) + \big(4(-5) - (-2)(-4)\big)(\mathbf{e_2} \wedge \mathbf{e_3}) + \big(3(-4) - 4(2)\big)(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= \big(-4 - (-15)\big)(\mathbf{e_1} \wedge \mathbf{e_2}) + (-20 - 8)(\mathbf{e_2} \wedge \mathbf{e_3}) + (-12 - 8)(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 11(\mathbf{e_1} \wedge \mathbf{e_2}) - 28(\mathbf{e_2} \wedge \mathbf{e_3}) - 20(\mathbf{e_3} \wedge \mathbf{e_1}),\end{aligned}$$

we find that

$$\begin{aligned}\mathbf{BC} &= \mathbf{B} \bullet \mathbf{C} + \mathbf{B} \wedge \mathbf{C} \\ &= 0 + 11(\mathbf{e_1} \wedge \mathbf{e_2}) - 28(\mathbf{e_2} \wedge \mathbf{e_3}) - 20(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= 11(\mathbf{e_1} \wedge \mathbf{e_2}) - 28(\mathbf{e_2} \wedge \mathbf{e_3}) - 20(\mathbf{e_3} \wedge \mathbf{e_1}),\end{aligned}$$

This enable us to get

$$\begin{aligned}\mathbf{AC} + \mathbf{BC} &= 33(\mathbf{e_1} \wedge \mathbf{e_2}) - 84(\mathbf{e_2} \wedge \mathbf{e_3}) - 60(\mathbf{e_3} \wedge \mathbf{e_1}) \\ &= (\mathbf{A} + \mathbf{B})\mathbf{C}.\end{aligned}$$

■

CONCLUDING REMARKS

In this paper, we only examine the commutativity and distributivity of the geometric product. The associativity and other properties of this product are still open to further research .

ACKNOWLEDGMENTS

This research is supported by the Research Grant 2023 of Universitas Jenderal Soedirman.

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Robust Geographically Weighted Regression : Modeling Sugarcane Yield in East Java

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Abstract. Geographically weighted regression (GWR) is a popular method for examining spatial heterogeneity in a regression model. However, this method is inherently unreliable for outliers, which can lead to a biased estimate of the underlying regression model. Robust Geographically Weighted Regression (RGWR) is a method that extends the GWR model to handle outliers in the dataset. RGWR is a robust regression method that uses a weight function to reduce the effect of outliers in the dataset RGWR handles outliers in the data by down-weighting their influence using a weighting function such as tukey bisquare. In this study, RGWR will be applied to sugarcane yield data in East Java. Sugarcane is major crop in this region, and modeling its yield . It can help farmers predict how much they will be able to harvest each season. This information can then be used to make better decision about planting, fertilizing, and harvesting. Additionally, accurate yiels models can help ensuring food security in the region. In short, modeling sugarcane yield is a crucial step towards building a more sustainable for east java and can reduce sugar import. Based on the AIC, MSE and R^2, it is known that in data containing outliers, the performance of RGWR is better than GWR.

INTRODUCTION

Spatial analysis is a fundamental aspect of understanding and analyzing data that is geographically distributed. Traditional regression models, such as Ordinary Least Squares (OLS), assume that the relationship between variables is constant across space. However, in many cases, this assumption is violated, leading to biased and unreliable results. To address this limitation, researchers have developed a more advanced technique known as Geogrpahically Weightes Regression. GWR creates a separate OLS equation for each location in the dataset, which includes the dependent and explanatory variables of locations that fall within the bandwidth of each target location. Bandwidth is the distance metric or number of neighbors used for each local regression equation. [1]

One of the parameter estimates in GWR is Weighted Least Square (WLS) [2]. WLS is a popular statistical approach for estimating parameters in regression models. It is a version of ordinary least squares (OLS) that gives various weights to each observation based on its significance or precision. While WLS is good at dealing with heteroscedasticity and improving parameter estimates, it is also sensitive to outliers [3] [4]. Outliers are observations that deviate significantly from the general pattern or trend of the data. They can arise due to measurement errors, data entry mistakes, or genuine extreme values. The presence of outliers can distort the relationship between variables and affect the parameter estimates obtained through regression analysis. The results of parameter estimate may be biased as a result of outliers. [5].

To overcome these challenges, a robust version of GWR has been developed, known as Robust Geographically Weighted Regression (RGWR). RGWR combines the benefits of GWR with robust statistical techniques, providing a more accurate and reliable approach to spatial analysis. RGWR addresses the limitations of traditional GWR by incorporating robust statistical methods that are less sensitive to outliers and influential observations. These methods ensure that the estimated coefficients are not unduly influenced by extreme values, resulting in more robust and reliable parameter estimation.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020009-1–020009-9; https://doi.org/10.1063/5.0241579

Robust GWR builds upon the basic principles of GWR but incorporates robust statistics to make the model more resilient to outliers. It achieves this by using robust estimation methods, such as robust regression or robust weights, to downweight the influence of outliers on the model estimation process. One common approach in robust GWR is to use robust regression techniques such as least absolute deviation, M, S and MM estimation. [6] and [4] uses the least absolute deviation method to estimate GWR parameters on data that contains outliers. According to [7] M estimator produces the most efficient parameter estimators compared to other estimators. M estimator is generalization of the maximum likelihood estimator. It is minimize the loss function of the weighting function, such as tukey bisquares function [8].

In this article, the M estimator will be used to estimate the GWR parameter and will be applied to sugarcane yield. Sugarcane is the main raw material for making sugar in Indonesia. Based on the ministry of Industri, in 2023, Indonesia still needs sugar imports of 4.6 million tons. This indicates that sugar cane yields for sugar production have not been met and need to be increased. East java become the largest sugar yield region with 1.19 million tons produced. Modeling sugar cane yield can have significant impact on farmers livelihoods and the economy as a whole. It can help farmers predict how much they will be able to harvest each season. This information can then be used to make better decision about planting, fertilizing, and harvesting. Additionally, accurate yiels models can help ensuring food security in the region. In short, modeling sugarcane yield is a crucial step towards building a more sustainable for east java and can reduce sugar import.

BASIC CONCEPT

Regression analysis is a statistical tool for examining the connection between one or more independent variables and a dependent variable. It is commonly used in economics, finance, social sciences, and engineering to predict and understand the behavior of a dependent variable based on the values of independent variables. A regression model can be formulated as equation (1)

$$y_i = \beta_0 + \sum_{k=1}^{p} \beta_k x_{ik} + \varepsilon_i \tag{1}$$

With
y_i = observed values of the *i*-th dependent variable (with *i =1,2,…,n*, where *n* is the number of observations)
x_{ik} = observed values of the *k*-th independent variables in *i*-th observations (with *k*=1,2,..,p, where *k* is the number of explanatory variables)
$\beta_0, \beta_1, \dots, \beta_p$ is estimated regression coefficients, and ε_i is normally distributed error with mean zero and constant variance.

The matrix representation of Equation (1) is as follows:

$$\boldsymbol{y} = \boldsymbol{X\beta} + \boldsymbol{\varepsilon} \tag{2}$$

Spatial Heterogeneity

Spatial effects, also known as spatial dependency and spatial heterogeneity, distinguish spatial data from other types of data. The term "spatial heterogeneity" describes the differences in characteristics between various geographic areas. An occurrence in one place and those in the surrounding regions are said to be spatially dependent. The Breusch-Pagan test is expressed as follows to assess the existence of spatial heterogeneity given the hypotheses.

$H_0: \sigma^2_{(u_1,v_1)} = \sigma^2_{(u_2,v_2)} = \cdots = \sigma^2_{(u_n,v_n)} = \sigma^2$ (there is no spatial heterogeneity)
$H_1: at\ least\ one\ i\ where\ \sigma_i^2 \neq \sigma^2; i = 1,2,\dots,n$ (there is spatial heterogeneity)

The formula for the Breusch-Pagan statistical test is as follows: [9]

$$BP = \left(\frac{1}{2}\right) \boldsymbol{h}^T (\boldsymbol{Z^T Z})^{-1} \boldsymbol{Z^T} \sim \chi^2_{p+1} \tag{3}$$

with

$\boldsymbol{h}$ **:** vector element $h_i = \left(\frac{e_i^2}{\sigma^2} - 1\right)$

$\boldsymbol{Z}$ **:** explanatory variables matrix

H_0 is accepted if $BP \leq \chi^2_{(p+1)}$, where $\chi^2_{(p+1)}$ is critical value of chi-square distribution and p is number of explanatory variables

Geographically Weighted Regression

In order to deal with the problem of geographical variety, [9] devised GWR, an effective point estimating technique. GWR basically uses a concept from the linear regression model but with the addition of a weighting matrix. GWR is used to generate regression coefficients for each location where observations were made, resulting in spatially varying coefficients. The formula for GWR is as follows:

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^{p} \beta_k(u_i, v_i)x_{ik} + \varepsilon_i \quad (4)$$

where:

y_i : Observed values of the i th response variable (with i =1,2,…,n)where n is the number of observations)

x_{ki} : observed values of the k-th explanatory variable at (u_i, v_i) with $k = 1,2,...,p$), where p is the number explanatory variables) and (u_i, v_i) is the spatial coordinates of location i, where u_i shows the position in longitude, while v_i shows the position in latitude

$\beta_0 (u_i, v_i)$: The intercept of the equation was determined based on location i th and t.

$\beta_k(u_i, v_i)$: k^{th} local parameter regression estimates on location (u_i, v_i)

ε_i : i^{th} residual, assumed $\varepsilon_i \sim N(0, \sigma^2)$

The weighted least squares (WLS) approach was used to estimate the local parameters of the GWR using the weight function (W), according to [11]. The weighting for each individual location in the GWPR model is determined by employing a fixed and adaptive kernel function such as Gaussian and Bi-Square.

The GWR parameter estimations for each location can be expressed as follows:

$$\hat{\boldsymbol{\beta}}(u_i, v_i) = (\boldsymbol{X^T W_i X})^{-1} \boldsymbol{X^T W_i Y} \quad (5)$$

Spatial Weight Function Of GWR

The GWPR model's weights are critical since they describe the relationship between the observation data. During parameter estimation, these weights define the influence of points on the location (u_i, v_i). Points that are closer to the site will have a higher impact than those that are further away. Weighting on GWR modeling can be accomplished through a variety of approaches, including the use of kernel functions. The Gaussian weighing function can be calculated with the following equation (6)

$$w_{ij} = exp\left(-\frac{1}{2}\left(\frac{d_{ij}}{h_i}\right)^2 \right) \quad (6)$$

with d_{ij} is the distance between location to – i and location to -j and h_i is a different bandwidth value for each location to-i. The Euclid distance (d_{ij}) between the location to – i and location to - j is obtained using equation (7)

$$d_{ij} = \sqrt{\left(u_i - u_j\right)^2 + (v_i - v_j)^2} \quad (7)$$

M Estimation

M estimation is one of the robust regression estimation methods. The letter M denotes that the M estimation is of the maximum likelihood kind. It is an extension of the maximum likelihood estimate method and a robust estimation. The principle of M estimation is to minimize the residual function ρ

$$\hat{\beta}_M = \min_{\beta} \rho(y_i - \sum_{j=0}^{k} x_{ij}\beta_j \tag{8}$$

We must find a solution

$$\min_{\beta} \sum_{i=1}^{n} \rho(u_i) = \min_{\beta} \sum_{i=1}^{n} \rho\left(\frac{e_i}{\sigma}\right) = \min_{\beta} \sum_{i=1}^{n} \rho\left(\frac{y_i - \sum_{j=0}^{k} x_{ij}\beta_j}{\sigma}\right) \tag{9}$$

To obtain (9), we set estimator for σ :[12]

$$\hat{\sigma} = \frac{MAD}{0.6745} = \frac{median\,|e_i - median(e_i)|}{0.6745} \tag{10}$$

For ρ function we use the Tukey's bisquare objective function :

$$\rho(u_i) = \begin{cases} \dfrac{u_i^2}{2} - \dfrac{u_i^4}{2c^2} + \dfrac{u_i^6}{6c^4}, & |u_i| \leq c \\ \dfrac{c^2}{6} \quad , & |u_i| > c \end{cases}$$

The first partial derivative $\hat{\beta}_M$ to β so that

$$\sum_{i=1}^{n} x_{ij}\psi\left(\frac{y_i - \sum_{j=0}^{k} x_{ij}\beta}{\hat{\sigma}}\right) = 0, j = 0,1, \ldots, k \tag{11}$$

where $\psi = \rho'$, x_{ij} is i-th observation on the j-th independent variable and $x_{io} = 1$.

Equation (11) can be solved by defining a weighted function [10]

$$\omega(e_i) = \frac{\psi\left(\frac{y_i - \sum_{j=0}^{k} x_{ij}\beta}{\hat{\sigma}}\right)}{\left(\frac{y_i - \sum_{j=0}^{k} x_{ij}\beta}{\hat{\sigma}}\right)} \tag{12}$$

Because $u_i = \frac{e_i}{\hat{\sigma}}$, equation (12) can be written with

$$w_i = \begin{cases} [1 - (\dfrac{u_i}{c})^2]^2, & |u_i| \leq c \\ 0, & |u_i| > c \end{cases}$$

For Tukey's bisquare weighted function we take $c = 4.685$. So equation (11) becomes

$$\sum_{i=1}^{n} x_{ij} w_i (y_i - \sum_{j=0}^{k} x_{ij}\beta) = 0, \quad j = 0,1, \ldots, k \tag{13}$$

Equation (13) can be solved with iteratively reweighted least squares (IRLS). We assume that there is an initial estimate β^0 and $\hat{\sigma}_i$ is a scale estiamte. If j is number of parameters then

$$\sum_{i=1}^{n} x_{ij} w_i^0 (y_i - \sum_{j=0}^{k} x_{ij}\beta^0) = 0, \quad j = 0,1, \ldots, k \tag{14}$$

Equation (14) can be written in matrix notation as

$$\boldsymbol{X'W_iX}\beta = \boldsymbol{X'W_iY} \tag{15}$$

Where $\boldsymbol{W_i}$ is a $n \times n$ matrix with its diagonal elements are the weighted. A detailde description of M estimation is presented in Algorithm 1.

Algorithm 1

1. Calculate regression coefficients using OLS
2. Identify data outlier
3. Calculate $\hat{\beta}^0$
4. Calculate residual value
5. Calculate $\hat{\sigma}_i = 1.4826\, MAD$
6. Calculate $u_i = \frac{e_i}{\hat{\sigma}_i}$
7. Determine the weighted value
8. Calculate $\hat{\beta}_M$ using weighted Least square (WLS) method with weighted w_i
9. Repeat steps 4-8 to obtain convergent value of $\hat{\beta}_M$

Model Selection

Akaike Information Criterion (AIC) can be used for the selection of the best models [3]. The AIC value is calculated as follows:

$$AIC = 2n\ln(\hat{\sigma}) + n\ln(2\pi) + n + tr(S) \tag{16}$$

METHOD

The data used in this study is sugarcane yields in 2019 obtained from Directorate General of Estate Crop Coverage. Area used in this study is in East Java, which consist of 38 regions/cities. In this study, sugarcane yields are modeled through 3 explanatory variables. The variables used in this study are detailed in Table 1.

TABLE 1. Variables Used in this Study

Variables	**Information of Variables**	**Unit**
Y	Sugarcane Yields	tons
X1	Sugarcane plantation area	Ha
X2	Rainfall	mm
X3	Number of farmers	person

The procedures of this study are as follows:
1. Describe the data
2. Outlier detection with boxplot
3. Perform Breusch- Pagan test to detect spatial heterogeneity
4. Perform GWR and GWR with M estimation (MGWR)
5. Calculate AIC values
6. Compare the GWR and M GWR

The research method in the form of a flowchart is presented in Figure 1

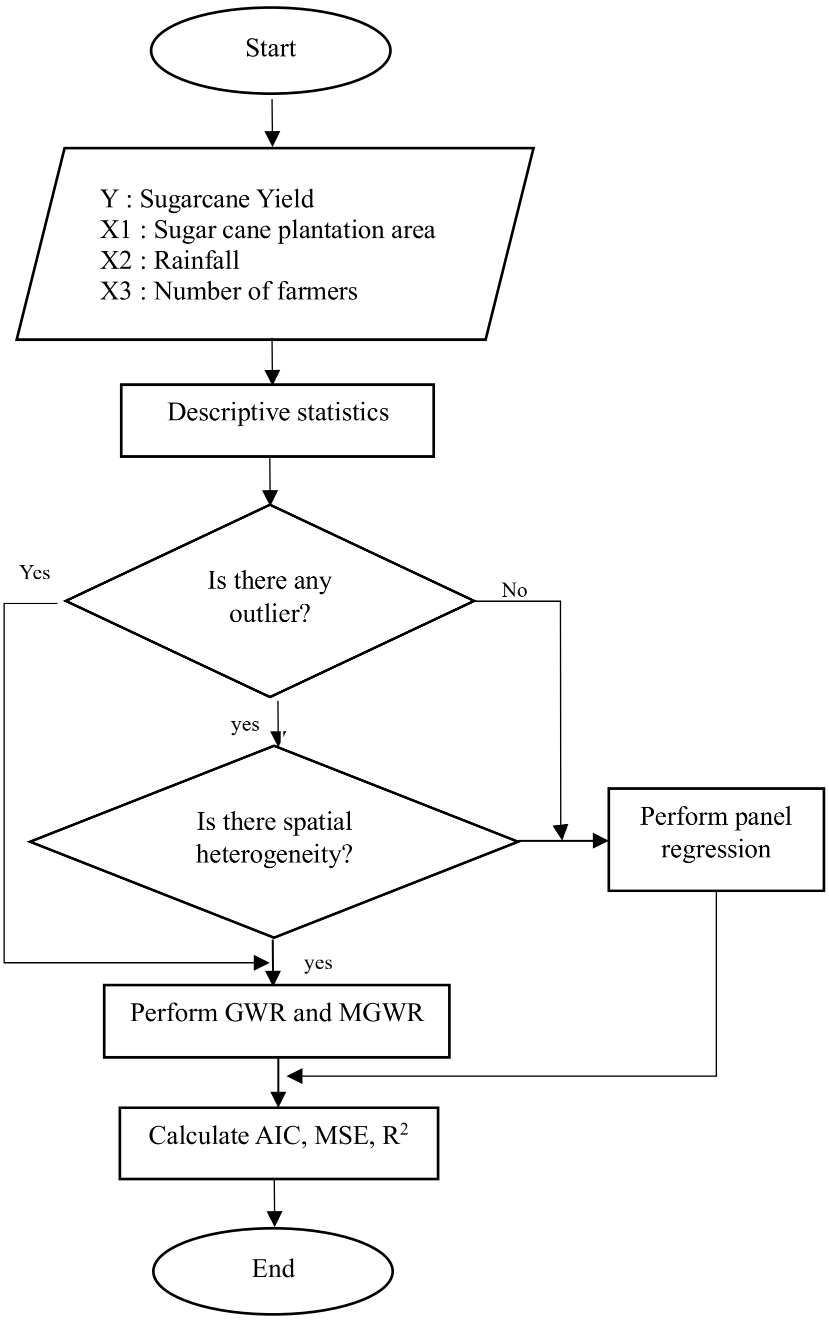

FIGURE 1. Flowchart

RESULT

The heatmap of sugar cane production in East Java in 2019 is presented in Figure 2.

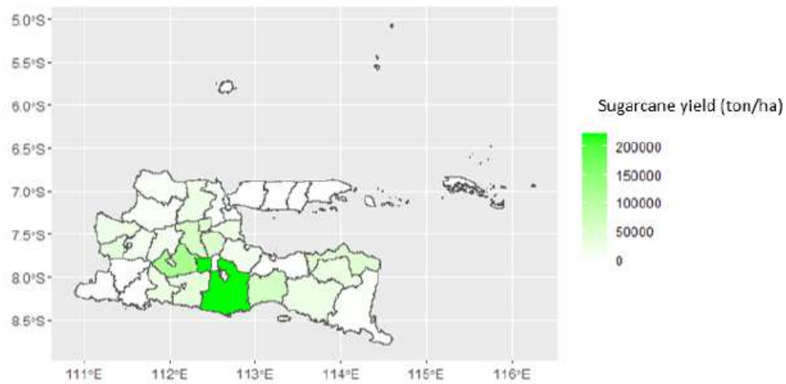

FIGURE 2. Heatmap of East Java Sugarcane Yield in 2019

Figure 2 shows that the darker the green color on the map, the higher the sugarcane yield in the district/city. In 2019, Malang Regency was the district/city with the highest sugar cane production in East Java. However, there are five districts/cities that do not have sugarcane yield, namely Pacitan Regency, Pamekasan Regency, Sumenep Regency, Blitar City and Surabaya City. This can be seen from the white map of the district/city. The summary of the data can be seen as Table 2.

TABLE 2. Data Summary

Variable	Mean	Min	Max
Y	27.343,30	0	240.075,00
X1	4.822,90	0	44.956,00
X2	175,63	4,07	785,90
X3	12,25	2,00	27,00

The Breucsh-Pagan test for spatial heterogeneity concludes that the global model has non-constant variance.It is indicated by p-value 0,016. As a result, the GWR model can be used to characterize the link between sugar cane yield and explanatory variables On the other hand, outlier detection using boxmap reveals that there are outliers in the data. The outliers are in Malang District and Kediri District. The boxplot shows by Figure 3.

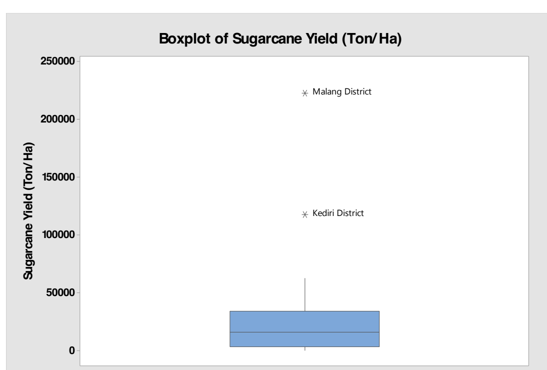

FIGURE 3. Boxplot of Sugarcane Yield (Ton/Ha)

The GWR model obtained using adaptive gaussian kernel function with optimum bandwidth is 8,95. The parameter estimation by GWR as follows:

TABLE 3. GWR Model Local Parameter Estimation Summary

Parameter	Minimum	Maximum	Mean	Standard Deviation
β_0	-0,067	0,058	0,0034	0,027
β_1	0,905	1,109	1,107	0,044
β_2	-0,06	0,043	-0,105	0,016
β_3	-0,017	0,043	0,0044	0,0104

The M GWR model also obtaines using adaptive gaussian kernel function. The parameter estimation by MGWR as follows :

TABLE 4. M GWR Model Local Parameter Estimation Summary

Parameter	Minimum	Maximum	Mean	Standard Deviation
β_0	0	0,625	0,352	0,159
β_1	0	6,7	1,8	9,8
β_2	0,52	0,95	0,85	0,079
β_3	0,014	0,97	0,82	0,175

Based on the results of the analysis using GWR, a global model was obtained

$$\hat{y} = -0.00 + 0.7609\mathrm{X}_1 + 0.0905\mathrm{X}_2 + 0.2054\mathrm{X}_3$$

The results of the analysis using MGWR obtained a global model

$$\hat{y} = -0.0407 + 0.9839\mathrm{X}_1 - 0.0072\mathrm{X}_2 - 0.0169\mathrm{X}_3$$

The variable that influences sugarcane yield based on the Wald test is harvest area (P<0.05) while the variables rainfall and number of farmers have no effect (P>0,05). These results are in line with the research of [13] which modeled the variables that influence sugarcane yield. Analysis using GWR also shows test results with the same conclusion.

The selection of the best model in this research was carried out based on the Akaike Information Criterion (AIC), Mean Squared Error (MSE), and coefficient of determination (R^2). The best model is the model with the smallest AIC and MSE and the largest R^2 .

TABLE 5. Best Model Selection Criteria

Model	AIC	MSE	R^2
GWR WLS	124,815	0,0403	0,9388
MGWR	102,803	0,0358	0,9443

Table 4 shows that the MGWR model is better than the GWR model. This is indicated by the AIC and MSE values of the MGWR model which are smaller than the GWR. These results are in line with research [14] that compared robust regression method in GWR using Least Absolute Deviation (LAD) and M estimator. The results of this research show that the performance of the GWR model with the M estimator is better than the GWR model with LAD and WLS.

CONCLUSION

From this study we can conclude sugarcane yield was only influenced by harvest plantation area, while rainfall and the number of farmers did not influence it. Based on the smaller AIC and MSE value MGWR is the best model for modeling sugar cane yields in East Java. This is also shown by the R value of the MGWR model being greater than the GWR model.

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Estimation of Uniresponse Ordinal Logistic Nonparametric Regression Model Based on Multivariate Adaptive Regression Spline

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Abstract. One of the adaptive methods in nonparametric regression that is able to accommodate interactions between predictor variables is the Multivariate Adaptive Regression Spline (MARS) method. MARS modeling has been developed based on the types of response variables involved in regression modeling, one of which is categorical (qualitative) response variables. The MARS method with categorical responses (both binary and ordinal) can be used as a modern statistical classification method, where the classification in MARS by using ordinal logistic regression approach. Estimation of function in ordinal logistic regression is assumed smooth based on the ordinal MARS model, namely as the MARS ordinal logit model. The development of previous studies only discussed binary responses, while for cases with responses of more than two categories, the MARS method was needed that could analyze ordinal responses. This study estimates the parameters for an ordinal category response using ordinal logistic nonparametric regression model based on MARS. This study aims to estimate the cumulative probability of ordinal logistic nonparametric regression model using the MARS estimator. Maximum Likelihood Estimation (MLE) method is used to obtain parameter estimation. The results showed that the distribution of the ordinal scale response variable with three categories in the MARS model is multinomial distribution, that the log-likelihood function of the ordinal response random variable will be maximized to obtain the parameter value. Estimators for parameters cannot be obtained directly (because the resulting function is non-linear), so Newton-Raphson iteration is used to obtain parameter estimates.

INTRODUCTION

Nonparametric regression is a modelling approach for describing relationship between the response variable and the predictor variable that does not assume a certain pattern. In the nonparametric regression approach, the model estimation form of the relationship pattern is determined based on the existing pattern in the data [1][2]. A lot of nonparametric regression methods (approaches) that provide flexibility in parameter estimation have been developed so far, including the spline approach consisting of truncated spline, Multivariate Adaptive Regression Spline or MARS, penalized spline and smoothing, local linear; local polynomials and kernels. The nonparametric regression approach mentioned above develops a method that considers the flexibility, model goodness and better interpretation, one of which is the spline method.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020010-1–020010-14; https://doi.org/10.1063/5.0242167
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Splines are widely developed because they have excellent flexibility and interpretation among other nonparametric regression methods or approaches. A spline is one type of polynomial cut, namely a polynomial that has segmented properties [3][4]. Given this segmented property, splines are able to provide more flexibility than ordinary polynomials. Nonparametric regression problems that are often encountered in the use of multi predictor data are cases of high dimensionality (curse of dimensionality). Powerful method that is able to overcome high-dimensional cases is MARS [5].

The MARS method is an adaptive approach that combines truncated spline regression and Recursive Partitioning Regression (RPR), first introduced by Friedman in 1991. The truncated spline method requires the predictor variable to be on a continuous scale so that it allows many knots to be generated, while the predictor variable in the MARS method could be in the form of a categorical or continuous scale. Another advantage of MARS is that it is able to accommodate interactions between predictor variables expressed in basis functions. It is match for cases of high-dimensional data [6]. The MARS method is able to accommodate additive effects and interactions between predictor variables in data modeling. MARS gives better estimator or approaches the regression curve shape of the response and predictor relationship patterns that do not follow a certain form, compared to using only an additive model [7]. This is in accordance with [8] which states that the MARS method is able to obtain good predictive results for the shape of the regression curve from the unknown pattern relationship between the response and the predictor.

MARS is a classification method in modern statistics, which has flexibility in modeling so that it is able to provide excellent classification performance [9]. Research by [10] applied the MARS method to classify employee work status in Demak Regency and produced a classification accuracy of 90%. Another research by [11] modeled the lecturer performance index using survival analysis with the MARS approach, where the MARS model produced a classification accuracy of 88%. Thus, MARS is also suitable for cases of calculating data classification accuracy that require response variables to be categorical.

Classification in MARS is based on a logistic regression approach [8]. Logistic regression is an analysis used to perform the relationship between categorical response variables and categorical and continuous predictor variables [12]. The logistic regression equation is obtained from the form of the estimated probability function of a successful event or certain event occurring, which is then carried out on this opportunity function by transforming the logit to a logit link function form. This link logit function is the MARS model, or is referred to as the MARS logit model. Researchers [13] have studied MARS with binary category responses in modeling the case of poor households in Kalimantan, while researchers [14] have studied MARS with category responses on modeling students' graduation into accelerated classes. The two studies compared the MARS method with other modeling methods, both of which concluded that the MARS method was better in modeling and classification.

This study estimates the parameters for an ordinal category response using ordinal logistic nonparametric regression model based on MARS. This study aims to estimate the cumulative probability of ordinal logistic nonparametric regression model using the MARS estimator. The development of categorical MARS research only achieves responses with binary categories, while research on ordinal category responses has never been developed. Maximum Likelihood Estimation (MLE) method used for estimating the parameters model.

MATERIALS AND METHOD

Ordinal logistic regression is a regression analysis used to analyze the relationship between predictor variables and response variables, where the response variable is polychotomous with an ordinal scale [15]. The model that can be used for ordinal logistic regression is the cumulative logit model, where in this model there is the ordinal nature of the Y response as outlined in the cumulative probability. Thus, the cumulative logit model is a model obtained by comparing the cumulative probability that is the probability less than or equal to r response variable category on p predictor variables expressed in vector $\mathbf{X}$, or can be written as $P = \left(Y \leq r \mid X_i\right)$ [10].

Cumulative probability $P = \left(Y \leq r \mid X_i\right)$ stated as follows [14]:

$$P = \left(Y \le r \mid X_i\right) = \pi\left(x_i\right) = \left(\frac{\exp\left(\beta_{0r} + \sum_{m=1}^{M} \beta_m x_{im}\right)}{1 + \exp\left(\beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik}\right)} \right) \tag{1}$$

With $x_i = \left(x_{i1}, x_{i2}, ..., x_{im}\right)$: predictor variable of observation $i \left(i = 1, 2, ..., n\right)$ for each p predictor variable, while $r = 1, 2, ..., R$ is the response variable category.

Estimation of ordinal logistic regression parameters is done by parsing them using the logit transformation $P = \left(Y \le r \mid X_i\right)$ described as follows [15]:

$$g_r\left(x\right) = \text{logit}\, P\left(Y \le r \mid X_i\right) = \ln\left(\frac{P\left(Y \le r \mid X_i\right)}{1 - P\left(Y \le r \mid X_i\right)}\right)$$

$$= \ln\left(\frac{\dfrac{\exp\left(\beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}}{1 - \dfrac{\exp\left(\beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}} \right) = \beta_{0r} + \sum_{k=1}^{p} \beta_k x_{ik} \tag{2}$$

with value β_k for each $k = 1, 2, ..., m$ in each ordinal logistic regression model is the same.

For example, if there are three response categories, namely $r = 1, 2, 3$ then the cumulative probability of r category response is described as follows [15]:

$$P = \left(Y \le 1 \mid x_i\right) = \left(\frac{\exp\left(\beta_{01} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\beta_{01} + \sum_{k=1}^{p} \beta_k x_{ik}\right)} \right) \tag{3}$$

$$P = \left(Y \le 2 \mid x_i\right) = \left(\frac{\exp\left(\beta_{02} + \sum_{k=1}^{p} \beta_k x_{ik}\right)}{1 + \exp\left(\beta_{02} + \sum_{k=1}^{p} \beta_k x_{ik}\right)} \right) \tag{4}$$

Based on Equations (3) and (4), the cumulative probability of each category of response variables is obtained, namely:

$$P=\left(Y_r=1\,|\,x_i\right)=\pi_1\left(x\right)=\left(\frac{\exp\left(\beta_{01}+\sum_{k=1}^{p}\beta_k x_{ik}\right)}{1+\exp\left(\beta_{01}+\sum_{k=1}^{p}\beta_k x_{ik}\right)}\right) \tag{5}$$

$$\begin{aligned} P\left(Y_r=2\,|\,x_i\right)&=\pi_2\left(x\right)=P\left(Y\le 2\,|\,x_i\right)-P\left(Y_r=1\,|\,x_i\right)\\ &=\frac{\exp\left(\beta_{02}+\sum_{k=1}^{p}\beta_k x_{ik}\right)}{1+\exp\left(\beta_{02}+\sum_{k=1}^{p}\beta_k x_{ik}\right)}-\frac{\exp\left(\beta_{01}+\sum_{k=1}^{p}\beta_k x_{ik}\right)}{1+\exp\left(\beta_{01}+\sum_{k=1}^{p}\beta_k x_{ik}\right)} \end{aligned} \tag{6}$$

If Equation (2) is applied to 3 response categories, namely $r=1,2,3$ then the cumulative logit model for each response category can be described as follows:

$$\begin{aligned} \hat{g}_1\left(x\right)&=\ln\left(\frac{P\left(Y\le 1\,|\,x\right)}{1-P\left(Y\le 1\,|\,x\right)}\right)=\ln\left(\frac{P\left(Y\le 1\,|\,x\right)}{P\left(Y>1\,|\,x\right)}\right)\\ &=\ln\left(\frac{P\left(Y=1\,|\,x\right)}{P\left(Y=2\,|\,x\right)+P\left(Y=3\,|\,x\right)}\right)=\beta_{01}+\beta_1X_1+\beta_2X_2+\ldots+\beta_pX_p\\ \hat{g}_2\left(x\right)&=\ln\left(\frac{P\left(Y\le 2\,|\,x\right)}{1-P\left(Y\le 2\,|\,x\right)}\right)=\ln\left(\frac{P\left(Y\le 2\,|\,x\right)}{P\left(Y>2\,|\,x\right)}\right)\\ &=\ln\left(\frac{P\left(Y=1\,|\,x\right)+P\left(Y=2\,|\,x\right)}{P\left(Y=3\,|\,x\right)}\right)=\beta_{02}+\beta_1X_1+\beta_2X_2+\ldots+\beta_pX_p \end{aligned} \tag{7}$$

In this study, the link logit function of ordinal logistic regression is used as the basis for classification in MARS. The next discussion focuses on MARS.

According to Friedman (1991), the MARS model is obtained from the forward and backward stepwise algorithms as follows,

$$\hat{f}\left(x\right)=\beta_0+\sum_{m=1}^{M}\beta_m\prod_{k=1}^{K_M}\left[s_{km}\left(x_{v(k,m)}-t_{km}\right)\right] \tag{8}$$

with,

β_0 : parent base function (constant)

β_m : coefficient of basis function *m*

M : number of base functions (nonconstant basis function)

K_m : degree of interaction

s_{km} : the value is 1 or -1 if the data is to the right of the knot point or the left of the knot point.

If $s_{km}=+1$, so $\left[+\left(x_{v(k,m)_i}-t_{km}\right)\right]_+=\begin{Bmatrix} x_{v(k,m)_i}-t_{km} & \text{, if } x_{v(k,m)_i}>t_{km}\\ 0 & \text{, on the contrary}\end{Bmatrix}$

If $s_{km}=-1$, so $\left[-\left(x_{v(k,m)_i}-t_{km}\right)\right]_+=\begin{Bmatrix} t_{km}-x_{v(k,m)_i} & \text{, if } t_{km}>x_{v(k,m)_i}\\ 0 & \text{, on the contrary}\end{Bmatrix}$

$x_{v(k,m)}$: predictor variable, $x_{v(k,m)_i} \in \left\{x_j\right\}_{j=1}^{p}$

t_{km} : knots value of predictor variable $x_{v(k,m)}$, $t_{km} \in \left\{x_{v(k,m)_i}\right\}_{i=1}^{n}$

The MARS model in Equation (8) can be written as follows,

$$y_i = \beta_0 + \sum_{m=1}^{M} \beta_m B_m\left(x\right) + \varepsilon_i \tag{9}$$

where, $B_m\left(x\right) = \prod_{k=1}^{K_M}\left[s_{km}.\left(x_{v(k,m)} - t_{km}\right)\right]$

so that in matrix form it can be written as,

$$\mathbf{Y} = \mathbf{B}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \quad \text{where,}$$

$$\mathbf{Y} = \left(Y_1, Y_2, ..., Y_n\right)^T, \boldsymbol{\beta} = \left(\beta_1, \beta_2, ..., \beta_m\right)^T, \boldsymbol{\varepsilon} = \left(\varepsilon_1, \varepsilon_2, ..., \varepsilon_n\right)^T$$

$$\mathbf{B} = \begin{pmatrix} 1 & \prod_{k=1}^{K_1} s_{1m}(x_{1(1,m)} - t_{1m}) & \cdots & \prod_{k=1}^{K_M} s_{Mm}(x_{1(M,m)} - t_{Mm}) \\ 1 & \prod_{k=1}^{K_1} s_{1m}(x_{2(1,m)} - t_{1m}) & \cdots & \prod_{k=1}^{K_M} s_{Mm}(x_{2(M,m)} - t_{Mm}) \\ \vdots & \vdots & \vdots\vdots\vdots & \vdots \\ 1 & \prod_{k=1}^{K_1} s_{1m}(x_{n(1,m)} - t_{1m}) & \cdots & \prod_{k=1}^{K_M} s_{Mm}(x_{n(M,m)} - t_{Mm}) \end{pmatrix} \tag{10}$$

Equation (8) can be described as follows,

$$\begin{aligned} \hat{f}\left(x\right) = \beta_0 &+ \sum_{m=1}^{M} \beta_m \left[s_{1m}.\left(x_{v(1,m)} - t_{1m}\right)\right] + \sum_{m=1}^{M} \beta_m \left[s_{1m}.\left(x_{v(1,m)} - t_{1m}\right)\right]\left[s_{2m}.\left(x_{v(2,m)} - t_{2m}\right)\right] \\ &+ \sum_{m=1}^{M} \beta_m \left[s_{1m}.\left(x_{v(1,m)} - t_{1m}\right)\right]\left[s_{2m}.\left(x_{v(2,m)} - t_{2m}\right)\right]\left[s_{3m}.\left(x_{v(3,m)} - t_{3m}\right)\right] + \ldots \end{aligned} \tag{11}$$

and in general Equation (11) can be written,

$$\hat{f}\left(x\right) = \beta_0 + \sum_{i=1}^{v} f_i\left(x_i\right) + \sum_{i,j=1, i\neq j}^{v} f_{ij}\left(x_i, x_j\right) + \sum_{i,j,k=1, i\neq j\neq k}^{v} f_{ijk}\left(x_i, x_j, x_k\right) + \ldots \tag{12}$$

RESULT AND DISCUSSION

Given predictor variable data $\left(x_{1i}, x_{2i}, ..., x_{ki}\right)$ and one response variable $\left(y_i\right)$, $\left(i = 1, 2, ...n\right)$, p indicates the number of predictor variables and n indicates the number of observations. If the relationship between the predictor variable and the response variable is expressed in a regression function f whose form is unknown and can be approximated by a nonparametric regression model, then in general the relationship can be expressed in the form of a nonparametric regression equation [16]:

$$\begin{aligned} y_i &= m(x_i) + \varepsilon_i \\ &= f_i(x_{1i}, x_{2i}, \ldots, x_{ki}) + \varepsilon_i \quad ; \; i = 1, 2, \ldots, n \end{aligned} \tag{13}$$

With $m(x_i)$ is an unknown regression function, ε_i is the random error on the observation i which independent of each other. Equation (13) for data of k predictor variables $(x_{1i}, x_{2i}, \ldots, x_{ki})$ and one response variable (y_i), $(i = 1, 2, \ldots n)$, then it can be written:

$$y_i = f_i(x_{1i}, x_{2i}, \ldots, x_{ki}) + \varepsilon_i \quad ; \; 1, 2, \ldots, n \tag{14}$$

If the response variable data scale is ordinal category, then the approach method used is the Ordinal Logistics Regression method. Equation (7) can be expressed in the form of a cumulative logit model as follows:

$$g_r(x) = \text{logit}\, P(Y \le r \mid X_i) = \ln\left(\frac{P(Y \le r \mid X_i)}{1 - P(Y \le r \mid X_i)}\right) = \ln\left(\frac{P(Y \le r \mid X_i)}{P(Y > r \mid X_i)}\right) \tag{15}$$

$r = 1, 2, 3$ is the response variable category.

If the estimator used in the logistic regression model is Multivariate Adaptive Regression Spline (MARS), then the MARS logit model with three ordinal categories of response variables $(Y = 1, 2, 3)$ refers to Equation (15) then applies:

$$\begin{aligned} \hat{g}_1(x) &= \ln\frac{P(Y \le 1)}{(1 - P(Y \le 1))} = \ln\frac{P(Y \le 1)}{P(Y > 1)} \\ &= \ln\frac{P(Y = 1)}{P(Y = 2) + P(Y = 3)} = \beta_{01} + \sum_{m=1}^{M} \beta_m \prod_{k=1}^{K_M} \left[s_{km} \cdot \left(x_{v(k,m)} - t_{km} \right) \right] \\ \hat{g}_2(x) &= \ln\frac{P(Y \le 2)}{(1 - P(Y \le 2))} = \ln\frac{P(Y \le 2)}{P(Y > 2)} \\ &= \ln\frac{P(Y = 1) + P(Y = 2)}{P(Y = 3)} = \beta_{02} + \sum_{m=1}^{M} \beta_m \prod_{k=1}^{K_M} \left[s_{km} \cdot \left(x_{v(k,m)} - t_{km} \right) \right] \end{aligned} \tag{16}$$

For example, the response variable is the incidence of diabetes mellitus with categories:
1 : normal, 2 : pre-diabetes, 3 : diabetes
Then:

$$\begin{aligned} \pi_1 &= P(\text{normal}) = P(Y = 1) \\ \pi_2 &= P(\text{pre-diabetes}) = P(Y = 2) \\ \pi_3 &= P(\text{diabetes}) = P(Y = 3) \\ \pi_3 &= 1 - \pi_1 - \pi_2 \end{aligned}$$

so,

$$\ln\frac{\pi_1}{\pi_2 + \pi_3} = \beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x)$$

$$\ln\frac{\pi_1+\pi_2}{\pi_3}=\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)$$

where, $B_m\left(x\right)=\prod_{k=1}^{K_M}\left[s_{km}\cdot\left(x_{v(k,m)}-t_{km}\right)\right]$ (17)

Then from Equation (17) we get:

$$\frac{\pi_1}{\pi_2+\pi_3}=\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)$$

$$\pi_1=\left(\pi_2+\pi_3\right)\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right) \tag{18}$$

$$\frac{\pi_1+\pi_2}{\pi_3}=\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)$$

$$\pi_1+\pi_2=\pi_3\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right) \tag{19}$$

where,

$$\pi_3=1-\pi_1-\pi_2=1-\left(\pi_1+\pi_2\right)$$
$$\pi_1+\pi_2=1-\pi_3$$
$$\pi_2+\pi_3=1-\pi_1 \tag{20}$$

To get value π_1, then from Equation (18) substituted into Equation (20):

$$\begin{aligned}
\pi_1&=\left(\pi_2+\pi_3\right)\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\\
&=\left(1-\pi_1\right)\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\\
&=\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-\pi_1\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)
\end{aligned}$$

$$\pi_1+\pi_1\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)=\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)$$

$$\pi_1\left((1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)=\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right) \tag{21}$$

$$\pi_1=\frac{\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}$$

To get value π_3, then from Equation (19) substituted into Equation (20) so that it can be obtained:

$$\pi_1+\pi_2=\pi_3\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)$$
$$1-\pi_3=\pi_3\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)$$
$$\pi_3+\pi_3\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)=1$$
$$\pi_3\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)=1 \tag{22}$$
$$\pi_3=\frac{1}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}$$

To get value π_2, then from Equation (17) and (18) then obtained:

$$\pi_2=1-\pi_1-\pi_3$$
$$=1-\frac{\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}-\frac{1}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}$$
$$=\frac{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)-\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}$$
$$=\frac{1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)+\left(\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}$$
$$\frac{-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-1-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}$$
$$\pi_2=\frac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}$$
$$=\frac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}-\frac{\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}$$

$$\pi_2 = \frac{\exp\left(\beta_{02} + \sum_{m=1}^{M} \beta_m B_m(x)\right) - \exp\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x)\right)}{\left(1 + \exp\left(\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x)\right)\left(\beta_{02} + \sum_{m=1}^{M} \beta_m B_m(x)\right)\right)\right)} \tag{23}$$

Thus, the response variable of the three ordinal categories follows the multinomial distribution $Y \sim M(1; \pi_1, \pi_2)$ with the probability density function (pdf) as follows:

$$f(n_1, n_2) = P(Y_1 = n_1, Y_2 = n_2) = \pi_1^{n_1} \pi_2^{n_2} \pi_3^{1-n_1-n_2} \tag{24}$$

The above function is in accordance with research [17] which modeled the risk of hypertension using the linear of additive nonparametric logistic regression method, where the response variable also consists of 3 categories.

To estimate the parameters of $\beta_{01}, \beta_{02}, \beta_m$, then use the Maximum Likelihood Estimation (MLE) method with the following steps:

1. **Take** n **random samples** $Y_{1i}, Y_{2i}, x_{1i}, x_{2i}, \ldots, x_{ki}$ $\quad ; 1, 2, \ldots, n$

   From Equation (9) then obtained:

$$Y_{1i}, Y_{2i} \sim M\left(1; \pi_{1i}(X_i), \pi_{2i}(X_i)\right)$$

$$\pi_{1i} = \frac{\exp\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x_i)\right)}{(1 + \exp\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x_i)\right)}$$

$$\pi_2 = \frac{\exp\left(\beta_{02} + \sum_{m=1}^{M} \beta_m B_m(x)\right) - \exp\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x)\right)}{\left(1 + \exp\left(\beta_{01} + \sum_{m=1}^{M} \beta_m B_m(x)\right)\right)\left(1 + \exp\left(\beta_{02} + \sum_{m=1}^{M} \beta_m B_m(x)\right)\right)}$$

$$\pi_3 = \frac{1}{1 + \exp\left(\beta_{02} + \sum_{m=1}^{M} \beta_m B_m(x_i)\right)} \tag{25}$$

   Where $x_i = x_1, x_2, \ldots, x_k$

2. **Determine the Likelihood and In-Likelihood Functions**

$$L(\beta_{01}, \beta_{02}, \beta_m) = \prod_{i=1}^{n} \left(P(Y_{1i} = n_{1i}, Y_{2i} = n_{2i})\right)$$

$$\begin{aligned} \ln L(\beta_{01}, \beta_{02}, \beta_m) &= \sum_{i=1}^{n} \ln \prod_{i=1}^{n} \left(P(Y_{1i} = n_{1i}, Y_{2i} = n_{2i})\right) \\ &= \sum_{i=1}^{n} \ln \prod_{i=1}^{n} \left(\pi_{1i}^{y_{1i}} \pi_{2i}^{y_{2i}} \pi_{3i}^{1-y_{1i}-y_{2i}}\right) \\ &= \sum_{i=1}^{n} \left(y_{1i} \ln \pi_{1i} + y_{2i} \ln \pi_{2i} + (1 - y_{1i} - y_{2i}) \ln \pi_{3i}\right) \end{aligned}$$

$$=\sum_{i=1}^{n} y_{1i}\ln\left(\frac{\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}{(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right)+$$

$$+y_{2i}\ln\left(\frac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}\right)+$$

$$+\left(1-y_{1i}-y_{2i}\right)\ln\left(\frac{1}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right)$$

$$L\left(\beta_{01},\beta_{02},\beta_m\right)=\prod_{i=1}^{n}\left(P\left(Y_{1i}=n_{1i},Y_{2i}=n_{2i}\right)\right)$$

$$\ln L\left(\beta_{01},\beta_{02},\beta_m\right)=\sum_{i=1}^{n}\ln\prod_{i=1}^{n}\left(P\left(Y_{1i}=n_{1i},Y_{2i}=n_{2i}\right)\right)$$

$$=\sum_{i=1}^{n}\ln\prod_{i=1}^{n}\left(\pi_{1i}^{y_{1i}}\pi_{2i}^{y_{2i}}\pi_{3i}^{1-y_{1i}-y_{2i}}\right)$$

$$=\sum_{i=1}^{n}\left(y_{1i}\ln\pi_{1i}+y_{2i}\ln\pi_{2i}+\left(1-y_{1i}-y_{2i}\right)\ln\pi_{3i}\right)$$

$$=\sum_{i=1}^{n} y_{1i}\ln\left(\frac{\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}{(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right)+$$

$$+y_{2i}\ln\left(\frac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)}{\left(1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)\left(1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x\right)\right)\right)}\right)+$$

$$+\left(1-y_{1i}-y_{2i}\right)\ln\left(\frac{1}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right)$$

$$
\begin{aligned}
\ln L(.) &= \sum_{i=1}^{n} y_{1i}\left[\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i) - \ln\left(1+\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right)\right] \\
&+ y_{2i}\left(\ln\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right) - \exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right) \\
&- \ln\left(1+\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right) - \ln\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right) \\
&- (1 - y_{1i} - y_{2i})\ln\left(1+\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right) \\
&= \sum_{i=1}^{n} y_{1i}\left[\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i) - (y_{1i} + y_{2i}) - \ln\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right] \\
&+ (1 - y_{1i} - y_{2i} + y_{2i})\ln\left(1+\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right) \\
&+ y_{2i}\left[\ln\left(\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right) - \left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right)\right] \\
&= \sum_{i=1}^{n}\left[y_{1i}\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i) - (y_{1i} + y_{2i})\ln\left(1+\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right)\right)\right] \\
&- (1 - y_{1i})\ln\left(1+\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right) \\
&+ y_{2i}\ln\left(\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right) - \exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)\right)
\end{aligned}
\tag{26}
$$

3. **Maximize** $\ln L(\beta_{01}, \beta_{02}, \beta_m)$

   If presented in matrix form, then β_m becomes $\boldsymbol{\beta} = (\beta_1, \beta_2, ..., \beta_m)$

   a. **Necessary conditions**

$$
\frac{\partial \ln L(\cdot)}{\partial \beta_{01}} = \sum_{i=1}^{n}\left[\begin{array}{l}
y_{1i} - \dfrac{(y_{1i} + y_{2i})\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)}{1+\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)} \\
-y_{2i} - \dfrac{\exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)}{\exp\left(\beta_{02} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right) - \exp\left(\beta_{01} + \sum_{m=1}^{M}\beta_m B_m(x_i)\right)}
\end{array}\right]
$$

$$=\sum_{i=1}^{n}\left[y_{1i}-\left(y_{1i}+y_{2i}\right)\pi_{1i}\left(\mathbf{x}_i\right)-y_{2i}\frac{\pi_{1i}\left(\mathbf{x}_i\right)\pi_{3i}\left(\mathbf{x}_i\right)}{\pi_{2i}\left(\mathbf{x}_i\right)}\right]$$

$$\frac{\partial \ln L(\cdot)}{\partial \beta_{02}}=\sum_{i=1}^{n}\left[\begin{array}{l}\dfrac{-\left(1-y_{1i}\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}-y_{2i}\\ -\dfrac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\end{array}\right]$$

$$=\sum_{i=1}^{n}\left[\left(y_{1i}-1\right)\pi_{2i}\left(\mathbf{x}_i\right)+y_{2i}-\frac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right]$$

$$\frac{\partial \ln L(\cdot)}{\partial \boldsymbol{\beta}}=\sum_{i=1}^{n}\left[\begin{array}{l}Y_{1i}\mathbf{X}_i^T-\dfrac{\left(y_{1i}+y_{2i}\right)\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)\mathbf{X}_i^T}{1+\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\\ -\dfrac{\left(1-y_{1i}\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)\mathbf{X}_i^T}{1+\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\\ +y_{2i}\left(\dfrac{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)\mathbf{X}_i^T-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)\mathbf{X}_i^T}{\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)-\exp\left(\beta_{01}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)}\right)\end{array}\right]$$

$$=\sum_{i=1}^{n}\mathbf{X}_i^T\left[Y_{1i}-\left(Y_{1i}+Y_{2i}\right)P_{1i}\left(\mathbf{X}_i^T\right)-\left(1-y_{1i}\right)P_{3i}\left(\mathbf{X}_i^T\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)+Y_{2i}\right]$$

$$=\sum_{i=1}^{n}\mathbf{X}_i^T\left[\left(y_{1i}+y_{2i}\right)\left(1-P_{1i}\left(\mathbf{X}_i^T\right)\right)-\left(1-y_{1i}\right)P_{3i}\left(\mathbf{X}_i^T\right)\exp\left(\beta_{02}+\sum_{m=1}^{M}\beta_m B_m\left(x_i\right)\right)\right] \tag{27}$$

$$\vec{g}\left(\beta_{01},\beta_{02},\boldsymbol{\beta}\right)=\begin{bmatrix}\dfrac{\partial \ln L(\cdot)}{\partial \beta_{01}}\\ \dfrac{\partial \ln L(\cdot)}{\partial \beta_{02}}\\ \dfrac{\partial \ln L(\cdot)}{\partial \boldsymbol{\beta}}\end{bmatrix} \qquad \operatorname{var}\left(\begin{bmatrix}\hat{\beta}_{01}\\ \hat{\beta}_{02}\\ \hat{\boldsymbol{\beta}}\end{bmatrix}\right) \tag{28}$$

b. Enough conditions

$$\mathrm{H}\left(\beta_{01},\beta_{02},\boldsymbol{\beta}\right)=\begin{bmatrix}\dfrac{\partial \ln L(\cdot)}{\partial \beta_{01}^2} & \dfrac{\partial^2 \ln L(\cdot)}{\partial \beta_{01}\partial \beta_{02}} & \dfrac{\partial^2 \ln L(\cdot)}{\partial \beta_{01}\partial \boldsymbol{\beta}}\\ & \dfrac{\partial \ln L(\cdot)}{\partial \beta_{02}^2} & \dfrac{\partial^2 \ln L(\cdot)}{\partial \beta_{02}\partial \boldsymbol{\beta}}\\ & & \dfrac{\partial^2 \ln L(\cdot)}{\partial \vec{\beta}\partial \boldsymbol{\beta}}\end{bmatrix} \tag{29}$$

$\mathrm{H}(\cdot)$ must be negative definite, where $\mathrm{H}(\cdot)$ is a Hessian matrix.

$$\textbf{Newton Raphson Iteration} =\begin{pmatrix}\beta_{01}(m+1)\\ \beta_{02}(m+1)\\ \boldsymbol{\beta}(m+1)\end{pmatrix}=\begin{pmatrix}\beta_{01}(m)\\ \beta_{02}(m)\\ \boldsymbol{\beta}(m)\end{pmatrix}-\mathrm{H}^{-1}\beta_{01}(m)\beta_{02}(m)\boldsymbol{\beta}(m)g(\cdot) \tag{30}$$

$$\operatorname{var}\left(\begin{bmatrix}\hat{\beta}_{01}\\ \hat{\beta}_{02}\\ \hat{\boldsymbol{\beta}}\end{bmatrix}\right)=-\mathrm{H}^{-1}(\cdot) \tag{31}$$

Based on the results of Newton Raphson iteration, the $\beta_{01},\beta_{02},\boldsymbol{\beta}$ value is obtained.

CONCLUSION

The distribution of the ordinal scale response variable with three categories in the MARS model is multinomial distribution, that the log-likelihood function of the ordinal response random variable will be maximized to obtain the parameter value. Parameter estimation of $\beta_{01},\beta_{02},\boldsymbol{\beta}$ value can be obtained from:

$$\textbf{Newton Raphson Iteration} \quad =\begin{pmatrix}\beta_{01}(m+1)\\ \beta_{02}(m+1)\\ \boldsymbol{\beta}(m+1)\end{pmatrix}=\begin{pmatrix}\beta_{01}(m)\\ \beta_{02}(m)\\ \boldsymbol{\beta}(m)\end{pmatrix}-\mathrm{H}^{-1}\beta_{01}(m)\beta_{02}(m)\boldsymbol{\beta}(m)g(\cdot)$$

$$\operatorname{var}\left(\begin{bmatrix} \hat{\beta}_{01} \\ \hat{\beta}_{02} \\ \hat{\boldsymbol{\beta}} \end{bmatrix}\right) = -\mathrm{H}^{-1}(\cdot)$$

ACKNOWLEDGMENTS

The authors would like to thank to "Center for Education Financial Services" and "Indonesia Endowment Funds for Education" for supporting the funding of this research. The authors also thank to Faculty of Sciences and Technology, Airlangga University for supporting and facilitating this research.

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Using Factor Analysis and Regression Analysis to Develop Model of Customer Relationship Management Systems Evaluation

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Abstract Nowadays, globalization is experiencing increasingly rapid development and is very difficult to separate from human civilization, even since its inception. Apart from that, the era of globalization also promises convenience for humans. The development of information technology, as a result of globalization, has encouraged various innovations which of course make things easier for someone to do various things with the help of technology. One of the consequences of the growth of technological knowledge at this time is giving rise to a new stigma in life, namely internet use. The internet itself provides benefits for everyone so they can connect with each other without any restrictions (Harto, Pratiwi, Utomo, & Rahmawati, 2019). Internet user not only comes from adults but is also used by teenagers and children. Item to achieve a competitive advantage for corporations. This research was conducted to develop an evaluation of the implementation of the CRM system to identify the main factors of successful implementation and then create a model that can predict future strategy implementation. To analyze these factors, factor analysis is employed, and it also helps to build a model of ~~the~~ associated factors in conjunction with a regression analysis. The results showed 5 (five) main factors, namely CRM Reliability, CRM Under Usage, Capability, Unpreparedness, and Quality of Customer Relations.

INTRODUCTION

Customers are people in general who need potential products and services and make purchases [1]. Meanwhile, satisfaction is a person's feeling of happiness or disappointment that comes from a comparison between his impression of the performance (or results) of a product and his expectations, a satisfied customer is a customer who feels they are getting value from a supplier, manufacturer, or service provider. Value can come from products, services, systems, or something emotional. Satisfied customers are customers who will share satisfaction with producers or service providers and even with other customers. There are five main drivers of customer satisfaction, namely product quality, price, service quality, emotional factors, and cost and ease of obtaining products or services [2].

CRM is a series of integrated activities to identify, acquire, maintain, and develop profitable customers. With the main aim of optimizing company profits through customer satisfaction. Customer Relationship Management (CRM) is an important factor in current business. According to a study conducted by Wahyudi (2021), CRM helps businesses to strengthen relationships with their customers and improve customer loyalty. In using CRM, companies can find out their customers' needs and provide better service as well as optimize customer experience. This can increase satisfaction among customers and increase their engagement with the brand, which ultimately can bring long-term benefits to the business. In Wibowo's research (2020), CRM is a crucial aspect of developing business, especially in the increasingly competitive digital era. In this era, the use of technology and data is an important factor in

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020011-1–020011-9; https://doi.org/10.1063/5.0241584
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

implementing strategy Effective CRM. Companies need to utilize technology and data to Analyze customer behavior and understand their needs so they can provide a better customer experience and increase customer loyalty

FIGURE 1. Time series data of problem statement

LITERATUR REVIEW

CRM Component

In implementing CRM, companies need to understand customer needs and preferences, manage interactions with customers effectively, and ensure proper communication with customers. In addition, other research also shows the existence of additional goals of CRM, such as improving product or service quality, optimizing business processes, and gaining better insight into markets and customers. The use of technology in CRM can also help companies to obtain more accurate customer data and gain better insight into customer behavior, needs, and preferences. Hence, CRM implementation can effectively help companies achieve their goals, in terms of customer satisfaction operational efficiency, and company profits.

Relationship Marketing

Marketing is one of the main activities that is generally carried out by business actors to support the process of business continuity to develop and earn money profit, and survival [7]. Marketing can also be interpreted as activities that go beyond just selling or advertising by involving the satisfaction of customer needs. With marketing, companies can create value for existing customers and build strong relationships with customers to get value in return. Marketing is defined as an activity, a set of rules and processes for creating, communicating, delivering, and exchanging offers that have value to buyers, customers, partners, and society [8]. Generally, marketing is used to gain profits based on the sale of goods and services created in the process of fulfilling the needs of buyers. Marketing also involves the process of managing good relationships between businesspeople and customers to be able to attract new customers by promising superior value to provide satisfaction [9]. It can be concluded that marketing is a process where business actors involve customers to build strong relationships and create value to gain profits in the process of meeting existing customer needs [10].

In the marketing mix or what is known as the mix marketing is a set of tactical marketing tools that a company can control and combine to produce the desired response in the target market. The marketing mix is classified into seven major groups called the 7Ps which consist of Product, Price, Place, Promotion, People, Physical Evidence, and Process [11] which are explained as follows:

1. Products, Products are aspects that will be sold in a business process, this includes goods or services that have functional value needed by consumers. The products sold must have a function in meeting the needs and desires

of consumers. In addition, the product being sold must have a value that is superior to other products on the market so that it is easily accepted by consumers.

2. Price, Price is an aspect related to the exchange value that must be paid by consumers to obtain goods or services sold by business actors. Price is an important aspect because consumers consider price as a factor to consider when purchasing a good or service. In this regard, the right price is a price that can follow the movement of market dynamics.
3. Place, Place is an aspect of the location where the business process is carried out and is an important factor because it requires strategic location considerations. With the development of the times, modern business is experiencing developments where there is an online business using internet media as a strategic location.
4. Promotion, Promotion is an aspect related to marketing and advertising business activities with the aim of making consumers more familiar with and interested in using the products or services being sold. Promotion must consider things that can change Consumer perceptions and become positive regarding the image of the products and services offered. Promotion can also be done in many ways, both traditional techniques using face-to-face and modern techniques using social media or the internet as a means of promotion.
5. People, The person aspect or known as participants are all actors who want a part of the service presentation and therefore can influence the buyer's perception. Elements that are closely related to this aspect include employees, companies, and consumers in the environment.
6. Physical Evidence, Physical evidence is an aspect related to the real physical environment where products or services have a tangible record of evidence. Apart from that, in this aspect, there is also an interaction process between business actors and consumers where each tangible component facilitates the appearance and communication of existing services.
7. Process, Process is an aspect related to all actual procedures, mechanisms, and flow of activities carried out. In this case, the service or product process created can be delivered or presented in the form of system operations.

Customer Satisfaction

Recent studies show that customer satisfaction is an important factor in business success. customer satisfaction can influence customer loyalty and intentions repeat purchases, and customer recommendations to others [12]. Therefore, companies need to understand the factors that influence customer satisfaction and ensure a positive customer experience. Several factors that influence customer satisfaction include product or service quality, price, service, and communication with customers. Satisfaction can be measured by how well customer expectations are met and loyalty is measured by how willing customers are to make repeat purchases. Moreover, customer satisfaction helps organizations and companies increase their returns and gain competitive advantage [13].

Research Instrument

In this research, social media has the benefit of increasing sales and profitability, creating advertisements, acquiring new customers, and retaining customers. Companies are considered to have an obligation to implement CRM in marketing strategy because it view it as a powerful marketing tool that can provide useful customer experience insights and adapt to new trends in social media. Based on the results of this research, and it instrument can be built as follows: Table 1.

TABLE 1. Development of Research Instrument

	Factors	Indicators	Statement
CRM Components	***Technology***	*Availability*	Information systems can be developed to be accessed at different times and locations quickly. [14].
		Data Analytics	Information systems can be developed to expect data transformation to occur. [14].
		Reliability	Technology carries out tasks reliably, accurately, and consistently [14].
	People	*Behavior*	Attitude and service towards customers is friendly and respectful [15].

	Factors	Indicators	Statement
		Competencies	employee's basic abilities in carrying out service work [15].
		Enthusiasm	Always enthusiastic and caring about customer service [15].
	Process	*Customer-oriented*	Service to customers that is oriented to customer needs and expectations [16].
		Complaint handling	Companies must be able to handle complaints and dissatisfaction from customers [16].
		Simplicity	Good communication with customers and easy contact with customers is good service for customers [16].
	Knowledge	*Knowledge Acquisition*	Developing the company's ability to understand the knowledge possessed by customers is important [17].
		Customer-knowledge	Developing a company's ability to understand knowledge from a customer perspective is important [17].
Relationships Marketing	***Financial Benefit***	*Reward Program*	Giving gifts to loyal customers needs to be done [18].
		Discount & Promos	It is necessary to provide discounts and promotional prices for loyal customers [18].
	Social Benefit	*Friendship*	It is necessary a close relationship between the company and customers regarding activities, marketing, product sales and after-sales service [19].
		Fraternization	It is necessary a family relationship between the company and customers regarding activities, marketing, product sales and after-sales service [19]
		Personal Recognition	There needs to be a friendly relationship between fellow retail sellers so they can get to know their customers [19]
	Structural Ties	*Trust*	There needs to be a sense of mutual trust between customers and sellers or product providers [20].
		Information Sharing	There needs to be a sense of mutual sharing of information between customers and sellers or product providers [20].
		Preferential Treatment	Companies should always provide better special treatment to individual customers [20].
Customer Satisfaction		*Overall Satisfaction*	It is necessary to carry out customer-based evaluations to gain customer experience in transactions with the company [21].
		Confirmation of Expectation	There needs to be a match between the company and the customer's service expectations [21].
		Positive Word of Mouth	The pleasant experience of products and services consumed by customers needs to be conveyed to other people [21].
Customer Loyalty		*Recommend to others*	Enjoyable experiences with products and services consumed by customers need to be recommended to others [22].
		Immunity to Competitor	There are differences in function and quality between products and services from each company even though they are in the same category [22]

Factors	Indicators	Statement
	Repeat Purchases	The company's hope is that customers will repurchase products [22]
	Purchase Interline Product	There is a possibility that customers will buy other products if they are dissatisfied with the service they receive [22]
Brand Image	*Perceived belief*	The perception or belief that customers have in the brand image of a company's products is very important [23].
	Functional Image	Customers can recognize the brand image from the function of the product purchased [23].
	Identity	Companies need to identify their performance capabilities in conveying the values, functions and uniqueness of their products [23].

RESEARCH METHOD

Population and Sample

The number of samples depended on the level of desired accuracy or error. Based on the formula with a standard error of at least 5% the samples were used in this study, which involved approximately 348 respondents. The questionnaire was distributed to 348 respondents. However, 332 respondents completed the questionnaire.

Methods of data analysis

Questionnaires were distributed to respondents, and the questions in the questionnaire were designed according to the needs of the information required for testing factor analysis in this study. Likert scale was used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena. The questionnaire consisted of two parts; the first part was to collect respondent data. Respondent data required are as follows: Gender, Age, Know the topic of E-Commerce, Business area, Generation, a Current learning media assessment. The second part is the part that is formed by factor analysis points statement built by several factors, which factors in question are all factors that have been discussed previously.

RESULT AND DISCUSSION

Respondents Profile

The results of research data processing in the form of a number of questionnaires related to primary data after being filled in by respondents internally, are shown in Table 2,

TABLE 2. Respondents Profile

Total samples	332
Gender	
Male	170 (51%)
Female	162 (49%)
Age (Year)	
< 18 Year	0 (0%)
18-21	234 (70%)
21-25	79 (24%)
> 25	19 (6%)
Current e-commerce media	**Assessment**
value 4	4
value 5	21
value 6	35
value 7	141
value 8	109
value 9	20
value 10	2

Business area		
Information system	73	(22%)
Computer science	56	(17%)
Engineering	28 (8%)	
Economic & communication	46	(14%)
Design	48	(15%)
Business management	38	(11%)
Literature	43	(13%)
Generation		
< 2016		7
2016		34
2017		17
2018		32
2019		41
2020		201
Know the topic of	**Customer**	
Familiar	326 (92%)	
Not familiar	6	(8%)

As shown in Table 2, 4 subjects gave a score of 4, 21 subjects gave a score of 5, 21 people, 35 subjects were assigned a score of 6, 141 subjects gave a score of 7 respondents, 109 subjects gave a score of 20 subjects gave a score of 9, and only 2 subjects gave a score of. No respondents gave a value of 1 to 4. The assessment aims to examine the respondents' views of E-Commerce today. By implication, it also aims to examine the potential of using E-Commerce ~~can~~to improve respondent interest and learning outcomes. Results showed that the majority of respondents gave a score of 7, implying that E-Commerce is good enough yet to be improved further.

Limitation of Research

1. This research focuses on the effect of the use of instructional media interest in E-Commerce and learning outcomes for respondents with the factors of knowledge management.
2. The discussion does not cover everything outside knowledge management.
3. The method of data collection is a questionnaire, which means it is very dependent on the quality of the answers of the respondents.
4. The number of respondents has not yet reached the whole of the population.

The results of the analysis of respondent interest and learning outcomes related to the implementation of E-Commerce can be seen after the formation of a regression model that uses the new factors generated so that it can be used to predict and determine strategies for increasing interest in the future.

$$\boldsymbol{Y(x) = 7.199 + 0.186\,X1 + 0.001\,X2 + 0.115\,X3 + 0.153\,X4}$$

This formula is interpreted in a model that can be seen in Figure 2.

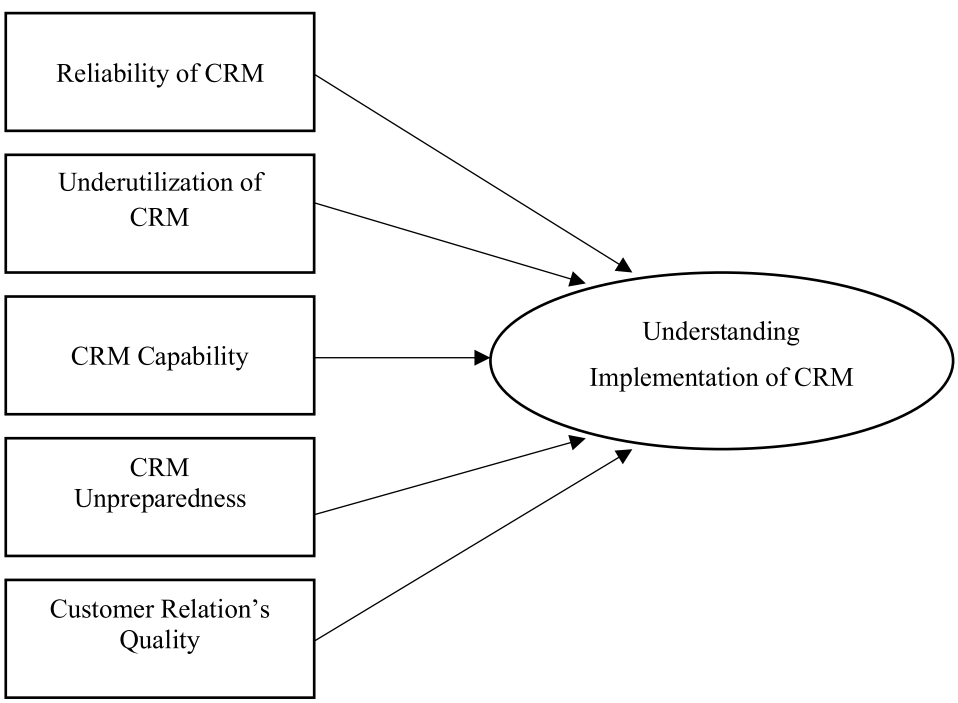

FIGURE 2. Relation between dependent and independent variable

The authors used the level of understanding of CRM implementation as a dependent variable in the model developed. Meanwhile, the factor score variable was used as an independent variable. Based on this, the authors continued the factor regression analysis as in Appendix L8. From the results of this analysis, a regression equation can be prepared that illustrates the application of CRM at PT. XYZ.

$$\mathbf{Y = 7.061 + 0.087\,X1 - 0.077\,X2 + 0.057\,X3 - 0.024\,X4 + 0.122\,X5}$$

Based on the resulting equation, the CRM implementation model at PT. XYZ can be observed in Figure 3

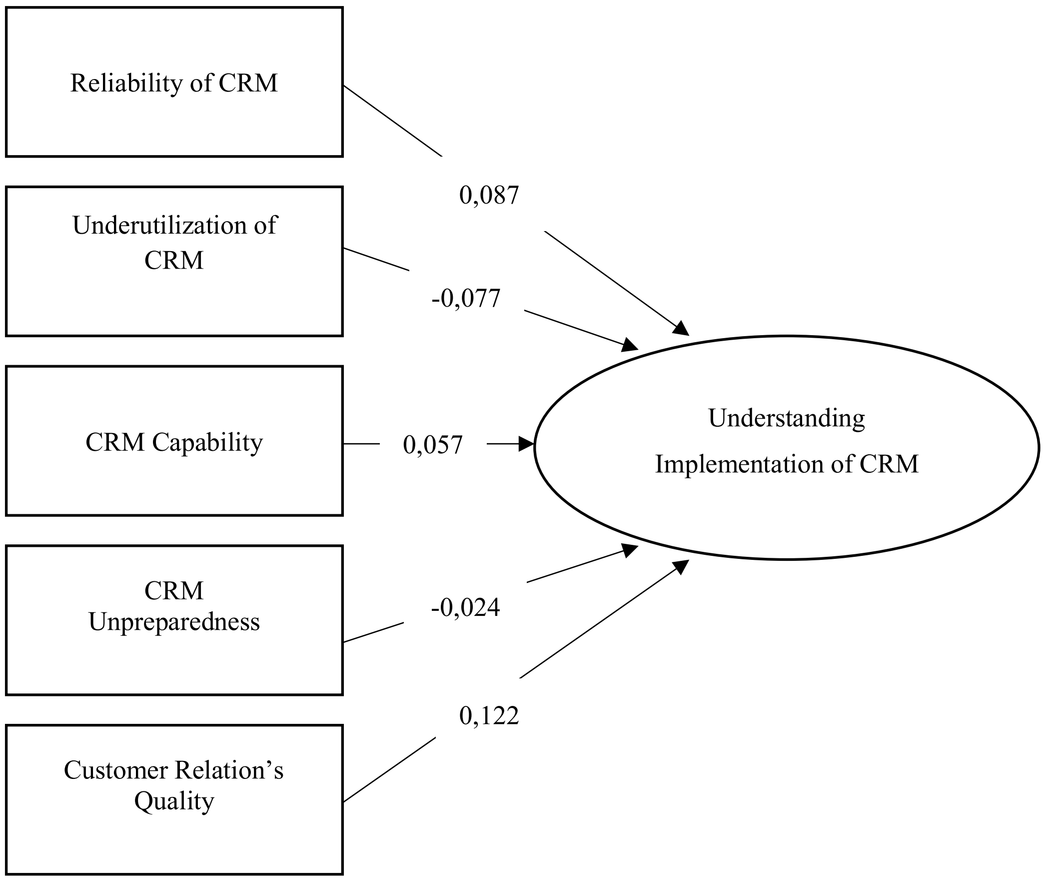

FIGURE 3. Factors Affecting CRM Implementation

At this stage, after carrying out factor regression, finding factor scores, and forming a model, this will be followed by identifying the minimum and maximum values for each factor found. Data processing for the minimum and maximum values of the factors can be seen in Appendix L9, where the values contained in factor X are the values contained in the new factor that is formed. X1 is a factor of CRM Reliability, X2 is a factor of Underutilization of CRM, X3 is a factor of CRM Capability, and X4 is a factor of CRM Unpreparedness, the following are the minimum and maximum value limits for the five factors:

$$\mathbf{Y = 7{,}061 + 0.087\ X1 - 0{,}077\ X2 + 0{,}057\ X3 - 0{,}024\ X4 + 0.122\ X5}$$

With an explanation of the X value limitations:

$$-5.199856 < X1 < 2.465724$$
$$-3.900014 < X2 < 3.143861$$
$$-4.093666 < X3 < 2.478331$$
$$-4.265005 < X4 < 2.449196$$
$$-3.989227 < X5 < 2.725575$$

In maintaining good relationships with customers, companies can manage CRM by:

1. Make it easy for customers to search information about companies
2. Provides convenience and increases process flexibility payments made by customers
3. Improve service quality so that it can be more up-to-date regarding information relating to billing, service, or other issues other questions

4. Provide technical support and offers provided through telephone lines such as customer service calls
5. Provide policy and protection to every customer
6. Oriented to provide services that focus on fulfilling Customer needs and customized services are as diverse as possible Types of packages to choose from
7. Can pay more attention to customer needs and provide interactive and convenient communication channels for customers
8. Listen to customer opinions which can be channeled through questionnaire after conducting treatment or surveys on social media

CONCLUSION

Based on data analysis and data discussion, conclusions were drawn from this research regarding Factor Analysis and Regression Analysis to Develop a Customer Relationship Management System Evaluation Model
as follows:

1. CRM Reliability (X1) has a positive and significant influence towards Customer Relationship Management for company customers. This proves that there is a dependency on the CRM system as marketing which includes the dimensions of online communities, interaction, sharing of content, accessibility and credibility which can be used as a medium to build and maintain relationships with customers.
2. Underutilization of CRM (X2) has a negative and significant influence on customer service to customers. This proves that the CRM system as marketing which includes the dimensions of online communities, interaction, sharing of content, accessibility, and credibility can influence Dermies customer satisfaction which can influence the desire to recommend, the intention to return.
3. Customer Relationship Management has a positive and significant influence on Customer Satisfaction among customers. This proves that Customer Relationship Management includes the dimensions of easy access to services, quick access to services, privacy protection, extended service hours, customized services, and more diversified service channels able to influence customer satisfaction from customers.

ACKNOWLEDGMENT

The authors would like to thank the Directorate General of Higher Education, College Excellence Basic Research grants, Ref. Number: B/112/E3/RA.00/2021. Subject: Announcement of Recipients of Research Funding at Universities for Fiscal Year 2021

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On Fermat's Equation over 2-by-2 Matrices Integers Modulo Prime

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Abstract. In this paper we investigate the solvability of Fermat's matrix equation over the group of nonsingular matrices of integers modulo prime. Here we use literature review to construct the theories. It is obtained that the equation $X^n + Y^n = Z^n$ always has solution in $GL_2(\mathbb{Z}_2)$ and for $n = 3$ the equation has solution in $GL_2(\mathbb{Z}_3)$. This result can be extend more general to $GL_m(\mathbb{Z}_p)$, for $m > 2$ or $p > 3$.

INTRODUCTION

The equation $a^n + b^n = c^n$ with $n > 2$ has no solution for $a, b, c \in \mathbb{N}$. This is known as the Fermat's Last Theorem. At the beginning of 1637, Fermat's Last Theorem had become a conjecture. Nevertheless, Wiles [1] proved that this proposition is true. An extension of this equation that is widely discussed is the Fermat's equation in matrices (see [2 – 6]). Furthermore, the Fermat's equation has been investigated in 2×2 integer matrices [7], rational matrices [8], general linear group $GL_2(\mathbb{Z})$and special linear group $SL_2(\mathbb{Z})$ of 2×2 matrices with $det = 1$ [3]. In matrix form, we can rewrite Fermat's equation as $A^n + B^n = C^n$ where $A, B,$ and C are matrices. In this form for $n \geq 4$, Mao-Ting and Jie [9], proved that Fermat's matrix equation has many solutions in a set of 2×2 positive semi-definite integral matrices, and has no nontrivial solutions in some classes including 2×2 symmetric rational and stochastic quadratic field matrices. Because of all references are discussed with infinite set, and there is no investigation with finite set. Here we are going to propose Fermat's equation with particular finite set and construct some theories.

On the other hand, Herstein [10] proposed a problem of counting the order of the group $G = \left\{\begin{pmatrix} a & b \\ c & d \end{pmatrix} \middle| a, b, c, d \in \mathbb{Z}_p, ad - bc \neq 0\right\}$ where p is prime. The solution of this problem is $|G| = p^4 - ((2p-1)^2 + (p-1)^3)$. Hadi [11] extend this problem with $m \times m$ nonsingular matrix and obtain the solution that is $|G| = p^{m^2} - \left[1 + (p^m - 1)\sum_{j=0}^{m-2}\left[(p^m - p)^j \sum_{k=0}^{m-1} p^k\right]\right]$. Of course, for any prime and integer n, G is finite and the solvability of Fermats' equation has different approach to develop. In this paper, we study the solvability of Fermat's matrix equation $A^n + B^n = C^n$ using the group of 2×2 matrices of integers modulo prime for $n \geq 2$.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020012-1–020012-4; https://doi.org/10.1063/5.0244686
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

MOTIVATION

Fermat's Last Theorem stated that the equation $a^n + b^n = c^n$ with $n > 2$ has no solution for $a, b, c \in \mathbb{N}$ (see [12]). At the beginning, this theorem was famous in integers problems. Moreover, Wiles [1], showed the Fermat's matrix equation $A^n + B^n = C^n$ with $n > 2$ has no solution for A, B, and C 2×2 matrices of integers. But in contrast, if $A = \begin{pmatrix} 0 & 1 \\ a & 0 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 \\ b & 0 \end{pmatrix}$, and $C = \begin{pmatrix} 0 & 1 \\ c & 0 \end{pmatrix}$ where a, b, and c satisfies the Phytagorean equation $a^2 + b^2 = c^2$, then $A^4 + B^4 = C^4$. This amazing discovery was founded by Domiaty [13] in 1996. From this, we can conclude that the Fermat's matrix equation $A^4 + B^4 = C^4$ has infinitely many solutions in 2×2 integer matrices. Another problem in the set of matrices is discussed by Ribenboim [14]. One important problem about Fermat's matrix equation is to investigate the solvability in the set of matrices. Khazanov [3] gave an example of the necessary and sufficient condition for solvability of $A^n + B^n = C^n$ when $A, B, C \in SL_2(\mathbb{Z})$, $SL_3(\mathbb{Z})$, or $GL_3(\mathbb{Z})$. Basically, all references above use infinite set of matrices. In this article, we investigate the solvability for 2×2 matrices of integers modulo prime.

METHODS OF RESEARCH

In this paper, we deal with the set consists of 2×2 matrices of integers modulo prime and using various literatures to compare the result. The method involves many steps as follows:

1. Start with $p = 2$ and derive some properties using arbitrary integers n. Here we need some algebra techniques to obtain the result.
2. Continue with another prime number and arbitrary integer n to find the necessary and sufficient conditions for the solvability of Fermat's equation.
3. Construct some theorem (if possible) as conclusion of the discussion.

In addition, the concept of a group is used to explain some argument which proposed. The diagram below showed the step about the solvability of Fermat's equation.

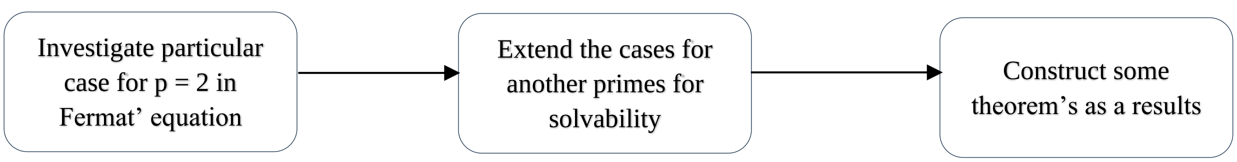

Diagram 1. The process to find the necessary and sufficient conditions for the solvability of Fermat's equation

RESULTS AND DISCUSSION

In view of group of matrices of integers modulo prime, let us consider the group of nonsingular 2×2 matrices of integers modulo 2 ($p = 2$). The group is $G = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} \middle| \, a, b, c, d \in \mathbb{Z}_2, ad \neq bc \right\}$ which is denoted by $GL_2(\mathbb{Z}_2)$. Here we have the elements of $GL_2(\mathbb{Z}_2)$ are $A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$, $D = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$, $E = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$, and $F = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$. The multiplication table of elements in $GL_2(\mathbb{Z}_2)$ is given below.

TABLE 1. Table of closed property on group $GL_2(\mathbb{Z}_2)$ under multiplication matrix.

×	**A**	**B**	**C**	**D**	**E**	**F**
A	A	B	C	D	E	F
B	B	A	D	C	F	E
C	C	F	A	E	D	B
D	D	E	B	F	C	A
E	E	D	F	B	A	C
F	F	C	E	A	B	D

Moreover, in group theories, the identity matrix is A and it is useful to develop the necessary and sufficient condition on Fermats' equation. Now, let us consider the addition of matrices in $GL_2(\mathbb{Z}_2)$. Clearly, the system is not closed since many singular matrices appear in the table below.

TABLE 2. Table for addition of elements in $GL_2(\mathbb{Z}_2)$.

+	**A**	**B**	**C**	**D**	**E**	**F**
A	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$	$\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$	$\begin{bmatrix}0 & 0\\1 & 0\end{bmatrix}$	F	$\begin{bmatrix}0 & 1\\0 & 0\end{bmatrix}$	D
B	$\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$	E	$\begin{bmatrix}1 & 0\\0 & 0\end{bmatrix}$	C	$\begin{bmatrix}0 & 0\\0 & 1\end{bmatrix}$
C	$\begin{bmatrix}0 & 0\\1 & 0\end{bmatrix}$	E	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$	$\begin{bmatrix}0 & 1\\0 & 1\end{bmatrix}$	B	$\begin{bmatrix}0 & 1\\0 & 0\end{bmatrix}$
D	F	$\begin{bmatrix}1 & 0\\0 & 0\end{bmatrix}$	$\begin{bmatrix}0 & 1\\0 & 1\end{bmatrix}$	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$	$\begin{bmatrix}0 & 0\\1 & 1\end{bmatrix}$	A
E	$\begin{bmatrix}0 & 1\\0 & 0\end{bmatrix}$	C	B	$\begin{bmatrix}0 & 0\\1 & 1\end{bmatrix}$	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$	$\begin{bmatrix}0 & 0\\1 & 0\end{bmatrix}$
F	D	$\begin{bmatrix}0 & 0\\0 & 1\end{bmatrix}$	$\begin{bmatrix}0 & 1\\0 & 0\end{bmatrix}$	A	$\begin{bmatrix}0 & 0\\1 & 0\end{bmatrix}$	$\begin{bmatrix}0 & 0\\0 & 0\end{bmatrix}$

Note that A is the identity element in group $GL_2(\mathbb{Z}_2)$ (under multiplication) but is not identity element under addition. Using Table 1 and Table 2, we have the fact that:

- $A^2 = B^2 = C^2 = E^2 = A$, $D^2 = F$, and $F^2 = D$
- $A + D = F$, $A + F = D$, and $D + F = A$
- $B + C = E$, $B + E = C$, and $C + E = B$

Here we have that $X^2 + D^2 = F^2$, $X^2 + F^2 = D^2$, and $D^2 + F^2 = X^2$ for $X = A, B, C, E$. Since there are no more solutions, we have the following result:

Lemma 1 The matrix equation $X^2 + Y^2 = Z^2$ has 12 solutions in $GL_2(\mathbb{Z}_2)$.

Now for $n = 3$, we have the fact below:

- $A^3 = D^3 = F^3 = A$, $B^3 = B$, $C^3 = C$, and $E^3 = E$
- $B^3 + C^3 = E^3$, $B^3 + E^3 = C^3$, and $C^3 + E^3 = B^3$

From these, in short conclusion we can say that the equation $X^3 + Y^3 = Z^3$ has 3 solutions in $GL_2(\mathbb{Z}_2)$. Further, we notice that since B, C, and E are self-inverse then all the solutions of $X^3 + Y^3 = Z^3$ will be the solution of $X^5 + Y^5 = Z^5$, $X^7 + Y^7 = Z^7$, and so forth. Here we have the following result:

Lemma 2 For every $k \in \mathbb{N}$, the matrix equation $X^{2k+1} + Y^{2k+1} = Z^{2k+1}$ has at least 3 solutions in $GL_2(\mathbb{Z}_2)$.

Now we continue with specific form. Notice that if $A^k + Y^k = Z^k$ for some $k \in \mathbb{N}$ then we have $Z^{2k} = (Z^k)^2 = (A^k + Y^k)^2 = A^{2k} + A^kY^k + Y^kA^k + Y^{2k}$. Now since A is the identity and $2X = 0$ for every $X \in GL_2(\mathbb{Z}_2)$ then we have $Z^{2k} = A^{2k} + Y^{2k}$. Since we have $A + D = F$ and $A + F = D$ then we have the following result:

Lemma 3 For every $k \in \mathbb{N}$ we have $A^{2k} + D^{2k} = F^{2k}$ and $A^{2k} + F^{2k} = D^{2k}$.

Now we go with higher p. Note that the number of elements in $GL_2(\mathbb{Z}_3)$ is 48. Hence, the multiplication table is very large. However, if we denote I as the identity matrix then for any matrices $A \in GL_2(\mathbb{Z}_3)$ we have $(I + A)^3 = I^3 + 3A + 3A^2 + A^3 = I^3 + A^3$ since $3X = 0$ for any matrices $X \in GL_2(\mathbb{Z}_3)$. We only need to choose the matrix A such that $I + A$ is invertible so the equation $X^3 + Y^3 = Z^3$ has solution in $GL_2(\mathbb{Z}_3)$. This can be done since we can choose, for example, $A = \begin{bmatrix}0 & 2\\1 & 0\end{bmatrix} \in GL_2(\mathbb{Z}_3)$. Hence, we can conclude that the equation $X^3 + Y^3 = Z^3$ is solvable in $GL_2(\mathbb{Z}_3)$.

REMARK We can generalize this result by noting that if $X, Y \in GL_2(\mathbb{Z}_3)$ are commute, i.e. $XY = YX$, then we have $XXY = XYX = YXX$ and $XYY = YXY = YYX$. Hence, $(X + Y)^3 = X^3 + 3X^2Y + 3XY^2 + Y^3 = X^3 + Y^3$.

CONCLUSION

Based on the result, the Fermat's matrix equation $X^n + Y^n = Z^n$ always has solution in $GL_2(\mathbb{Z}_2)$ while for $n = 3$ the equation has solution in $GL_2(\mathbb{Z}_3)$. This research can be continued with the group $GL_m(\mathbb{Z}_p)$, $m > 2$ or $p > 3$.

ACKNOWLEDGMENTS

This research is supported by Lembaga Penelitian dan Pengabdian Masyarakat (LPPM) Universitas Negeri Jakarta. We would like to thank all colleagues in Program Studi Matematika-FMIPA Universitas Negeri Jakarta for their support during the research.

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The Analysis of Factors Influencing roduct Competitive Advantage in Improving Marketing erformance of *Kre' Alang* Weaving

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Abstract. The creators of *Kre' Alang* weaving in Sumbawa Regency are concerned about the existence of fake *Kre' Alang* woven fabrics that are made not according to the quality standards and aesthetics typical of Sumbawa *Kre' Alang* originating from other districts in West Nusa Tenggara Province. The selling price is lower than the original *Kre' Alang* woven fabric, so consumers prefer fake *Kre' Alang* woven fabrics. If the government does not pay attention to this problem in preserving one of the cultural heritages of Sumbawa Regency, the weavers who maintain the existence of *Kre' Alang* weaving will be threatened. Therefore, this study examines the product competitive advantage and marketing performance of *Kre' Alang* weaving by taking into account the influencing factors and indicators. The research results are expected to be the basis for the government and weavers in making decisions to maintain the existence of *Kre' Alang* woven fabric by imitating *Kre' Alang* woven fabric and weaving from other regions. The method used to analyze this uses a structural equation model (SEM) and Lisrel 8.8 software as a tool. The research data were obtained by distributing questionnaires to the *Kre' Alang* weavers in Sumbawa Regency as a sample, and 109 weavers were willing to be respondents. The research results show that the competitive advantage of *Kre' Alang* woven products is influenced by product innovation, while the marketing performance of *Kre' Alang* woven products is influenced by technological orientation. The existence of a mediating variable in the form of competitive advantage can significantly increase the influence of technological orientation and product innovation on the marketing performance of *Kre' Alang* woven products, compared to the direct influence.

INTRODUCTION

Like other tribes in Indonesia in general, those in the Sumbawa district, West Nusa Tenggara province, also have the skill of weaving *songket* cloth, namely *Kre' Alang* woven cloth, which has been passed down from generation to generation from the ancestors of the Sumbawa [1]. *Kre' Alang* is a Sumbawa woven craft in the form of *songket* cloth made from cotton thread strung with gold or silver thread. Kre Alang is a typical Sumbawa weaving craft and is the identity of the Sumbawa people which is often used in various cultural activities. The variety of motifs applied to Sumbawa *songket* cloth reflects the great creativity of the weavers to enrich the treasures of decoration as works of art that are inseparable from the cultural roots of the community [2].

There is a lot of piracy, counterfeiting, or unhealthy competition between entrepreneurs. This incident also occurred with the *Kre' Alang* woven cloth in the Sumbawa area, where there was an fake of the patterns on the weaving by weavers from other regions. This is proven by the large number of *Kre' Alang* woven products circulating among the public, which are produced in different areas that do not pay attention to the standardization of the original *Kre' Alang* weaving created in the Sumbawa district, so the quality is not good. Therefore, the *Kre' Alang* woven cloth

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020013-1–020013-6; https://doi.org/10.1063/5.0242695

offered to the public is much cheaper than the original one. Suppose there is no solution to this problem from the regional government or related parties. In that case, the existence of *Kre' Alang* woven cloth entrepreneurs who preserve the cultural heritage passed down from generation to generation from the ancestors of the Sumbawa people will disappear. To maintain the existence of *Kre' Alang* weaving, the relevant parties need to register the creation and obtain legal protection to avoid imitation of the pattern or motif of the woven fabric in the form of modifications that will indirectly eliminate its original character [3]. Apart from that, it is necessary to study the factors that support the competitive advantage of *Kre' Alang* woven products and the factors that support the increased marketing performance of *Kre' Alang* weaving. So, it can be an input for *Kre' Alang* weaving practitioners and local governments in maintaining their existence amidst competition from fake weaves from other regions.

Kre' Alang woven products on the market are unique and characteristic, and each thread fiber is rich in tradition and cultural arts. However, in the era of globalization and rapid technological development, *Kre' Alang* weaving faces significant challenges to maintain industry sustainability and market supremacy. *Kre' Alang* woven products symbolize cultural heritage and have considerable economic potential. However, competition in the textile industry is getting more challenging due to technological advances and changes in consumer trends [4]. Therefore, a thorough understanding of the factors that influence the competitive advantage of *Kre' Alang* woven products is fundamental. In this context, this research aims to analyze the factors that influence the competitive advantage of *Kre' Alang* woven products, especially regarding technological orientation, product innovation, and marketing performance. Competitive advantage is a crucial concept of marketing strategy in how *Kre' Alang* weaving can differentiate itself from competitors in the market. Technology orientation is a critical aspect of increasing the competitive advantage of *Kre' Alang* weaving. This research examines how technology is used in the marketing performance of *Kre' Alang* weaving. Product innovation is significant to meet the ever-changing needs of consumers. Innovation can help create products more aligned with market tastes to determine the product's competitive advantage. Exploring innovative efforts in design, color, materials, and manufacturing techniques can influence the attractiveness of *Kre' Alang* weaving.

The method used in this research is the Structural Equation Modeling (SEM) method [5]. Previous research applied the SEM method to the *Kre' Alang* weaving problem to determine the factors influencing consumer decisions in purchasing *Kre' Alang* weaving products [6]. This method can also choose indirect effects from deciding on direct impacts. A direct influence between two latent variables occurs if an arrow connects the two variables, where the estimated value between the variables measures this influence. An indirect effect between two variables can arise if one variable influences another variable through one or more latent variables according to the trajectory contained in the research model [7]. Apart from analyzing product marketing performance factors, the SEM method can also be used to analyze decision-making problems, some of which are analyzing factors that influence service satisfaction [8] , examining factors that influence retail presence [9], factors influencing word of mouth marketing [10] and analyzing factors that influence mobile banking usage [11].

METHOD

Conceptual Model

The research variables used in this research are the technology orientation variable (X1), the product innovation variable (X2), the competitive advantage variable (Y1), and the marketing performance variable (Y2). The technology orientation variable (X1) consists of indicators of using the latest technology, accelerating customer service, supporting innovation, and ease of operation [12]. The product innovation variable (X2) consists of discovery, development, duplication, and synthesis indicators [13]. The competitive advantage variable (Y1) consists of hands of Product Uniqueness, Product Quality, and Competitive Prices [14], and the marketing performance variable (Y2) consists of indicators of Financial Performance, Operational Performance, and Market-Based Performance [15]. The conceptual model in this research follows the model from previous research, namely the one in analyzing the factors that influence the marketing performance of batik products [16] , as in Figure 1.

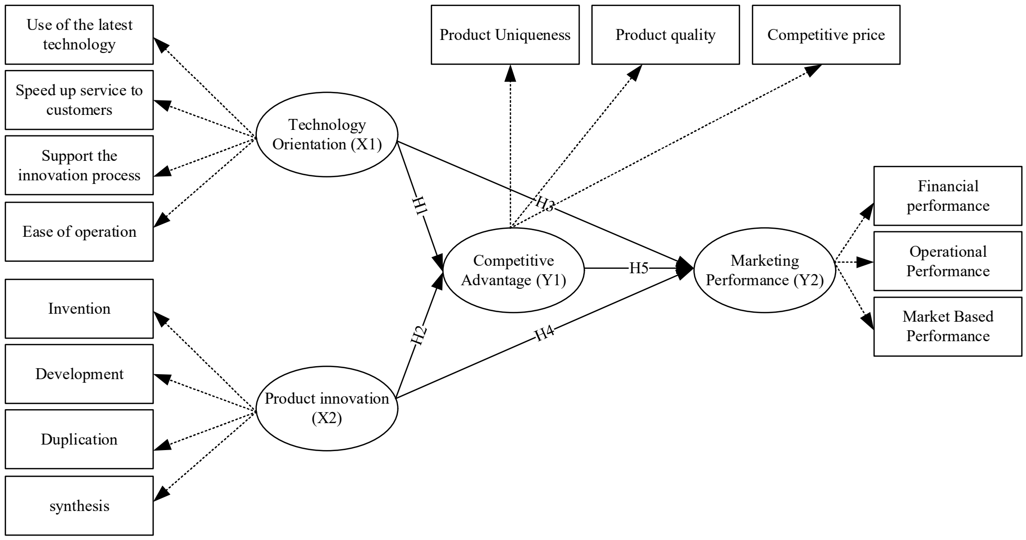

FIGURE 1. Conceptual Model

The question items contained in the research questionnaire explain the indicators of each research variable used. The data in this research is primary data obtained by distributing questionnaires to respondents, namely *Kre' Alang* weavers in Sumbawa Regency, using purposive sampling techniques. The population in this study are *Kre' Alang* weavers in Sumbawa Regency, whose population size is unknown. Therefore, the method used to determine the sample size is the Lemeshow method [17] . The minimum sample size required is 96 respondents, and the number of *Kre' Alang* weavers willing to fill out the questionnaire is 106. To determine the factors that significantly influence the product competitive advantage and marketing performance of *Kre' Tenun Alang* using the Structural Equation Modeling Method (SEM) and the Lisrel 8.8 software [18] .

Based on Figure 1, the influence of exogenous variables on endogenous variables is grouped into two types: direct impact and indirect influence [19]. Therefore, the research hypotheses can be structured as follows:

1. Direct impact
   - H1: Technology orientation factors have an immediate and significant effect on the competitive advantage of *Kre' Alang* woven products
   - H2: Product innovation factors have a direct and significant effect on the competitive advantage of *Kre' Alang* woven products
   - H3: The technology orientation factor has a direct and significant effect on the marketing performance of *Kre' Alang* woven products
   - H4: The product innovation factor has a direct and significant effect on the marketing performance of *Kre' Alang* woven products
   - H5: Competitive advantage factors have a direct and significant effect on the marketing performance of *Kre' Alang* woven products
2. Indirect influence
   - H6: The competitive advantage factor is a mediating factor that influences the significant relationship between technological orientation and marketing performance of *Kre' Alang* woven products
   - H7: Competitive advantage is a mediating factor that influences the significant relationship between product innovation and marketing performance of *Kre' Alang* woven products

The t value is to determine whether the influence of exogenous variables on endogenous variables is strong. If the t-value is > 1.96, then the relationship between the two variables has a significant impact [20] . The t value is obtained from the data processing output using Lisrel 8.8 software for direct influence. Meanwhile, for indirect effects from the Lisrel output, the t value can then be analyzed using Equation (1) [21] .

(1)

Where:

: Path coefficient to ; : Standard error of coefficient

: Path coefficient to ; : Standard error of coefficient

RESULT AND DISCUSSION

Testing the feasibility of structural model equations requires analysis of several model feasibility criteria, such as factor loading, chi-square (χ^2), degrees of freedom (df), p-value, and RMSEA [18]. Based on the analysis of questionnaire data using Lisrel software to test these items, the loading factor value for each variable with indicators is more than 0.5, which means the model is valid. The chi-square value is 87.11, which meets the criteria $0 \leq \chi^2 \leq 2df$, so it is considered "fit". The df value obtained is 55, which means it is greater than 0, so it is said to be "fit". The obtained p-value of 0.00107, less than 5%, is considered a "marginal fit". Meanwhile, the RMSEA value obtained was 0.074, less than 5%, regarded as "fit" [22] . Based on the analysis, the number of "fit" and "marginal fit" categories is greater than the "not fit" category, so the overall model is fit [18] .

The next stage is to analyze the influence of each exogenous variable on endogenous variables using the SEM method. The following are the results of structural equation analysis using Lisrel 8.8 software in Figure 2 and Table 1.

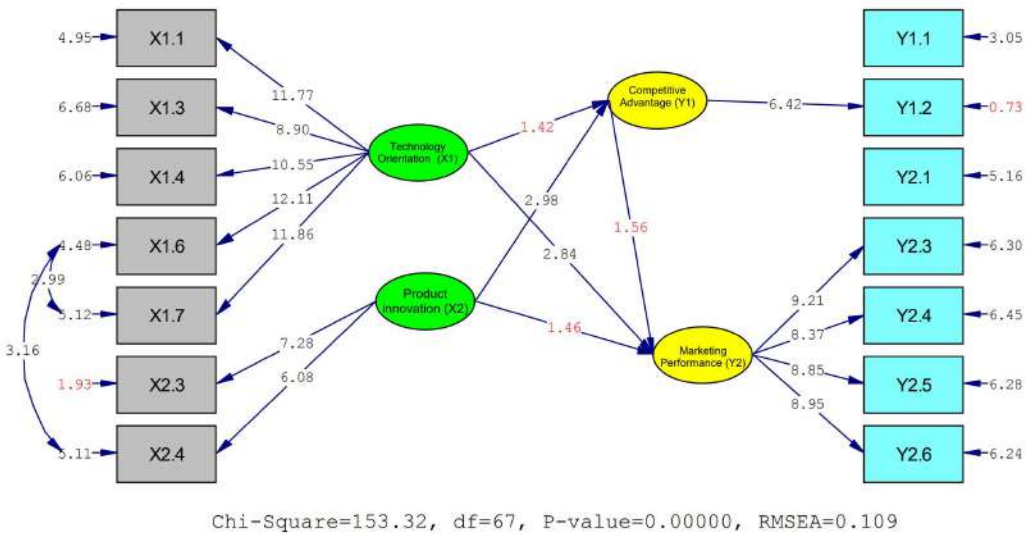

FIGURE 2. T-value

TABLE 1. Estimation Results of Direct Effects Between Variables

Structural Relationships	T- alue
Technology Orientation (X1) - Competitive Advantage (Y1)	1,42
Product innovation (X2) - Competitive Advantage (Y1)	2,98
Technology Orientation (X1) - Marketing Performance (Y2)	2,84
Product innovation (X2) - Marketing Performance (Y2)	1,46
Competitive Advantage (Y1) - Marketing Performance (Y2)	1,56

Based on Figure 2, Table 1, and the research hypothesis, it is possible to test the level of direct influence of exogenous variables on endogenous variables with the following analysis.

1. Technology orientation factors have an immediate and not significant effect on the competitive advantage of *Kre' Alang* woven products.
2. Product innovation factors have a direct and significant effect on the competitive advantage of *Kre' Alang* woven products.
3. The technology orientation factor has a direct and significant effect on the marketing performance of *Kre' Alang* woven products.
4. The product innovation factor has a direct and not significant effect on the marketing performance of *Kre' Alang* woven products
5. Competitive advantage factors have a direct and not significant effect on the marketing performance of *Kre' Alang* woven products

The indirect effect can be analyzed from the standard error coefficient value and the path coefficient value so that, using equation (1), the t-value can be determined. The t-value to assess the level of indirect influence through the competitive advantage factor (Y1) in this research is show in Table 2.

TABLE 2. T-value of Indirect Influence Through Competitive Advantage

Structural Relationships	ath Coefficient	Standard error	T-value
Technology Orientation (X1) - Competitive Advantage (Y1)	0,16	0,11	-
Product innovation (X2) - Competitive Advantage (Y1)	0,39	0,13	-
Technology Orientation (X1) - Marketing Performance (Y2)	0,31	0,11	1,41
Product innovation (X2) - Marketing Performance (Y2)	0,19	0,13	0,93
Competitive Advantage (Y1) - Marketing Performance (Y2)	0,18	0,18	-

The indirect influence of each technological orientation factor and product innovation factor on marketing performance through the *Kre' Alang* competitive advantage factor can be analyzed using Table 2 and research hypotheses. The results of the analysis are as follows:

1. The competitive advantage factor is a mediating factor that influences the insignificant relationship between technological orientation and marketing performance of *Kre' Alang* woven products.
2. Competitive advantage is a mediating factor that influences the insignificant relationship between product innovation and marketing performance of *Kre' Alang* woven products.

The indirect and total influence values can be analyzed using Figure 2 and Table 2. The results of the analysis are in Table 3. The total influence is the sum of the direct and indirect impacts.

TABLE 3. Results of Direct, Indirect, and Total Effects Analysis

Structural Relationships	Direct influence	Indirect influence	Total Influence
Technology Orientation (X1) - Competitive Advantage (Y1)	0,16	-	0,06
Product innovation (X2) - Competitive Advantage (Y1)	0,39	-	0,49
Technology Orientation (X1) - Marketing Performance (Y2)	0,31	0,34	0,65
Product innovation (X2) - Marketing Performance (Y2)	0,19	0,57	0,76
Competitive Advantage (Y1) - Marketing Performance (Y2)	0,18	-	0,21

Based on the data in Table 3, the indirect influence of the technology orientation variable (X1) on marketing performance (Y2) is more significant than the direct influence of these two variables. This shows that the technology orientation variable (X1) can more effectively improve marketing performance (Y2) with the mediating variable in the form of competitive advantage (Y1) between these two variables. Likewise, the indirect influence between the product innovation variable (X2) and marketing performance (Y2) is greater than the direct influence of these two variables. This shows that the product innovation variable (X2) can more effectively improve marketing performance (Y2) if there is a mediating variable in the form of competitive advantage (Y1) between these two variables.

CONCLUSION

Based on the analysis, the product innovation factor significantly affects the competitive advantage of *Kre' Alang* woven products, while the technology orientation factor has no significant impact. The technology orientation factor significantly affects the marketing performance of *Kre' Alang* woven products. In contrast, the product innovation and competitive advantage factors do not have any significant effect. In addition, if compared with the direct influence between technological orientation factors and product innovation factors on the marketing performance of *Kre' Alang* weaving products, the existence of a mediating variable in the form of product competitive advantage factors can have a significant influence in improving the marketing performance of *Kre' Alang* weaving products by paying attention technology orientation factors and product innovation factors.

ACKNOWLEDGMENT

The research team would like to thank the Ministry of Education and Culture for funding this research through the 2022/2023 novice lecturer's research scheme. In addition, the research team would like to thank the *Kre' Alang* weavers in Sameri Village, Sumbawa Regency, West Nusa Tenggara Province, who were willing to fill out this research questionnaire.

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Application of Factor Analysis Methods to the Development of System Performance Measurement Models in Company

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Abstract - PT Pelita Air Service (PT PAS) is an aviation company focused on aircraft rental services (air charter). As a subsidiary of PT Pertamina, PT PAS must follow the system used by PT Pertamina so that financial reports can be monitored in real-time. This research aims to look for factors that influence the measurement results of the implementation of the Enterprise Resource Planning (ERP) system and build an Information Technology (IT) performance measurement model. The IT measurement theory used is the IT Balanced Scorecard and the data analysis method is carried out using factor analysis. Indicator selection was carried out using a literature study of research and journals related to ERP implementation and IT performance measurement, then the data was processed using the Confirmatory Factor Analysis (CFA) concept. The result obtained is that there are new factors formed from a number of grouped variables which can be represented as variables a, b, c, d. The process using this factor analysis method can then be used as an indicator in determining IT performance and can be designated as a Key Performance Indicator (KPI) for IT measurement construction.

INTRODUCTION

PT Pelita Air Service (PT PAS) is an aviation company focused on aircraft rental services (air charter), founded on January 24, 1970. PT PAS is a subsidiary of PT Pertamina. The forerunner of this company is the aviation service PT. Pertamina plays a role as a supporter of air transportation provider activities. In its development, the role and benefits of subsidiaries (including joint venture companies) are required to be even greater. PT. Pertamina is not only required to increase the autonomy and independence of its business units but is also required to create a conducive climate for the development of the performance of its subsidiaries so that they have better performance and strong competitiveness, PT. PAS is authorized to accept projects from other companies with the permission of PT. Pertamina. The use of information technology at PT. applications created by companies, so several divisions use general applications (Microsoft Office) rather than homemade applications. PT. Pertamina as the parent company wants to produce real-time financial reports so PT.PAS must adapt to using an ERP system that is in line with its parent company.

Enterprise Resource Planning is a program used by companies to coordinate information in each business area to help manage the entire company [1]. Since March 2011 PT. PAS started using an Enterprise Resource Planning system, with a Human Resources Management (HR) module for payroll, a Financial Accounting (FI) module for budgeting and budgeting, an Asset Management (AM) module for managing the procurement of goods and services, a Materials Management module (MM) regulates aircraft spare parts, Use of ERP systems at PT. PAS initially only served as client hosting for servers, most of which were located at PT. Pertamina includes application development. However, as the use of the ERP system at PT.PAS progresses, it will be directed towards becoming an independent system. From this case, researchers will look for factors that influence ERP implementation and create a measuring tool for implementing the ERP system used by PT. PAS.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020014-1–020014-8; https://doi.org/10.1063/5.0241585
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

LITERATURE REVIEW

Performance Measurement

To guarantee that operations are accurately aligned with the firm's vision, performance measurement is conducted in the context of monitoring and analyzing all corporate resources. The information gathered from performance measurement may also be utilized by the organization to monitor planning and make necessary revisions to plans. The definition of performance measurement [2], is "periodically determining the operational effectiveness of an organization, its organizational units, and employees based on previously established targets, standards, and criteria."

It is possible to see user happiness from these performance metrics. Customer or user happiness may be measured and tracked using a variety of techniques. The next part illustrates this approach [3]:

1. Complaint and suggestion system: Any customer-focused business must give its clients convenient ways to voice their concerns, criticisms, ideas, and complaints.
2. Ghost Shopping: Hiring a number of people to pose as prospective customers for goods from internal or external companies is one technique to gauge consumer satisfaction.
3. Lost customer analysis: wherever possible an organization contacts customers who have stopped using their services and products or have changed manufacturers so that the organization understands why this happened.
4. Customer satisfaction surveys: most research on satisfaction uses survey methods [4]. Measuring consumer satisfaction through this method can use various methods such as:
    a. Directly reported satisfaction: measurement using specific items that ask directly about the level of satisfaction felt by customers.
    b. Derived satisfaction: this measurement uses several questions that are asked regarding two main things, such as the level of customer hope or expectations for the service or product, the second is the customer's perception of the service or product that they have experienced.
    c. Problem analysis: this measurement uses a way in which respondents express the problems they face related to the organization's products or services and suggestions for improvement.
    d. Importance-performance analysis: in this technique, respondents are asked to assess the importance.

Information system development is aimed at making it easier for users to carry out their work. However, several studies and several facts have found that several information systems have been successfully developed, but in the end, are not used by their users. Some of the systems that have been developed have been categorized as successful, and some have failed [5]. Before discussing the success of information systems, it is a good idea to know how an information system is said to have failed. Failure of an information system occurs due to several things, as stated in Laudon's article which states that failure information system because it fulfills one or more of the following three things [6]:

1. The information system does not perform as it should.
2. Not operating at a certain time
3. Cannot be used as desired.

Another research that discusses information system failures is research conducted by [7]. This research states that information system failures can be categorized into two, namely the information system fails to be distributed and the second category is that the new information system fails to be accepted by its users [8]. From the statements made by these authors, it is important to research the opinions of users regarding the information systems they use. This opinion can take the form of asking users about their experiences using an information system. Some questions that are often used are whether an information system is what it should be, operates according to the time, and can be used as desired by the user [9]. [10] describe four scales of ERP implementation success, in Table 1.

TABLE 1. ERP Implementation Success Scale

Category	Description
Class A	1. The management group operates the company using its ERP. 2. Accurate and comprehensive data. 3. Makes use of the most recent ERP software version
	4. The business receives all of the advantages of an ERP system. 5. The ERP system is not being effectively utilized by the management team.
Class B	1. Mostly accurate and comprehensive data.

Category	Description
	2. A few unofficial or fragmented systems.
	3. The ERP System provides several advantages to the business. 4. Using the ERP system's portal for sales orders and accounting.
Class C	1. Not benefiting from an ERP system's integrative advantages. 2. A system that is not in use by anyone 3. The management group operates the company using its ERP.
Class D	1. Accurate and comprehensive data and makes use of the most recent ERP software version 2. The business receives all of the advantages of an ERP system.

Source: ERP Implementation Success Scale [10].

Balanced Scorecard

From the four perspectives which are the result of modifications to the traditional Balanced Scorecard, an IT The four views that are stated in the IT Balanced Scorecard framework table are represented by the balanced scorecard framework, which was created [11].

"Balanced and scorecard in the initial experimental stage, the scorecard is defined as a score card, meaning it is a score card that will be used to plan scores that will be realized in the future" [12], are the two terms that make up the phrase "To assess executive performance in a balanced way across several dimensions—financial and non-financial, short- and long-term, internal and external—one must be balanced." [13]. There is more to the Balanced Scorecard than merely operational or tactical measurement. Scorecards are used by creative businesses as a strategic management tool to monitor long-term plans and create management procedures [14] like:

1. Make the plan and vision clear and understandable.
2. Explain and make connections between different strategic goals and actions.
3. Arrange, establish goals, and coordinate several strategic projects.
4. Expand strategic learning and feedback.

Companies can benefit from the Balanced Scorecard in the following ways, according to Kaplan and Norton [15]:

1. To accomplish both short- and long-term goals, the company's strategy and vision are integrated through the use of the Balanced Scorecard.
2. Managers may examine the company from both a financial and non-financial standpoint (customers, internal business processes, and learning and growth) with the use of the balanced scorecard.
3. Managers may evaluate their investments in creating systems, processes, and human resources to enhance future business performance with the use of the Balanced Scorecard.

IT Balanced Scorecard

[16] made the transition from a balanced scorecard to an IT Balanced Scorecard (IT BSC) as follows, Figure 1.

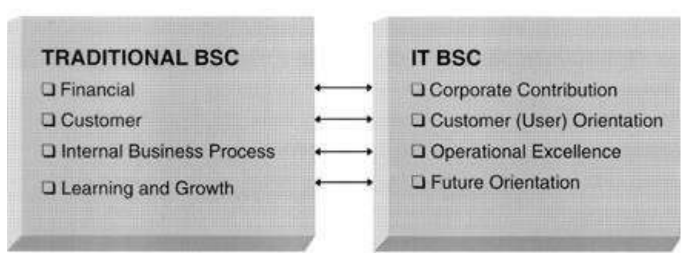

FIGURE 1. From *Balance ScoreCard* To *IT Balanced Scorecard*

From the four perspectives which are the result of modifications to the traditional Balanced Scorecard, an IT Balanced Scorecard framework was formed which represents the four perspectives [2] that can be described in the IT Balanced Scorecard framework Table 2.

From the four perspectives which are the result of modifications to the traditional Balanced Scorecard, an IT Balanced Scorecard framework was formed which represents the four perspectives that can be described in the IT Balanced Scorecard framework table.

1. *Corporate Contribution Perspective*
   The corporate contribution, also known as the organizational contribution perspective, assesses information technology performance from the perspectives of shareholders, directors, and top management. Information technology review may be divided into two phases: the short term, which takes the form of a financial assessment, and the long term, which is project-oriented and focuses on the functionality of the technology itself.
2. *User Orientation Perspective*
   The user orientation perspective assesses IT performance from the viewpoints of business users, or our customers, as well as customers of other business units that are currently in operation. From this vantage point, the company determines which market categories to join and which consumers to target. Organizations may match their target market segments and their customers with key customer metrics, such as happiness, loyalty, retention, acquisition, and profitability, by adopting this user orientation viewpoint.
3. *Operational excellence perspective*
   This viewpoint evaluates information technology performance from the standpoint of information technology management, as well as from the perspectives of individuals involved in audits and rule-makers. An organization's internal business operations, which are seen through an examination of the organization's operations and innovation, demonstrate its operational excellence.
4. *Future orientation perspective*
   This viewpoint evaluates IT performance from the standpoint of the department, taking into account implementation, current practitioners, and professionals. The organizational framework needed to enable the accomplishment of the objectives in the previous three views will be set up on this last viewpoint. From this point on, the business has to be ready to manufacture goods or provide services with adequate service capabilities in the future.

Factor Analysis

Common factors are fewer than the original variables. Unique factors are usually considered equal to the number of variables. [3] there are several uses of factor analysis, namely:

1. Extracting main variables from manifest or indicator variables. Or reducing variables into new variables with fewer numbers.
2. Make it easier to interpret analysis results, so that realistic and very useful information is obtained.
3. Grouping and mapping objects (mapping and clustering) based on the characteristics contained in the factors.
4. Checking the validity and reliability of research instruments.
5. Is the initial step (as input data) of various other data analysis methods.

Furthermore, factor analysis can be divided into 2 types based on its purpose, namely Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) [4].

1. Exploratory Factor Analysis aims to find or explore factors from existing measurement indicators. In this concept, researchers rely on the results of the analysis to form factors that are relevant to the research objectives.
2. Confirmatory Factor Analysis has a different approach. In this concept, researchers have tried to group indicators into more general factors, based on input from existing concepts and theories.

RESEARCH METHOD

This research uses the IT Balance Scorecard framework, which is a measurement concept through four perspectives, all of these perspectives are related to each other. In this research, we conducted research focusing on the operational excellence perspective which refers to infrastructure that can support the Future Orientation perspective to help employee performance. as a user of information technology tools in fulfilling and increasing the company's contribution / Business Value. This evaluation begins by aligning the company's vision, mission, and strategy [5]. After that, an IT Strategy map is prepared which is divided into 4 (four) perspectives from which strategic measures are then determined. In the IT Balance Scorecard framework, an operations excellence perspective is used, this is done to look at the infrastructure in implementing ERP at PT. PAS, Successful implementation of an ERP system is very possible because there is a clear IT performance measurement plan for the results of its implementation. Users, business processes, technology, and governance are all involved in the intricate shift of linked information systems and business processes that ERP deployment [6]. Changing conventional business processes to integrated business processes, not only requires technical mechanisms but also requires changing the user's mindset to understand the process changes. Likewise, changes in the infrastructure technology used greatly determine the success of ERP implementation [7].

RESULT AND DISCUSSION

Demographic of Respondents

The number of questionnaires returned corresponded to those distributed to respondents, namely 210 respondents who interacted with the company's information system. The questionnaire distributed contains data regarding introduction to the information system, length of work, gender, age, highest level of education, and length of time using the information system. From the demographics of the respondents, researchers can see that based on the introduction of information systems in the company, almost all respondents are familiar with it. Based on the length of work, it can be seen that respondents who have worked for 1 - 2 years dominate using application systems in the company.

Reliability Test

Statistics Subscription so that the Cronbach's Alpha value was known as follows, Table 2.

TABLE 2. Reliability Test Results

Cronbach's Alpha	N of Items
0.959	25

(Source: author's analysis results, 2022)

From the reliability test in the table above, it shows that the alpha coefficient for 25 variables has a value greater than 0.8, namely 0.959, meaning that the questionnaire questions used in this research are considered reliable.

TABLE 3. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.933
Bartlett's Test of Sphericity	Approx. Chi-Aquare	5063.350
	df	300
	Sig.	0.000

(Source: author's analysis results, 2022)

TABLE 4. Factor Extraction and Cumulative Values

Extraction	Cumulative Value (%)
3 factors	69,065
2 factors	62,952
1 factor	55,332

Based on the table, the first to third factors have a significance value below 0.5%, each with a value of 0.00, 0.168, or 0.458, so these factors are reliable to be included in the IS implementation evaluation model /IT. After carrying out the regression, the bottom value will be obtained for each factor to carry out the calculation model as follows:

$$\mathbf{Y = B0 + A_1X_1 + A_2X_2 + A_3X_3}$$

The values obtained from the regression results of these factors with the respondents' understanding are as follows:

B0 = 5.129
A1 = 0.373
A2 = 0.081
A3 = -0.044

From the model above, development of systems performance measurement model can be described as shown in the image below, Figure 2.

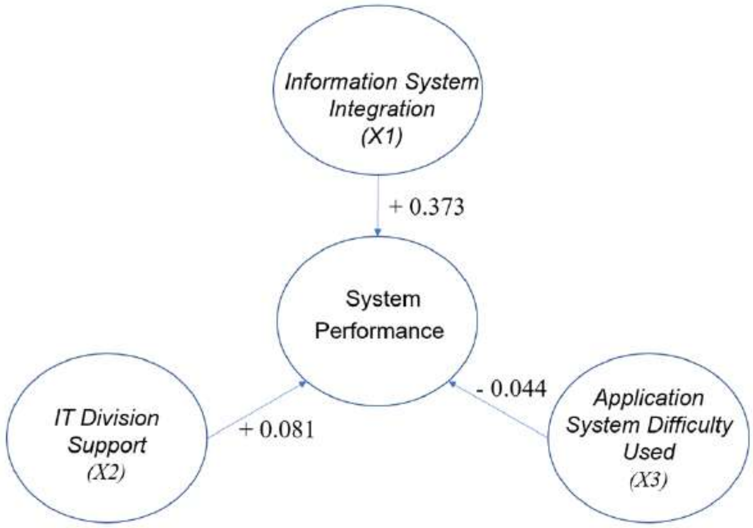

Figure 2. Value Factors used to development of systems performance measurement model (Source: author's analysis results, 2019)

Model of Development of Systems Performance Evaluation

From the factor score and model values above, it can be seen that the evaluation of development of systems performance on respondents' understanding, regression was carried out to get the minimum and maximum values, then the minimum value of factor $X_1 = -2.934$, factor $X_2 = -3.794$, factor $X_3 = -3.195$ and the maximum value of factor $X_1 = 2.633$, factor $X_2 = 1.853$, factor $X_3 = 2.139$.

With factor regression, the minimum and maximum value limits are obtained as follows:

$$\mathbf{Y = 5.129 + 0.373\, X_1 + 0.081\, X_2 - 0.044\, X_3}$$

With the constrains,

$$-2.934 \leq X_1 \leq 2.633$$
$$-3.794 \leq X_2 \leq 1.853$$
$$-3.195 \leq X_3 \leq 2.139$$

Managerial Implications

Based on the minimum and maximum values found for each, the following evaluation values will be obtained:

TABLE 5. Simulation of Model

	Y	B_0	X_1	X_2	X_3
Current	5.129	5.129	0	0	0
Minumum	3.867	5.129	-2.934	-3.794	-3.195
Maximum	6.167	5.129	2.633	1.853	2.139
Un-expected	3.632	5.129	-2.934	-3.794	2.139
Expected	6.402	5.129	2.633	1.853	-3.195

(Source: author's analysis results, 2022)

This research is one approach to measuring system performance, in this case, ERP implementation. Some suggestions that would like to convey are as follows.

1. PT. PAS should be able to manage the ERP system as a whole starting from infrastructure, manufacturing, training to licensing so that PT. PAS can determine which needs are suitable to increase productivity to support the business.
2. Performance measurement is an ongoing process and may continue to change. For this reason, companies need to evaluate existing measurement models and develop them if necessary.

3. From the results of the research conducted, KPIs and assessments can be used to measure performance that can be applied to companies.

CONCLUSION

From all the explanations carried out in the previous chapter, it can be concluded that: The research uses the IT Balanced Scorecard framework to measure the performance of ERP implementation, measurements based on strategy maps and factors that influence ERP system measurement results, to find factors that influence ERP system measurement results, indicators are needed, these indicators are obtained through literature study of research and journals related to ERP implementation, these indicators were determined using a questionnaire filled out by 100 employees who used ERP, from the results of the questionnaire and analysis was carried out using the Confirmatory Factor Analysis (CFA) method.

It can be concluded that human resources, implementation processes, and information technology infrastructure have a significant impact on ERP implementation. The weight of each KPI is determined by the relationship value between the indicator and factors that influence the ERP system measurement results so that the KPI can be said to be a valid measurement model to use.

Next is the readiness of PT's infrastructure. PAS in implementing the ERP system is as follows, PT information technology services. PAS can meet infrastructure needs in implementing the ERP system because PT. PAS correctly, quickly and accurately in carrying out all work, the company must maintain the performance of information technology services to support the business system run by the company. Based on the existing infrastructure configuration, it is possible to use the ERP system correctly. Traffic capacity capabilities are less suitable if connected outside the company, but internal traffic capacity capabilities are in accordance with needs. Data storage needs to be added to implement the ERP system because the previous data storage still contains data from applications that have been used.

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Customer Satisfaction in Using The Quick Response Code Indonesian Standard (QRIS) on The Menu List

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Abstract. A coffee shop is a place of business that offers a variety of beverages, including coffee, as well as snacks or pastries for customers to enjoy. In addition to providing coffee and beverage products, coffee shops usually offer facilities such as Wi-Fi access, power plugs, and comfortable seating. Customers at Coffee Toffee take a long time to order drinks and meals since they must wait in line as the server enters their order before it is delivered. As a result of no numbers at each table, servers are also extremely perplexed about where clients are seated. The ordering information system on the menu uses web-based Customers to easily order menus at each table utilizing the QR code system by scanning it with their smartphone's camera or scanner. This research aims to evaluate the Barcode System Menu List implementation in Coffee Toffee to satisfy customers. A Quantitative method was used, and data were analyzed using statistical analysis t-test, F-test, and linear regression to test hypotheses. The result is the QRIS Payment Variable has a significant positive influence on Customer Satisfaction.

INTRODUCTION

Today's technological developments demand the advancement of better information systems. In today's era, people want something instant, with the presence of coffee shops considered the most suitable for the lifestyle of urban people today. A coffee shop is a place visited with the aim of gathering and relaxing with friends. Coffee Toffee is one of the recommendations for a good and comfortable coffee shop to visit. Coffee Toffee shop consists of three employees, namely two waiters and one cashier. The menu ordering system at Coffee Toffee already uses a website-based cashier system. But sometimes customers have to wait in line for a long time, and the cashier will input the order by giving a number on each order, then the waiters will look for the order number at each table. At one time, Coffee Toffee arrived, and many customers and waiters were confused about delivering orders because they had to search and shout to mention the customer's order number. Due to the unstructured and systematic ordering system, a menu ordering system is created using a different QR code at each table. This QR code was created by Denso Wave in 1994 with the intention of speedily transmitting information and eliciting a reaction. Previous research, "Design of a Food Ordering System with a Web-based QR-Code," explained a system that is able to facilitate the online ordering process and is able to help related parties in promotions, especially to customers [1]. Furthermore, "Restaurant Reservation Information System" explains an application that helps customers to make reservations, food orders, and payments anywhere and anytime by showing proof of reservation, namely proof of QR code [2].

In this increasingly advanced digital era, electronic payments are growing and increasingly popularly used. One of the latest innovations in electronic payments is the use of QRIS (Quick Response Code Indonesian Standard), which changes the way we pay instantly and easily. QRIS is a QR code-based electronic payment application that allows users to pay bills or make transactions easily using just a smartphone. In payment using QRIS, users only need to scan the QR code found at the merchant or place of payment and confirm the payment. The use of QRIS has several advantages, including the ease and speed of transactions that are very high, as well as better security because users do not need to provide sensitive information such as credit card numbers or Internet banking passwords. In

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 020015-1–020015-7; https://doi.org/10.1063/5.0241587

addition, QRIS can also be used for payments in various places, ranging from small stalls to large stores. However, as is the case with other new technologies, the use of QRIS also has certain risks and disadvantages that need to be considered. Therefore, there are advantages and disadvantages of using QRIS in electronic payments, as well as providing advice on the best way to use this application safely and wisely.

One of the advantages of using QRIS is the ease and very high transaction speed. Users only need to scan the QR code found at the merchant or place of payment and confirm the payment. This process is very fast and does not require a long time compared to other payment methods. In addition, QRIS can also be used for payments in various places, ranging from tiny stalls to large stores, so it is very flexible and practical to use in everyday life. However, the use of QRIS also has certain disadvantages and risks that need to be considered. The most considerable risk in using QRIS is the security risk. Despite the fact that QRIS does not request sensitive data from customers, such as credit card details or passwords for internet banking, users nonetheless risk losing money if the QR code is mishandled or stolen. In addition, there is also the risk of losing money if the user is not careful in scanning the QR code, such as scanning a fake QR code created by an irresponsible party. Therefore, it is very important for users to pay attention to the risks and weaknesses of using QRIS in electronic payments. Users should also ensure that they use this app wisely and in accordance with the security policies imposed by banks or other payment service providers.

LITERATURE REVIEW

Terminology

Some of the benefits of QRIS for sellers/merchants include:

1. Following the trend of digital cashless payments, potential sales expansion is due to payment alternatives other than cash.
2. One QR Code for all payments
3. Reduction of cash/petty cash management costs:
4. No need for change
5. Part of the sales money is directly deposited in the bank and can be viewed at any time.
6. The risk of cash being lost/stolen is reduced
7. Reducing the risk of loss due to receiving payments with counterfeit money
8. Transactions are recorded automatically, and transaction history can be viewed
9. Building a credit profile for banks, the opportunity to obtain working capital is greater
10. Ease of paying bills, fees, and non-cash purchases of goods without having to leave the store.

Meanwhile, the benefits of QRIS for buyers/consumers include the following:

1. Safe, all activities are licensed and directly supervised by Bank Indonesia
2. Easy to use.
3. No need to always carry cash, aka cashless.
4. There is no need to think about whether the merchant has the QRIS feature.

How to transact using QRIS?

For those who have never used QRIS, follow the following method:

1. Make sure the balance in mobile banking or e-money like Go Pay/OVO/Shopee pay is sufficient.
2. For example, using a balance in mobile banking for transactions at a coffee shop.
3. Also, make sure that the beverage outlet can transact using QRIS
4. After the bill shows the nominal to be paid, open the mobile banking application on the smartphone and click the pay option using QR.
5. Request a QR code from the drink outlet, and scan the code using your smartphone.
6. If so, first check the identity of the owner of the code in the mobile banking application. Is it appropriate?
7. If appropriate, enter the nominal bill to be paid, and complete the transaction.
8. Then, the balance will be deducted according to the nominal entered into the coffee shop account.

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7. If appropriate, enter the nominal bill to be paid, and complete the transaction.
8. Then, the balance will be deducted according to the nominal entered into the coffee shop account.

According to Choi and Mattila, "the use of technologies such as barcode systems in restaurants can improve ordering efficiency and provide a more interactive and modern experience for customers, which can improve overall customer satisfaction" [3]. Previous research conducted by Cheng and Tsai, the use of a barcode system can allow coffee shops to carry out more effective and measurable promotions, such as providing discounts or special promos through mobile applications integrated with the barcode system [4]. Kim and Hyun found that "the use of mobile applications integrated with in-restaurant barcode systems can provide a more interactive customer experience and facilitate the ordering process, which can ultimately increase customer satisfaction"[5]. The barcode system is used to speed up and facilitate the process of ordering food in restaurants. When customers order food, they can scan the barcode code on the menu list provided to see more detailed information about the food they ordered. The use of barcode systems in restaurants has shown the potential to increase customer satisfaction by improving order efficiency and accuracy.

A study published in the International Journal of Hospitality Management in 2018 showed that the use of barcode systems in restaurants could increase customer satisfaction by speeding up the ordering process and reducing errors in bookings. The study involved 320 respondents from fast-food restaurants in China. The results show that the use of barcode systems in food ordering can increase customer satisfaction by reducing the time it takes to order food, improving ordering accuracy, and increasing customer satisfaction. In addition, the use of barcode systems in restaurants can provide a more interactive and modern customer experience, which can also increase customer satisfaction. In a study published in the Journal of Retailing and Consumer Services in 2016, conducted in South Korea, it was shown that the use of barcode systems in restaurants could improve customer perception of service quality and provide a more modern and innovative customer experience.

Using barcode systems can improve customer satisfaction by improving efficiency, accuracy, and customer experience. This can help improve restaurant service quality and strengthen customer relationships. Thus, the second hypothesis of the relationship between the Barcode System Menu List with Customer Satisfaction has a significant effect. Relationship of QRIS Payment to Customer Satisfaction. The use of QRIS in electronic payments can contribute significantly to customer satisfaction. This is especially the case because the use of QRIS provides convenience, speed, and convenience in the payment process. In a business context, QRIS can help increase customer satisfaction because the use of QRIS can minimize the time needed for the payment process. Hence, customers no longer need to spend time waiting in line in long queues to pay bills. With QRIS, customers can pay their bills with just a few clicks on their smartphones.

In a study published in the Journal of Retailing and Consumer Services in 2020, Chen et al. concluded that "the use of QR code payments positively affects customer satisfaction and loyalty, with ease of use and transaction speed being major factors in influencing customer satisfaction [6]. In a study published in the International Journal of Information Management in 2020, conducted by Zou and Li, they found that the use of mobile payments, including QRIS, significantly affects customer satisfaction, with transaction speed and convenience being key factors in influencing customer satisfaction [7]. The study used data from a customer survey of 432 respondents who used mobile payments in payments in China. The results of the study show that the easier, faster, and more convenient the use of mobile payments, including QRIS, the higher the level of customer satisfaction. This shows that QRIS can be an effective tool to increase customer satisfaction in electronic payment transactions.

In addition, other studies have also shown that the use of QRIS can improve efficiency and reduce customer waiting time at checkout, which can also contribute to increased customer satisfaction. In addition, by making it easier for customers to make payment transactions, QRIS can also help improve customer experience and strengthen customer loyalty [8]. In a study published in the Journal of Hospitality and Tourism Technology in 2020, conducted in South Korea, it was shown that the use of QRIS in hotel payments can improve customer experience and strengthen customer loyalty. Overall, there is evidence that the use of QRIS in electronic payments can contribute to increased customer satisfaction by improving efficiency, speed, convenience, customer experience, and customer loyalty [9]. Therefore, the use of QRIS can be an effective strategy for businesses to increase customer satisfaction and strengthen relationships with customers. The first hypothesis of the relationship between QRIS payments to customer satisfaction has a significant effect.

RESEARCH METHOD

A survey or questionnaire is employed as the research method, and respondents are restaurant patrons who utilize the barcode and QRIS payment systems to order off menus. Furthermore, the data collected from respondents were analyzed using techniques test hypotheses. In addition, other data collection methods, such as observation and interviews with restaurant managers or customers, can also be used to obtain more detailed and in-depth information on research topics.

Researchers can design research instruments in the form of questionnaires, which include questions related to customer experience using the barcode and QRIS payment system menu lists and the level of customer satisfaction with the service. Researchers can collect data by distributing questionnaires to respondents who are restaurant customers.In addition, researchers can also conduct content analysis to extract common themes or patterns from customer responses and views related to the menu list of QRIS barcode and payment systems, as well as factors that affect customer satisfaction. In addition, researchers
can also provide recommendations or suggestions related to the development of a menu list of QRIS barcode and payment systems to increase customer satisfaction.

RESULTS AND DISCUSSIONS.

Validity Test

According to Ghozali, validity tests are used to measure the validity or absence of a questionnaire. A questionnaire is said to be valid if the questions on the questionnaire are able to reveal something to be measured [10].

If r counts > r table, then the statement item is valid.

If r counts < r table, then the statement item is invalid.

The distribution of questionnaires in validity and reliability tests was given to 50 respondents of the study. The value of the table r with the provision df = n – 2, which means 50 – 2 = 48, and the signification rate of 5% of the number obtained = 0.379.

TABLE 1. Validity Test Results

Variable	Indicator code	R Count	R Table	Information
Barcode	X1. 1	0.761	0.379	Valid
System	X1. 2	0.685	0.379	Valid
Menu	X1. 3	0.694	0.379	Valid
(X1)	X1.4	0.812	0.379	Valid
QRIS	X2. 1	0.715	0.379	Valid
Payment	X2. 2	0.767	0.379	Valid
(X2)	X2. 3	0.776	0.379	Valid
	Y.1	0.635	0.379	Valid
Customer	Y.2	0.843	0.379	Valid
Satisfacti	Y.3	0.763	0.379	Valid
on (Y)	Y.4	0.689	0.379	Valid
	Y.5	0.879	0.279	Valid

The table above shows that the 12 statement items given to 50 respondents have a calculated *r* greater than the table r of 0.379, which means that all the indicator items of the statement are declared valid.

Reliability Test

The results of the reliability test were declared reliable if Cronbach's Alpha value was greater than 0.60 [11].

TABLE 2. Research Instrument Reliability Test Result (Cronbach's Alpha)

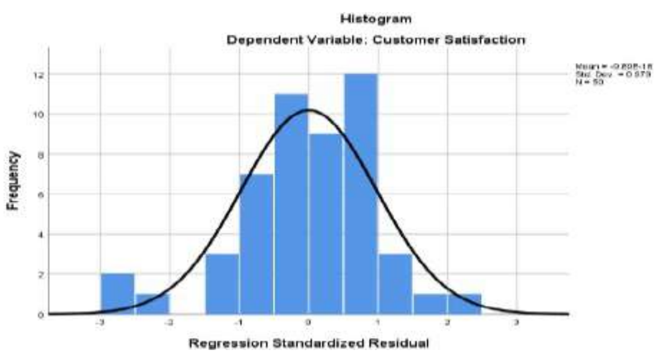
No	Research Variables	Cronbach's alpha (α)	Information
1	Barcode System Menu (X1)	0.723	Reliable
2	QRIS Payment (X2)	0.617	Reliable
3	Customer Satisfaction (Y)	0.809	Reliable

Source: results of data processing researchers, 2023

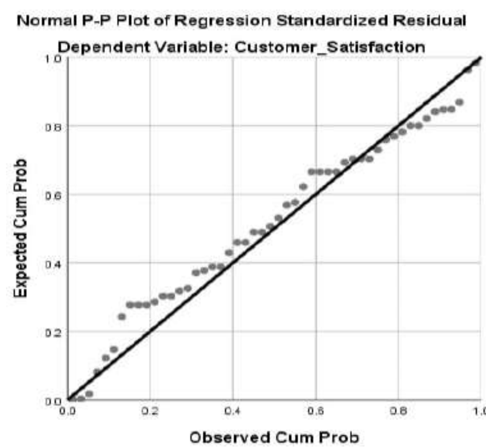
It can be concluded that this study is a reliable or acceptable questionnaire for the data used.

Normality Test

The residual regression is tested using normal testing. The P-P Plot chart was used for the testing. Data that spreads out into dots not far from the diagonal line is considered normal data, as shown in Figure 1:



Histogram Dependent Variable: Customer Satisfaction



Histogram Graph Image and Normal P-P Plot

FIGURE 1. Diagram of Normal Data

Given that the P-P Plots image on the right of the regression result already demonstrates the existence of a typical graph pattern, namely the distribution of points that are close to the diagonal line, the histogram graph in the left image demonstrates that the bell-shaped distribution of data does not deviate from the left or to the right of the line. As a result, it is claimed that the data is normally distributed.

Heteroskedasticity Test

The heteroskedasticity test tries to determine whether there is a variance difference between the residual of one observation and the residual of another observation in the regression model (See Figure 2)

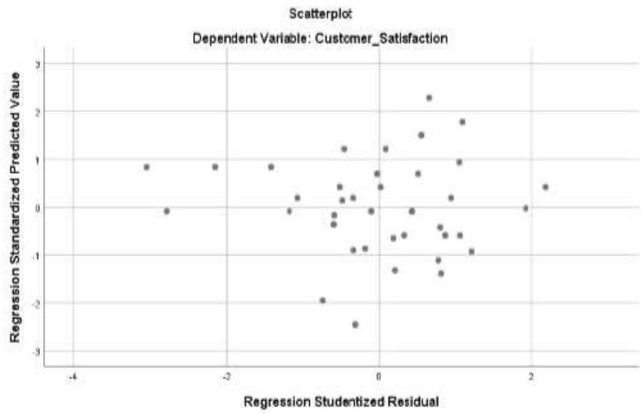


FIGURE 2. Scatterplot

The results of heteroskedasticity testing showed that there was no clear pattern of these points. This suggests that the regression model has no symptoms of the presence of heteroskedasticity, which means that there are no significant disturbances in this regression model.

Multiple Linear Regression Analysis

Multiple linear regression analysis is used to determine the magnitude of the influence of the Barcode and QRIS Payment System Menu List variables partially r simultaneously or together on Consumer Loyalty. The statistical calculations in multiple linear regression analysis are in full in the appendix and are further described in the following Table 3:

TABLE 3. Results of Multiple Linear Regression Analysis
Coefficients[a]

		Unstandardrized Coefficient		Standardrized Coefficients			Colinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	111.259	51.849		2.146	.037		
	Barcode_System_Menu_List	.260	.134	.265	1.938	.059	.668	1.498
	QRIS_Payment	.472	.143	.451	3.298	.002	.668	1.498

[a]Dependent Variable: Customer_Satisfication

These findings can be used to create the following regression equation model, which can be represented as a standardized regression equation:

$$Y = 111.259 + 0.265\ X1 + 0.451\ X2 + e \qquad (1)$$

These equations show that the QRIS Payment variable has a coefficient of 0.265 and that the Barcode System Menu List variable has a coefficient of 0.451, making it the most significant free variable.

Coefficient of Determination Test (R2)

The coefficient of determination test (Test R2) aims to measure the extent to which free variables can explain the variation of bound variables, both partially and simultaneously (See Table 4).

TABLE 4. T- Coefficient of Determination Test (R2)Test Results

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.642[a]	.412	.387	37.66342

a.Predictors: (Constant), Barcode_System_Menu_List_QRIS_Payment
b.Dependent Variable: Customer_Satisfication

As a result above, the value of R is 0.642, then the coefficient of determination (R *Square*) is 0.642 x 0.642 = 0.412. This means that the ability of free variables to explain the variants of their bound variables is 41.2%. This means that 58.8% (100% - 41.2%) bound variable variants are described by other factors.

CONCLUSION

The Barcode System Menu List variable has a positive influence on Customer Satisfaction. In contrast, the regression equation yielded a significant level for the Barcode System Menu List of 0.265 with a sig value of 0.059. This result shows that Coffee Toffee has a Barcode System Menu List that makes Customers Satisfied. The QRIS Payment Variable has a significant positive influence on Customer Satisfaction, where QRIS Payments have a significant level obtained from the regression equation of 0.451 with a sig value of 0.002. This means that the QRIS Payment applied by Coffee Toffee with consumers is good enough to satisfy consumers.

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The Meaning of Nakal (*Naughty*) in its Collocations with Male and Female in Indonesian: A Corpus-Based Study

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Abstract. The purpose of this study is to find similarities & differences in the meaning of the word *nakal* (naughty) when collocated with female and male. This corpus-based research applies a mixed method with a sequential explanatory strategy (Creswell & Creswell, 2018), where in the initial stage, quantitative data collection is carried out on the Indonesian corpus through the Leipzig Corpora Collection (LCC) and Sketch Engine applications. The statistical tests used are Log-likelihood for LCC and LogDice for Sketch Engine. Quantitative analysis was conducted to obtain the frequency of use of *nakal* and their collocation with male & female gender. Significant collocation analysis results were used as data in qualitative analysis. By using concordance features with KWIC -5 to +5, the context of *nakal* usage in each gender group will be obtained. This concordance data helps the process of determining semantic categorization. The semantic categories are determined based on the tagset in The UCREL semantic analysis system (USAS). After the categorization is done, similarities and differences in the meaning of *nakal* can be obtained. The results explain that *nakal* in adult male and female is metaphorical. The frequency of *nakal* that collocate with female is much more than with male. Whether side by side with females or males, nakal is associated with money and intimate/sexual relationships. Although both have negative connotations, *nakal* in female has a more negative connotation than in male. Society more often discusses *perempuan nakal* as behavior that is prohibited by religion or leads to sin, while *laki-laki nakal* as behavior that breaks the law or leads to arrest or imprisonment.

INTRODUCTION

In a society, a word can have a negative connotation, even though in other societies this is not the case. This happens because language is part of a culture (Thomas & Wareing, 2007). The implication is that in certain societies, a word that is considered taboo to say may not apply to other societies. For example, the word *anjing* (dog), in Western culture, is metaphorically interpreted as an animal that is loyal, loving, protective, and other positive characteristics. (Lakoff & Kövecses, 2012; Lakoff & Turner, 1989; Lakoff & Johnson, 2003), whereas in Eastern (Malay) culture, the word *anjing* is metaphorically interpreted as an animal that is dirty, filthy, unclean, and other negative characteristics. (Imran, 2011). This is the reason why dog can be a swear word in Eastern society that is not found in Western society.

An expression does carry its own connotation. This happens because the meaning of an expression is always based on people's feelings and thoughts (Herianah et al., 2022). Similar to the word *anjing* (in Western and Eastern cultures), the word *nakal* also seems to have different meanings when collocated with female and male. Through an initial search conducted by researchers on online news in Indonesia, there are differences in the meaning of *nakal* (naughty) in the news about men and women. Each has different nuances and connotations in the news. When we type the keywords "laki-laki nakal" on the *google.com* search site, we will get news about male delinquency. At the top of the search results, there is news in *https://suara.com* (Fundrika, 2021) entitled *Kenapa Banyak Perempuan Lebih Suka Lelaki Nakal?* (Why Do Women Prefer Bad Men?). In the news article, *nakal* is defined as free-spirited, likes challenges,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030001-1–030001-11; https://doi.org/10.1063/5.0241583
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

and provides a sense of security or protection. Then, when we type the keywords "wanita nakal", what we get in the top search results is a news article from *www.kliktimes.com* entitled *Ciri-Ciri Wanita Nakal, Malaikat Penggoda yang Bitchy* (Characteristics of Naughty Women, Bitchy Temptress Angels) . In the news, nakal is defined as bad, a scourge, and a center of desire. Through this meaning, there appears to be a difference between the word nakal in collocation with female (s) and with Male (s). When collocated with men, nakal is interpreted as an act that is still tolerated, even liked, but when collocated with women, nakal is interpreted as an act that is hated.

From the point of view of conceptual metaphor, the word *nakal* in the two phrases, *laki-laki nakal* and *perempuan nakal*, is a metaphor. This is in accordance with Dorst (2011) definition of metaphor, where the meaning is based on physical, perceptual, and cultural correlations in experience. Nakal in the two phrases is a form of metaphor because it is not interpreted literally, where literally, the word naughty is defined as disobeying, disturbing, and so on, especially for children.

In exploring the use of the word nakal that collocates with female(s) and male(s), corpus-based research is needed in order to obtain community language data in a whole context so that the results obtained are comprehensive. Through corpus linguistics, the frequency or popularity of the words *nakal* collocated with males and females can be presented, and the similarities and differences in the use of *nakal* with females and males can also be presented.

Against this background, this study will use a corpus-based approach to analyze the use of the word *nakal* in the context of its collocation with the gender group of male and female in an Indonesian language corpus representing various communication contexts. The results of this study are expected to provide a deeper insight into the use of the word nakal and the connotations attached to it in the Indonesian language, as well as how this reflects social norms and cultural aspects in Indonesian society.

THEORETICAL FRAMEWORK

Corpus Linguistics is widely used as a basis for research on words. One of the foundations of corpus-based research is that a word cannot be interpreted in isolation, but in association with words that accompany it in great frequency (T. McEnery & Hardie, 2011). For example, the word *diagnosis* is a word that often accompanies the words *doctor*, *patient*, and *disease* so we can interpret the word diagnosis as a word in the HEALTH domain. What is meant as a domain in this case is a cognitive entity, which is a mental experience, representational space, concept, or conceptual complex (Evans & Green, 2018; Langacker, 1989). Simply put, when the word *diagnosis* comes up in a conversation, it is likely to be about health.

In corpus linguistics, there are a number of features that are utilized in the analysis. These features include frequency, collocation, semantic preference, concordance, and many other aspects that play an important role in revealing the complexity of people's language use. Understanding these features is a key foundation for researchers to explore the meanings, patterns, and linguistic conventions present in a text corpus. All these features together help track, analyze, and explore the meaning contained in the language used by people in various communication contexts.

Frequency features help identify the extent to which words or word groups are used in the corpus. Frequency is the number of occurrences of a word or language unit in a corpora. Leech (2011) says that the only benefit of a corpora that cannot be provided in any other way is frequency. The frequency that corpora provide can be analyzed at different levels of language use (e.g., lexical, grammatical, and pragmatic) as well as with respect to single-occurrence or co-occurrence of words. (Ädel, 2015; Granger, 2012; A. McEnery et al., 2006; T. McEnery & Hardie, 2011).

Collocation is the relationship between words that occur together with other words (T. McEnery & Hardie, 2011), such as the word *diagnosis* with the words *doctor*, *patient*, and *disease*. If diagnosis is the central word, then doctor, patient, and disease are referred to as collocates. In this study, *nakal* is the central word so in the phrase *perempuan nakal* (naughty woman), the word *perempuan* is a collocate of the word *nakal* (if the frequency of the two words meeting is high). Collocations can be considered as part of culture or the reality of the universe realized through a set of lexical elements whose meanings are related.

Semantic preference is the relation between words that appear side by side in a meaning field (Lindquist, 2009). This means that semantic preference allows researchers to understand more about the word choices that humans use in various contexts. An example of this is the use of the word *diagnosis*. Because it often appears with the words *doctor*, *patient*, and *disease*, researchers, without looking at the context outside the language or who is expressing it, can tell that diagnosis is a term in the HEALTH domain. In addition, within the scope of corpus linguistics, there is the term semantic prosody. The basis of the existence of semantic prosody is the assumption that every word cannot be interpreted without the words that accompany it, meaning that we can interpret a word if we include other words that are beside the word. As stated by Yuliawati (Yuliawati, 2016), a word is very dependent on the words that accompany it. Therefore, the word *nakal* that is side by side with a male, does not necessarily mean the same when it is side by side with a female.

Concordance is a feature that provides concrete examples of how words are used in sentences. Through Evison (2010), we know that concordance is important because it allows us to see a large number of examples of word usage in their original context. Concordance in research will make it easier for researchers to see the tendency of the context of using naughty words when collocating with women and men.

The use of corpus linguistics in tracing differences in word usage can be seen from Phoocharoensil's research (2021). The study aimed to determine the differences between the words *persist* and *persevere*. The results indicated that *persist* tends to appear together with words or phrases that describe negative situations that continue, while *persevere* is used in contexts that reflect strong determination and great effort in completing difficult tasks. It can be seen that with corpus linguistics, even words with very close meanings can be traced.

The utilization of corpus linguistics to reveal the representation of women has been carried out by Karimullah (2020). By utilizing the political corpus on the Internet, this research identifies the ways in which women are represented. The exploration of representations of women and gender agency in the study revealed a mismatch between the messages of women's empowerment promoted by these outlets and the implicit discursive representations of gender and gender agency.

Besides being able to reveal gender representation in a domain such as the research above, the use of the corpus approach can also be used to reveal the comparison of females and males. Sarfo-Kantankah research (2021) examines Ghanaian parliamentary discourse around gender, male and female lemmas/lexemes/nouns, and the topics/themes that characterize them. This research shows that females are discursively constructed as a vulnerable and disadvantaged group, while males are constructed as having masculine characteristics, such as strength, authority, and competence in earning a living. Then, women's issues are constructed from a problem-solution perspective and men are positively constructed as great. In addition, this study also concluded that gender-sensitive parliaments can strengthen the position of gender-based interests.

Brun-Mercer (2021) research compared women (woman('s) & women('s)) and men (man('s) & men('s)) in 193 speech texts of the UN General Assembly General Debate in the fall of 2015. The study found that women appeared more than men, while man appeared more than woman. The results of this study indicate that these General Debate speeches do not conceptualize women and men equally, and more often refer to women as a group in need of protection and support, and men as political figures and respectable individuals.

Krendel's research (2020) investigates how the lemmas *woman*, *girl*, *man*, & *guy* are used to discursively represent and construct gender identity in an anti-feminist forum on the discussion site Reddit. The results of this study suggest that *women* and *girls* are dehumanized and sexually objectified, negatively judged for their morality and honesty, and constructed as desiring hostile behavior from male social actors. In contrast, *men* are constructed as victims of female social actors and external institutions, and as a result, are unhappy and insecure.

In language research using corpus processing tools, there are choices in determining the language data used. *First*, researchers collect the corpus data themselves, such as Brun-Mercer's research (2021) which uses 193 speech texts of the General Debate of the UN General Assembly. *Second*, researchers utilize corpora data that has been collected in corpus-based applications. For example, Yuliawati's research (2018) utilizes two corpora, namely *ind_mixed_2013* in the Leipzig Corpora Collection (LCC) application which provides 1.2 billion tokens of Indonesian language data and *IndonesianWaC* corpora in the Sketch Engine application which provides 89.8 million tokens of Indonesian language data. The huge number of tokens in the two corpora was sufficient for Yuliawati's (2018) research on the usage of the words Perempuan and Wanita so that she could conclude that Perempuan tends to be used in relation to their role in the public sphere, while Wanita tends to refer to their role in the domestic sphere. Similar to Yuliawati's (2018) research, this research also utilizes the Indonesian corpus provided in LCC and Sketch Engine.

METHOD

This research applies a mixed method with a sequential explanatory strategy (Creswell & Creswell, 2018), that is, in the initial stage, quantitative data collection is carried out on Indonesian corpus data named ind_mixed_2013 through the Leipzig Corpora Collection (LCC) application and IndonesianWaC through the Sketch Engine application. The statistical tests used are Log-likelihood for LCC and LogDice for Sketch Engine. These statistical tests are available in each application. Quantitative analysis was conducted to obtain the frequency of the word *nakal* as well as its collocation with female and male gender. Referring to Lee (2018), female and male gender in this study can be in the form of male pronouns (e.g. *pria, laki-laki, lelaki, cowok*), female pronouns (e.g. *wanita*, *perempuan*, *cewek*), including familial vocabulary for male (e.g. ayah, bapak, kakek, etc.) & female (e.g. ibu, bunda, nenek, etc.), and also gendered names (e.g. Ahmad, Eko, Dinda, Rani), and gender-marked vocabulary (e.g. aktor, aktris, etc.).

The results of significant collocation analysis are used as data for qualitative analysis. By using concordance feature with Keywords in Context -5 to +5, the set of *nakal* that collocates significantly with male & female will be obtained. The sets in the concordance analyzed to obtain semantic categories with the aim of obtaining similarities and differences in the use of *nakal*. The basis used for semantic categorization is The UCREL semantic analysis system (USAS). USAS is an application to perform semantic analysis automatically (Rayson et al., 2004), but in this study, USAS, with 21 major tagsets in it, was used as the basis in semantic categorization or word clustering. Miles & Huberman (2004) interactive model was used in this qualitative analysis. In addition, a theoretical perspective of Cognitive Semantics was used, particularly in the context of conceptual metaphors (Evans & Green, 2018; Kovecses, 2010; Lakoff & Turner, 1989).

RESULTS AND DISCUSSION

In order, this chapter will present the results and discussion on 1) the frequency of the word *nakal*, 2) Collocation of the word *nakal* with the gender groups female and male,, 3) similarities and differences in the meaning of *nakal* when collocated with female and male.

Frequency of the Word *Nakal*

Frequency in corpus linguistics is a means to capture the popularity of a word in a particular language. The most frequently used statistics in corpus linguistics are the frequency of occurrence and the frequency of co-occurrence of two or more linguistic variables (Gries, 2008). In this section, the frequency of the word *nakal* obtained through the *Search* feature for the ind_mixed_2013 corpus in the LCC application and through the *Word Sketch* feature for the IndonesianWaC corpus in the Sketch Engine application is presented.

Through ind_mixed_2013 which consists of 1,206,281,985 tokens, the word *nakal* appears 15,928 times or 13.02 times per one million words, while through IndonesianWaC which consists of 90,120,046 tokens, the word *nakal* appears 1,193 times or 13.23 times per one million words. In other words, the popularity of *nakal* in the two corpus data tends to be the same.

Collocation of *Nakal* with Female and Male

From the search results of the word naughty in both applications, significant collocates of the word *nakal* emerged. TABLE 1 shows the top 10 collocates of *nakal* in ind_mixed_2013 (left and right) and TABLE 2 shows the top 10 collocates (left and right) of *nakal* in IndonesianWaC. The data are shown in order of the largest score based on the Log-Likelihood statistical test for *ind_mixed_2013* and Logdice for *IndonesianWaC*. Prepositions, assignments, or conjunctions are not included in this list.

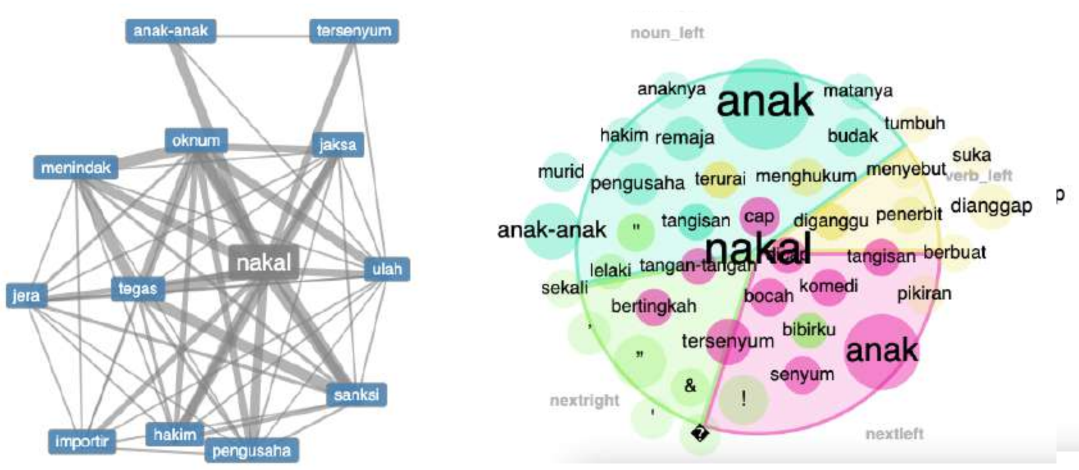
TABLE 1. The Top 10 Collocates of *nakal* in ind_mixed_2013

No	Left	Left (english)	score	kanan	Right (English)	score
1	anak	child	5297	Syahrini	Syahrini	101
2	jaksa	prosecutor	1590	oknum	individual	97
3	hakim	judge	1450	sekali	once	89
4	pengusaha	businessman	1441	Miley	Miley	73
5	tersenyum	smile	1379	Nadila Ernesta	Nadila Ernesta	62
6	anak-anak	children	1210	ditindak	actioned	61
7	importir	importer	1141	lagi	again	56
8	pedagang	traders	1039	padaku	on me	53
9	ulah	action	882	banget	really	49
10	berbuat	do	879	Nadila	Nadila	49

TABLE 2. The Top 10 Collocates of *Nakal* IndonesianWaC

No	Left	Left (English)	Score	Right	Right (English)	Score
1	cap	stamp	6.7	bibirku	my lips	6.6
2	bertingkah	acting up	6.6	lelaki	man	3.1
3	tangisan	tears	6.5	sekali	once	1.8
4	tersenyum	smile	6.3	hingga	until	1.1
5	komedi	comedy	6.3	itu	it	0.5
6	tangan-tangan	hands	6.2	seperti	like	0.5
7	dicap	stamped	6.1	saja	just	0.2
8	bocah	boy	5.9			
9	senyum	smile	5.6			
10	anak	child	5.4			

If we notice, the top collocates of nakal in TABLE 1 and TABLE 2 whose statistical scores are more significant are the left collocates. It can also be seen that the significant right collocates of the word nakal in the IndonesianWaC corpora are only 7, not up to 10. This is probably because *nakal* is an adjective. In Indonesian, word combinations tend to place adjectives on the far right In the top 10 collocates, neutral-gender pronouns dominate, such as *anak* (child)*, anak-anak* (children)*,* dan *bocah* (boy including professional terms, such as, yaitu *jaksa* (persecutor)*, hakim* (jugde)*, pengusaha* (businessman)*, importir* (importer)*, pedagang* (traders)*,* dan *oknum* (individuals). Referring to the theoretical framework of conceptual metaphor ((Kovecses, 2010; Krikmann, 1996; Lakoff & Turner, 1989; Lakoff & Johnson, 2003; Noviana & Saifudin, 2021), when collocated with neutral gender words that indicate children's age, the word *nakal* is in its literal meaning, while when collocated with neutral-gender words that indicate profession, *nakal* is in its metaphorical meaning. Literally, *nakal* is interpreted as wayward, disobedient, disturbing, and so on, while metaphorically, naughty is interpreted as a crime, abuse of authority, or can be said to violate the law. For example, the combination of the word *jaksa nakal* (naughty (rogue) prosecutor) means that there is a person with the job of a prosecutor who abuses authority or commits a violation of the law. When the keyword *jaksa nakal* was used in the *google.com* search tool, the top article was titled *Kejaksaan Agung Pastikan Tindak Tegas Jaksa Nakal: Banyak yang Dipidanakan* (*Attorney General's Office Ensures Firm Action Against Rogue (Naughty) Prosecutors: Many Criminalized*) (*news.detik.com*) and the second top article was titled *Masyarakat Jangan Takut Melaporkan Jaksa Nakal* (People Should Not Be Afraid to Report Rogue (Naughty) Prosecutors) (komisi-kejaksaan.go.id). This shows that nakal is literally associated with children, not adults. Visualization or word graph of nakal collocates on ind_mixed_2013 can be seen in FIGURE 1 (a) and on IndonesianWaC can be seen in FIGURE 1 (b).



(a) (b)

FIGURE 1 Visualization of Top Colocates of the word *Nakal* on ind_mixed_2013 and IndonesianWaC

In the top 10 collocates in the two corpora, there are several collocates that become data in this study, i.e. gendered-name (Syahrini, miley, Nadila Ernesta, Nadila) and male pronoun (lelaki). The presence of these words in the top 10 collocates in the two corpora indicates that popular *nakal* are used literally (in children) and metaphorically (in adults).

The results of the search for *nakal* collocates with female in the *ind_mixed_2013* and *IndonesianWaC* corpus can be seen in TABLE 3 and TABLE 4. In the tables, the collocates are displayed in order based on the highest to lowest significance score.

TABLE 3. Collocate the Word *Nakal* with Female in ind_mixed_2013

No	Left	Left (English)	Score	Right	Right (English)	Score
1	Wanita	Woman	512	Syahrini	Syahrini	101
2	Perempuan	Woman	330	Miley	Miley	73
3	caddy	caddy	116	Nadila Ernesta	Nadila Ernesta	61
4	cewek	girl	112	Nadila	Nadila	49
5	gadis	girl	87	gadis	girl	3.9
6	perempuan-perempuan	women	58			
7	wanita-wanita	women	49			
8	gadis-gadis	Girls	28			
9	cewek-cewek	girls-girls	24			
10	Devi	Devi	18			
11	Siswi	Schoolgirl	11			

TABLE 4. Collocate the Word *Nakal* with Female in IndonesianWaC

No	Left	Left (English)	Score	Right	Right (English)	Score
1	gadis	girl	3.4	-		-
2	wanita	woman	2.9			
3	perempuan	woman	2.6			
4	ibu	mother	0.6			

Through TABLE 3 and 4, it can be seen that the collocates of the word *nakal* in the female gender are in the form of 1) singular female pronouns (wanita, perempuan, cewek, and gadis) and plural female pronouns (perempuan-perempuan, wanita-wanita, dan cewek-cewek); 2) gender-marked vocabulary (caddy and siswi); 3) familial vocabulary (ibu); and 4) gendered names (Syahrini, Miley, Nadila, and Devi).

Furthermore, the results of the search for *nakal* collocations with male in the ind_mixed_2013 and IndonesianWaC corpus can be seen in TABLE 5 and TABLE 6. The collocates displayed in the tables are sorted by significance score from high to low.

TABLE 5. Collocate the Word *Nakal* with Male in ind_mixed_2013

No	Left	Left (English)	Score	Right	Right (English)	Score
1	Pria	man	128	Bieber	Bieber	39
2	lelaki	man	41	Justin	Justin	36
3	pria-pria	men	35	Rodgers	Rodgers	26
4	laki-laki	men	22	Anto	Anto	25
5	om	uncle	15	Pak	Sir./Mr.	19
6	cowok	guy	14	lelaki	man	6
7	Bob	Bob	13	Pria	man	4.9
8	Abang	Older Brother	11			
9	Suaminya	Her husband	9.7			
10	Said	Said	7.2			
11	Om	Uncle	5.9			

TABLE 6. Collocate the Word *Nakal* with Male in IndonesianWaC

No	Left	Left (English)	Score	Right	Right (English)	Score
1	kakek	Grandfather	4.7	lelaki	man	4

The collocates of *nakal* in the male gender group through TABLE 5 and 6 are in the form of 1) singular male pronouns, i.e. *pria, lelaki, laki-laki,* dan cowok and plural male pronouns, i.e. *pria-pria*; 2) familial vocabularies, i.e. *om*, *abang*, *suaminya*, *pak*, and *kakek*; 3) gendered-name, i.e. *Bob*, *Said*, *Bieber*, *Justin*, *Rodgers*, and *Anto*.

Based on the data, it is known that there are differences between the female and male gender groups that collocate with *nakal*. The female group is divided into 4 categories, i.e. pronouns, familial vocabularies, gender-marked vocabularies, and gendered-name, while the male group is divided into 3 categories, i.e. pronouns, familial vocabularies, and gendered-name. Although the difference is not much, it can be said that the *nakal* collocation is more widespread in females than males. In terms of number, there are more collocates in the female group than in the male group, i.e. 20 for female, and 19 for male. In addition, from the significance scores, the female group is clearly far above the male. In the top 5 collocates, for example, it can be seen that the words *wanita, perempuan, cewek, caddy,* dan *gadis,* have Log-likelihood significance scores of 512, 330, 116, 112, 87, respectively, while the words *pria, lelaki, pria-pria, laki-laki,* dan *om* have significance scores of 128, 41, 35, 22, and 15, respectively.

Melalui frekuensi tersebut, dapat dikatakan bahwa pada dewasa dan orang tua, nakal lebih identik pada jenis kelamin perempuan, sedangkan pada anak-anak atau remaja, nakal cenderung dilakukan oleh anak atau remaja laki-laki (see Ganta & Soetjiningsih, 2022; Izzah, 2022). Meskipun demikian, penyimpulan ini masih perlu ditelusuri lebih lanjut karena kata *perempuan* dan *laki-laki* tidak hanya digunakan pada dewasa atau orangtua, tetapi juga anak-anak dan remaja (see Yuliawati, 2018).

Similarities and Differences of nakal when Collocating with Female and Male

In an effort to get the similarities and differences in the meaning of the word *nakal* in its collocation with female and male, the researcher utilizes the concordance feature. With the concordance feature, the context of the use of the word *nakal* when collocated with each gender group will be obtained. Each *nakal* collocate, both in male and female groups, is analyzed based on the words that accompany it. The basis of this analysis is that a word cannot be interpreted in isolation, but in association with words that accompany it in a large frequency (T. McEnery & Hardie, 2011). What needs to be underlined is that the concordance data analyzed are males and females who act as subjects or perpetrators of delinquency, not objects or victims of delinquency. For example, when analyzing the concordance data *nakal + female*, the female is the subject or perpetrator of the delinquency, not the victim. In this analysis, the USAS tagset is used as a reference in determining the semantic categories before meaning. The number of USAS categories is 21, but there are many subcategories in each of these categories. TABLE 7 vides information about the categorization results on *nakal + female* dan *nakal + male.*

TABLE 7 Semantic Categorization

No	Collocations	Categories
1	nakal + female	Religion
		Clothes and personal belongings
		Judgement of appearance
		employment
		relationships: intimate/sexual
		knowledge
		groups and affiliations
		politeness
		body
		money
2	nakal + male	thoughts
		law
		sight
		touch
		speech acts
		money
		personality traits
		relationship: intimate/sexual

TABLE 7 shows that *nakal* when collocated with female has a meaning that is divided into 10 categories, i.e. 1) religion (in this category a naughty woman can be seen or judged by things that are not in accordance with religion or violate religious norms, such as being associated with maksiat, sin, aurat, and so on), 2) clothes and personal belongings (in this category a naughty woman can be shown through a revealing way of dressing), 3) Judgement of appearance (in this category naughty women can be seen from their general appearance, not only clothes, but also movements, dances, grooming, etc.), 4) employment (in this category a naughty woman is identified with a profession, or conversely a profession is identified with a naughty woman), 5) intimate/sexual relationships (in this category, naughty women are interpreted as behavior that leads or is oriented towards sexual relations), 6) knowledge (in this category, naughty women are caused by superficial knowledge about good and bad), 7) groups and affiliations (in this category, naughty women are a certain social group, equivalent to drunkards, street children, and so on), 8) modesty (in this category, naughty women are those who go against the value of modesty), 9) body (in this category, female delinquency can be identified from the shape of the body or the extent to which body parts are visible), and 10) money (naughty women can be identified with money, for example, needs, lifestyle, and so on). Some concordance data of *nakal + female* can be seen in TABLE 8.

TABLE 8. Concordance of *Nakal + Female*

... ada juga yang bilang **perempuan**	**nakal**	/ pelacur) yang bertobat , perempuan ...
... berpakaian serba hitam seperti **wanita**	**nakal**	dan murahan.
... kebagian peran sebagai **wanita**	**nakal**	memang kerap memamerkan aset seksinya ....
Ibu sudah basah ya Tanya Rendra	**nakal**	
Cecile sebagai **gadis** remaja yang	**nakal**	, naif, dan belum matang.

... there are also those who say	**naughty**	**women** / prostitutes) who repent, women ...
...dressed all in black like a	**naughty**	and slutty **woman**.
... part of the role as a	**naughty**	**woman** often shows off her sexy assets ....
You (Ibu) are is already wet (horny), ask Rendra	**naughty**	
Cecile as a	**naughty**	naive and immature teenage **girl**.

When collocated with male, the meaning of *nakal* falls into 10 categories. 1) thought (in this category, a naughty man does not only come from sensory behavior, but also from thought or imagination); 2) law (in this category, naughty in men is interpreted as behavior that violates the law, starting from body shaming of the opposite gender, to rape and molestation behavior), 3) sight (in this category, naughty in men can come from their eyesight, which is the gaze and blink at the opposite gender), 4) touch (through this category, naughty in men can be interpreted through the act of touching women's body parts), 5) speech acts (naughty men can be interpreted through the act of speaking to women), 6) money (through this category, naughty men are identified with money, the ability to pay, and so on related to wealth), 7) personality traits (naughty men can be interpreted as a character or personality trait, such as rebellious or childish), 8) relationships: intimate/sexual (naughty in men can be associated with sexual desire or passion). TABLE 9 displays some examples of the nakal + male concordance data analyzed.

TABLE 9. Concordance of *Nakal + Male*

... malah makin banyak **pria-pria**	**nakal**	yang **memperhatikan** Lidya.
... sebagai hidangan santapan mata-mata	**nakal**	para **lelaki**.
... kekesalan seorang wanita pada **lelaki**	**nakal**	yang **menggodanya**.
... disebabkan oleh **jari** sang **kakek**	**nakal**	.
nakalnya adalah nakal **biasa**, yakni	**nakal**	**laki-laki** pada umumnya.

... even more	**naughty**	**men** are paying attention to Lidya.
as a meal for the	**naughty**	eyes of **men**.
... a woman's frustration with a	**naughty**	**man** who flirts with her.
... caused by the grandfather's	**naughty**	fingers.
His naughty is ordinary naughty, that is	**naughty**	**men** in general.

Whether in conjunction with female or male, the word *nakal* is interpreted as negative behavior and contrary to the norms prevailing in society. Nonmetaphorically (in children), *nakal* is the behavior of disobeying (to the orders or words of parents) and disturbing (peers), while metaphorically (both in its collocation with female and male), *nakal* is the behavior of disobeying (to the teachings or norms that apply) and disturbing (the opposite gender).

In addition, whether side by side with females or males, nakal is associated with money and intimate/sexual relationships. In the environment of Perempuan Pekerja Seks (female sex workers) (PPS), money is a key element of commercial sexual relationships (Pujhana et al., 2022). The more money the PPS gets or the customer gives, the deeper the relationship will be. The emergence of the category *money* & *relationship: intimate/sexual* in both sex groups illustrates that both naughty women and naughty men boil down to money and sexual desire. In simple terms, society agrees that PPS and their customers can both be called *nakal*.

Behind the similarities related to money, there is actually a difference between *nakal + female* and *nakal + male*. In various concordance data, it is recorded that a naughty female is the one who needs/receives money, while a naughty male is the one who gives/pays money. This gives an indication that the difference between *nakal + female* and *nakal + male* is in action. In TABLE 7, it is shown that *nakal* in male means more actions, both psychological, social, and linguistic, which are the categories of *thought, sight, touch,* and *speech acts*, which are not found in the *nakal + female* category. In other words, with the activities of thinking, seeing, touching, and speaking, males can be said to be naughty. In addition, a naughty woman can be judged only by her clothes and appearance. A woman whose clothes are tight or revealing, displaying certain body parts is a depiction of a naughty woman, but a man whose clothes are tight or revealing will not get the naughty man label.

The above may be the reason why the frequency or popularity of the collocation *nakal + male* is much smaller than *nakal + female* (TABLE 3-6). A further reason for such frequency is that *nakal* in male is also often replaced by the idioms *hidung belang* and *buaya darat*. The encounter between *hidung* (nose) and *belang* (striped) in the ind_mixed_2013 corpora has a significance score of 28.718 (Log-Likelihood) and in the IndonesianWaC corpora has a score of 10.8 (LogDice). In these two corpora, *belang* is the highest collocate of the word *hidung* and *hidung* is the highest collocate of *belang*. Likewise with the *buaya darat* idiom, although it does not place at the top when collocated, the meeting of *buaya + darat* (crocodile + land) has a high significance, that is 1,012 (Log-Likelihood) and 7.4 (LogDice).

In conceptual metaphor theory (Kovecses, 2010), the use of the idioms *hidung belang* and *buaya darat* to replace *nakal* aims to be concretization and euphemistic. Then, these pronouns do not apply to replace *nakal* in women. There are terms such as *pelacur* (prostitute), *lonte* (prostitute), *Pekerja Seks Komesrisal* (Commercial Sex Worker) (PSK), Wanita Tunasusila (Female Sex Worker) (WTS) and Perempuan Pekerja Seks (Female Sex Worker) (PPS), but these words refer to a specific job or profession, whereas *nakal* in women do not refer only to these professions.

Then, in TABLE 7, there is a *religious* category in *nakal + female* and a *law* category in *nakal + male.* Through concordance data, it is found that people more often discuss *naughty women* as behavior that is prohibited by religion or causes sin, while *naughty men* as behavior that violates the law or causes arrest or imprisonment. This may be the underlying reason that perpetrators of sexual harassment are dominated by men (Jannah, 2021). Wijaya (2008) said that Pancasila (the source of legal order in Indonesia) is a forum for implementing and practicing religious norms, including Islamic teachings, in social and state life. Therefore, because it is associated with religion, naughty in female are at a higher level than in male.

Furthermore, society assumes that *perempuan nakal* is a profession, while a *laki-laki nakal* is just a personality trait. Pelacur, lonte, and PSK (prostitutes and sex workers) (see Khumaerah, 2017; Subet & Daud, 2018) are occupations that are associated with the female gender, not the male. Moreover, *perempuan nakal* can be specifically associated with the designation of Wanita Tuna Susila (women who are sexually promiscuous) (WTS) or Perempuan Pekerja Seks (Female Sex Workers) (PPS) (see Indah & Kartasasmita, 2018; Pujhana et al., 2022; Rusyidi & Nurwati, 2019). The association of *nakal* as a *profession* in female and only as a *character trait* in male clearly shows that there is an imbalance. In this case, although both have negative meanings, the word nakal is interpreted more negatively when associated with female than male.

CONCLUSION

When collocated with both female and male genders, *nakal* is a behavior that is not good, breaks the rules, and disturbs the opposite gender. However, *nakal* has a specific difference in meaning when associated with female and male. *Nakal* in female is interpreted as a sin that is dealt with through a religious approach, while *nakal* in male is a violation of the law that is dealt with through imprisonment and or fines; female, without taking any action, can already be called *nakal*. People can judge a woman as *nakal* simply by her clothes and appearance. In fact, just by looking at clothes, people can already associate it with a job or profession, whereas men need more effort to be called nakal because men are called nakal from their thoughts, stares, winks, whistles, and touches, even their wealth). In other words, being *nakal* in male is a more active behavior than in female. These facts make the word *nakal* in female at a higher level than in male, which also means that *nakal* in female has a more negative connotation than in male.

ACKNOWLEDGMENTS

I am grateful to the Faculty of Teacher Training and Education, University of Jember, for permission and funding for publication.

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Women's Language Politeness in Buying and Selling Transactions in the Astambul Market: A Pragmatic Study

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Abstract.Language politeness affects the fluency of one's communication. The polite and respectful language will create good feelings between speakers and speech partners. This study will discuss the language politeness of women in buying and selling transactions. Talking about buying and selling relates to women buying and selling transactions, directly or indirectly. The language women use is different from the language spoken by men. The study results show that women's language politeness applies the politeness principle stated by Leech, namely applying tact maxim, applying generosity maxim, applying approbation maxim, applying modesty maxim, applying agreement maxim, and applying sympathy maxim.

INTRODUCTION

Language is a communication tool that is often used in interacting with others. Language is used to convey messages to others. There are two varieties of language, the spoken variety and the written variety. Language is a person's mirror. When a person communicates the language of his personal appointment. That is, with language one can know our personality [1].

Speaking well and politely is one way for someone to respect the interlocutor in communicating. Everyone needs to understand language politeness because humans are language creatures who always carry out oral and written communication [2]. Whether or not a person's speech can reflect the person's personality [3]. Language is a system. System of order. Obviously it is a system language ranging from sounds, phonemes, morgems, words, sentences [4] One important dimension in language is that Jesus uses language for many different purposes. Language usage also varies depending on the situation and contes [5].

The role of language is very important in society, language is used as a means to communicate with individuals with one another. Language is used as a communication tool that is influenced by two factors, namely social factors and siteal factors. Language use is influenced by social factors such as gender, education, age, and economic level. The siteal factors in question are, for example, who wants to speak in what language, to whom he speaks, when he speaks, about what things he wants to talk about, and also what purpose he talks about [6]

Humans use language to interact and socialize in the hope of harmony in society. However, the use of this language is not as easy as imagined. This happens because in communicating must pay attention to speech partners and speech situations so that the purpose of communication can be conveyed properly [7]. Language is used both formally and informally. It is formally used in government such as schools and offices. While the non-formal variety language is used in stalls and in the market, of course, what is used is the non-formal variety language.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030002-1–030002-8; https://doi.org/10.1063/5.0241610
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Scope of Pragmatics dan Politeness Principle

There are at least three scales measuring language politeness ratings that are still used as a reference basis for language unity research with a pragmatic linguistic framework. The three scales are politeness according to Geoffret N Leech, 2) Brown dan Levinsin, dan 3) [4].

Every country has its own identity, and language is an important part of that identity. Language has a close relationship with culture.[9] Each region is culturally different. As a result of different cultures, there are certainly different indicators of language politeness. The science that studies language politeness, namely pragmatics. This state is related to Pragmatics, which is the study of meaning [10]. Pragmatics is the study of how speech has meaning [11] pragmatics pragmatic is also the study of the use of language in communication, especially the relationship that occurs between sentences and context and the situation in which the sentence is used [12].

Therefore, in language, politeness is needed. Language politeness is closely related to social relations in society. Language politeness is a way of expressing ideas, ideas, the purpose of which is to provide compatibility in every speech. Through language manners, a trait can be seen in a person from his language system. [8]

Language impairment is basically closely related to social relations in society. Polite language is the most suitable tool that is often used in communicating. Polite language certainly pays attention to the rules that apply in society [13].

Talking about language politeness, of course, cannot be separated from the theory of language politeness. The theory of politeness of language among those advanced by Leech [11]. Overall, the principle of politeness proposed by Leech consists of six maxims that must be considered by speakers and speech partners, namely tact maxim, generosity maxim, approbation maxim, modesty maxim, Agreement maxim, and Sympathy maxim. Dozie and Otagburuagu [14] explain that civility emphasizes the ability of interactions to engage in conversation by observing acceptable social and cultural norms that facilitate barrier-free interaction. Thus, politeness is behavior that is expressed in a good or ethical way. Politeness is a cultural phenomenon, so what is considered polite by one culture can be seen as rude in the context of another culture. Every nation certainly has differences regarding the concept of politeness [15].

According [[16] Language users are influenced by social and situational factors. Language use influenced by social factors such as gender, education, age, and economic level. The situational factors in question are, for example, who speaks in what language, who to speak, when to speak [6].

Gender has an influence on human life, especially language. The concept of gender raises pros and cons both among society, academia, and government since then and even now [17]. (Lisna and Ansari stated that everyone has four language skills, namely reading, writing, listening, and speaking. In the field of language, gender is believed to be one of the factors in a person's language ability. This is in accordance with the opinion of Sunderland [18] which states that there is a relationship between gender and language skills. Women's language is certainly different from men's. Men and women have their own language characters. In terms of the amount produced, many experts say that women spend more words than men. [21].

Application of Language Politeness Maxims in Buying and Selling Transactions Based on Leech's Politeness Scale.

Politeness in Language: Speak women's language in buying and selling transactions in the Astambul market. The speech that shows the application of the principles of civility includes there is the application of the maxim of wisdom, the application of the maxim of approbation, the application of the maxim of agreement, the application of the maxim of generosity, the application of the maxim of appreciation, the application of the maxim of sympathy. The following is described the results of research in buying and selling transactions in Astambul Market whose speakers and speech partners are women.

The maxim of wisdom adheres to the principle of reducing profits on oneself and maximizing profits on others. The following includes remarks that apply the principle of maxim of wisdom in buying and selling transactions in Astambul market.

TABLE 1. Speech application of the maxim of wisdom

No.	Speech	Speech context
	Pembeli: Lima puluh ribu semua, ya Bu. *Fifty thousand all, yes ma'am.* Penjual : Baik tapi beli semua jualannya '*Good but buy all the sales*	Transactions between sellers and buyers in the vegetable market. seller
	Penjual :Harga pas Bu, nanti saya tambah ikannya saja' 'The price is right ma'am, I will just add the fish'	**.** Speech occurs when transactions occur in the fish market

Speech (1) delivered by a buyer to the seller. The seller offers the buyer the goods at a price of fifty thousand. When a buying and selling transaction occurs between the fruit seller and the buyer. Statement (1) It is clear that what the seller says by buying all the seller's merchandise has maximized the profit for the seller by buying all the seller's merchandise. The above speech includes polite speech by applying the maxim of wisdom.

Speech is delivered by a seller to buyers who bid the price offered. The seller stays with the price offered to the buyer. Speech (2) it is clear that there is a party that benefits, namely the buyer even though the price is fixed but the seller adds to the fish purchased by the buyer. Utterances spoken with great sincerity. The speech is really so that the buyer feels benefited. The speech spoken by the seller includes polite speech, namely by applying the maxim of wisdom that holds on to dealing with losses to oneself [8]

Maxim of Approbation

The maxim of simplicity or the maxim of generosity in this maxim prioritizes the interests of others. This maxim gives an advantage to others. The following utterances are

TABLE 2. Speech the application of the maxim of approbation

No.	Speech	Speech context
	Penjual : Tidak usah bayar kalau mau jualan di toko saya. No need to pay if you want to sell front in my shop'	The speech occurs when the fruit seller wants to pay to the merchant who owns the shop because he participates in trading in front of the store
	Penjual 1: Boleh ikut dagang di lapak dekat Ibu. You can participate in trading at the stall near Mother. Penjual 2 : Silakan tapi tidak luas tempatnya. 'Go ahead but not the area'	The speech occurred between two sellers

The speech in data (3) and (4) is very clear that in speaking one party always wants to give something to the other party. In both data, it is clear that the speaker is giving something to others. Data (3) the speaker does not want to accept the daily rent that will be paid by street vendors who trade in front of his shop. The speech was spoken by a female seller.

Speech in data (4) occurs When there are other sellers who want to participate in selling merchandise, speakers are willing to give a place willing to give a place. Of the two utterances, including polite, namely applying the maxim of generosity. By giving something free to others in need.

Application of The Maxim Of Angreement

In the maxim of appreciation emphasizes that people can be considered polite in society if in the practice of speaking always try to give appreciation to others. The following is the speech between sellers and buyers that occurred in the Astambul market.

TABLE 3. Speech the application of the maxim of agreement

No.	Speech	Speech context
4.	Penjual: Ibu coba belanja di toko saya banyak diskon. *Mom tried shopping at my store a lot of discounts.* Pembeli: Baik saya akan belanja di toko Ibu. *Well I will shop at Mom's store.*	Speech delivered by a buyer to the seller
5.	Pembeli :Anak saya tidak suka warna baju yang dibeli kemarin, boleh saya tukar dengan warna yang lain. *My son doesn't like the color of the clothes bought yesterday, can I exchange it with another color* Penjual: Boleh, silakan pilih warna yang lain saja. *Boleh, silakan pilih warna yang lain saja*	Speech is spoken by sellers and buyers when buyers want to exchange purchased clothes.

Data (4) and (5) include speech that applies the principle of politeness in language, namely the maxim of agreement. In data (4) the seller offers the goods to the buyer at a discount. Hearing the discount, the seller agreed to buy at the store. In data (5) the buyer stated that the clothes bought yesterday were not liked by his son, the buyer wanted to change the color. The seller expresses an agreement to choose the desired color of the shirt. Both data include polite speech because in both data there is an agreement between buying and selling.

Application of The Maxim of Simplicity

The maxim of humility or maxim of humility principle of speech participants is expected to be humble by reducing praise to oneself and maximizing praise to others [20] Someone is said to be rude in speech if they always praise themselves. The following speech is an application of the maxim of simplicity.

TABLE 4. Speech application of the maxim of generosity

No.	Speech	Speech context
6.	Penjual : Cocok sudah di badan bajunya. 'It fits already on the body of his clothes'. Pembeli: Iya pas sekali. *'Yes, just right'.*	Buyers praise the clothes to be purchased
7.	Pembeli : Warna coklat tu model hanyarkah, bagus sekali modelnya. '*Warna coklat tu model hanyarkah, bagus sekali modelnya'.*	Speech occurs when buyers see clothes in clothing stores.

The speech in data (6) occurs when the seller offers clothes to the buyer. Buyers praise the clothes to be purchased. Speech spoken by buyers includes polite speech by giving praise to others and reducing praise for yourself. The speech spoken is in accordance with the principle of politeness in language, namely the maxim of simplicity. Speech (7) also includes polite speech because it is speech that applies the maxim of simplicity, which is a maxim that maximizes the interlocutor and minimizes praise for oneself [8] . Remarks delivered by buyers by saying that the model of clothes sold by the seller of the model is good. The speech is very clearly praising the opponent.

Application of The Maxim Of Appreciation

This maxim is often also called the compatibility maxim. This maxim emphasizes that speech participants can build compatibility with each other in speech activities. If there is an agreement between the speaker and the speech partner, including polite speech. If in a speech there is an attitude of defiance, refutation or against being considered impolite speech. The following includes speech that includes the application of the maxim of consensus in buying and selling transactions.

TABLE 5. Speech the application of the maxim of appreciation

No.	Speech	Speech context
9.	Pembeli : Berapa harga ikan semuanya? '*How much does the fish all cost?* Penjual: Semuanya harga 100 ribu. *'All of them are priced at 100 thousand'* Pembeli: Boleh kurang, saya mau jual lagi ikan. ' *Can be less, I want to sell more fish'.* Penjual : Boleh asal dibeli semua. *'Original purchased all.*	Speech occurs in fish markets when sellers offer their wares.

The buyer and seller in the data speech 9 are in the process of agreeing on a price. The buyer asks the seller to reduce the price offered because the buyer is reasonable because he wants to resell. Based on speech data, 7 includes polite speech because it is in accordance with the maxim of consensus. The maxim of consensus is said to be polite if the speaker and speech partner carry out the agreement of both parties. So that both parties do not feel aggrieved and both agree on what is said. The following is also the application of the principle of politeness, namely the maxim of consensus.

Application of Sympathy Maxim

This maxim seeks to maximize mutual sympathy and slaing minimizes anti-certainty between the speaker and the speech partner. In Nadar [21] it is affirmed that this maxim of sympathy is manifested by assertive and expressive speech. In the maxim of sympathy, in principle, language politeness is expected so that speech participants always maximize sympathy between one party and another. [22].

TABLE 6. Speech the application of the maxim of sympathy.

No.	Speech	Speech context
10.	Pembeli A: Saya beli ikan tapi ternyata mahal sekali. *'I bought fish but it turned out to be very expensive.* Pembeli B : Mungkin itu memang rejeki ibu yang jualkan. *'Maybe it was indeed the fortune of the mother who sold'*	Buyer A complains that it is too expensive to buy fish but instead expresses the fortune of the seller's mother
11.	Pembeli : Mengapa Ibu belum pulang juga. *Why hasn't Mom come home yet.* Penjual : Dagangan saya masih belum habis. *My trade is still not out of stock.* Pembeli : Saya beli saja dagangan ibu biar cepat pulang. I just bought my mother's merchandise to go home quickly.	Buyers buy sellers' merchandise that has not sold yet

The speech in data 10 and 11 includes polite speech because in these utterances the partner speaks sympathy to others by suggesting that if it is indeed what is bought expensive, there is nothing because it is indeed fortune, other buyers sympathize not impathy for what buyer A malicious. Meanwhile, in data 11 also when the speaker sees the speech partner, That is, the seller of Belm went home also turned out that the sale had not been sold. As a form of sipati, buyers buy the merchandise offered

Characteristics of Women's Language Politeness in Buying and Selling Transactions at Astambul Market

Softer Word Choice

Women often use softer, more condescending words in communication to create atmosphere. Women in ordinary speech prioritize feelings, especially in traction buying and selling softer with greeting words to smooth the conversation. From some speeches based on data analysis, women tend to be softer with low intonation when sellers offer goods to buyers. Sellers tend to avoid language that is too dominant in transactions. So that buying and selling transactions can take place.

Use of Appreciation Expressions

The impression of Women's Language includes the use of expressions of appreciation. Awards can be used to reward speech partners. The use of appreciation expressions is used usually in accordance with the maxim of appreciation, which is a maxim that emphasizes appreciation with the opposite speaker. This maxim avoids ridiculing each other, cursing each other, and also demeaning each other. Acts of mutual ridicule include acts that do not respect others. The expression of appreciation is shown by in the sale and purchase transaction of receiving what is sold by the speaker.

Pay attention to Interpersonal Relationships

Women's language politeness often focuses on maintaining good interpersonal relationships. Women are more likely to press down with feelings, sometimes ignoring logic. In buying and selling transactions in the Astambul market, there are several sayings whose purpose is to maintain interpersonal relationships. When buyers buy goods that are actually not needed but because there is a bad feeling or pity that they are not bought then buyers, women sometimes buy without thinking about whether the goods purchased are needed or not. If male buyers are rarely like this, they think more about what the benefits of the goods to be bought are.

Using Nonverbal Language

In addition to verbal language, politeness in women's language is also seen in body language, facial expressions, and intonation. Women are more likely to maintain a well-mannered posture and use friendly facial expressions. In buying and selling transactions, this nonverbal language is indispensable for both sellers and buyers when transactions occur. Both sellers and buyers of facial expressions and intonation of speech are given great attention. With friendliness it may be the buyer who originally did not want to buy but When the seller offers with polite language, it may be an attraction for the buyer.

Factors Affecting Language Impression in Buying and Selling Transactions in Astambul Market

The factors that determine whether or not language use is determined by two things, namely linguistic factors and donuistic factors. In buying and selling transactions, this also applies. The linguistic factors in question are elements related to linguistic problems, such as word choice, stylistic use. While non-linguistic factors are topics of conversation and contests and communication situations.

a. Linguistic aspects

The use of diction.

The right choice of diction will affect whether or not a speech is polite. Polite speech, of course, the choice of words does not disturb others, does not harm others. What are the choices of words that support polite speech. a) The common use of the word is the word please when asking for help from others so that the person being asked for help does not feel ordered. b) Acknowledgments after the other person has performed the Action as desired by the speaker. c) Use the greeting words Mr. and Mrs. instead of calling names only, especially if the speaker is older. d) saying sorry if the speech spoken may harm others.

Use of language style

The use of language style is one of the factors that are polite in speaking. The style of language used in speech is a metaphorical language style whose purpose is to smooth the speech of language users. Majas personification is also one of the factors that make polite language. The content of speech delivered indirectly can be said to be polite speech using majas personification.

1. **Non-linguistic aspects**

Speakers not only involve language factors but also non-linguistic factors also determine language politeness. There are two non-linguistic factors that determine whether or not speech is polite.1) the topic of conversation. The topic of conversation often results in politeness and not a speech. Topics of conversation that do not offend or demean the speech partner will be polite speech. In buying and selling transactions, this is very important, if the topic discussed in this case what is sold is certainly smooth communication. 2) The context of the communication situation is all the circumstances that support the occurrence of communication. The context of the communication situation in question is the place, time, psychological condition of the speaker, environmental response to speech [1] In buying and selling transactions, things are very appropriate because the place of the market situation is certainly different from the situation at school. Speakers can certainly adjust to the conditions in which speech is made. The psychological condition of speakers and speech partners also determines language politeness. For example, the speaker's speech When offering sales has not sold well or no one has bid from the beginning, of course, the difference with trading that has many enthusiasts. If the seller of merchandise has not sold, of course, the way to offer and serve buyers is also different and the speech is more polite.

CONCLUSION

Language politeness in buying and selling transactions in the Tambbul market there are 6 maxims that determine santuna no language, tact maxim, applying generosity maxim, applying approbation maxim, applying modesty maxim, applying agreement maxim, and applying sympathy maxim. The six maxims applied in buying and selling transactions are supported by four characteristics of polite language 1) Softer word choices, 2) Use of appreciation expressions, 3) Pay attention to interpersonal relationships, and 4) Nonverbal language politeness. The application of the principle of politeness and the characteristics of language politeness must also be supported by other factors, namely physical and non-linguistic factors.

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Development of Creative Economic Industrial use Based on Regional Potential as a Local Economic Development Effort (Study of The Potential for Regional Potential-Based Creative Economic Development as Solo's Effort Towards the Unesco Creative City Network)

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Abstract
The creative industry sector is mushrooming in Indonesia, one of which is in the city of Surakarta. This research aims to describe how the development of creative industries is an effort to develop the local economy in the city of Surakarta. This research is descriptive qualitative in nature using literature review data collection techniques. The findings show that the development of this creative industry is able to increase regional economic development. The implications found are that it is hoped that the community, especially cultural actors and craftsmen, apart from industries that are used to develop the local economy, are also expected to develop product values while still paying attention to the aesthetic values that are characteristic of this craft, and for local communities, good communication is needed. good from the government. as well as more attention to providing facilities and infrastructure in making songko' recca so that it can run effectively and efficiently. Apart from that, work programs in related agencies are needed for the development of creative industries, especially in the fields of culture and crafts.

INTRODUCTION

Indonesia is the largest archipelagic country in the world consisting of 17,504 large and small islands. Indonesia is also known as a large nation, which has a diversity of ethnicities, cultures, religions and history [1]. Apart from that, Indonesia is also the fourth most populous country in the world after China, India and the United States [2]. The rich natural conditions and everything in them hold a lot of potential and opportunities to build a better Indonesia. Therefore, the importance of government policies regarding the potential of each region in reducing poverty and inequality in society. One effort to reduce this gap is through regional development programs [3].

To improve welfare, can be seen in Wong's (1998) economic development targets, which were initially oriented towards continued growth of the large-scale economy and are now a priority for future development. To increase economic growth and social welfare in Indonesia, the government has made policies, one of which is to advance the industrial sector. However, Buss (1999), apart from relying on the industrial sector as the source of the country's economy, the government also relies on creative human resources. The contribution of the creative economy to the national economy is increasing clearly.

The creative economy has been widely debated in the academic and public policy fields due to the increasing relevance of the creative sector in the economy and its relevance for development. However, the lack of data and indicators is one of the main obstacles to understanding the relevance of the creative economy as well as to the development of public policies that consolidate creative activities and contribute to development [4].

The development of the creative economy in Indonesia has become more massive since 2006. The development of the creative economy has become increasingly rapid and has attracted many job opportunities for the community.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030003-1–030003-8; https://doi.org/10.1063/5.0242796

In paying attention to the creative economy, the government formed the Ministry of Tourism, combining it with the creative economy sector in 2019 through Presidential Regulation no. 69 of 2019, became the Ministry of Tourism and Creative Economy. In terms of state income, the creative economy's contribution to state income is quite large, even though in recent years the world has been hit by the Covid 19 pandemic.

The contribution of the creative industry to State Revenue is stated to be three creative industry sectors with the largest contribution to GDP, namely the culinary subsector at 41.40 percent, fashion at 18.01 percent, and crafts at 15.40 percent. In the creative industries, these three sectors promise an export value of 19.9 billion US dollars or 13.7 percent of total national exports (www.kemenparekraf.go.id). The three export destination countries are the United States at 30 percent, Switzerland at 11 percent, and Japan at 7 percent. This proves that the launch and of course support from the government for the creative industry itself has had a very significant impact on the Indonesian economy at large.

Based on Government Regulation no. 24 of 2022, there are also a number of responsibilities and roles for regional governments in developing the creative economy in their regions. The main responsibility and role of local governments in the creative economy sector is to facilitate the development of a marketing system for creative economy products based on intellectual property. This facilitation can take the form of: (1) Technical guidance; (2) Integrated electronic business licensing and/or registration services; (3) Access and/or financing assistance; (4) Business information/consultation services; (5) Marketing promotion assistance; (6) Provision of a digital collective management system; (7) Marketing access; (8) Marketing incubation through designated institutions; (9) Assistance in calculating Intellectual Property assessments; and/or (10) Legal aid and assistance services.

The government also remains committed to directing its targets to improve the quality of human resources, creating a climate to encourage community initiative and self-reliance, especially to produce and market products to increase income and living standards. One of the ways being sought is local economic development in the creative industry sector. Creative industry is an economic activity that utilizes natural potential as raw materials to become finished materials, namely the folk craft industry, or household crafts which are able to provide employment or business opportunities in preserving and developing traditional works of art [5].

Seeing the creative economy in the city of Solo began to appear since the Solo City Tourism Office established the Creative Economy Development Sector in 2017. And in 2018, 16 sub-sectors took turns taking advantage of creative spaces that had never previously been visited by ordinary people. Creative creative actors themselves are usually start-up entrepreneurs who need assistance to develop their creativity. (www.investasi.surakarta.go.id).

Providing these facilities will certainly be very beneficial if carried out in an appropriate manner. Therefore, creative economic development design is very necessary. With a measurable creative economy development design, the Serang Regency Government can carry out activities in the context of facilitating the development of a marketing system for creative economy products on target. Currently, 17 creative economy subsectors have been established by the Ministry of Tourism and Creative Economy, as follows:

No.	Creative Economy Subsector	No.	Creative Economy Subsector
1.	Game Developer	10.	Photography
2.	Architecture	11.	Visual Communication Design
3.	Design Interior	12.	Television and Radio
4.	Music	13.	Kriya
5.	Art	14.	Advertising
6.	Product Design	15.	Performing Arts
7.	Fashion	16.	Publishing
8.	Kuliner	17.	Application
9.	Film, Animation and Video		

Regional specialization is very necessary for planning development policies and for formulating regional strategies. The large number of economic subsectors that can be developed shows that it is very necessary to study the potential for creative economic development based on regional potential in the hope of being able to map creative economic actors in the City of Surakarta, sothe Surakarta Government can maximize its responsibilities and roles in accordance with statutory regulations and useful in increasing economic growth, alleviating poverty and absorbing labor in the city of Surakarta.

METHOD

The method in this writing uses a literature study regarding the development of local creative industries in the city of Surakarta.

LITERATURE REVIEW

Creative Economy

Human creativity has become a driving force for economic development in the world. It is the process of generating ideas, expressions and forms. Without creative thinking and action, there will be no development. The result of creativity is innovation [6]. The heart of the creative economy is the creative industry (UNCTAD 2010). The development of the creative sector can mean new dimensions and sources of regional development that bring new forms of innovation, creativity, partnerships and networks. To develop a creative economy, it is necessary to know the region and support the key factors of the creative economy, therefore leadership and participation, awareness and education, infrastructure, investment and policy.

The main point of the creative economy is the human creativity produces ideas, the realization of which initiates production which is characterized by high added value and marked economic growth [7] . The Creative Economy has the potential to generate income and jobs through promoting social inclusion, cultural diversity and human development [8] . It includes economic, cultural and social aspects that interact with technology, intellectual property and tourism destinations.

Development of the Creative Economy Industry

The Republic of Indonesia is also aware to the creative economy which focuses on the process of producing goods/services by relying on expertise and creativity as intellectual property hopes that the Indonesian economy can compete in the global economy [9]. The creative industry develops in Indonesia, it shows that the Indonesian economy is able to innovate and compete with other countries. This condition also shows that the Indonesian economy is one step ahead. Global developments also affect the economy, so creativity is needed to answer global challenges. This is due to increasingly tight competition between economic actors [10] .

This creative industry is also believed to be able to answer basic short and medium term challenges. Such as the problem of low post-crisis economic growth, high poverty rates, high unemployment, and low industrial competitiveness in Indonesia [10] . From these problems, the creative industry is also expected to be able to answer challenges such as the issue of global warming, the use of renewable energy, deforestation and reducing carbon emissions, because the direction of the development of this creative industry is towards an environmentally friendly industrial pattern and the creation of added value for products and services originating from intellectuality. human resources possessed by the Indonesian nation [11] . The resulting creativity can open up needed jobs. Therefore, this industry must be developed as one of the pillars of the Indonesian economy. Therefore, assistance capital is needed by the government so this industry can continues to grow [12] .

The strength in encouraging economic growth and development of a region or city can be seen from economic level. That is productivity of creative humans and talented humans or humans who rely on their knowledge, abilities that exist within themselves [13] .

Local Economic Development

Local economic development is essentially a process by which local governments or community-based groups manage existing resources and enter into new employment arrangements with the private sector, or among themselves, to create new jobs and stimulate regional economic activity [14] . Local economic development is a process in which local governments and community organizations are involved to maintain, stimulate and encourage business activities to create jobs [15] . Furthermore, local economic development is also a process of formulating development institutions in the region, increasing human resource in creating better products, and fostering industry and business activities on a local scale [16] .

Modern economic growth theory states that investment in human resources is an important role in development. Quality human resources for developing countries is an important factor in catching up with other countries. In this era increasingly developing of technology and information, there is increasing evidence that good mastery of technology will have an impact on the quality and quantity of development itself [17].

The Role of the Creative Economy in Community Welfare

The Creative Nation project developed by the Australian government in 1994 heralded creative work as a key element for the country's economic development, it was also in efforts by the UK in 1997 to identify the most competitive sectors in the global economy that the concept of creative industries has spread to the whole world.

This has led to the proposition that we now live in a new phase of capitalism. It is generally acknowledged that this new phase of capitalism is characterized more by the logic of innovation in the regime of discovery than by the logic of reproduction in the previously hegemonic regime of repetition, and likewise culture and creativity are fundamental resources for generating economic value and differentiation in an increasingly globalized world. The creative industry plays a role in economic growth towards GDP. The creative development of industry requires educated consumers and an educated workforce, that is to say, people who have a high level of cultural and aesthetic values. Industry is developing where the environment is friendly, open and free. One could argue that the development of the creative sector brings with it freedom, equality between people, and the strengthening of cultural [18] .

The cultural and creative industries, which thrive in regions and regions, are in a strategic position to link creativity and innovation. They can help improve local economies, stimulate new activities, create new and sustainable jobs, have important spillover effects on other industries and increase the attractiveness of regions and cities. Therefore, creative industries are a catalyst for structural change in many industrial zones and rural areas with the potential to revive their economies and contribute to changes in the region's public image. The creative economy sector should be integrated into regional development strategies to ensure effective partnerships between civil society, business and public authorities at regional, national and European level (European Commission, 2010a). Without the direct involvement and participation of all these subjects, it is impossible to talk about sustainable and market-oriented development of the region [18].

Region-Based Creative Economy

The reason for being concerned with the economy at different territorial levels follows from the fact that cities and urban areas have always been places where human creativity flourishes. Here, not only did the world's great arts and fundamental advances in human thought originate, but also major technological breakthroughs that created new industries and even new models of production. Since cities have become large and complex enough to present urban management problems, they have also become urban laboratories, where they develop technological, organizational, legal and social solutions to their own growing problems [19] .

A new approach to the development of economic centers in the region leads to the formation of creative cities and creative clusters. Creative cities are urban complexes in which cultural activities of various kinds are an integral part of the functioning of the city's economic and social life, and include intellectual capital applied to products, processes and services[8] . In creative cities and creative clusters, the important elements are local and regional governments with management and policy approaches. Local and regional governments play a vital role as they are in a position to provide attractive places for creative professionals to live and work, as well as developing a supportive regulatory environment that encourages the industry's continued creativity [20] . Through participation from government at all levels, the social conditions, representation, labor market and jobs for creative people, along with the living environment and housing, facilities, clusters and incubators, in creative areas are developed and developed, including the potential impact of displacement social and economic [8].

RESULTS AND DISCUSSION

Layout and Geographical Conditions of the City of Surakarta

Astronomically, the city of Surakarta is located between 110˚45'15"-110˚45'35" East Longitude; 7˚36'-7˚56' South Latitude. The city of Surakarta, which is also known as the city of Solo, is a lowland located in the basin of the slopes of the Lawu Mountains and the Merapi Mountains with a height of around 92m above sea level. Meanwhile, the slope of land in Surakarta City ranges from 0-15%. The city of Surakarta is divided and flowed by 3 (three) large rivers, namely the Bengawan Solo river, Kali Jenes and Kali Pepe. In ancient times, the Bengawan Solo River was very famous for its beautiful panorama and traffic.

Regional Potential

1. Strategic areas from the point of view of economic aspects are integrated areas which include:

a. Jalan Jend Corridor. Gatot Subroto and parts of Jalan Dr. Rajiman (Coyudan) Kemlayan Village-Serengan District;
b. The planned corridor for the North Ring Road passes through Mojosongo Village, Jebres District, Nusukan Village, Kadipiro Village and Banyuanyar Village, Banjarasari District.
Efforts made to develop the strategic areas mentioned above are:
1) Development of infrastructure and facilities for trade, industry and services.
2) Development of regional commodity marketing outlets.
3) Development of formal and informal urban economic sectors in one development unit.
4) Development of industrial designated areas.

2. Strategic areas from the point of view of socio-cultural aspects are directed at the Kasunanan Palace, Mangkunegaran Palace and Sriwedari Park areas. Efforts made to develop the strategic areas mentioned above are:
   1) Increased coordination with other Regional Governments in improving road, bridge and public transportation infrastructure.
   2) Economic and social empowerment.
3. Strategic area of the city from the point of view of scientific interests in the Solo Techno Park area. Efforts made to develop the strategic areas mentioned above are:
   1) ncreased coordination with other regional governments in improving infrastructure towards strategic science areas.
   2) Economic and social empowerment of communities around productive areas.
   3) Limiting activities in the area without disturbing the area's function as a science facility.
4. Strategic area of the city from an environmental interest point of view, in the Taru Jurug Animal Area. Efforts made to develop the strategic areas mentioned above are:
   1) Limiting activities or events located in strategic areas of environmental function and carrying capacity.
   2) Strict regulations for activities that are permitted in certain areas.

TABLE 1. Spread Of Creative Industries in Surakarta

No	Classification	Subdistrict				
		Laweyan	Serengan	Jebres	Banjarsari	Pasar Kliwon
1	Architect	-	1	-	-	-
2	Design Interior	-	-	1	-	1
3	Visual Communication Design	1	-	3	1	-
4	Product Design	3	3	50	26	17
5	Films, Animations, Videos	-	-	-	1	-
6	Photography	-	3	7	5	7
7	Kriya	17	12	6	19	2
8	Culinary	1	5	1	7	-
9	Music	-	6	3	-	4

No	Classification	Subdistrict				
		Laweyan	Serengan	Jebres	Banjarsari	Pasar Kliwon
10	Fashion	36	7	3	10	2
11	Game Applications	-	-	-	1	-
12	Publishing	2	2	50	28	62
13	Advertising	1	50	9	1	9
14	TV, Radio	-	-	3	1	-
15	Performing Arts	15	3	12	15	8
16	Art	3	3	-	2	1
	TOTAL	**78**	**95**	**148**	**117**	**57**

Source: https://publikasiilmiah.ums.ac.id

Based on Table 1, it can be concluded that the Jebres District area, which consists of 11 sub-districts, is capable of having the most creative industries. Looking at the types of classification, it can be concluded that publishing plays a big role in the creative industry, followed by product design, advertising and fashion.

Batik is the Famous Craft in Surakarta, that should be able to play a key role in a creative industry, because Javanese culture is strong in the cultural customs, so that is should be able to boost the creative industry in the city of Surakarta. The growth of the creative industry should be able to grow rapidly in the city of Surakarta, which is the government's agenda for developing the national economy. MSME players or creative industry players must have competitiveness at both regional and national and international levels. Accelerating economic development, preparing facilities, restructuring MSME credit, labor-intensive programs, and providing regional tax concessions for MSMEs are the right solutions in times of uncertain conditions like these, especially to guide the creative industry to progress further amidst uncertainty (disruption).

Attraction of the City of Surakarta

The city of Surakarta has attractiveness in 4 (four) sectors as in Table 2

TABLE 2. Sector of The city of Surakarta

Types of Creative Industries	The product
Performing Arts	SIPA, IBMF, SOLO MENARI, BATIK SOLO, MICE, dll
Product Design	Mebel, keris, souvenir
Fashion	Batik di PGS, Klewer, Laweyan, Kauman
Culinary	Tengkleng, Timlo, Nasi Liwet, Serabi Notosuman

It can be said that the potential for developing investment based on the creative economy is currently in the era of adaptation when the pandemic conditions have not yet shown any clear changes, so investment development is directed at several factors, such as strengthening the creative industry that is already running in the city of Surakarta. The development of creative industries as an effort to develop the local economy in the City of Surakarta can be seen from:

1. Facilitate the community to increase the creativity of human resources.

The government provides facilities and infrastructure to support the growth of new workers which of course has a positive impact, namely reducing the unemployment rate. If there are adequate facilities, small entrepreneurs will also start their businesses in the creative industry sector, especially in the city of Surakarta. This finding is also in line with previous research which emphasizes the importance of local government support for small and medium businesses (Putra, 2015; Sedyastuti, 2018). It is recommended that regional governments need to be more committed to being ready to facilitate product marketing, facilitate access for business actors to banking, protect intellectual property rights, increase cooperation between provinces and districts/cities for the sustainability of required raw materials (Sidauruk, 2013). Regional governments can also strengthen personal, community and institutional and increase strategic partnerships to accelerate the growth of creative industries (Rochani, 2017).

2. Optimizing the use of technology for product marketing

In the economic field, condition of society using technology in various activities has changed today's market behavior, where before technological advances, when someone wanted to get the goods they needed, consumers had to go to the nearest shop or traditional market. This is also done by Surakarta MSMEs in marketing their products. He explained that marketing his products no longer experiences difficulties with increasingly modern technological developments, coupled with the Covid-19 conditions, marketing products via social media is very helpful. He further explained that the existence of technology is very helpful for business actors, especially creative economy product businesses where actors use social media to market their products such as WhatsApp, Instagram and YouTube.

Industrial products in the city of Surakarta are considered to be very supportive in advancing the creative economy. Apart from print media (newspapers) and electronic media (TV), social media (Blogs, Facebook and Tweeter) are also considered very helpful in promoting products or groups of creative economy actors (Isa, 2016; Nakara et al., 2012). the role of print and electronic media has a role in informing creative promotions.

3. Creativity and innovation in the form of training or coaching

Creativity and innovation also need to be possessed by every craftsman so that the products produced are competitive and have a uniqueness that makes them different from other products and can maintain their business with their characteristics. Therefore, to foster creativity and innovation, training and coaching are needed.

Training and coaching are very important to foster creativity and innovation among craftsmen. The training provided by MSME owners takes the form of providing material about product design and manufacturing practices with their characteristics, while coaching is carried out from the management side as stated (Gibb, 1997; Lans et al., 2008; McKenzie, 2021; Simpson et al., 2004) The creation of industrial actors can be increased through training, advocacy and coaching, as well as monitoring.

4. Relationship between Institutions

Regarding creative industry processing, it must also be supported by related actors, namely the government, where the community is the main actor in the target business and the government is the supporting actor for the business. Therefore, the relationships created must be interrelated between the actors involved. This is also explained in Dias Satria's research which states that relations between government and society must be created to support industrial creativity in increasing promotions to various regions, in addition to making local products that are known to the wider community (Mylonas & Petridou, 2018; Ruth Eikhof & Warhurst, 2013; Satria, 2011).

CONCLUSION

The development of creative industries in the city of Surakarta can work well in the presence of the craftsmen and actors concerned. Natural resources and technology are also sufficient for the development of crafts and culture in the city of Surakarta. Then there is the role of the government, in this case additional capital for the development of creative industries. The impact of this industrial development certainly increases local economic development, especially community income and local income, but there are still several inhibiting factors that must be considered so that songko' recca craft can survive while maintaining its characteristics.

The study also suggests several recommendations for stakeholders in research. For the community in particular, apart from the fact that this craft industry is also used to develop the local economy, it is hoped that in developing the creative industry we will still pay attention to the aesthetic values that are its characteristic. For local governments, good communication requires more attention by providing facilities and infrastructure in the process of developing Solo City as one of the creative cities in Indonesia so that it runs effectively and efficiently. Apart from that, it is also necessary to have work programs in related agencies regarding the development of creative industries, especially in the fields of culture and arts.

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Evaluative Acts in the Language of Kartini's Letter as a Representation of Ideological Conflict

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Abstract. Kartini was one of the pioneers of women's emancipation in Indonesia before independence. The collection of Kartini's letters was famous in Europe when Mr J. H. Abendanon published it in the Netherlands in 1911 with the title *Door Duisternis Tot Licht*. Sulastin Sutrisno translated the book with the title *Surat Kartini tentang dan untuk Bangsanya* in 1979. One of Kartini's friends who received this letter was Miss Zeehandelaar, a feminist figure in the Netherlands. There is a form of experiential evaluative act in a letter that expects, complains, criticizes, and influences. Kartini positions herself in the letter as the narrator's subject and the object being told in the form of her knowledge and thoughts about herself and her nation amidst the conditions at that time. The language acts in the letter show that there is a conflict between Kartini's views and traditional ideologies and colonial powers, such as emancipation, education, social society, nationalism, and literacy.

INTRODUCTION

Communication can be achieved by writing [1]. Language in writing can describe a writer's speech act in expressing something [2]. One form of written communication is letters [3]. Language acts have goals such as promising, requiring, etc. [4]. The author's written speech act conveys a message to readers [5],[6] and [7]. The message cannot be separated from the results of the author's knowledge, experience, and thought processes. Thus, the language used in the letter can show the author's speech acts with the specific aim of expressing his knowledge, attitudes, and thoughts about himself and the environment. There is a collection of letters that is interesting to research because it describes language acts with various purposes and shows the relationship between language, power, and ideology, namely Kartini's Letters.

Kartini was one of the pioneers of women's emancipation in Indonesia [8]. Kartini became known to the European public in 1911 through a collection of letters to her friends in the Netherlands. A collection of Kartini's letters entitled *Pintu Duisternis Tot Licht* describes Kartini's attitude towards what she saw, heard, and felt in her life [9]. Speech acts that describe Kartini's attitude can be seen in speech sentences written to criticize, complain, and so on. Expressive speech is an evaluative form of feudal and colonial ideology and power, which was contrary to knowledge and thinking at that time[10] Munfarida stated that Fairclough emphasized that written discourse is a medium for someone to process meaningful language. His discourse shows how to see, act, and think. This was directly related to the strength of the person.

Pragmatics is the study of interpreting language that involves linguistics and message conveyors, and receivers, and other contexts, Okeke in[11]. Through this research, we reveal Kartini's thoughts, which not only focus on the issue of women's emancipation in Indonesia. This theory uses pragmatic discourse with Sara Mills' critical-discourse approach. The reference source for this research is the primary data originating from the book entitled *Surat-Surat Kartini*, from the translation of Sulastin Sutrisno by Offset Harapan Printing-Bandung, based on the 4th printing of

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030004-1–030004-7; https://doi.org/10.1063/5.0241752

Door Duisternis Tot Licht, published by N.V. Electr Drunkkeru-Luctor Et Emergo S- Gravenhage and Ge Nabrink & ZN Amsterdam 5th printing edition.

Ideological Representation

Representation refers to images outside the text [12]. Meanwhile Rethina Velu & How [13] mention representations related to signs that can be explored by discursive structures because they reflect socio-cultural life that contains hope. Fairclough in ([14] Eriyanto and [15] Silaswati), states that representation is everything that is described in the text such as people and events.

Kartini, through her letters, provides images that express her knowledge and thoughts about family life, society, politics, social and culture. Some of these things have ideological conflicts with Kartini. [16] Arwanto states that ideology refers to the knowledge and ideas that exist at certain times . [17] Samsuri et.al stated that ideology is a way to express desires. [18] Erenözlü states that ideology can perpetuate groups that are considered dominant. Ultimately, the strongest group dominates the other groups. [14] Silaswati mentions Fairclough and Wodak, that this language lies between struggling social groups to propose ideologies. Larrain (1996) in Darma [19] and Sunarto [20] states that ideology is a view of the values of certain social groups to defend and advance their interests. A systematic analysis of Kartini's letter discourse related to research problems is as follows.

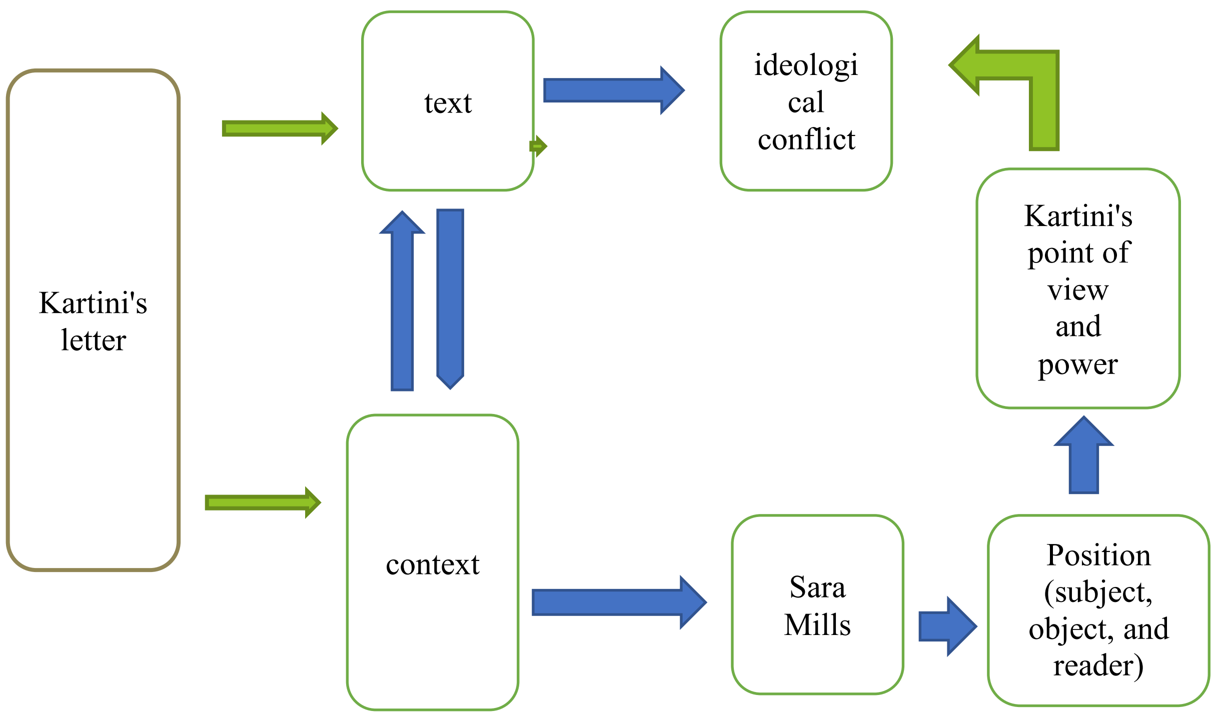

FIGURE 1. Systematic analysis of evaluative acts in the language of Kartini's letters as a representation of ideological conflict

Evaluative Acts In The Language Of Kartini's Letter

Details of Kartini's correspondence with Miss Zeehandelaar from 1899-1903

Kartini's correspondence friends, such as Estella. H. Zeehandelaar, Hendri Hubertus Van Kol, Abendanon and Rosa Manue Abendanon-Mandri, M.C.E. Ovink-Soer, Dr. N. Adriani, Prof. Dr. NO. Anton and Di Jena, and H.G. de Booij-Boissevain [21] .This research took only two letters addressed to Miss Zeehandelaar as representatives of other letters. Kartini's letters addressed to Miss Zeehandelar in the book *Surat-Surat Kartini (SSK)*, *Refleksi dan untuk Bangsanya*, lasted from 25 May 1899 to 25 April 1903. Thirteen letters were issued over the four years. For this research, the researcher took only two of Kartini's letters: early 1899 and late 1903. This was to determine the consistency of Kartini's actions and the representation of Kartini's views on the life of her nation throughout the correspondence activities. Kartini died on September 13, 1904. The following are details of Kartini's correspondence to Miss Zeehandelaar.

TABLE 1. Details of Kartini's correspondence with Miss Zeehandelaar from 1899-1903 in the book *Surat-Surat Kartini*, Translated by Sulastin Sustrisno [21]

No	Time	Page	Sheet
1	May 25, 1899	1-8	5 1/2 sheets
2	August 18, 1899	8-12	4 ½ sheets
3	November 6, 1899	13 -20	8 sheets
4	January 12, 1900	24-39	15 ½ sheets
5	23 August 1900	63-77	19 ½ sheets
6	January 9, 1901	87-89	2 ½ sheets
7	October 11, 1901	128-142	14 sheets
8	February 15, 1902	159-162	3 sheets
9	March 14, 1902	170-174	4 ½ sheets
10	May 17, 1902	195-204	9 sheets
11	August 15, 1902	236-238	2 ½ sheets
12	October 11, 1902	277-279	2 ½ sheets
13	April 25, 1903	320-323	4 sheets

Evaluative Acts in Kartini's Letter to Miss Zeehandelar

There are evaluative acts that reveal thought patterns, psychology, and feelings in Kartini's letter addressed to her friend, Miss Zeehandelar. This evaluative acts can be seen in the letter. The following is an explanation for this.

1. The evaluative act of expecting

This evaluative act is the expectation that something better will happen after the action has been taken. [4] Fisher et.al mentioned the act of expecting as a part of an evaluative act. An example of Kartini's evaluative act in the form of expecting can be seen in the representation of this letter which shows that Kartini through her letter has expressed her expectation for Miss Zeehandelaar. One of her expectations was that she wanted to change women's lives so that they could be independent, but in reality, the condition of women at that time was still shackled by custom. Meanwhile, a letter to Miss Zeehanderlar on May 25, 1899, described Kartini's expectations that her friends would never think that they had changed their ideals of advancing their nation through education at any time.

2. The evaluative act of complaining

A condition that causes discomfort will cause complaints to those who feel it [15]. Complaints are expressions of disappointing and unpleasant experiences [16]. The strategy for conveying emotional burden is manifested in the form of complaints.

These two letters indicate that Kartini used evaluative complaints. Kartini complained to her friend, Miss Zeehandelar about the influence of opium on the level of crime in society. Meanwhile, the second letter, Kartini, complained about customs that prevented Javanese women from learning foreign languages. This causes a lack of knowledge.

3. The evaluative act of criticizing

This action relates to suggestions aimed at evaluating a condition considered negative [17]. Criticism is given to disapproved acts or speech [18]. Criticism is the response to inconsistent situations. Criticism comprises messages that are broken down into criticisms that contain negative or positive responses.

Kartini's two letters illustrate two comparative criticisms. The first criticism is directed at Western habits that one side brings goodness, while the other brings negative aspects, such as the culture of drinking. Meanwhile, a quote from a letter dated April 25, 1903, uses an exclamation sentence marked with an exclamation mark on the word "patience!". Kartini criticized her previous attitude of not understanding the meaning of patience. At the same time, according to her, the reformer must be a patient.

4. The evaluative act of influencing

This speech act takes the form of a convincing reason for the truth supported by facts. [25] Purwanta et.al stated that influencing is an action with a strategy to convince people about the truth presented. [6] Stepchenkova says that this act of communication outlines information based on strong arguments.

Kartini submits arguments to propose, state and suggest something according to her knowledge and thoughts about the topic she is writing about. The purpose of this communication was for her friend Zeehandelaar to support or agree with what she said. The first letter is about the reason why Kartini likes books, namely, that books will provide information that will foster her enthusiasm for progress in life. In the next letter, Kartini suggested that her departure from the Netherlands would not be completely cancelled. There is one reason for this.

Kartini's Knowledge and Thoughts in the object of Kartini's letter to Miss Zeehandelaar

Based on Kartini's evaluative acts contained in her letters to Miss Zeehandelar, one can see the position of the subject, object, and reader, according to Sara Mills. This shows that Kartini's letters have the characteristics of feminist discourse. Based on the exploration of words, sentences, and mailing addresses, there is no representation of cornering, blaming, or degrading women to themselves or others. The following is a representation of Kartini's evaluative speech acts towards herself and her nation from the perspective of Sara Mills' critical discourse analysis.

TABLE 2. Representation of Kartini's evaluative speech acts towards herself and her nation from the perspective of Sara Mills' critical discourse analysis.

No	Evaluative Acts	Time	Subject	Object	Reader
1	Expecting	May 25, 1899	Kartini	Kartini's knowledge and thoughts about the impact of Emancipation	Miss Zeehandelaar
		April 25, 1903	Kartini	Kartini's knowledge about European education and living in the Dutch East Indies for education	Miss Zeehandelaar
2	Complaining	May 25, 1899	Kartini	Kartini's knowledge and thoughts about crimes that arise in society due to opium	Miss Zeehandelaar
		April 25, 1903	Kartini	Kartini's knowledge and thoughts because Prohibition of language learning by custom for women	Miss Zeehandelaar
3	Criticizing	May 25, 1899	Kartini	Kartini's knowledge and thoughts about the influence of the two sides of Western civilization on her nation	Miss Zeehandelaar
		April 25, 1903	Kartini	Kartini's knowledge and thoughts about the need for patience as a reformer	Miss Zeehandelaar

No	Evaluative Acts	Time	Subject	Object	Reader
4	Influencing	Mei 25, 1899	Kartini	Kartini's knowledge and thoughts about the influence of books on her life	Miss Zeehandelaar
		April 25, 1903	Kartini	Kartini's knowledge and thoughts for learning and teaching her people in the Dutch East Indies	Miss Zeehandelaar

Table 2 shows Kartini's position as the subject of the story. At the same time, she is also an object that is told about the knowledge and thoughts she has, both towards herself and others. Miss Zeehandelar read the letter.

Thus, Kartini's position in this discourse is the main subject. The letter written by Kartini using the self-greeting word 'I' proves this. The reader is Miss Zeehandelar and is visible on the far right side of the letter, which reads Jepara, May 25, 1899 (Miss E.H. Zeehandelaar) and 25 April 1903 (Miss E.H. Zeehandelaar).

The knowledge and thoughts that Kartini conveyed to Miss Zeehandelar at that time can be seen as the object of discourse in the letter. The object of the discourse has what meaning, who it conveys, and how it conveys it. What was conveyed included her thoughts on the influence of emancipation on her nation, the benefits of education in Europe and teaching in the Dutch East Indies to her nation, the evils of opium on her nation, and the influence of the prohibition on language learning for girls. Kartini conveys this knowledge and thoughts as a view using denotative and connotative diction. Miss Zeehandelaar read what Kartini said continuously until their last correspondence stopped.

Representation Of Ideological Conflict In Kartini's Letters

The evaluative speech act that Kartini used in her letter to Miss Zeehandelaar was one of the attitudes she showed to imply a conflict between Kartini's views based on her knowledge and thoughts (views) at that time and the power and ideology of feudal customs and the colonial government system. Kartini's knowledge, ideas and position were a source of power in the letter's discourse, the context of which is reflected in the following explanation.

1. Emancipation

There is a representation of Kartini's views on evaluative acts towards emancipation. Through the act of wishing, she wanted freedom and independence for a woman, whereas the traditions at that time were so strong that they could bind girls, such as the prohibition on leaving the house and the perceived violation of girls going to school.

2. Modern education

Furthermore, the complaint in the next letter expressed Kartini's view that getting an education to learn languages would enable children to gain knowledge. However, traditional powers and ideologies have prohibited this.

3. Social concern

Kartini expressed her social condition by complaining about her people suffering from opium. She believes that this would not happen if no one supported the buying and selling of opium. The power of the colonial government with its ideology has caused the circulation of opium on the island of Java to increase, bringing misery to the people.

Furthermore, Kartini views the influence of Western civilization. Criticizing the power and ideology of Western civilization has two sides: positive and negative for the nation. One of these is alcohol, which can bring evil into human life.

4. Nationalism

In the first letter, Kartini, through the power of knowledge, experience, and thought, realized that providing education to her people could start from the surrounding environment amidst ideology and the restrictive power of customs and the colonial government. The next letter shows that the attitude in her view was that she was elected as a reformer, not having to quickly study and live temporarily in the Netherlands to obtain the education she previously wanted.

Finally, the next letter shows Kartini's convincing actions in a view that shows the existence of nationalism because she wanted the Indies to progress like Europe did at that time. According to her, at that time, the Indies were far behind colonial rule.

5. Literacy

Through the act of influence, Kartini argued in her view that books brought enlightenment to her life amidst the power and ideology of tradition and the colonial period, which limited her space as a Javanese woman at that time.

CONCLUSION

The evaluative acts contained in Kartini's letter include the acts of expecting, complaining, criticizing, and influencing. Kartini's position when presenting the action is as the subject of an object narrative related to the power of knowledge and thought, while the reader of the letter is Miss Zeehandelaar. The representation of ideological conflict put forward by Kartini in the evaluative act includes the view of emancipation amidst traditional ideological power that limits women's space for movement, the view of the importance of modern education for the progress of the nation amidst restrictive customary and political power, and the view of social concern to avoid opium amidst government ideological support. Colonialism, strengthening the ideology of nationalism amidst the power of feudal and colonial ideologies, and Kartini's views on the role of books in opening up knowledge amidst the limitations of power and ideology.

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Enhancement of Women Crafters' Role in Madurase Cultural Tourism After Pandemic Through Their Female Subjectivity

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Abstract: The research aims are elaborating the manifestation of female subjectivity by women crafters to develop their role in Madurase cultural tourism after pandemic and the gendering based tradition which definition of women arises gender inequality. Mostly previous researches only focus on women *batik* crafters in Madura. Hence, this research fills the gap to analyze Madurase tradition creating gender inequality challenged by the women crafters in Madura by their female subjectivity to enhance their role in *batik* as cultural tourism after pandemic. The research is conducted in Klampar village where the women *batik* crafters live in the society which shows gendering based tradition and in the era of after pandemic that leads them to work smarter utilizing social media to boost their batik selling. Interviewing and recording the women crafters of their role in cultural tourism after pandemic and their resistance against gendering based local tradition are designed for the qualitative research. Main results are the women crafters join some workshop, visit some social media, and build a network to increase their capacity to involve well to cultural tourism after pandemic and challenge the tradition that limits their space in the society. Hence their female subjectivity supports them to show their existence in the society which applies tradition that leads only male owns privilege. The research may give benefit to the area of women and cultural tourism after pandemic. The research may advance the research about how women in rural area that is limited by the local tradition but their existence of the embodiment of female subjectivity enhance their role to cultural tourism. The novelty is made as the two focuses that are women batik crafter and their local tradition are interconnected to show the enhancement of women batik crafter to Madurase cultural tourism.

INTRODUCTION

The tourism industry is the most strategic sector to improve economy in a region, including Madura, East Java [1]. Uniquely, women in Madura play a fundamental role in the tourism industry, especially the *batik* tourism industry. When the husbands work outside the village, the wives fill in their time with *batik* making until they return to their home. As time goes by *batik* making is no longer an activity for free time to waiting for her husband return home. Nevertheless, because of the public interest towards *Madurese batik* which is growing from time to time, then *batik* making has the potential to become an activity that produce money and foreigner exchange to support the financial family of women batik crafters in Madura.

The *batik* home industry is a tool to strengthen social and economic capacities [2] [3] [4] especially in rural areas [5]. Occasionally some tourists come from outside the village of Klampar Pamekasan visited to buy *batik* directly from the women *batik* craftsmen. However, unfortunately, the production of *batik* made by the women of Klampar village is mostly purchased by *batik* entrepreneurs. This causes the selling price what they specify is not as big as when the tourists come directly to buy home industry *batik* production. Female batik workers, especially those working as homeworkers, are paid low wages, which puts them at a disadvantage and do not receive the same

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030005-1–030005-16; https://doi.org/10.1063/5.0241704
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

benefits as those working in formal sectors [6]. Many women crafters face challenges in marketing their products and accessing exhibitions to showcase their work. This lack of exposure hinders their ability to reach a wider market and sell their products effectively [7]. Some of these women *batik* artisans accept the situation even though the disappointment accompanies it because the *batik* is not worth the energy, thought, and taste that is poured out to produce *batik* quality.

Women crafters in Klampar sell their hand made batik in a passive way that is waiting for the arrival local and national tourists and businessmen in their homes. Those women belong to the second prior generation generation Z and Alpha. They are a generation that most do not have the ability to run social media both to promote, socialize, to trade their *batik* product. Indeed, the existence of new media is in promotion will be very helpful for presenting tourism industry information [8]. They are women who were born before the information age technology and growing up in a society that defines women based on gender. That women do not have the opportunity to continue their education as high as the opportunities that men have. A definition that reflects gender inequality. According to their psychological and biological difference, the status and role of women still remains lower than male workers. To be empowered, female batik workers cannot overcome their powerless individually. In this case, formation of women social organization having female batik workers as a base is very important, because when groups of women together, they able to identify their own problems and priorities, even frame strategy to be used to struggle for change in gender relation at home and in the society [9].

However, some of the women *batik* artisans are not fully handed over their handmade *batik* to the *batik* entrepreneurs who came visit their homes with a ball pick-up system. Craft women the *batik* home industry takes its own business path by selling production hand-written *batik* works of art by utilizing social media. Choice Such a system of selling *batik* production can be carried out if it is supported by the ability to utilize social media owned by women of generation Z and Alpha.

Generation Z and Alpha women are women who were born in the technological era information. They are women who have grown up in a society that has experienced a shift in the definition of gender-based women due to changes time. As the times change, their generation is able to show their potential so as to be able to break down the definition of women who are gender unfair, especially the societal dogma that entrepreneurship tends to be described by character of masculinity [10]. As this shows inequality of gender that they have, this is one form resistance to the dogma given by the surrounding community to women [11]. Who argues that resistance is not always interpreted as resistance to tear down power. With its potential, home industry *batik* production becomes family economic support so that their welfare restores life those who were previously economically deprived [12]. Working outside the home and contributing to the industry, women are able to increase the overall family income [13]. This means that women's positions should not be judged as inferior to men, as they have equal opportunities in the workplace to contribute to the family's financial well-being In addition to the potential of natural resources attractive locale for tourism, so it is very supportive if batik as a creative industry in Klampar become cultural tourism destination. Natural resource in the form of unique and halal local food and drinks, a quiet village atmosphere and beautiful, and a river that is clear and flowing fast enough is a gift of resources unique and beautiful nature. All of them are supporting partners for local *batik* became an icon of cultural tourism in Klampar Pamekasan after the pandemic.

The contrasting descriptions are between village women in Pamekasan district who still shackled by the definition of women from a patriarchal society and those who are able shifting the definition of women from a patriarchal society sparked the interest of researchers to learn more about the definition of women from patriarchal society in the Klampar village, Pamekasan district and its impact. The two phenomena are this contrast is also the reason for researchers to study further about the subjectivity of women and its impact. Both of these research objectives are very important to be realized considering the potential of village *batik* in Klampar, Pamekasan sub-district which is good in supporting the development of halal tourism and post-Madura eco *batik* pandemic. Besides that, the potential for local natural resources is unique, good, and halal such as food, traditional regional drinks, a quiet and beautiful village atmosphere, and a river with clear water and flowing fast enough to attract researchers to dig further as supporting partners for local *batik* which has become an industry icon creative for post-pandemic halal and eco tourism [9]

Literature Review

In describing life experiences, Beauvoir explains that women today seek to demonstrate their independence concretely as an effort to undermine the myth that has existed so far that women are creatures that depression in men. However, their efforts are efforts to recognition of humanity is not easy to materialize. It is because they have socialized from birth and carried out from generation to generation about the world of femininity, namely Women are the main male subordinate economically and socially. From that point women learn to assume themselves, how they experience situations mentioned the things that cause him to be closed, and what mechanisms are allowed for them to avoid the situation. Everything becomes a parameter how the hard struggle of women in the past to get to the future. Word usage female and feminine emphasizes the origin of the singular feminine. It is thus necessary to study woman's traditional destiny carefully. What I will try to describe is how woman is taught to assume her condition, how she experiences this, what universe she finds herself enclosed in, and what escape mechanisms are permitted her. Only then can we understand what problems women heirs to a weighty past, striving to forge a new future—are faced with [14].

It is not economic, psychological, or biological fate that defines the moment of birth a baby girl in society, but a civilization that defines femininity. Girls are equal to boys; they kiss, touch, and caress their mother with aggressive manner, they share the same jealousy of the new birth; they showing the same behaviour, namely anger, urinary problems, sulking, attracting the attention of adults in the same way. Up to adolescence there is no difference between woman and man. A girl shows toughness, intellectual flair, and not there is a ban on competition between the sexes. One is not born, but rather becomes, woman. No biological, psychic, or economic destiny defines the figure that the human female takes on in society; it is civilization as a whole that elaborates this intermediary product between the male and the eunuch that is called feminine [14].

Fundamentally, at the age of six months, the baby begins to understand the expressions of his parents and know himself as an object. Boys get knowledge from people grown up that a man doesn't cry, doesn't receive kisses, and doesn't look himself in the mirror. Many things are demanded of boys because they are superior, pride in his manhood socialized him to get through difficult things the. Mothers make it a tradition that having male genitalia is a thing great tradition and pride. Boys can be proud of their genitals urinating standing up and making fun of girls who urinate through the hole so it has to sit.

This is a privilege for him that promotes a sense of superiority. A warning to girls that if they urinate, they have to be careful because the spray power spreads everywhere. The child is persuaded that more is demanded of boys because of their superiority; the pride of his virility is breathed into him in order to encourage him in this difficult path; this abstract notion takes on a concrete form for him: it is embodied in the penis; he does not experience pride spontaneously in his little indolent sex organ; but he feels it through the attitude of those around him. Mothers and wet nurses perpetuate the tradition that assimilates phallus and maleness; whether they recognize its prestige in amorous gratitude or in submission, or that they gain revenge by seeing it in the baby in a reduced form, they treat the child's penis with a singular deference [14].

When a man seeks his identity through his genitals, girls make a doll as a parable of himself. They dress up, pamper dolls, and thought he was a special doll. They begin to know the meaning of words pretty like a doll and want to resemble like a doll or a picture of a princess doll or fairy tale. During the weaning period, the boys went through a tough period with narcissism on her genitals while girls are strengthened by themselves are objects that happens to most girls. The doll helps her but doesn't define their role in society. Thus from an early age girls have been taught about feminine female character and continue to develop in their personality. It is also society that is responsible for determining the fate of girls.

Stepping on adulthood as adult women they are also waiting for the presence of men to fulfil and vent their desires. The hope is a handsome man rich, charming, and mighty like a prince so they can feel the caress of love, love like in the caress of a safe and comfortable hug from dad. They believe about the superiority and prestige of men who are not childish, regardless of position social and economic, world rulers, not much to say. They are interested in being partner who is subordinate to the man. Parents will support, dad is proud with the success of her daughter, the mother sees the well-being of her child. Wedding not only an honour but a career in comparison other. With it allows women to achieve perfection socially and meet sexual needs as lover and mother. With their marriage freeing himself from his parents' house and his mother's arms. Also they are open the future instead of actively engaging in passive conquest and submitting to her husband's power.

From childhood, the little girl, whether wishing to realize herself as woman or overcome the limits of her femininity, has awaited the male for accomplishment and escape; has awaited the male for accomplishment and escape; he has the dazzling face of Perseus or Saint George; he is the liberator; he is also rich and powerful, he holds the keys to happiness, he is Prince Charming [14].

The theory of female subjectivity was also initiated by Foucault and this theory used in this study as a supporting theory of the main theory. Embodiment the subjectivity of women rolled out by Foucault is the basis for conducting the analysis on two socio-cultural phenomena that occur in the lives of women in public.

The women living in a society that reflects the system patriarchy gets influence from the system that defines its existence. the definition limit the space for movement as fellow human beings with men. The definition is gender unfair. But when they then have the power to break through definition that limits it they apply what Foucault called embodiment of female subjectivity.

According to Foucault, power microphysics is investing in the human body and make it subject to the object of knowledge. Furthermore, it is explained that technique which used to subdue the body is with discipline. This discipline will influence behaviour, gestures, and attitudes. Discipline produces an obedient body, which can be transformed, and which can be scaled up. Foucault develops an analysis of the microphysics of power; he examines the way that the power-knowledge complex "invest[s] human bodies and subjugate[s] them by turning them into objects of knowledge." Foucault explores the "body as the object and target of power." He develops an analysis of the methods and techniques used to subject the body; he calls these methods and techniques disciplines. Disciplines operate on the body affecting behaviour movement, gestures, and attitudes. Disciplines produce docile bodies; bodies "that may be subjected, used, transformed and improved.

Foucault added that with discipline, someone will gain new skills and strengths as well as possible different relationships with the body somebody. Thus the formation of a woman's body is carried out with discipline if faced with traditional gender norms, it will expand the social branches and political. Some political and social rules for women have historically been constrained by norms culture. Women assumed to be physically weak have limited access to areas requiring physical strength.

In Foucault's book, it is described about women who obey the practice feminine and done with discipline. Girls are used to some discipline exercises such as controlling body weight, plastic surgery, use of make-up. This shows that not only are women obedient to the dominating power, but also produce certain skills, talents, and abilities. In other words with discipline in practicing the use of make-up, women will improve their sense about color, shape, and creativity. Their abilities emerge from a context of interests which is dominated by men, namely the beauty of women to please men [15]. It is at this point that Foucault's thinking is in harmony [14] that women are not objects for men. They are required to be beautiful they even try to be as beautiful as a doll or princess or an angel like in the story fairy tales to satisfy the needs of men.

RESEARCH METHODS

The research carried out is an ethnographic qualitative research. All data presented in the form of words, phrases, sentences in the form of response utterances. the data then analysed based on the theory that has been set. Collection technique the data is by interviewing young female respondents in the village of Klampar, Pamekasan who became the craftsmen and traders of Klampar's written batik and several officers from related services by recording, recording, and taking photos. Some related agencies are officers from the East Java women's protection service and the culture and tourism service East Java, Pamekasan cooperative and UMKM service, tourism and culture office Pamekasan, Pamekasan industry and trade office. Data collection techniques as well carried out by visiting the web and social media of respondents and related offices how to record. Data triangulation was carried out by discussing literature research and discussions with expert.

This study analyses the subjectivity of women batik artisans and businessmen in its role in post-pandemic halal and eco cultural tourism. This is a research that is social humanistic in nature so that the design used is qualitative. As explained by [16] that historically the origin of qualitative research is from sociology, anthropology, evaluation, and the humanities. in the moment analysing the subjectivity of these women researchers made observations and interview. Observations and interviews were carried out on patterns of behaviour, language, and actions research subjects thoroughly in a natural and timely manner persist. The research design is an ethnographic qualitative design. Matter as explained by [16] in his book: Ethnography is a design of inquiry coming from anthropology and sociology in which the researcher studies the shared patterns of behaviours, language, and actions of an intact cultural group in a natural setting over a prolonged period of time. Data collection often involves observations and interviews.

The theory of female subjectivity [14] forms the basis analyse the subjectivity of women carried out by research subjects. Perspective Feminism was carried out in this qualitative research to describe the culture of the local community which frames women, giving rise to them oppression for women. This is as explained [17] as follows: Feminist perspectives view as problematic women's diverse situations and the institutions that frame those situations. Research topics may include policy issues related to realizing social justice for women in specific contexts or knowledge about oppressive situations for women [17].

Furthermore [17] explained that research ethnography examines questions about groups sharing culture, experiences, use of native language, differences from other cultures, and verification of accuracy data. In ethnographic research, [17] advanced a taxonomy of ethnographic questions that included a mini-tour of the culture-sharing group, their experiences, use of native language, contrasts with other cultural groups, and questions to verify the accuracy of the data. This research raises questions related to the experiences of a number of female artisans and cultural industry entrepreneurs in addressing the social definition of themselves as well as verify the accuracy of the data.

The research was conducted in the Propos sub-district, Parmesan district. Implementation the research was conducted in individual batik workshops and batik centres. Batik workshops individuals and batik centres which are the research objectives are those located in Propos sub district, Parmesan regency. The reason for choosing Klampar village as the research location is because the village is famous with batik creative industry. Besides it is also because batik artisans and entrepreneurs in Klampar village are women who live in the same neighbourhood that prioritizes the privileges of men. But the women succeeded break through the boundaries imposed by society. The reason why the local community places special restrictions on women because of perception society that considers women as second citizens after men. Research was also conducted at the East Java Women's Empowerment service, the service East Java Tourism, the Pamekasan Women's Empowerment service, the Cooperative service and UMKM Pamekasan, and the Youth and Tourism Office of East Java. This research was conducted from mid-August to mid-December 2022.

The research subjects were Madurese women who became artisans and traders of Pamekasan batik. They are in Klampar, Pamekasan district. Women batik artisans aged between 25 – 60 years and women batik entrepreneurs aged between 20 – 34 years. Madurese women batik artisans have no background formal educational background to have a formal educational background to elementary school or madrasah ibtidaiyah. Madurese women batik artisans are them who have good batik skills obtained by independent learning (self-taught) or by learning from previous generations or training held by related institutions or agencies. Madurese women, batik entrepreneurs, have backgrounds the lowest formal education background is senior high school or madrasah aliyah. Madurese women batik entrepreneurs are those who have business literacy and technology. Madurese women who are involved in this cultural creative industry is the successor of the previous generation. Thus it can be said that the batik creative industry is a family industry that has been run for generations from generation to generation. Madurese women who are the subject of this research are third generation.

The data sources of this research are primary and secondary data sources. Data source primary is data resulting from interviews and observations on the subject study. Secondary data sources are data available in journals, proceedings, blogs, books, web, social media, and East Java Women's Empowerment service officers, East Java tourism service, Pamekasan Women's Empowerment service, service Pamekasan Cooperatives and SMEs, the Pamekasan Youth and Tourism service, and the agency Pamekasan Trading Industry. Either primary data or secondary data collect data about research needs. There are two research needs, namely the need for data on the age development of the respondents associated with the definition of socio-cultural binding and the need for data about the awareness of the subjectivity of female respondents to address the socio-cultural definition that binds to the development of his age. In addition, secondary data sources from journals and proceedings of the year of publication are no more than 10 years so that knowledge renewal can be carried out in a sustainable manner in no time.

The research phase includes preparation, collecting data, processing data. Activity preparation for this research includes activities to determine the location and subjects became the target of this research. Determination of research locations is as written in the sub-chapters regarding research locations and determination of research subjects are as follows written in the research subject sub-chapter in chapter 3. The next activity which is research preparation is formulating questions for respondents to get the data referred to in this study. Research questions are like that written in the sub-chapter about research questions in chapter 1. Next, which is the preparatory activity is asking for permission from the office of Bakebasbangpol (National and Political Unity Agency) in Pamekasan which is used to obtain entry permits at research locations that have been set.

The next stage of activity is to collect data. At this stage the activities carried out by the researcher are collecting primary data and secondary to several questions that have been formulated. Collecting data with interviews and observations of research subjects and designated offices are also conducted for this stage. The final stage is processing the data. At this stage the activities carried out are: reducing data and displaying data, analysing data, concluding and verify, increase the validity of the results, and narrate the results.

There are several techniques of collecting data carried out in this study. The first technique is an in-depth interview of the research subject and some of the officers in the service that has been set before. The second technique is observation or observations. Researchers made observations of research subjects, namely Madurese women as batik artisans and entrepreneurs in batik-producing villages in Klampar village, Pamekasan regency and its environment. Several things are observed is in accordance with what has been formulated in the purpose of this research. The next technique of data collection is documentation. Documentation is done on the subject research and several services that have been previously mentioned about data needed in this research.

Activities carried out in data analysis, is data reduction. this activity includes selecting, focusing, simplifying, and changing some data collected from the field. This reduction is carried out continuously in activities study. Until the time the data display produces the appropriate data intended this research. The next activity in data analysis is presenting data. Activity it displays the data in an organized manner making it easy to interpret those data. The data displayed is in the form of words, sentences which are description of some of the questions that have been formulated. Because of a social phenomenon culture is complex and dynamic, so the data found can be experiencing development. The last activity in data analysis is interesting conclusion. The conclusions drawn are based on what happened in the field, without adding or subtracting existing ones. Conclusion in the form of a description related to the two issues raised in this study.

This activity is an important activity for this type of qualitative research. Because this activity examines or corrects the data collected to ensure that the data collected is accurate. This activity is a test of the validity of the data by testing validity and reliability The activity of testing the validity of this data is measured from the point of view of experts who are competent on the issues raised in this study. This activity is called by triangulation. Competent experts will examine the data that has been collected in accordance with their expertise so that the data is available to them will be correct and reliable. Thus, the analysis carried out will maximally achieve the objectives of this study. The resulting conclusions can be used to provide research development on female subjectivity for its role in halal and eco cultural tourism in Pamekasan.

RESULTS AND DISCUSSION

Female subjectivity embodied by the women batik crafters in Klampar village is elaborated here. It shows how their reaction against the local tradition that puts them as subordination. The description reveals their effort to resist against the definition of them that create inequality for the early year until they are as the batik crafters. They must apply their creation and strategy to promote and sell their hand-made batik to support their family economy. Beside the local tradition that limits their access is also elaborated in here to show how their effort to challenge it.

Respondents' Awareness Describing the Women Subjectivity

Respondents' awareness of the definition of socio-culture in each age development provide positive benefits for respondents so that they are able to go through every challenge faced. Some of the young generation respondents are quite critical in responding social definition of piercing and cutting for their children. Their baby is not having a piercing or cutting when a new born or under six months because the knowledge gained that these activities are at risk to be carried out on infants. Literacy about baby health and other literacy related to their baby get it easy from mobile phone. Some information read from google and social media such as Instagram, Tik Tok, twitter, Facebook, Whatsapp, Line, and others so on help them to understand what is best for their baby.

They are the younger generation who are familiar and master digital because of them growth and development in the IT era. The development of information technology facilitates generation young people to access all the info with just a touch of a finger on their cell phone. The last fifteen years of use and role internet for human life has changed drastically [18]. With more sophistication smartphone and tablet technology, the expansion of technology in accessing Wi-Fi and 4G, and the development of social media, more and more people are accessing the internet to do many things. The younger generation who are currently under the age of four are recovering years is the largest internet user. The widespread use of the internet and the use of smartphones in society Madura has an impact on the growth of critical power towards what is in around them [19].

The subjectivity of women respondents was also tested when they had a family in young age. Those who were betrothed since they were still in elementary school and underwent early marriage, had to quit school. This is done because they have to divert all attention on the new obligations as a wife in accordance with that view already exist in the local community, namely taking care of the household. serving husband, children, and taking care of all the needs of the house is the main obligation attached automatically when it has become a wife. Women's traditional role in the household even with a double workload. women workers have to carry out multiple responsibilities, resulting in a heavy burden [20]. In carrying out domestic obligations the respondent is assisted by the closest family, such as the respondent's mother and sister who are in the same house as the respondent.

The closest relative of the respondent is aunt (mother's younger sister), nyanyah (sister mother's daughter), and sepopoh (children of mother's siblings) sometimes also help respondents perform domestic obligations. That's because they live together in one land long which consists of several houses and mutual assistance (mutual help) values that have been become a local tradition. The real challenge delivers the impact is heavy for respondents especially those who are still underage, but it becomes small reduced because there is assistance to carry out domestic obligations [21]. This also has an impact on the mental health of respondents who underwent a new status as a wife and received limitations in several ways, namely school and social. Thus the immediate family is a support system for respondents who face major challenges regarding their domestic role.

The family as a supporting system and local values is also an asset basis to assist respondents in developing the Pamekasan batik business as a family inheritance. Batik as a family business has been run for generations descended from generation to generation. Therefore, the respondents are very close to the activity batik. Since childhood, namely when I was still in elementary school or on an equal footing they have been dabbling in written batik. They already did the activities of striking and punching white cloth since I was still in elementary school or equal. After growing up, during junior high school or equivalent and high school or equivalent they get skills activities batik. These skills are useful later on to develop his ability in batik creativity.

There are two stages in batik, namely preparation and making batik. Process preparation is a series of preparatory work on several types of white cloth which can be used for batik. The preparation process includes cutting, washing, starching, boiling, and wrapping batik cloth. Cutting is an activity to cut white cloth as the basic material for batik with a size of 2m x 1.5m or more. Washing is cleaning a white cloth with clean water. This was done at the river near the respondent's house. Size is inserting white cloth into starch solution water. Boiling is removing starch from *mori* by smearing a cloth white it evenly with peanut oil, soda ash, *typol*, and enough water then the mori is dried. The process of setting is repeated for three weeks with the aim that the color seep into the fabric fiber perfectly. Memplong is ironing cloth white so it doesn't wrinkle so it's easy to do the process of making batik.

In the preparatory process, the respondent carried out all activities assisted by the family closest to the respondent. Mothers, brothers, sisters and cousins, nephews, aunts, uncles, husband and nephew who live around the respondent's residence are family the closest person who helps the respondent in carrying out batik activities. That matter done with several considerations, namely to make it easy and fast when needed, to establish brotherhood, and to mutually strengthen the family economy. This matter in line with research conducted by [15] that Pamekasan batik plays an important role in the development of creative industries in Pamekasan, Madura, East Java but also has an impact on the socio-economic conditions of local, regional and national communities.

After the preparation process has been carried out, the next process includes *njaplak, nyanting, ngiseni, nyolet, ngelir, nglorod, nyasah,* and *njemur*. *Njaplak* is an activity of drawing patterns on white cloth as the basic material to make batik with a pencil. *Nyanting* is the activity of making batik with to thicken the pattern image with a solution of wax which is inserted into the canting. *Ngiseni* is the activity of colouring patterns that have been drawn with a canting. *Nyolet* is the activity of coating patterns that have been coloured with wax. *Ngelir* is an activity put the cloth that has been drawn as batik into the dye water. *Nglorod* is inserting cloth batik to a special boiler filled with boiling water so that the wax peels off the cloth. *Nyasah* is cleaning batik cloth into the river. *Njemur* is drying batik cloth in the sun. In carrying out the manufacturing process respondents' batik are assisted by their closest family as well. This is caused by Madurese people known as people who live in groups or communal society [21]. They live to help each other in togetherness and it becomes the identity of the Madurese people.

Some photos of the stages of the activities of the respondent and his closest family in carrying out the activity Klampar's written batik activities are shown to get a concrete picture stages, the complexity and difficulty of doing written batik activities. This is also a goal to describe the subjectivity of village women in Klampar, Pamekasan. The first stage for making written batik is *njaplak* that is drawing a white cloth which has been washed first and starched with the aim that it is easy during release evening. In this activity the respondent draws a pattern that already exists in his thoughts on the white cloth that had been prepared in figure 1.

FIGURE 1. drawing the batik pattern on the white cloth

Fabric size is 2 meters x 1.5 meters or wider. The type of cloth used is *primisima mori* cloth, gray cloth, rayon cloth, and cotton cloth. *Primisima mori* fabric is a type of cloth that is the best among the types of fabrics that have been mentioned. Drawing tools on a white cloth used is a writing pencil.

Next is a photo of the respondent's editing activities in figure 2.

FIGURE 2. incising the wax on the cloth

Activity of nyanting is incising wax that has melted on a white cloth will be drawn with canting. When changing the position of the canting tip, it looked up top in anticipation of the night dripping. The night is thawed over the skillet for a period of three seconds for temperature adjustment on the canting. When editing carried out in a sitting position and the position of the stove to the right of the craftsman.

After *nyanting*, the activities carried out are *ngiseni*. Ngiseni is coloring the pattern on the cloth with remasol or indigosol and the tool used is a brush. Here is a photo of the shoring activity that was carried out by you respondents to help with their batik activities in Figure 3.

FIGURE 3. colouring the pattern on the cloth

After *ngiseni* the next is *nyolet*. The pattern that has been given a wall colour using the night with a wooden tool. The goal is when the cloth is dyed in colour, the basic pattern colour does not fade. The following is a photo of the *nyolet* activities carried out by respondent's sibling in Figure 4.

FIGURE 4. a wall colour using the night with a widen tool

After the cloth has been dyed in the desired colour as the base colour then drained so that the colour on the fabric fibers can be absorbed to the fullest. The next is doing *nglorod* activities. The *nglorod* activity is carried out by the husband or the male family because this activity is very risky. *Nglorod* is eliminating or release the night on the cloth. The cloth is boiled in boiling water until evening let go so that the drawn batik motif appears. Boiling water, burning fire, heavy cloth with boiled water, and the process of lifting and soaking cloth in that water boiling with wood is a risk faced in *nglorod* activities. Here's a photo *nglorod* activities assisted by the husband of the respondent in Figure 5.

FIGURE 5. Eliminating the night with boiling water

After *nglorod*, the respondents carried out activities to wash batik cloth. this activity conducted by respondents in the river not far from where they live. Washing batik cloth or *nyasah* has been made clean so that the remnants of the wax that are still attached can be removed missing in Figure 6.

FIGURE 6. Washing the Batik cloth

Batik cloth becomes smooth and does not fade in the hands when it is marketed and held by consumers.
After washing the batik cloth, drying is carried out in Figure 7.

FIGURE 7. Drying the Batik

The last process of the first stage is drying batik cloth or *njemur* which is to dry wet batik cloth. When drying batik cloth is not done in the hot sun, but enough sunlight and wind to speed up the drying process. After the drying activity is end of the first process, a second process is carried out, similar to the first process of making written batik, namely *nyanting, ngiseni, nyolet, ngelir, nglorod, nyasah,* and *njemur*. The second *nyanting* activity is carried out with the aim of confirming the motifs on the batik cloth. The following is a photo of batik activity or second sorting performed by the respondent's family in Figure 8.

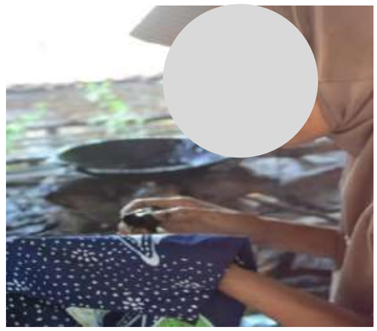

FIGURE 8. Confirming the motifs on the Batik

When carrying out these steps the respondent was assisted by his closest family. This is because the process of making batik is complicated, so it requires several workers to help respondents do written batik. Thus the respondent can still carry out these additional tasks but it is important to do this because it supports the family's economy while still prioritizing the main task as a wife. After becoming a wife who made herself have to be at home, continuing the family batik business became the choice of activity and business occupied by the respondents. The respondent's husband helps the respondent to run the family batik business as an additional family income. The batik business is a cultural business that promises big profits [22]. In other words, batik is a cultural tourism to increase community economic empowerment [23]. Respondents as the younger generation who are very familiar with the use of mobile phones and social media run a batik business by utilizing social media. The following photo in Figure 9

FIGURE 9. Advertise the Batik on Social Media

Shows the respondent's batik business offered on Facebook. By displaying typical Pamekasan batik on mannequins, respondents added captions with some information.

The posted batik photos are the best chosen to provide an attractive visual picture to consumers. With the aim of growing consumer interest. Information about batik, namely batik motifs, prices, quantities available, batik process, fabric materials, fabric sizes, and whatapp contact person numbers are presented as captions to help consumers carry out inquiries and purchase activities online. This shows business skills using mobile media. This shows the subjectivity of Klampar, Pamekasan women batik artisans and entrepreneurs in addressing the challenges faced by both socio-cultural and economic challenges.

Findings about the age development of batik artisan respondents in the Proppo sub-district, Pamekasan district starting from infancy to adulthood and how socio-cultural defines this age development. From 1-40 days old, Madurese baby girls have experienced two incidents that injured parts of their organs. This is to confirm gender status as a baby girl and to make it look beautiful. The first activity is punching holes at the lower ends of the two earlobes for a place to put earrings [24]. If you don't put earrings in your ears, then the community considers it a boy baby and this will become gossip in the community. Society already has an ingrained and ingrained perception that a baby girl is wearing earrings on the earlobe. The act of punching holes in both earlobes makes the baby cry, bruises, and can also be swollen for some time. The baby's mother sometimes cannot bear to see what happened when her baby got a piercing. Meanwhile, baby boys did not receive the treatment of having holes in their ears so that they did not experience crying, injuries, or fussing.

The second is the activity of cutting or slightly injuring the skin covering the clitoris of baby girls. Female genital mutilation (female genital cutting) is done with the perception that it suppresses libido when a girl is growing up. Thus helping to suppress sexual appetite and maintain self-respect until the time comes for marriage [25] [last changed]. Another perception that has developed in society is that baby girls who are not circumcised are considered non-Muslim [26]. When undergoing circumcision activities the baby will cry, bruise, and can also be swollen at the pierced earlobe (piercing) for some time. So that the baby will usually be fussy for some time. While baby boys undergo circumcision when they have grown to become boys before entering puberty. Thus the pain suffered is more understandable and manageable because it can communicate well.

For the two activities experienced by batik artisans in Klampar, Pamekasan district, the tools used were simple tools and were used by people who did not have a medical background in 1960 and 1970. Because of this, the effects of the pain were so pronounced. It can also cause an infection because the baby is allergic to metal or jewellery when the baby's immune system is still weak. As a result, the baby will receive treatment in the hospital to receive antibiotics for 48 hours [27]. The baby's mother sometimes couldn't bear to see the incident where both ears were perforated and the female genital mutilation of her newborn baby. However, there is nothing that the baby's mother can do except accept the traditions that have been carried out by the local community for a long time. If not, then the family will become the centre of attention of the villagers because they do not carry out traditions that have existed for decades [26]. This social sanction will have the effect of making the family more anxious, sad, and even sick.

After moving on to school, some of the respondents as batik artisans and entrepreneurs in villages in the Proppo sub-district, Pamekasan district, did not finish or continue their formal education. But they finished their madrasah school which was lived in the afternoon by reading the Al-Quran. So it is undeniable that some of them cannot read and write. But they can read the holy Koran. This is due to the perception of the local community that formal education for girls is low. Education is not important for girls because in the end they will become housewives who take care of their husbands, children and home. The local community's thinking illustrates the ideal of women as mothers and wives with domestic roles [29]. The mind-set that has been there for generations making girls in villages in Klampar, Pamekasan district, have limitations in accessing formal education. Another factor that causes limited access to formal education for women is the economic background that comes from underprivileged families [30][31].

Those who quit and did not continue on to higher formal schooling then worked in the fields, fields and houses to help their parents. Thus the burden on parents to provide financially for them when they go to school is reduced because they have stopped going to school and also the burden of doing their daily work is also lighter because they provide energy assistance. This indicates that they not only have limited opportunities to access formal education but also exploitation of labor when they are underage occurs. It is different from boys who do not have limitations in accessing formal education because of the stigma that the domestic role is only for girls. So that boys have an open opportunity to complete and continue formal education. Boys are not obligated to think about domestic roles.

From the age of elementary school or the equivalent, some respondents and entrepreneurs experienced a period of engagement. This happened for a number of reasons, namely family financial reasons, religion, the myth of *tako' sangkal* (black magic), and the stigma of *praben toah* (old maid). Financial reasons are because the parents come from underprivileged families, so when a family of the prospective fiancé proposes to their daughter, the daughter's parents will accept it. This is intended to reduce the financial burden of financing his daughter's needs and shift some of the responsibilities from father to fiancé [32]. The reason for religion is to maintain the self-esteem of girls so they don't fall into relationships that are prohibited by religion. Therefore, religion is one of the reasons held firmly by people there. Because they believe that religious teachings are true. Apart from that, religion can also raise people's awareness about the importance of living life by knowing religious knowledge, but sometimes it backfires due to excessive exploitation. Religions may evoke people's consciousness of their limited control over both human natures and nonhuman natures, and that over exploitation can backfire [33]. The local reason is called as *pamali* for rejecting a daughter's first proposal because she is worried that it will prevent the daughter from getting a husband in the future (*tako' sangkal/ black magic*). The reason for the tradition is to get married young after the first menstruation or before the age of 17 so that you are not gossiped about as *praben toah* (old maid).

Since accepting the application, the women had to be prepared both psychologically and physically. Psychologically, they are no longer free to make friends with other members of the opposite sex and leave the house except with their family or fiancé [34]. If they go outside the house, then suspicion and surveillance the local community is carried out. Physically they are taught how to take care of their limbs with traditional ingredients so that their fiancé looks charming. They are also given clothes, jewellery, and makeup to support their appearance when their fiancé visits them. These two preparations can have a psychological impact on the perpetrator because at a very young age the perpetrator is required to mature instantly. Early arranged marriages have an impact on mental health, namely feelings of depression, high anxiety because they are not ready to marry at a very young age.

Even at that age, the respondent did not understand what was happening to him [34]. However, because they were still too young, the respondent easily accepted what was required of him. Apart from that, matchmaking involving underage respondents could even apply while in the womb is considered a normal thing because it has become a tradition that has been going on for generations [35]. In contrast to boys who undergo an application there is no limit to establishing social relations with those around them and can leave the house without permission from their fiancé and without any suspicion or gossip from society.

When entering the household period the respondent has a new status as a wife. So that they have the obligation to obey their husbands, take care of their husbands, do domestic work, conceive, take care of themselves and care for children. The activities of the wife going in and out of the house are monitored by the husband. *Kobhung* is a site in *taneyan lanjheng* (long land) in every residence that helps the husband to supervise the activities of going in and out of the wife's house. This shows the wife's position which is hierarchically below the husband's position in the local Madurese culture. So you have to obey your husband absolutely [36]. In other words, *Kobhung* is a site that becomes a symbol that emphasizes that the husband has dominant power over his wife. This hierarchy can cause suffering for wives and provide privileges for husbands. The wife must comply with the tradition that has been in force for a long time because it has become a doctrine, namely that men are actors who control women's ethics because God gives superiority to men. The local community's perception of the expression *bhupa'-bhabhu-ghuru-rato* (dad and mom, mom and dad, teachers, leaders) reflects the obedience of the community to one of which is the husband as the leader of the family. A value that cannot be negotiated because they are sacred figures and form the basis of a social hierarchy.

At the time when the respondent became a batik craftsman, the community's opinion of women was low and underappreciated both in the work environment and in their family [12]. In his work environment he does not receive protection because his work is considered informal work and he is paid low wages because he is seen as doing light, easy work and not selling it directly to buyers. The batik artisans sometimes experience damage to the skin of the hands when heating the night to make batik. However, they did not receive health funds for this incident because they were informal workers. Craftsmen who don't sell their batik immediately, there are collectors who help them to offer and sell to buyers and this is the reason why the price of the batik they produce is low and makes them disappointed [12]. While the majority of collectors are men, they get big profits because they directly offer and sell batik merchandise to buyers.

Women who have a big role in the process of making batik and can make their own money from the work they have done, but when they return home they still carry out domestic roles. The results of working as a batik craftsman can function to supplement family income when the husband's income as a farmer is insufficient. However, after returning from work, caring for children, serving husbands, and cleaning the house must still be done. This is different from husbands who come home from working in the fields, they will rest and receive services from their wives. This is an illustration of the patriarchal system that gives privileges to men and women as subordinates, namely a wife who obeys and serves her husband. Worse, when the respondent was when he was a batik craftsman and had a family at a young age, the burden of responsibility became heavier. The burden of working as batik artisans and when working on domestic roles provides multi burden roles for respondents.

The stages of development of women batik artisans and traders associated with the socio-cultural definition that developed in the community in the village of Klampar, Pamekasan district, indicate a patriarchal system that is applied in household life. The patriarchal system in the history of gender is a system that places the male power over women in all aspects of life. men restrict and control the public role of women [36]. Women are placed as Other (Others/Not their group) which are under the power of men because men are concrete owners of power. This is as explained [14] that since long ago in the early days of patriarchy, men tried to make women depend on him in every way. Thus all actions are made to fight women. So the women were designated as Others (Not their group).

History has shown that men have always held all the concrete powers; from patriarchy's earliest times they have deemed it useful to keep woman in a state of dependence; their codes were set up against her; she was thus concretely established as the Other. Each stage of the development of the respondent's age as a woman cannot be separated from the socio-cultural definition that reflects the existence of a patriarchal system in society. Women are subordinates who are below in the household and community hierarchies. The highest position in the household hierarchy is the husband and in society is the man. So that daughters must be obedient to their fathers and mothers and wives to obey their husbands. As Other (not their class), women are the second class of society after men. Therefore, the socio-cultural definition accepted by women is to challenge women and recognize that the real power is men. When a baby experiences a piercing to gain recognition as a beautiful woman and cutting to gain legitimacy as a follower of Islam. When she was a child, she could not access up to high school because ideally a woman had a domestic role (*kasor/*bed*, dapor/*kitchen*, somor/*well). When you are married, you get limited social access from your husband with the intention of maintaining the honour of your wife, husband and family. Even in batik selling activities, women craftsmen are made dependent on collectors, the majority of whom are men because of social access restrictions and because women are considered not as good as men in matters of trading outside the home. It is a local perspective that public spaces are for men and private spaces such as homes are for women.

CONCLUSION

The subjectivity of women batik artisans and traders in the village of Klampar, Pamekasan district comes with a reaction against several socio-cultural definitions that are not gender-equitable. Some of them are the younger generation who decided not to have their babies pierced and cut at birth for reasons of health considerations. This reason is owned by the younger generation because their literacy towards baby health develops well with the availability of this information on their cell phones. They also revolutionize the manufacture and sale of their written batik which does not only rely on conventional methods. They also make the latest creations in the manufacture and sale of batik with the help of applications on the internet and social media. With special applications such as Pinterest, they explore up-to-date, modern, elegant batik images while maintaining local wisdom. With social media like Facebook, they display the best photos of their written batik with captions that explain the product and include their contact person to make it easier for consumers to get further information. They are the younger generation who are agents of change for the Madura batik creative industry as an icon of post-pandemic halal and eco tourism. The subjectivity of women appears to provide changes to women who were previously only focused on the domestic role to widen the role of the family, regional, provincial and national economy.

The socio-cultural definition is accepted by Klampar village batik artisans and traders from birth to household provides challenges for women and gives privileges to men. The social definition of a new born is that so that the baby is considered a girl, the cultural activity that is used as a tradition is piercing. Furthermore, the social definition of newborn girls is that babies are considered Muslim if they have carried out cultural activities which are used as traditions, namely cutting (circumcision). This activity is also a sign of obedience to the *Kiai* (the leader in Islam) because this activity is a recommendation of the *Kiai* and the *Kiai* for the Madurese community is an elite group that plays a social role and has power in society [37][38]. The Madurese expression that reflects the social hierarchy of the Madurese people is *Bhuppa'* /mom and dad/parents *Bhabbu'* /dad and mom/parents *Ghur*u/ teacher *Rato/* leader (which is the embodiment of piercing and cutting activities on new born girls. At the lower strata, such as ordinary people, they must obey and follow the strata above, namely the *Kiai*. Even though there are some physical (bleeding, bruising, swelling, and irritation) and psychological (pain, worry, and trauma) impacts caused by piercing and cutting. However, these activities are still carried out because they have become a tradition of the local community and if they are not carried out, then social sanctions such as being used as gossip and being considered as bad parents or even compassion for their babies because they do not get the treatment of piercing and cutting.

The next social definition relates to the expression that women will eventually carry out domestic roles (*somor*/well, *dapor*/kitchen, *kasor/*bed) and this is the cause of the culture of early marriage [25]. Feelings of pride and happiness when their daughter has been proposed to and worry if they refuse the application submitted because tako' sangkal/ black magic is the main cause of girls in Klampar village, Pamekasan district, the older generation have limitations in accessing school to a high level [30] [39]. Since accepting the engagement, the girl has experienced limitations in accessing social activities both online and offline. The permission of the fiancé or husband becomes the main and important issue when they have a family for their partner. Even in the layout of the house in each long yard the *kobhung* was built to implement power the husband is concrete about his wife because the building which is a tradition of the local community functions to control the wife's activities and the entry and exit of the wife from the house [34].

Social definitions are also accepted in their role as wives who work as batik artisans and traders, namely that they are still subordinate to their husbands. So that when you have finished working as a batik craftsman and trader, you still have to do your domestic role in taking care of your husband, children and home. Even the handiwork of their batik by the older generation requires collectors, who are mostly male, to be offered to buyers. In this case they depend on men and this is proof that men have concrete power. The selling price of their batik works is very low and makes them complain when they are bought by collectors. However, the selling price of the batik becomes expensive when it is offered to consumers and the profits received by collectors become large. Thus the definition of subordination is not only in the relationship between husband and wife, but also in the relationship between owner-craftsman and collector-craftsman.

ACKNOWLEDGMENTS

The researcher would like to thank you to University of Trunojoyo Madura (UTM) which leads the researcher to do research and do publication of the research. The research grant is annual program that is worth for developing the research atmosphere in UTM.

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Investigation of Entrepreneurial Intention: Factors and Implications

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Abstract . The number of entrepreneurs in Indonesia is still falling behind that of other countries, accounting for only 3.47% or about 9 million people of the total population. In comparison, the number of entrepreneurs in Singapore has reached 8.5%, while Malaysia and Thailand have reached 4.5%. If the low number of entrepreneurs continues to be overlooked, it may have an impact on the lag of economic development and public welfare, threatening the sustainability of the economy. This research aims to (1) identify the number of entrepreneurial university students (2) investigate supporting and inhibiting factors of entrepreneurial intention, and (3) find the implications of entrepreneurial intention on the emergence of new entrepreneurs. This study employs a qualitative design utilizing literature review of journals, previous research findings, and data. Data collection was carried out through questionnaires distribution and interviews with respondents who are students of Universitas Sebelas Maret. Subsequently, data analysis was conducted using descriptive narrative technique and interactive analytical model by Miles and Huberman. The findings indicate that (1) the number of university students who run a business is still small (2) factors that can influence entrepreneurial intention including internal factor, entrepreneurial attitude, and contextual factor (3) entrepreneurial intention has an impact on the emergence of new entrepreneurs. Given the small number of entrepreneurs, efforts should be made to improve this situation.

INTRODUCTION

Indonesia is currently facing the problem of limited job opportunities for university graduates due to the recent increase in the number of intellectual unemployed. This condition is exacerbated by global competition, such as the enforcement of AEC (ASEAN Economic Community) which puts Indonesian graduates up against foreign graduates. Therefore, university graduates need to be guided and supported not solely to become job seekers, but also to become job creators. One alternative way to reduce unemployment is cultivating entrepreneurial intention of university students, because university graduates are expected to train young entrepreneurs to be able to open their own business. The number of young entrepreneurs in Indonesia is only about 0.18% from the total population, falling behind a developed country like United States of America with 11.5% and Singapore with 7.2% of young entrepreneurs. In fact, according to consensus, it is ideal for national development to have up to 5% of the total number of entrepreneurs, as it can create a competitive edge for the country. University graduates must be encouraged and supported to have entrepreneurial intention.

One of the factors for the growth of entrepreneurship in a country is the role of universities in providing entrepreneurial education. Universities have a responsibility to foster and instill entrepreneurial skills in graduates and also to encourage them to do entrepreneurship. From the previous studies that have been conducted on human entrepreneurial motivation, it can be concluded that someone's entrepreneurial intention is influenced by several factors, which can be viewed as a unified framework including various internal, external, and contextual factors [1], [2]. Internal factors that originate from within the entrepreneur can include personal characteristics and sociodemographic factors such as age, gender, work experiences, family background, and others that can influence individual's entrepreneurial behavior [1], [3]. On the other hand, external factors come from outside of the individual, it may include the surrounding environment and contextual condition of their career. It is advisable for universities to adopt a specific entrepreneurial education model that is grounded in empirical input to equip students with valuable knowledge so that students' enthusiasm for entrepreneurship can be cultivated.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030006-1–030006-5; https://doi.org/10.1063/5.0244935
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Research findings revealed that numerous characteristics that determine entrepreneurial behavior may be learned and shaped. Thus, certain personality traits, such as the need for achievement, a strong locus of control internally, and high creativity and invention, impact an individual's intention to become an entrepreneur [3], [4]. Similarly, it is believed that a person's attitude toward entrepreneurship can shape entrepreneurial intentions [5]. Although contextual factors receive adequate attention from researchers, academics, social, and business environmental conditions [5]. In Indonesia, there is still a lack of study on student and alumni intentions to pursue entrepreneurial careers. A number of research studies have been conducted, including student entrepreneurial motivations [6], university alumni motivations to become entrepreneurs [7], student entrepreneurial profiles [8], management students' intention to become entrepreneurs [9], the profile of educated young entrepreneurs in Yogyakarta [10], comparative study of the entrepreneurial intentions of Javanese and non-Javanese students [11], are still exploratory, descriptive, and partial studies. Besides, most of the research on students' entrepreneurial intentions comes from outside of the country [5], and the findings are not always suitable to the Indonesian context.

This research has two main objectives. First, developing and evaluating empirical determinants of entrepreneurial intention aimlessly provides whole new insights into a new independent variable or predictor. [12] uses entrepreneurial variables such as age, education, skills, gender, and risk assessment as predictors. [13] added family member opportunities and parental employment as entrepreneurial intention predictors. On the other hand, this study attempts to integrate multiple predictor variables addressed in prior literature by [12] and [13] into one model. The two studies have helped to fill the gap in the literature by reviewing large sample data results from India that were previously done by [14], who conducted a comparative study on entrepreneurial behaviors and intentions in India, China, Thailand, and Australia. However, the previous studies conducted by the researcher differed from one another because this research is focused on the potential for entrepreneurial intent between pupils and university students who are currently receiving entrepreneurship education either at school or university.

Based on the research background and research urgencies previously explained, this research focuses on identifying the influence of multiple factors related to someone's entrepreneurial intention, both internal factors such as individual characteristics (sociodemographic) and contextual factors on student entrepreneurial intentions. The findings of this study are expected to be used in the development of a university entrepreneurship education learning framework, specifically to encourage the emergence of graduates who pursue entrepreneurial careers.

METHOD

The research method employed in this study is qualitative with a literature review. The purpose of the author using this method is as follows: (1) to identify the number of students who are entrepreneurs, (2) to investigate the supporting and inhibiting factors of entrepreneurial intentions, and (3) the impact of entrepreneurial intentions on the emergence of new entrepreneurs. The secondary data for this study was gathered from journals, research results, and previous research data. The data was gathered by circulating a questionnaire and conducting interviews with respondents, who were Sebelas Maret University students. Furthermore, data were analyzed utilizing descriptive narrative and interactive techniques using the Miles & Huberman Model. This study investigated entrepreneurial intentions in the context of factors and their implications.

DISCUSSION

Identification of the Number of Entrepreneurial Students

Entrepreneurs are individuals who start a business by willingly taking all the risks in pursuit of gaining profits and developing the business they owned by identifying opportunities and effectively utilizing any available resources [15][16]. [15] stated that one of the factors contributing to the growth of entrepreneurship in a country is the role of university in providing entrepreneurial education. Universities have a responsibility in fostering and instilling entrepreneurial skills of the graduates and encourage them to do entrepreneurship. However, the data collected in the field reveals that the number of students engaged in entrepreneurship is still low.

Multiple research findings indicate that the quantity of entrepreneurial students is relatively low in several universities. Research conducted by [17] revealed that there are only a few students who engage in entrepreneurial activities in Universitas Negeri Semarang, with only 1.07% of the total student population, which accounted for 28,815 students. The entrepreneurial intention among students of Universitas Negeri Semarang is low because they prefer a more stable job with a guaranteed income, resulted in their reluctance to start pursuing entrepreneurship. Another research by [18], which is conducted on 203 students of the Economics Education Program at Universitas Negeri Surabaya showed a low level of entrepreneurial interest among them. This is because they tend to choose working in a company according to their abilities rather than starting their own business. [19] stated that around 112 students of STKIP PGRI Tulungagung have a low entrepreneurial spirit and do not have a courage to take risks to do business. They believe that running a business has a tendency to be failed and does not guarantee their future. Students' reluctance to do entrepreneurship is also because they do not believe in their capabilities to enter the business world. [20] also discovered that students in Purwakarta have a low entrepreneurial spirit. In conclusion, evidence from previous studies at various universities in Indonesia indicate that the number of students who are interested to do entrepreneurship is still relatively low.

Factors Supporting and Inhibiting Entrepreneurial Intention

Fundamentally, the entrepreneurial spirit is influenced by internal and external factors [7]. Internal factors originate from within the entrepreneur themselves, consisting of personal characteristics, attitudes, willingness, and individual capabilities that empower them to engage in entrepreneurship. Meanwhile, the external factors come from outside, including surrounding environment such as family, business environment, physical environment, social economic environment, and more [21].

Another research study highlighted that the occupation of parents as entrepreneurs is believed to serve as an entrepreneurial role model and may shape their children's interest to engage in entrepreneurship in the future [22][4]. Besides, work experience also a strong supporting factor. Students with concrete experience in entrepreneurship (through their own ventures or involvement with their parents' businesses) tend to have stronger motivation to pursue entrepreneurship after graduating.

Several other studies have revealed that attitude characteristics such as autonomous authority, economic challenge, self-realization, security, and workload have a significant impact on students' entrepreneurial intention. The presence of contextual factor, such as academic support has also been shown to have a significant effect on students' entrepreneurial intention.

If there are supportive factors, there are also inhibiting factors that can hinder the development of individuals' entrepreneurial intention. Some of these factors include a perceived lack of managerial competence, limited entrepreneurial experience, inadequate planning experience, and the emergence of fear of failure [15], [23].

The Impact of Entrepreneurial Intention on the Emergence of New Entrepreneurs

The intention is an effective predictor of individual behavior and a good predictor of the decision to become an entrepreneur [14]. Entrepreneurial intention provides a solid framework for comprehending the entrepreneurial process. Entrepreneurial behavior is a planned and intentional process hence intention is used as the initial step in understanding individual entrepreneurial behavior. The stronger one's intentions appear, the more likely one is to behave. In the field of entrepreneurship, the stronger the entrepreneurial intention, the more likely someone's intention, urge, and determination to become an entrepreneur in the future.

The Theory of Planned Behavior (TPB) is one of several theories that can explain individual entrepreneurial intention. This theory explains that intention can influence individual behavior. It is a visible action, and the element itself is the behavior [24]. Thus, the higher the entrepreneurial intention, the more new entrepreneurs occur, because intention becomes an antecedent of behavior.

The theory of planned behavior (TPB) was developed by Ajzen in 1985. This theory investigates the factors that contribute to the production of human behaviors. It bases on the idea that human behavior is predictable because most activities are planned in accordance with various scenarios. Ajzen developed three fundamental variables that primarily influence behavior [8], namely:

1) Attitudes

   Attitudes are beliefs and evaluations of positive, negative, or neutral influences on behavior. Someone will have a favorable view of certain behaviors because they believe that doing so will yield positive effects.

2) Subjective Norms

   Subjective norms are felt as social pressures to engage in behavior that is considered to be characterized by an accumulation of available normative concepts regarding the anticipation of significant expectations. This refers to societal conceptions of behavior expectations held by individuals and groups that served as a vital reference point for individuals such as family, friends, and teachers.

3) Perceived Behavioral Control

Perception of the ease or difficulty of fulfilling an interest in behavior. Perceived behavioral control has two components: it reflects the availability of the resources needed to engage in such behaviors, including money, time, and other resources. The second component reflects someone's confidence in their ability to take action.

The theory of planned behavior (TPB) model can also be utilized as a resource planning and prioritization tool to help students improve their entrepreneurial intentions. Furthermore, students will have a better knowledge of entrepreneurial intention, which will assist them pursue their career goals as well as the bigger development goals of the country. Students are future entrepreneurs, and they should be encouraged to generate adequate career possibilities for themselves and to start their own dream businesses. Therefore, implementing the theory of planned behavior (TPB) model will contribute to the development of students' entrepreneurial intentions as well as economic development.

CONCLUSION

A number of studies still showed that there is a low level of students who want or are currently engaged in entrepreneurship, which has resulted in the emergence of several obstacles to students' entrepreneurial intention, such as a lack of individual competence in managerial terms, a lack of experience in entrepreneurship, a lack of experience in planning, and a fear of failure. Besides the inhibiting factors, there are several supportive factors that encourage students to have entrepreneurial intentions, such as influences from within and outside the student, parental employment, and behaviors like autonomy authority, economic challenge, self-realization, security, and workload. Thus, the more the entrepreneurial intention, the greater the number of new entrepreneurs, because intention becomes an antecedent of behavior.

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Indonesian Women in Education: The Nexus of Nature, Nurture, and Cultural Values

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Abstract: Women and education are two inseparable things. Education in society is initiated by mothers, as can be seen, for example, from the common phrase "mother is the first school". In addition, mothers' intervention in education in modern times is also often associated with the concept of 'nature and nurture', namely that it is natural for women to be teachers, and nurture is how women implement their natural abilities. However, in Indonesia, historically, before the 20th century, there was not much data on indigenous women who were directly involved in education. During the colonial period, indigenous women were generally considered not entitled to education, so women did not carry out the teaching process. Entering the early 20th century, two indigenous women figures were known as pioneers of women's education in Indonesia, namely Raden Adjeng Kartini and Dewi Sartika. They paved the way for women in Indonesia to be involved in the world of education. As time passes, women's contribution to education in Indonesia has increased. Their contributions can be seen in Indonesia's yearly increasing number of female educators. With that, this paper aims to trace the journey and development of women's contribution to education in Indonesia, to trace the factors that influence this development, and to trace women and the dynamics of cultural values related to the concept of nature and nurture since the early 20th century until the present.

INTRODUCTION

The nature vs. nurture debate has long been a cornerstone of psychology, sociology, and education discussions. It revolves around whether an individual's traits, behaviors, and choices are primarily determined by their inherent nature or influenced by environmental factors, upbringing, and culture. Applying this age-old debate to a specific context, we embark on a journey to understand the implications of the nature vs. nurture theory concerning indigenous women educators in Indonesia.

The choice to become an educator is a significant one, shaped by a multitude of factors. In the case of Indonesia, a remarkable phenomenon emerges when one examines the gender distribution among educators. There is a notable disparity between the number of female and male educators, with a considerable majority being women. To comprehend this phenomenon better, we will take a historical approach, delving into the 20th century and examining the influential roles Raden Ajeng Kartini and Dewi Sartika played. Their contributions to education in Indonesia provide a foundation for understanding the context in which indigenous women have chosen the path of educators.

This paper seeks to answer critical questions such as: Why do Indonesian women gravitate towards careers in education? Is there a significant difference between the numbers of male and female educators, and if so, what factors contribute to this gender disparity? Furthermore, how does culture shape the aspirations and choices of indigenous women in Indonesia regarding their careers in education?

To shed light on these questions, we will provide historical context, exploring the roles of Kartini and Sartika in pioneering female education. We will then examine current statistics and trends related to female educators in Indonesia. Subsequently, we will analyze the interplay of nature and nurture in shaping career choices, delving into the cultural influences that underpin the decisions of indigenous women.

The paper aims to comprehensively understand the nature vs. nurture debate within the specific context of indigenous women educators in Indonesia. By doing so, it seeks to contribute to the broader discourse on gender, education, and cultural influences. Let us embark on this journey through history, data, and culture to unravel the intricacies of indigenous women's choices to become educators in Indonesia.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030007-1–030007-7; https://doi.org/10.1063/5.0241709
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

UNDERSTANDING THE NATURE VS. NURTURE DEBATE

Historical Origins of the Debate

The nature vs. nurture debate is a fundamental question that has intrigued scholars and thinkers for centuries. It centers on the origins of human traits and behavior, asking whether they are primarily the result of inherent genetic factors (nature) or the influence of environmental, social, and cultural factors (nurture). This debate is deeply rooted in the history of psychology and philosophy.

The origins of the nature vs. nurture debate can be traced back to ancient philosophers such as Plato and Aristotle. Plato, for instance, believed in the inherent nature of knowledge and that individuals possessed certain innate qualities. In contrast, Aristotle argued that knowledge and behavior were shaped by experiences and environmental factors [10].

Fast forward to the 17th and 18th centuries, during the Enlightenment period, when philosophers like John Locke and Jean-Jacques Rousseau contributed significantly to this debate. Locke proposed the concept of the "tabula rasa," suggesting that individuals are born as blank slates and are shaped entirely by their experiences. On the other hand, Rousseau emphasized the importance of innate qualities, arguing that humans have natural inclinations influenced by their surroundings.[9]

The debate gained prominence in psychology in the late 19th and early 20th centuries. Notable psychologists such as Sigmund Freud and John Watson had differing views on the relative significance of nature and nurture. With his psychoanalytic theory, Freud emphasized the role of innate drives and early childhood experiences in shaping personality. Watson, a behaviorist, focused on the environmental factors that influence behavior, downplaying the role of genetics.

Modern Perspectives

Building upon the historical backdrop of the nature vs. nurture theory, we must consider how this debate has evolved in the modern era and how it continues to shape the choices of indigenous women in Indonesia regarding their careers in education. Modern perspectives on this theory emphasize the dynamic interplay between genetic predispositions (nature) and environmental influences (nurture). While the debate remains a central topic in psychology and related fields, contemporary scholars generally agree that both nature and nurture work in tandem to shape an individual's development [10].

One aspect where this interplay becomes evident is in the realm of genetics and heritability. Research in behavioral genetics and molecular biology has revealed that certain traits and behaviors have a genetic basis. For instance, studies have identified genetic markers associated with intelligence, personality traits, and preferences for specific career paths [11]. In the context of indigenous women in Indonesia choosing careers in education, these genetic predispositions might manifest in an affinity for teaching, patience, or other qualities conducive to educational roles.

However, it is crucial to recognize that genetic predispositions are not deterministic. They interact with environmental factors to produce observable outcomes. Take, for example, two sisters with a genetic predisposition for teaching. One sister may become a teacher if she grows up in an environment that values education and provides ample learning opportunities. The other sister, raised in an environment with limited access to education, might not pursue a career in teaching. This illustrates how nurturing factors, such as family, culture, and access to education, can either enhance or dampen the expression of genetic predispositions [13].

Moreover, the influence of culture cannot be understated. In Indonesia, culture plays a profound role in shaping career choices, especially for indigenous women. Traditional values, societal expectations, and gender roles intersect with the nature vs. nurture debate. For instance, the Javanese cultural value of "gotong royong," or communal cooperation, may instill a sense of responsibility toward educating future generations, motivating women to become educators. This cultural nurturing aligns with any genetic predispositions for nurturing qualities, strengthening the connection between nature and nurture [5].

In summary, modern perspectives on the nature vs. nurture theory recognize that genetic and environmental influences shape individuals' choices and behaviors. This dynamic interplay between nature and nurture provides a comprehensive framework for understanding why indigenous women in Indonesia may choose careers in education. To further explore this phenomenon and its implications, we will now turn to contemporary statistics and trends in the field of education, providing concrete evidence for the choices made by Indonesian women in the 21st century.

Contemporary Statistics and Trends in Indonesian Education

To better understand the choices made by Indonesian women in the 21st century, we turn our attention to contemporary statistics and trends in education. This data will shed light on the gender disparities in the teaching profession and help elucidate the intricate relationship between nature, nurture, and cultural influences.

Recent statistics from the Indonesian Ministry of Education highlight a notable gender gap in teaching. According to the latest available data from 2020, approximately 75% of educators in Indonesia are female [8]. This significant gender disparity points to a clear trend where women have chosen careers in education in more significant numbers than men. Such data support the notion that environmental factors, often considered a part of the nurture aspect, are crucial in motivating Indonesian women to pursue teaching careers. Cultural and societal nurturing has contributed to this trend, encouraging women to take on roles as educators, possibly influenced by values of nurturing, care, and communal cooperation deeply ingrained in Indonesian culture [5].

However, it is essential to examine the nature of these statistics. Beyond cultural nurturing, innate qualities and talents influence career choices [10]. Some women may possess natural inclinations toward teaching, such as patience, empathy, and communication skills. While these qualities are not exclusive to women, societal expectations and cultural factors might amplify them within the context of education [11]. Therefore, while highlighting the nurture aspect, the statistics do not discount the possibility of intrinsic predispositions influencing career choices [13].

This interplay between nature, nurture, and cultural influences becomes more evident when we consider the educational achievements of Indonesian women. Over the years, Indonesian women have excelled in various academic fields, including science, technology, engineering, and mathematics (STEM). This suggests that while cultural nurturing may play a role in steering women toward education, it does not limit their potential in other domains. Instead, it exemplifies how nature and nurture can work harmoniously, allowing Indonesian women to make informed career choices based on their talents and passions.

In this evolving landscape of Indonesian education, where the teaching profession remains a stronghold for women, the nature vs. nurture debate persists in a dynamic and complex manner. Within this context, we must delve deeper into the cultural influences that guide indigenous women's choices, connecting the dots between history, statistics, and culture to gain a comprehensive understanding of this phenomenon.

CULTURAL INFLUENCES SHAPING INDONESIAN WOMEN'S CAREER CHOICES

To understand why indigenous women in Indonesia tend to choose careers in education, we must delve deep into the cultural influences that guide their decisions. Culture is a dynamic tapestry woven from historical legacies, societal norms, religious beliefs, and communal values. By connecting these cultural dots to history and statistics, we can unearth the intricate layers that shape this phenomenon. In summary, the choices of indigenous women in Indonesia to pursue careers in education represent the culmination of a complex interplay between nature, nurture, and culture. Historical legacies, family and community values, religious and moral principles, and indigenous resilience contribute to this phenomenon. These cultural influences, deeply embedded in the fabric of Indonesian society, illuminate the multifaceted nature of the nature vs. nurture debate in the Indonesian context. Understanding these influences is pivotal in comprehending why indigenous women gravitate towards careers in education and how their choices contribute to the rich tapestry of Indonesian culture and society.

Historical Legacy and Iconic Figures

The enduring legacy of Raden Ajeng Kartini and Dewi Sartika is a source of inspiration for modern Indonesian women, particularly their inclination to pursue careers in education [4]. These iconic figures broke barriers and defied gender norms in pursuing education and advancing female education in Indonesia. They demonstrated that women could be society's leaders, educators, and change-makers. Today, Kartini and Sartika remain potent symbols of female empowerment, motivating indigenous women and others to follow in their footsteps. As a result, many contemporary indigenous women see education as a means of achieving social and gender equality, mirroring the aspirations of these historical figures.

The historical narrative of Kartini and Sartika reinforces the idea that education is a tool for empowerment, especially for women [2]. Their stories highlight the transformative power of education in elevating individuals and communities. Modern Indonesian women, including those from indigenous backgrounds, recognize that education can provide opportunities for personal growth and socioeconomic advancement. This awareness is particularly significant in regions where educational disparities and limited access to opportunities persist. The historical legacy of Kartini and Sartika amplifies the nurturing aspect of the nature vs. nurture debate, as it instills a sense of purpose and possibility among contemporary women.

Kartini and Sartika's commitment to education was deeply rooted in their desire to preserve Indonesia's cultural heritage [7]. They recognized the importance of preserving traditional values and knowledge while embracing modern education. Indigenous communities in Indonesia often have rich cultural traditions that they seek to protect and promote. Indigenous women who become educators can be vital in passing down cultural heritage to younger generations. In doing so, they blend cultural nurturing with their innate qualities, addressing the career choice's nature and nurture aspects.

Kartini and Sartika's legacy extends beyond education; it challenges gender stereotypes and norms [15]. By defying societal expectations of their time, these iconic figures paved the way for women to envision non-traditional roles and careers. Indigenous women, who may have faced even more entrenched gender stereotypes, find in these historical figures role models who exemplify courage and determination. The nurturing aspect of cultural values aligns with the natural aspect of innate qualities like resilience, adaptability, and a thirst for knowledge, enabling modern indigenous women to pursue careers that transcend traditional boundaries.

The Role of Family and Community

In Indonesia, the influence of family and community on career choices is profound, particularly in the context of indigenous women. This section explores how familial and communal values play a crucial role in shaping the career choices of modern Indonesian women, emphasizing the nurturing aspect of the nature vs. nurture debate.

Collectivist Values and Support Systems

Indonesian culture is characterized by collectivist values, where the interests of the family and community often take precedence over individual aspirations [5]. In indigenous communities, this collectivism is even more pronounced [1]. Elders, parents, and community leaders actively guide young individuals' life paths, including their career choices [7]. The nurturing aspect of these communal values encourages young women to consider careers that align with community needs and expectations. Education, as a means of uplifting the community, is viewed favorably and is often seen as a way for indigenous women to give back to their families and communities [12]

Nurturing from Family

Parents play a vital role in nurturing and guiding their children's career aspirations within the family unit. Mothers, in particular, are often seen as primary caregivers and educators within the home [5]. Indigenous women may have grown up in households where the importance of education and the role of educators are highly valued. As a result, they may be more likely to see teaching as a respectable and nurturing career choice. The familial nurturing aspect reinforces the trend of women choosing careers in education, as it aligns with cultural expectations and familial values [6].

Community Expectations and Role Models

Indigenous communities in Indonesia have their own set of expectations and role models. Those who have succeeded in education and careers often become role models for the younger generation. These role models serve as sources of inspiration and aspiration, reinforcing that education and educational careers are pathways to success [15]. This communal nurturing aspect extends to the broader community, where the success of one individual is celebrated as a collective achievement. Indigenous women, therefore, may feel a sense of responsibility to meet community expectations by pursuing careers in education.

Cultural Values of Nurturing and Care

Indonesian culture strongly emphasizes nurturing and care, particularly within familial and community contexts [5]. Indigenous women may be drawn to careers in education because they align with these cultural values. Teaching is often seen as a nurturing profession where educators guide and care for the intellectual and moral development of the younger generation [2]. This alignment between cultural values and career choice reinforces the nature vs. nurture debate's nurturing aspect, as it underscores culture's role in shaping career preferences [3].

Religious and Moral Values

Religion and moral values play an integral role in Indonesian culture, influencing the career choices of modern Indonesian women, particularly those from indigenous backgrounds. This section examines how religious and moral values contribute to decision-making and connects these influences to the nature vs. nurture debate.

Islamic Influence

In Indonesia, the majority of the population practices Islam, and the teachings of Islam hold significant sway over daily life, including career choices [3]. Islamic values emphasize the importance of knowledge and education, with the Prophet Muhammad saying, "Seek knowledge from the cradle to the grave" as a guiding principle [3]. This religious nurturing aspect encourages Indonesian women, regardless of their ethnic or indigenous background, to value education and potentially choose careers that involve imparting knowledge to others [4]. For indigenous women, embracing these Islamic values may further reinforce the path toward careers in education, as it aligns with their religious beliefs.

Moral Duty and Community Service

Islamic teachings also underscore the moral duty of individuals to serve their communities and promote justice and equity [3]. Indigenous women deeply rooted in their faith may view education, particularly the education of younger generations, as a means of fulfilling this moral duty [6]**.** The nurturing aspect of religious values intersects with personal qualities and motivations, influencing career choices. This connection bridges the gap between nature and nurture, highlighting how religious beliefs and moral values nurture a sense of purpose in indigenous women to become educators.

Interplay of Cultural and Religious Values

In Indonesia, cultural and religious values often intertwine, creating a seamless blend of beliefs and practices [5]. Indigenous communities have adapted Islamic teachings to align with their cultural traditions, further reinforcing the importance of education and community service [7]. This interplay between cultural and religious nurturing is particularly evident in the role of religious leaders and community elders who guide and mentor young women, encouraging them to pursue careers that contribute positively to society [15]. The nature vs. nurture debate comes to light here, showcasing how religious and cultural nurturing can harmoniously shape career choices.

The Moral Character of Educators

Educators are often perceived as individuals of high moral character who guide students academically, morally, and ethically [2]. This perception aligns with Islamic values, prioritizing good character and ethical conduct [3]. Indigenous women, driven by their religious and moral values, may see careers in education as opportunities to instill these virtues in future generations. The moral nurturing aspect, rooted in culture and religion, encourages them to choose careers that reflect these values.

Resilience and Adaptation

Resilience and adaptability are intrinsic qualities that play a pivotal role in shaping the career choices of indigenous women in Indonesia. This section explores how these qualities intersect with cultural and environmental factors, emphasizing the nature aspect of the nature vs. nurture debate.

Historical Context of Resilience

Indigenous communities in Indonesia have a long history of resilience and adaptation, facing challenges such as colonialism, environmental changes, and economic fluctuations [7]. These experiences have instilled resilience and adaptability as core qualities within the fabric of indigenous life. Indigenous women, in particular, often find themselves at the forefront of managing these challenges, whether it be through agriculture, community leadership, or other roles. These experiences provide a nurturing environment that fosters a sense of resilience and adaptability from a young age [12].

Resilience as Inherent Quality

Resilience can also be seen as an inherent quality, a product of genetic predispositions and environmental nurturing [6]. Indigenous women may naturally be inclined to persevere and adapt to changing circumstances. These innate qualities intersect with the cultural nurturing aspect, where community values encourage individuals to step up and take on roles that benefit the collective. In education, indigenous women may see teaching as a way to empower their communities, drawing upon their resilience and adaptability to navigate the profession's challenges [15].

Adaptation to Changing Roles

As Indonesian society evolves, so do the roles and expectations of women, including those from indigenous backgrounds. Indigenous women have demonstrated their ability to adapt to changing roles within their communities and beyond. Education represents a modern avenue through which indigenous women can contribute to their communities while adapting to societal changes. The nurturing aspect of cultural values aligns with the natural aspect of adaptability, as indigenous women use their innate qualities to excel in education and embrace changing gender dynamics [4].

Empowerment Through Education

Indigenous women who have experienced adversity firsthand understand the power of education in overcoming challenges. They recognize that education equips individuals with the knowledge and skills needed to address issues within their communities, fostering empowerment and self-reliance [2]. This awareness aligns with both the nurturing and nature aspects of the nature vs. nurture debate. It illustrates how indigenous women draw upon their resilience as an inherent quality and adaptability nurtured by their communities to make informed choices that lead to careers in education, symbolizing their commitment to empowering their communities [14].

CONCLUSION

The career choices of Indonesian women, particularly those from indigenous backgrounds, are the culmination of a complex interplay between nature and nurture. This intricate dance between inherent qualities and environmental influences paints a vivid tapestry of their educational and career trajectories.

Nature, represented by an individual's innate talents, interests, and personal characteristics, plays a foundational role in shaping career preferences. These inherent qualities can serve as the seeds from which career aspirations grow. For instance, a natural aptitude for certain subjects may lead to pursuits in related fields. However, nature alone is not the sole determinant; it serves as the canvas upon which the brushstrokes of nurture are applied.

Nurture, encompassing cultural, familial, and societal influences, emerges as a prevailing force in guiding Indonesian women's career choices. Cultural values, societal expectations, and familial support shape educational and vocational aspirations. Iconic figures like Raden Ajeng Kartini and Dewi Sartika, historical legacies of resilience and adaptability, religious and moral values, and communal nurturing contribute significantly to the nurturing aspect. These influences create an environment where specific career paths, notably in education, become not just choices but manifestations of cultural and societal values.

However, it is imperative to recognize that the nature vs. nurture debate in Indonesian women's career choices is not a binary opposition. Instead, it is a dynamic interplay where nature and nurture complement and enhance each other. Inherent qualities, like resilience and adaptability, interact with environmental factors to inform decisions. Cultural values and religious beliefs may nurture natural inclinations, reinforcing career choices.

In the journey of Indonesian women, particularly those from indigenous backgrounds, to become educators and contributors to their communities, nature and nurture are harmoniously interwoven. Their career choices are the product of their unique blend of inherent qualities and the nurturing environment that encourages them to excel in education and serve as agents of change. Therefore, this harmonious interplay of nature and nurture ultimately defines Indonesian women's educational and vocational paths, highlighting the richness of human development and the complexity of individual choices within cultural and societal contexts.

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The Popularity of Korean Culture Among Indonesian Millennial Muslims: Between Cultural Globalization and Religious Values

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Abstract. K-pop, a South Korean music genre has gained immense global popularity among millenials Muslims, including in Indonesia and other Muslims countries. Public and academic debates on this topic revolve around the increase interest of young Muslims and its impacts to their religious and cultural lives. Some of them see K-pop as a cultural threat that will weaken local values through the cultural imperialism. Others view that the popularity of K-pop is a logical consequence of a massive globalization throughout the world. Significant number of millennial Muslims follow this growing cultural trends and they think that K-pop is not a threat. The questions that arise in this topic are: Do K-pop a cultural threat to local culture? How K-pop can be compatible with Islamic values? These research questions will be answered through a qualitative approach with literature-based studies. The research found that K-pop bring global youth feel more connected to each other beyond cultural and religious boundaries. They are aware of living in a multicultural society and learn how to love and respect the diversity. However, K-Pop culture in Muslim society remains a homework on how young Muslim millenials still maintaining both global cultures, local identities and religious values.

INTRODUCTION

Indonesia is the fourth most populous country in the world, as well as the biggest Muslim country where the majority of population is Muslim. Indonesia is also very rich in cultural diversity, therefore Indonesian culture is different from other cultures. The difference lies in beliefs, religion, culture, and tradition. The diversity of religions because Indonesia has six of religions include: Islam, Christianity, Catholicism, Hinduism, Buddhism, and Confucianism. This diversity makes Indonesia become an interesting country for discussions. When discussing Islam and culture in Indonesia, the existing culture is very diverse. But after the entry of many foreign cultures, because it is caused by the increasingly rapid globalization which we must get dozens of information from various platforms available every day. Since the presence of foreign cultures entering Indonesia, the existing culture in Indonesia seems to be slowly fading away because of the enormous influence of foreign cultures. Yes, the foreign culture in question here is popular culture from the country of "Gingseng" or South Korea. Along with the passage of time and also the rapid development of information technology, it is one of the main factors that cause the entry of *Hallyu* or Korean wave in Indonesia, particularly among teenagers.

The entry of *Hallyu* was around the early 2000s which was when the emergence of the Korean TV drama series which was very popular at the time [1]. Not only TV drama series, but starting from the world of music, drama, fashion, culinary, variety shows, and beauty products that include Korean culture, it is currently a big plague for teenagers, especially women in their daily lives. One of the products resulting from the Korean Wave is its pop music or commonly referred to as K-Pop, which is a popular musical entertainment that includes various musical genres such as Pop, Hip-Hop, R&B, and Dance Pop that has raised the economy of South Korea. With the continuous development of popular culture, especially in the K-Pop music industry, 5 billion USD of revenue is generated in sales each year [2]. The term K-Pop can also be described as songs, music genres, and also dances produced by an idol, either from a group or solo [3]. Indonesia itself seems to be a "home" for K-Popers, in the Prambors media said that Indonesia occupies the first position with the fourth largest number of K-Popers in the world. not infrequently these K-Popers build a community of fans of their favorite idols on various platforms on social media with the aim of establishing a relationship between fellow fans [4].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030008-1–030008-7; https://doi.org/10.1063/5.0244930
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

But if we look back at the strong Islamic religion in Indonesia, what is the response of Islam itself regarding the popularity of K-Pop foreign culture that is currently being "consumed" by teenagers every day. Does Islam allow its followers to idolize someone? Some scholar suggest that popular culture needs to be restricted on many levels is a statement that has been made by many theologians of different religions, historically speaking. Specifically, Islam in some of its views considers that the diversion towards popular culture is prohibited, because then Muslims will divert their attention from religion and their obligations as Muslims will not be carried out as they should. Because religion is an eternal, sacred, and invaluable entity which is different from popular culture which is worldly, man-made, and ephemeral [5]. This causes a person to be away from religious morality and their obligations as Muslims. Since the entry of K-pop culture in Indonesia, there have been many impacts, especially on teenagers [6].

Many articles cite the negative impact of this influx of K-Pop. For example, the lack of love for the country's culture, fanaticism, and also the way a person looks. In terms of religion, it can reduce our sense of obedience to our obligations as Muslims and the fading of one's morality. However, if we are good at sorting out information, there are actually a lot of positive effects. Examples of positive impacts are attitude, unyielding spirit, discipline and hard work to achieve success, love to save money, learn new (foreign) languages, increase relationships, care for others, even learn how to love ourselves, and motivate ourselves to continue learning new things that have a positive influence on ourselves and others. And in terms of religion, we can learn that with the existence of a K-Pop fandom community, human beings are closely related to their relationship, especially for those who are Muslims. Thus, it is one of the reasons why someone admires an idol. Until now, there has been little research on the socio-religious theme of Islam and K-Pop culture [7]. Therefore, researchers will conduct an assessment of Islam and K-Pop culture, especially for K-popers in Indonesia, where the majority of the population is Muslim. In addition, researchers also try to build a counter narrative to the negative view of K-Pop culture with the aim of creating cultural assimilation and acculturation.

RESEARCH METHOD

This research uses a qualitative method based on literature study. In this research, two sources are used, namely primary and secondary. Where primary sources are sources that come from books, journals, and previous research that has been done by previous researchers as a basis for analysis in this study. while secondary sources are things that are independent of what has been published such as individual observations of the environment. The research stage is carried out by reviewing and synthesizing all the results of primary sources in a clear formulation and sequence in this study. Then the results of the synthesis are assembled into interconnected and related data. Meanwhile, the same thing will also be done to secondary sources with the aim that the data can be connected, compared and completed to each other. Then, the two data are united and linked into a single and clear unity.

RESULT AND DISCUSSION

K-pop, Cultural Imperialism, and Cultural Acculturation

In the 1960s cultural imperialism emerged and became a hot topic among political elites in the 1970s [8], the theory of cultural imperialism is a concept that illustrates how the process of cultural domination of one group over another group with cultural influences brought. One of the thinkers of the theory of cultural imperialism is Edward Said, he has a book entitled "Orientalism". In his book he discusses how Western countries dominate and hide Eastern countries by using stereotypical representations and one-sided knowledge about them [9]. Such thinking is evidence of the importance of intercultural postcolonial studies. Cultural imperialism is a process by which one culture imposes its political and economic control on another culture, but not by deploying political armed forces and physical force, but by means of its cultural values [10]. According to analysis, outside South Korea, especially in other Asian countries, the K-Pop genre has recently become a global phenomenon [11]. This Korean wave (*Hallyu*) product is considered profitable in countries located in East Asia, namely most of Japan, China, and Taiwan [12]. Its growing popularity has hypnotized millions of fans around the world, but behind its success lies cultural imperialism and how this phenomenon can affect the identity of a culture in other countries, especially in Indonesia. One of the important factors in the development of K-Pop's popularity in Indonesia is due to the rapid advancement of technology which includes social media such as Twitter, Instagram, Youtube, and other supporting platforms that can stream the music.

Herb Schiller is a figure who first introduced the theory of cultural imperialism in 1973. Globally, mass media dominates Western countries, because the Western third world media gives an implicit impression, it is the theory of cultural imperialism [13]. Therefore, there is a sense of their desire to imitate the culture seen in the media. According to the point of view on this theory, the destruction of the original culture in developing countries can occur if the mass media in developing countries imitate the mass media in developed countries, say like Korea (developed) and Indonesia (developing). Thus causing an impact on developing countries where more and more foreign cultural influences enter Indonesia and will eventually affect the original Indonesian culture itself. The global rise of K-Pop music certainly cannot be analyzed without consideration through a long and complex interaction with American culture. Meanwhile, according to another view, K-Pop is evidence of "Westernization" which does not mean describing it as the simple opposite of media imperialism [14]. Basically, cultural imperialism in the K-Pop industry can occur through the dominant influence of South Korean culture in music. In addition, the emergence of this theory of cultural imperialism is that humans do not have the freedom to determine how they think, and what they feel and how they live, because they react to what they see in the mass media. Thus, this theory of cultural imperialism provides insight into intercultural interactions that can form a pattern of domination and strong influence from one cultural group over another.

On the other hand, the entry of foreign cultures can usually be through the process of cultural acculturation, this process can occur in the form of assimilation or integration. In the form of assimilation, a stronger cultural group absorbs and replaces the cultural elements of another group, which causes cultural homogeneity. Whereas integration is the merging of cultural elements from both groups in a balanced manner, then creating a unique identity. The theory of cultural acculturation which can occur when two groups with different cultural backgrounds come into intensive direct contact. Cultural acculturation is a process of mutual interaction in which the two groups have different cultures, meaning that they can adopt and change aspects of each other's culture. Usually, cultural acculturation can occur through the exchange of ideas, values, social practices, music, language, visual arts, food, and other cultural elements [15]. There is one of the early thinkers in the theory of cultural acculturation, Robert Redfield, who has a book entitled The Folk Culture of Yucatan. In his book he defines acculturation as "cultural change resulting from direct contact between two previously separate groups" then this idea was developed by other researchers such as John Berry and Milton Bennett [16]. Milton Bennett founded the "Intercultural Development Research Institute" with the aim of supporting research into intercultural practical applications. According to him, when the organization of one's perception of cultural differences becomes more complex, one's experience of culture becomes more sophisticated and has the potential to exercise intercultural relationship competence to increase [17].

The emergence and development of export-oriented K-Pop began with a brief history of South Korean popular music. Ingyu Oh and Hyo-Jung Lee, they recognize the social and cultural changes that made K-Pop music fame prestigious. In addition, they also know, showing government policies and commercial interests that contribute to the cultural industry [18]. Thus from the theory of cultural acculturation where there are two different cultural groups, but can interact with each other and create a new blend through certain ideas. Thus, this process can involve assimilation or integration as well as cultural resistance. In conclusion, K-Pop is a complex phenomenon in which cultural imperialism and cultural acculturation coexist and influence each other. Feedback on cultural imperialism should be looked at carefully so as not to disguise global popularity with cultural colonization. Meanwhile, on the other hand, in the context of acculturation, K-Pop has brought new elements that are unique and become an important part, especially of the global music industry.

Islamic responses toward the development of K-Pop culture

The rapid development, especially in the Korean music industry or commonly known as K-Pop, has hypnotized many people around the world, including Muslims. In Islamic teachings, admiring or liking a culture is not prohibited as long as it does not conflict with the teachings of Islam [19]. Allah SWT says in Q.S. Al-Baqarah verse 120 which explains that if the incoming culture is felt to lead to a negative influence, then it is better for the culture to be abandoned. However, if the culture leads to positive things, then it would be nice for someone to be able to filter the incoming culture properly, so as not to cause fanaticism and consumptive behavior in admiring the foreign culture [20]. Islam also does not prohibit its followers from idolizing someone, because as long as the idols they admire have a positive influence and are a good example for themselves, then it is permissible for someone to admire their idols. If you look at the reaction of Muslims from the existence of this K-Pop culture, then not a little fanaticism arises in individuals in responding to the incoming culture [21].

Fanaticism or *ta'assub* is a dangerous disease, which is the behavior of the people of Jahiliyah because at that time they were fanatical about the religion of their ancestors [22]. Fanaticism is a trait that exists within individuals when they are fond of an object or subject, of course with excessive nature, for example, such as giving a gift to the idol [23]. Fanaticism will develop if this behavior can endanger others, especially if it leads to negative behavior such as aggressive behavior [24]. Therefore, Islam is very concerned about the entry of the development of K-Pop culture, because it is feared that there will be changes in the behavior of Muslims towards the entry of this foreign culture. In addition to the influence of fanaticism, there is also consumptive behavior that is feared to grow in individuals. In Islam itself, consumptive behavior or being excessive is not recommended, this has been explained in the Word of Allah SWT in Q.S. Al-Maidah verse 77 regarding someone who idolizes or admires idols in the view of Islam as long as the fan does not contradict the teachings of Islam, such as following fashion or resembling others, it is permissible. Because if someone has resembled or followed a people, then it is prohibited by Islam.

In this context, various perspectives on this popular culture get a reaction from Islam, seeing the rapid popularity of culture and products from South Korea [25]. In response to the rapid growth of K-Pop culture, there are a number of Muslims who positively accept the development of the K-Pop music industry [26]. Because they consider basically that art and entertainment are part of life that can be enjoyed without having to forget about moral values, religious ethics, and do not conflict with religious teachings. Meanwhile, there are some scholars who view that music as a whole is prohibited (*haram*) because they see that there are fragments of a lyric that contradict moral values in Islamic teachings. In addition, there is a connection with gender representation which often displays sexualized images or certain stereotypes about men or women [27]. Popular culture today is a powerful platform for ideological struggles that continually ask questions about what it means to be a Muslim in this modern society [28]. If we look again, that the Islamic view of K-Pop culture certainly varies from one Muslim individual to another, because Islam is a broad religion with a variety of cultures and different understandings, therefore it is very important for each Muslim individual to do self-reflection, because each individual is entitled to have their own opinion, and it is also possible for individuals to consult with people who have a broad and deep knowledge of religion, in order to decide how to deal with this K-Pop phenomenon according to their respective beliefs.

Cultural counter-narratives as an effort to reconcile Islam and K-pop

The conditions that have developed in the community show the existence of a social resistance that develops between those who enter the *hallyu* circle and those who reject it. However, it should also be understood that the cultural contestation that develops in the context of K-pop is not at a broad and massive level such as the contestation between conservatism and traditionalism or religiosity and secularization. Rather, it is a small skirmish between those who are *hallyu* and those who are anti-*hallyu*. Meanwhile, ordinary people are not actively involved in this matter in an effort to support or reject the entry of Korean culture into society. This happens because the *hallyu* phenomenon is a generational phenomenon like beatlemania and the like [29]. Thus, contestation is more developed and thrives in the midst of that generation. While other generations in society, only act and react to external matters and are seen in front of the public. Meanwhile, the internal problems that occur within it are difficult to understand because of generational differences in understanding a culture.

The big premise in discussing K-pop is about cultural imperialism and Islam's efforts to carry out protectionist policies in defending the values contained therein [30]. This has led to the general notion that K-pop culture is an attempt to colonize Indonesian religious and national culture. This notion can be seen when we discuss the issue at the beginning of the discussion. Where, social perceptions are formed and see that K-pop and *hallyu* are an attack on the culture that develops in society and must be eradicated to its roots [20]. However, this kind of notion is not realistic in an international constellation that requires cultural exchange and globalization activities among the world's population. Thus, trying to fight and make statements about the rejection of outside culture is counter-productive. Therefore, we need to realize that a counter cultural narrative is needed so that K-pop can be integrated and interconnected with the culture of Indonesian society, which aims to reconcile both parties without suspecting each other [31].

In essence, the relationship between one culture and another can be established in a positive relationship such as cultural assimilation and cultural acculturation. Where this relationship provides symbiotic mutualism to all parties without any harm to others. Therefore, some cases such as the entry of Islam in Indonesia, successfully occurred because of the assimilative and acculturative attitude of the spreaders of Islam in Indonesia [32]. Thus, Islamic culture can unite with Indonesian culture without a significant resistance movement to fight and reject Islamic culture that comes from the Arabs. This happened because of the efforts of the spreaders of Islamic culture who did it slowly without openly fighting and opposing the local culture that was developing. Therefore, people gradually accepted Islam as a religion and a culture that came from the hands of propagators from outside their region openly [33].

We can apply the same notion in the context of Korean culture which is currently growing rapidly in Indonesian society. Where an assimilative and acculturative attitude is needed for the *hallyu* group to be accepted by ordinary people. Because, Korean culture is a culture that is outside of local culture, so the community sees that the development of Korean culture is an imperialist attitude and Korea's efforts to build its power hegemony in international politics [34]. Therefore, the community strongly emphasizes local cultural protectionism which aims to maintain and protect ancestral culture from the arrival of other cultures that invade and attack local culture. Therefore, to achieve good assimilation and acculturation. Then there are three matters that must be resolved by the *hallyu* to achieve their cultural integration [35].

The first thing that needs to be resolved is the matter of the ontology building that develops in K-pop culture. This is very important to be addressed by *hallyu* in its development efforts in Indonesia. Because, K-pop always comes with prejudice and rumors that they defend their idols militantly and aggressively. These things are seen in several fights between fans or between community members [36]. This is certainly very contrary to the values of the national ontology that developed in Indonesia. Therefore, a change in the construction of ontology that deifies their idols needs to be changed into an ontology that understands that there is a boundary between the reality that develops and the expectations that exist regarding their idols. Thus, *hallyu* can be moderate and objective in understanding the situation and giving their opinions. These kinds of attitudes are currently developing among the majority of *hallyu,* so their Korean culture can slowly be accepted by ordinary people [31].

The second issue that needs to be resolved is the epistemological building used to introduce K-pop to the general public, which in this case is millennial Muslims. One of the problems that arise with K-pop is the existence of a Korean-centric framework. Where the interpretation of the progress and decline of knowledge in culture is judged by the reality that develops in Korea. This kind of matter in the context of millennial Muslim communities can be misunderstood and also misinterpreted as an attempt by K-pop to turn millennial Muslims away from Islamic teachings [37]. Thus, it creates a resistance and a wave of rejection that sees Korea as Europe. So to answer this issue, we need to understand and consolidate between the two cultures so that they do not dominate each other and suppress other cultures from existence [38]. This has the ultimate goal of building a culture that is integrative and interconnected to all cultures. So to achieve this, K-pop must relativize itself in the society it faces. Thus, millennial Muslims can accept the culture without abandoning their faith and creed.

The last issue that needs to be resolved is the matter of the axiological building used as the basis for K-pop in understanding behavior in society. It needs to be understood that K-pop is a culture coming from Korea that has ethical values that are different from the culture in Indonesia and Islam [39]. This has a significant influence on the perception of a society in assessing a case. Moreover, a culture like Islam, which has a long history of ethical studies, sees that the existence of new ethical values that do not align with what has developed in the Islamic world is a sign that the culture will be very different from what is in the middle of society [40]. So to answer this, K-pop must be able to adapt and leave ethical values that are different from what is understood by society. Because, the ethical values if still applied will be a form of counter-productive to the efforts of the development of K-pop culture. On the contrary, minimizing resistance and uniting the two cultures is the right action in building strong relations between cultures.

From the above, we realize that as long as K-pop and *hallyu* can position themselves well in society. Then resistance to that culture does not appear significantly. Conversely, if K-pop understands itself in an egoistic building. Then the community will be outraged and carry out an upheaval to expel Korean culture that develops in Indonesia. While specifically, this matter can also provide space for expression for millennial Muslims to interact with this Korean culture with the limitation that it does not interfere with their faith and creed. Because, if the matter has crossed the limit, there will be an effort of protectionism to fight and maintain the purity of Islam from outside influences.

CONCLUSION

This research highlights that K-pop has become a significant cultural trend and phenomenon with a diverse followers, including young Muslim communities around the world. the platforms of social media have played crucial role in connecting fans of K-pop globally. Muslims fans also engage in online talks that to many extent strengthen their sense of community, sense of belonging and identity among millenials. They have stronger connection to a global youth culture that transcends national boundary as well as religious boundary. This study recognizes also the complexity of aspects on how K-pop impacts on Muslim millenials and its various aspects of lives. The study also sees there are complex interplay between cultural globalization, local identity, and religious values. K-pop has led to an increased cultural exchange between youth in Korea and youth in other countries, inclusing young people in Muslim-majority nations like Indonesia. It serves as a cultural diplomacy, people-to-people diplomacy as a form of soft power in promoting Korean culture.

However, some of these millenials Muslims found the differences and tension between their religious and cultural values and K-pop songs and culture. In this issue, emerges the resistances to K-pop because they see there is a tendency to harm religious values and local culture identity among young Muslims. That is why we need to create a counter-narrative that effective and productive to balance Korean culture. We need to fix three binding and fundamental aspects that are the bases of the resistance of the rejecters. These are the attitudes of ontology, epistemology, and axiology which are considered incompatible with religious and national culture. Thus, there is a need to reorient these three aspects into a building that is assimilative and acculturative to local culture and indeed there is no attempt to dominate the existing local culture.

ACKNOWLEDGMENTS

The authors would like to thank for all supports from the University of Muhammadiyah Prof. DR. HAMKA (UHAMKA), Lemlitbang UHAMKA, Faculty of Islamic Studies (FAI)-UHAMKA, and Fakulti Bahasa dan Komunikasi, Universiti Pendidikan Sultan Idris (UPSI), Mu'allim Perak, Malaysia

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Revealing the Local Wisdom Values of *Tarsulan*' Tradition Carried Out at the Kutai Tribe Wedding in East Kalimantan

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Abstract. The 'Wedding Tarsulan' is an oral tradition belonging to the Kutai tribe, which is still maintained and practiced by the people albeit less frequently in recent days. This current study aims at revealing the local wisdom values embedded in the tarsulan, particularly in the context of wedding ceremonies of the Kutai Tribe. The method employed in this study was descriptive qualitative through an intensive library study to reveal, process, and describe the local wisdom conveyed in the tarsulan. The data collected in this study were the local wisdom values found in the tarsulan tradition carried out at a wedding ceremony. The data sources included the scripts of the wedding tarsulan which are still used by the people and well-documented in the forms of books, modules, and even those available online. The findings of this study indicated that the local wisdom values in the wedding tarsulan were related to seven main values, namely: (1) religiosity; (2) respect; (3) humility; (4) commitment; (5) prudence; (6) modesty, and (7) responsibility. All these seven values were found in the verses uttered by both the male and female minstrels (called as penerasul). Furthermore, these local wisdom values are still highly honoured by the Kutai people.

INTRODUCTION

The Kutai tribe is an indigenous tribe which belongs to the Old Malay tribe inhabiting the East Kalimantan region. The Kutai tribe has a highly diverse richness of arts and culture, including dance, music, drama, and other forms of cultural arts [1]. In their daily life, the Kutai tribe upholds civilization, culture, and customs that are carried out for generations[2]. One of the cultural traditions of the Kutai tribe that is still known is tarsulan (also known as terasul), which is a poem sung by the Kutai people (Dinas Kebudayaan dan Pariwisata, 2011) that has local wisdom values which are useful in the life of the Kutai tribe as a community. As a long-established traditional art, tarsulan still exists today in the Kutai community [3]. However, as time goes by, the wedding tarsulan is rarely used in marriage ceremonies these days. In addition, the government has designated an area in East Kalimantan region, particularly in Penajam Paser Utara Regency, as the new capital city of Indonesia so that the Kutai people will be faced with external cultural influences that are not necessarily in accordance with their way of life. As a result, it is not impossible that the Kutai people will be uprooted from their cultural roots so that the tarsulan which is also their identity will be lost.

At the beginning, tarsulan was a form of musical art sung by the nobles of the Kutai Kingdom, in particular it was called '*tarsulan berkatam Al-Qur'an',* which was sung by minstrels [4]. The tarsulan sung by the Kutai tribe was originally in the form of poetry. To maintain the existence of tarsulan, Kutai people have developed it into other literary arts that are associated with the cultural customs of the Kutai tribe [5]. Therefore, it is not uncommon for tarsulan to be played at the opening of the event or when making offerings of the people's harvest to the king and his relatives [6]. Nowadays, there are also tarsulan with political themes for political campaigning and tarsulan with social themes for social propaganda or social criticism. However, the tradition of tarsulan in marriage ceremonies is at the same time rarely practiced because it is rather expensive and requires extensive resources.

Tarsulan is conveyed by memorizing or uttering and it is passed down through the speech of grandparents, grandmothers, or tribal elders. However, there are also those who deliver tarsulan by reading or memorizing. In the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030009-1–030009-10; https://doi.org/10.1063/5.0243064
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

marriage ceremony, tarsulan is developed by a pair, namely the male and female minstrels representing the bride [7]. The male minstrel represents the bridegroom and the female minstrel represents the bride. The reading of the tarsul begins after the bride and groom sit on the aisle [8]. Therefore, as a literary work, tarsulan is an effective medium for channeling the message to be conveyed, both by the male and the female minstrels.

The tarsulan tradition contains local wisdom values that are still held and practiced by the Kutai tribe. Weighing good from bad, natural conditions and existing communities often become a reference to bring up the wisdom of knowledge and behavior as humans in civilized social life . The existing culture and customs provide a reference or guideline for local wisdom values from the wise ones in living one's life so as to give birth to community actions and behaviors that reflect the distinctive character of the Kutai people.

Local wisdom can be understood as a wisdom that applies to a place and can be understood as local ideas that are wise, full of wisdom, as well as value that is embedded and followed by the community . Knowledge, beliefs, understanding, insights, customs, or ethics that guide human behavior in life in one community can be categorized as local wisdom of a society. Local knowledge that has been integrated with belief systems, norms, and culture, as well as expressed in traditions and myths is adhered to for a long period of time. In anthropology, local wisdom is also known as indigenous or local knowledge or local genius, which is the basis of cultural identity.

Local wisdom is closely related to traditional although the concept of traditional does not necessarily mean backward. Therefore, local wisdom also changes as a result of the times and changes in society. As the owner of cultural elements, the community must consider cultural elements that must be preserved and cultural elements that can change. Changes in cultural elements are not felt by the owner . In this case, the change or development of one of the cultural elements that is considered traditional must be done gradually so that the existence of cultural supporters is not lost. If the existence of cultural supporters is lost, it will have implications for the loss of cultural identity, including the loss of values contained in the local wisdom of the community.

To obtain local wisdom values that are part of the community culture, the views of n[9]are used as a rationale. Local wisdom is a form of culture created by the ancestors of a nation that contains noble values and can be used in building national character. As an inseparable part of human life, either individually or communally, culture is closely related to the processes in human life regarding intellectual, spiritual, and aesthetic development, including as a view of human life, both individually and in groups. (Storey, 1993).

Meanwhile, [9] emphasized that local wisdom (often also called local genius) has cultural values of local communities that contain certain directions of wisdom. Local wisdom also has an extraordinary ability (charm) in solving the problems of human life. Furthermore, [9] revealed that cultural values/local wisdom are related to five main issues, namely (1) human life, (2) human work, (3) human position in time and space, (4) human relations with the surrounding nature, (5) human relations with each other. The five can be found in literary works, both oral and written, in the form of ideas, values, norms, and regulations for the welfare of human life, such as unity and integrity, learning from nature, mutual cooperation, tolerance, mutual respect, hard work, honesty. The culture of a region that contains local wisdom can be broken down into specific elements that are universal and can be found in the cultures of all nations. These cultural elements include language, knowledge system, social organization, system of human equipment and technology, human livelihood system, religious system, and art [9].

In this article, local wisdom can be understood as a view of life and knowledge as well as various life strategies in the form of activities carried out by local communities in answering various problems in fulfilling their needs. Therefore, the local wisdom of the Kutai tribe in this article relates to the local values contained in the oral tradition of tarsulan which is still maintained and applied in the life of the Kutai tribe.

Previous research related to tarsulan was conducted by [10] ; [7]; and [5]. [10] focused her research on the figurative language in the Kutai tarsul poem, Ngembang Labu, in Tanah Perdu, by Syaipul Anwar. The results show that there are three kinds of figurative language used in the tarsul that become the data source, namely (1) comparison type (including hyperbole, personification and eponymy); 2) repetition type (including alliteration and mesodiplosis); and 3) affirmation type (including repetition and parallelism).

[7] focused more on the preservation of Kutai Tribe's tarsul pantun in Samarinda. The results of his research showed that the Culture Office succeeded in preserving tarsulan in Samarinda. Pantun tarsulan used to be performed only during the betamat Al-Qur'an ritual and marriage ritual. Currently, tarsulan pantun can be performed by interspersing the art of Sandiwara Mamanda, traveling performances, and performing it on TVRI every Wednesday along with the Mamanda drama.

Meanwhile, [5] in his research on the cultural insights of the Kutai tribe focused more on Islamic culture in the customs, arts and literature of the Kutai people in an ethnographic-descriptive review. The results show that the Kutai tribe as a subculture in Indonesia has cultural channels in the form of customs, art and literature. The exploration of local cultural channels in the paper is intended to find the correct perspective on Islam in the interaction of local culture and society.

Therefore, this article will focus on exploring the values of local wisdom contained in the oral tradition of tarsulan, especially those held at weddings. Apart from the fact that this focus has not been studied much by previous researchers, this article can also be a medium for disseminating local wisdom and as a trigger for efforts to preserve oral traditions, especially tarsulan.

METHOD

This research employs descriptive qualitative methods through literature review to reveal, process, and describe the phenomenon of tarsulan in the culture of the observed community. Qualitative research prioritizes the meaning that is revealed around people's perceptions of an event. The research data is in the form of local wisdom values contained in the tarsulan tradition at the wedding ceremony. The data comes from several tarsulan that are still used by the community and have been documented, namely (1) the book Tingkilan and Tarsulan Suku Kutai compiled by Djumri Obeng and published by the Indonesian and Regional Literature Book Publishing Project, Ministry of Education and Culture, 1980; (2) the Kutai Literature Module book, written by the Indonesian Language and Literature Education Study Program, Department of Language and Arts Education, Faculty of Teacher Training and Education, Mulawarman University, 2021; and (3) the text (poem) of tarsulan uploaded from the internet. As a record of events that have passed, documents can take the form of writings, pictures, or monumental works of a person (Sugiyono, 2013).

The data collection process begins with collecting (1) understanding and exploring the meanings contained in the tarsulan which is the source of data, (2) finding local wisdom values contained in the tarsulan, and (3) categorizing these local wisdom values based on their types and criteria. The process is in accordance with that data collection can be done through a search and discovery of evidence in the documentation as a data source.

RESULTS AND DISCUSSION

The results showed that in the marriage tarsulan, local wisdom was found related to seven main values, namely (1) religiosity, (2) respect, (3) humility, (4) commitment, (5) prudence, (6) modesty and (7) responsibility. These local wisdom values are expressed through four issues that are often sung in the marriage tarsulan poem (Obeng, 1980), namely the expression of the heart (bride/groom); the expression of promises (commitment) in marriage; the expression of prayers to God; and the expression of gratitude to God. The values that become local wisdom are very useful in maintaining the order of life in society, nation and state for the Kutai tribe. The value of local wisdom is not only seen as a horizontal dimension, but also vertical dimension as the principle of mental resilience of human life.

Religiosity

The first value of local wisdom reflected in the tarsulan tradition is religiosity or religious values. Essentially, the function of tarsulan as oral literature of the Kutai tribe was originally used as a medium or means of religious ceremonies or sacred beliefs, namely khatam Al-Quran. This is in line with Mangunwijaya (1982) who said that "in the beginning, all literature is religious". Religious values are clearly expressed in the marriage tarsulan, as follows.

(Male Minstrel)	(Female Minstrel)
By Allah Raobbul Izzati I swear with a pure heart All your promises are kept As long as I live until I die	If so, it has been determined Let us sail the ark of life Navigating the ocean Because happiness is the hope

The ark is sailed
slowlyFull of
hope easily
Up to a port
Full of God's mercy
and favor

All the prayers you said
The happiness we've
been aiming for
May Allah grant you
Grace and favor always
poured out

(Source: Djumri, 1980)

The religious value in tarsulan poetry is very prominent. It is shown by many words/terms taken from the treasures of Islamic teachings. Tarsulan poetry always begins with praise to Allah, for example with the expressions *bismillah, alhamdulillah, mercy, blessings, for the sake of Allah*, and so on. Likewise, there are expressions of prayer, such as “May my wish be granted, may we all be safe, may Allah grant it,” and so on. This is in accordance with the demography of the Kutai Tribe community, the absolute majority of which is Muslim. Speech and actions related to the teachings of Islam have become a habit. The social life system also reflects the practice and manifestation of the crystallization of Islamic values.

In addition, religiosity values can be shown by being an individual who obeys the teachings of their respective religions, upholds tolerance, and lives in harmony with followers of other religions. Activities that can be implemented to materialize this value include reading the Koran before starting lessons and applying Islamic teachings in everyday life. In Wedding Tarsulan, this is shown by both male and female minstrels. It is shown in the expression of "in the name of Allah" by the male minstrel found in the following tarsul excerpt.

(Male Minstrel)
In the name of Allah we say,
facing the audience and
invitees.
Accept the love we serve,
in the presence of
the audience we recite

(Female Minstrel)
Alaikum mussalam
replied Adinda, please come in,
O brother.
Please sit with me,
what is the desire
in my chest?

[3]

Religious attitudes are also depicted in the end of the tarsulan. The male minstrel mentions the word Bismillah as an expression of the religiosity of a Muslim, as follows.

(Male Minstrel)

Bissmillah it begins

with the name of Allah we also convey

if we speak incorrectly

please forgive us

[3]

The attitude of religiosity by using the expression of *Bissmillah* indicates that the Kutai people start any activities or events by worshiping God as highly as possible. It indicates that humans as God's creation must be loyal and uphold the Creator.

Respect

Respect for others is a value of social life that is highly upheld. The poems of the wedding tarsul reflect this. When the groom and his entourage come to the bride, respect is expressed openly. Mutual respect between each other will bring about a very beautiful social harmony.

(Male Minstrel)	(Female Minstrel)
Assalamu'alaikum we convey Giving thanks to God This morning we come The groom and his entourage	Waalaikum salam that's the answer What is the purpose of the group's arrival Ladies and gentlemen Please enter No obstruction
Our host asked Are you ready to receive? Our arrival has a purpose To propose to your daughter	Then let's organize the event Please go inside the house Only good business has no obstacles Marriage is a Sunnah of our Prophet
Thank you then If you already agree Let us in through the door To go to the living room	Please don't be shy As we head to the headman The witnesses are waiting The marriage ceremony begins without hesitation.

(Source: https://www.niaga.asia/tarsul-tradisi-lisan-kutai-yang-telah-masuk-wbtb/)

When the groom comes to the host (the bride's side), before entering her house, the first thing done is paying respect by greetings: Assalamu'alaikum; then answered Wa'alaikum salam. Expression of respect continues by saying Respectful bow from the elder brother / / Presented to father and mother; which is answered with Respectful bow from me to the Mister / / To father and mother. This means that there is mutual respect and praying for mutual safety before conveying the actual intention. It can be a persuasion of closeness and kinship, as can also be seen as follows.

(Male Minstrel)	(Female Minstrel)
Assalamualaikum first greetings To the presence of my mother and myhusband. The presence of my damsel Have a family party together	Waalaikum salam as you say Your arrival is welcome If you wish, please explain To be heard in the assembly
Salutations from the Mister Arranged for father and motherGreetings to those present Special greetings to you	Respectful bow To father and mother Along with greetings to your damsel Waalaikum salam replied anyway

(Source: Djumri, 1980)

The attitude of respect conveyed by the male Minstrel is seen by the use of the expression 'respectful bow' from the male Minstrel himself and is also offered to the father, mother, audience, and most especially to the bride who is represented by the female Minstrel. In this context, respect is given to parents and peers (the bride). The attitude of respect in the marriage tarsulan is also evident in the poem delivered by the female minstrel, namely by the similar use of the expression 'respectful bow' addressed to the groom through the male minstrel and to the parents of the bride and groom.

Humility/Tawadpuk

A humble or *tawaduk* attitude makes a person easily accepted by others, including by the public. Therefore, a humble person can encourage someone to become a successful individual. This attitude of *tawaduk* is close in meaning to *tawakal*, which is a noble character. The attitude of *tawakal* is related to the belief in Allah, until one does not depend on anything other than Him. In other words, the attitude of *tawakal* is to depend and rely on Allah in everything [11].

The character of *tawaduk* or *tawakal* is part of the local wisdom values raised in the tarsul poem. Not being arrogant, not feeling himself superior, even better to favor others can be a powerful persuasion for social relations. Likewise, the person who is favored will not become "big-headed", but instead avoid and do not want to be praised so as not to forget themselves. This can be seen in the following tarsul poem.

(Male Minstrel)
My dear lord is like the moon
In the sky high with clouds
You're like a stump on a hill.
Perched on the woods

My sister, the white lord of the sapphire
My beauty, don't be mistaken
My lord, don't misunderstand
It's not that I am making it up

(Female Minstrel)
By the will of khalikul manan
Promises can't say no
The promise is in the grip of God
The hump and the moon can be friends

If it's really good, sir
Sweet talk with praise Against your majesty
In your heart there is no pleasure to worship

(Source: Djumri, 1980)

Compliments to prospective wives or to other people are a way of interpersonal communication as psychological and emotional persuasion. Communicating persuasively is a technique of establishing relationships in order to influence others by trying to change the beliefs, values, or attitudes of communicants [7].

Humility in the local wisdom of wedding tarsulan shows an attitude that is not arrogant and not haughty. Someone who has a humble nature is always calm, simple, and earnestly avoids arrogant actions. In the wedding tarsulan of the Kutai tribe, this is described by the female Minstrel in the following verse.

(Female Minstrel)
O my young Mister,
this damsel is poor and despised.
Indeed, the big heart is not perfect,
no one is useless [3].
Finished handwritten letters,

bouquets for memories. T
o the audience and invitees,
if we are wrong, please forgive

[3]

The humility conveyed by the female minstrel can be seen in the use of such words as “poor” and “despised”. The female minstrel even describes the bride as someone who lives uncertainly and dies unwillingly. In reality, in reality she is not at all a poor and despicable woman.

Commitment

Making a commitment in a household is fundamental and even mandatory. Commitment is a promise to stay together in a relationship (marriage) in various situations and conditions. Therefore, commitment is also related to the truthfulness of the promise. In tarsulan, the commitment and promise are conveyed by the male Minstrel. By keeping the commitment (promise), the marriage will last and conflict will be avoided. The following tarsul poem can illustrate this.

(Male Minstrel)	(Female Minstrel)
Encik Isya eats soup On a tapestry mat You feel very lucky Got my Damsel a pure diamond	Duke of Jepara Eating pineapple asks to peel it Don't be like grasping at an ember Feeling hot My mister, let go
Pineapple fruit from Jepara Easy to peel Even if it's hot as an ember I hold on tight and don't let go	Dutch boy sitting at the door Sitting looking at a garden Your pledge if so May it be delivered by the merciful God

[3]

The commitment and promise made by the groom can be seen through the use of words in the verse “Even though it's hot as an ember, I hold on tightly and don't let go”. In this context, the promise of what is good and bad will be borne by the groom when getting married. Thus, this is in line with the argument of Budianta, et al (2008) that one of the functions of literary works is to be a means of conveying messages about the truth, about what is good and what is bad. Some messages are clearly conveyed, while others are subtly implied.

Prudence

Thinking is not a simple act. Thinking involves various related aspects to form a concept or decide with various implications that follow. Wrong concepts and actions (decisions) are not only bad for themselves, but will affect the people around them. In building a household, choosing a partner must go through careful considerations, not just following emotional demands. The following tarsul poem can illustrate the value of prudence.

(Male Minstrel)	(Female Minstrel)
Great is the desire to come here	What you have said Have you thought of it?
Giving up life and self	The good and the bad are considered
To my fair damsel	So that in the future
The one I loved for a long time has become	there will be no regrets
My wife?	
I have thought in my heart	If so, please say
Carefully and thoroughly	May Allah grant you
My resolve is still	There is only one thing
decided for sure	you wish for
As long as I live until I die	Promise not to forget

(Source: Anwar et al., 1976)

The prudence that is reflected in the meaning of the tarsulan, both delivered by the male minstrel and the female minstrel, is also in line with the view of Lickona (2013: 7476) who says that one of the basic moral values taught by parents to children is wisdom. In this case, prudence in the tarsulan is certainly influenced by the teachings from parents about wisdom, tolerance, cooperation, and honesty in life in society.

Politeness

The local wisdom of politeness in the tradition of wedding tarsulan refers to a subtle and good attitude (language, behavior); patience and calmness. This is in line with the thoughts of Alisjahbana (1984) who said that language in literature becomes a human tool to express feelings or thoughts with a polite and pleasant language. If the thoughts and feelings are conveyed with polite language, the listener will certainly be happy. It is not impossible that the listener thinks that the speaker with polite language has a high character. In tarsulan, this polite attitude is shown, both by male minstrels and female minstrels, as follows.

(Male Minstrel)	(Female Minstrel)
Assalamualaikum, my Damsel, Please accept my greetings. I come not to play The desire in my heart is great [3]	Alaikum mussalam this Damsel replied, please come in, O my Mister. Please sit with me, what is the desire in your heart? [3]

[3]

The groom conveys his desire to propose to the bride with a polite language. This can be seen with the use of the words ‘my Damsel’ and ‘My Mister’ which have a meaning of the level of closeness between the two speakers. Likewise, when receiving or answering the desire of the male parties, the female parties accept it politely.

Responsibility

One of the characters developed by the Ministry of Education and Culture is that students or communities must be responsible for all actions taken. Responsibility is an obligation towards God, towards oneself, society, and the environment. In the Kutai tribe's wedding tarsulan, the responsibility is portrayed by the prospective bridegroom when proposing to the bride through male minstrels. The groom does not consider rich or poor. The attitude of responsibility is also related to human responsibility to God as His creation. In the wedding tarsulan, the bridegroom has thought about and is responsible for the risks of his choice. Being poor or rich is the will of the Almighty. This can be seen in the following tarsulan excerpt.

(Male Minstrel)

O young Damsel, you have thought of everything. Rich and poor do not avoid it,

that is the fate from God

[3]

The poem excerpt indicates that the groom who proposes to the woman has a responsible nature and does not see the woman based on whether she is rich or poor. In this context, the responsibility is in line with the statement of Supriyono, et al. (2018), who said that as a creature of God's creation, human beings have a responsibility to the Creator. All words and deeds while living in the world must be accounted for before God. Every virtue will be rewarded while every vice or mistake will be punished. This responsibility is transcendental and cannot be delegated to others. In this case, the responsibility is attached to the groom who must be responsible for the continuity of the household and his wife.

CONCLUSIONS

Tarsulan is one of the old traditions of the Kutai tribe in the form of poetry that is usually chanted as opening words at an event. Tarsulan aims to convey one's intentions towards others. As an old oral tradition, the existence of wedding tarsulan in Kutai Community has begun to be marginalized along with the presence of new ceremonial influences (traditions) that are considered more modern. The tarsulan verse is delivered to represent the thoughts and feelings of the bride and groom who want to get married. Most of the time, the thoughts and feelings are conveyed by the male minstrel (representing the groom) and the female minstrel (representing the bride). However, there are also tarsulan verses that are delivered by the bride and groom themselves.

Local wisdom containing seven main values (religiosity, respect, humility, commitment, prudence, politeness and responsibility) found in the wedding tarsulan was delivered by both minstrels (male and female). The values that have constituted local wisdom are related to the order of life in the community of the Kutai tribe. Moreover, the value of local wisdom not only shows the relationship between humans and humans, but also shows between human beings and the Creator.

Among the seven local wisdom values contained in the wedding tarsulan, religious values appear most often. This proves that the Kutai people have religion as the main foundation in their lives. In addition, the religious values not only appear at the beginning (opening) of the wedding tarsulan, but also appear in the middle or end of the tarsulan.

ACKNOWLEDGEMENT

The research team would like to thank the National Research and Innovation Agency (BRIN) for the financial support.

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Women Behind Baantaran: A Feminist Analysis of Women's Roles in Preserving the Cultural Tradition of Banjar

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Abstract: The cultural tradition of Baantaran, involving the giving of a dowry in Banjar society, has long been an integral part of wedding ceremonies. What is intriguing is that the essential role of women in preserving this tradition seems less prominent compared to the grandeur of the event itself. This research aims to analyze the fundamental role of women within the context of Baantaran from a feminist perspective, with the goal of uncovering overlooked contributions and their impact on the dynamics of Banjar culture. This study utilizes a qualitative methodology, involving in-depth interviews and text analysis of various reference sources related to Baantaran culture to gain a profound understanding of women's experiences, perspectives, and roles in the Baantaran tradition. The research reveals that women actively participate in negotiations, decision-making, and the execution of this tradition. Through a feminist analysis, this research also examines the impact of women's roles in the Baantaran tradition on the social, gender, and cultural dynamics within Banjar society. The findings demonstrate that women play a significant role in various aspects of organizing the Baantaran tradition. Women are not only executors but also bearers of cultural values and guardians of symbolism within this tradition. Furthermore, this research identifies changes in women's roles alongside shifts in social and cultural norms, including changes in how women are perceived in Banjar society. This study provides deeper insights into the role of women in preserving Banjar culture and how this role interacts with gender dynamics and cultural changes. The conclusions drawn from this research make a valuable contribution to understanding the importance of women's roles in preserving cultural heritage and how Banjar culture adapts to the changing times.

INTRODUCTION

Banjar culture, like many cultures in Indonesia, encompasses traditions, including marriage. Traditions are linked to the inheritance of cultural behaviors carried out socially, thus shaping the perspectives of specific communities [1]. This aligns with the notion that traditions are legacies containing values believed in by a particular community in their attitudes and behaviors, including the process of marriage [2]. One of the marriage customs within the Banjar community is the Baantaran tradition, which is the focus of this research. Baantaran is a tradition of presenting a dowry and is also part of the marriage ceremony. Baantaran can be described as the tradition of delivering the dowry given by the groom's side to the bride's side [3].

Honesty is a crucial element in wedding ceremonies in Banjar and generally consists of property or material values given by the groom's side to the bride or her family as a symbol of commitment and seriousness in building a family. Honesty usually includes requests from the bride's side to the groom's side [4]. This is why, in many honesty ceremonies, various women's accessories and even bedroom items are commonly found. Fundamentally, the tradition of giving a dowry is an integral part of weddings in many cultures worldwide, including in Banjar. However, this research will specifically focus on the role of women in this tradition. The role of women in giving dowries in Banjar is often seen as ordinary and overshadowed by the festive atmosphere of the event. Yet, upon closer examination, women play a significant role in the transmission of this tradition. In the context of the Baantaran tradition, women can have a significant role. They are involved in designing, managing, and ensuring the smooth implementation of Baantaran. However, within the framework of social and cultural changes occurring in Banjar society, the role of women in preserving the Baantaran tradition may face complex challenges and changes.

Therefore, in this research, it is crucial to understand the role of women in preserving the Baantaran tradition, how they adapt to changes, and how their roles can influence gender dynamics in society. This research will delve deeper into the role of women in this tradition and its impact on the social, cultural, and gender dynamics in Banjar society.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030010-1–030010-6; https://doi.org/10.1063/5.0241596
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

In this regard, previous research on the status and conditions of women has also served as a benchmark in determining dowry offerings within the Baantaran tradition [5]. The Baantaran tradition is considered to grant significant control to women, including the utilization of all offerings from men to women [6]. There is also the tradition of "babalas pantun" in the Baantaran process, which is rich in the cultural values of Banjar society [7]. Therefore, based on relevant previous research, it is found that studies on the Baantaran tradition have been conducted before, but with different focuses and approaches. Previous Baantaran research primarily explored it as a tradition accompanying the marriage ceremony in Banjar society, where it serves as both a dowry delivery process and a means of conveying messages to both prospective brides, men, and women through traditional verses. Furthermore, the determination of the dowry is influenced by several factors, including preserving the dignity of the groom and considering the social status of the bride's family.

Based on the explanations provided, there hasn't been research that delves deeper into the role of women in preserving Banjar cultural traditions, specifically in the context of Baantaran. This feminist approach will help in understanding how cultural and social changes affect women's roles in maintaining traditions and their impact on gender dynamics in society.

The long journey of human civilization has always been filled with a diverse array of cultures and traditions that depict the world's diversity. Amidst the diversity of traditions and customs passed down from generation to generation, there emerges a group of people who often become the primary custodians of a culture—women. The role of women in preserving and passing on traditions often resides in the background, hidden within the social and cultural fabric, and doesn't always receive the attention it deserves.

In an effort to uncover the potentially overlooked contributions and their impact on the dynamics of Banjar culture, this research applies a feminist lens. Through a feminist analytical approach, it is hoped that the spotlight can be directed towards the often overlooked role of women. Additionally, it is a step towards understanding how the Banjar community adapts to changing times while maintaining the integrity of its culture. This is a journey to broaden the horizon of understanding history, traditions, and the role of women in preserving cultural heritage.

Speaking of feminism, it aims to unearth the identity of women in all fields that have often been dominated by men [8]. Throughout history, women have been severely restricted [9]. Women have always held a lower and less significant position compared to men [10]. They were expected to remain within the confines of their homes and not appear in public [11]. Feminism exists to ensure full equality between women and men in specific circumstances [12]. Feminism represents women [13]. From these various viewpoints, it can be said that feminism is a study that explores how women can also empower themselves within society, just as men do. This is to strengthen the awareness that both genders have equal rights in life [14]. The right to freedom should be granted to all individuals regardless of their status and background [15].

The concept of feminism exists to scrutinize gender policies and their effectiveness in gaining recognition [16]. Through feminism, a more humane perspective can be offered for women [17]. Based on the opinions regarding equality between women and men, where women are often considered lacking in capabilities and are seen as only fit for serving their families within the household, feminism was born. It aims to provide women with the same opportunities and rights in all spheres, including education, social, and cultural aspects. Feminism is not about opposing men but building awareness of equal rights and roles for women in all fields that they desire [18].

In connection with this, it can be said that women have the ability to be empowered just like men, even in all aspects, including education, social, and cultural. In this research, the context of feminism will be examined within the scope of the Baantaran tradition. Baantaran itself, during its execution, is predominantly attended by women [19]. Therefore, women play a crucial role in the success of this event. Baantaran is a tradition that has been passed down through generations in the South Kalimantan Banjar community, involving the delivery of various gifts to the bride's side by women from the groom's side. These gifts include dowry money, rings, a set of prayer tools, the Quran, clothing, bags, shoes, and makeup items, all of which are tailored to the bride-to-be's requests. Building on this understanding, feminism in this research will explore the role of women in this tradition and its impact on the Banjar community. Through feminism, it is hoped to provide a deeper insight into the role of women in preserving and reviving this rich cultural heritage of Banjar, showing that women also play a part in upholding Banjar's cultural legacy.

The research method used in this study is qualitative, as it is easier to understand and uncover what lies behind social and cultural phenomena using qualitative methods. To unearth the truth and reveal facts within a phenomenon is an essential part of descriptive qualitative research [20]. Qualitative research means that researchers will provide a clear and objective description of the research results through clear sentences [21]. Qualitative research should depict and interpret the object as it is [22]. In line with this, the reason for choosing the qualitative approach is as follows: 1) the researcher becomes the key instrument, playing a direct role in data collection; 2) the data are descriptive, consisting of words and sentences; 3) data analysis begins with specific themes and progresses to more general ones, making it inductive; 4) the research results emphasize meaning, which is an essential focus.

Data collection techniques involve observation and interviews. Observation is conducted by the researcher through direct observation of the Baantaran tradition held in Pantai Ulin Village, Simpur District, South Hulu Sungai Regency, Kandangan City, South Kalimantan. Subsequently, interviews were conducted with 2 informants, with the initials IK, a 53-year-old female, and M, a 35-year-old female, to obtain important data related to the research object, which is the role of women in the Baantaran tradition as part of the marriage process in Banjar society, South Kalimantan. In this study, the researcher used an in-depth interview technique conducted directly by the researcher without intermediaries. The data analysis technique used in this research is the inductive-abstract data analysis technique. Inductive-abstract analysis is a data analysis performed based on observed events, and then the data is sorted and narrated or described, ultimately resulting in conclusions [5]. Therefore, the researcher presents the results of the data analysis by detailing each result and interpretation of the research data, thus building concepts that are research findings.

The Role of Women in the *Baantaran* Tradition

As previously explained, Baantaran is a tradition that has been carried out for generations in the wedding culture of South Kalimantan's Banjar. Based on the observations, Baantaran has the following sequence of events.

1. Opening

At the opening of the event, the host starts by inviting all the guests to say Bismillah and reciting Surah Al-Fatihah. The host for the Baantaran event is usually a woman, typically representing the family of the bride. As the host, she is responsible for guiding the event from start to finish. During the observation conducted at the Baantaran event held on Friday, August 4, 2023, in Pantai Ulin Village, South Hulu Sungai Regency, the host was Acil from the bride's side. Acil is a term used by the Banjar community to refer to the younger sister of either the father or the mother. Acil's background is that of a housewife who usually takes care of her children at home, with an additional job of managing a small shop in front of her house. However, she had the courage to become the host for the Baantaran event, and it was her first experience doing so.

2. Rectitation of the Quran (Reading of the Holy Quran)

During this event, it is guided by a 35-year-old woman with a background as a homemaker. She is a family member from the bride's side. Typically, the person chosen to recite the Quran should have the ability to read the verses of the Holy Quran with proper and beautiful pronunciation. Therefore, not just anyone can be the Quran reader.

3. Speech from the Men's Side Accompanied by Bapantun

The speech from the men's side usually contains words of submission and explains the purpose of their visit to the bride's family's house, which is to deliver the dowry items, hoping that the bride's family will accept them with all their shortcomings and strengths. The items brought typically hold symbolic meanings. For example, the Quran, a set of prayer tools, a prayer rug, serve as clothing that will be used to establish a household based on harmony, love, and blessings. Bringing "pisang raja" (a type of banana) symbolizes great hope, good wishes, and sweetness in the marital life. Fruits symbolize the hope for the newlyweds' household to be a source of blessings for those around them. Rings serve as a symbol of binding their relationship, while shoes/sandals symbolize their journey together in married life, always walking the straight path. Women's clothing signifies the hope that the bride and groom will keep their household secrets, maintaining harmony. Makeup is brought so that the bride can always present herself well to her future husband. Lastly, "lakatan" or glutinous rice symbolizes the hope that the couple will always be united, and the bonds between both families will remain strong forever.

In this session, the speech is also delivered by a woman, typically an elder woman from the groom's family. This woman doesn't necessarily need to have a specific background, but usually, if she is an esteemed elder within the family, she tends to have the experience to represent and give a speech during the Baantaran ceremony, especially within her family circle. Based on the conducted interviews, she has a background as a housewife. Before concluding her speech and presentation, she also incorporates verses of poetry and "papadahan," which contain advice and guidance for the two prospective newlyweds. An example of such "papadahan" is as follows.

Kaina amun kawin sama kaya naik jukung saikung di muka, saikung di balakang. Satu di balakang mengayuh nang di muka mangamudi agar perjalanan sampai ka ujung. Jadi jangan sampai nang di muka mana mangayuh, mangamudi, nang di belakang guring. [Later when you get married, it's like riding a boat, one in front, one behind.

The one behind paddles while the one in front steers, so the journey can reach its destination. So, don't let the one in front paddle and steer while the one behind is asleep].

Nasi sapiring badua
[One plate of rice for two]
Jangan dua piring sauraangan
[Don’t use two plates separately]
Sudah kawin pian badua
[Now that, you’re married]
Harus mau sanasib sapananggungan
[Both of you should be willing to share your fate and destiny together]

4. Speech from the female Side Accompanied by Bapantun

The welcome from the female side is generally an expression of gratitude for the arrival of the male side at the house of the female bride-to-be. It signifies the seriousness of the occasion as they bring all the dowry and gifts intended for the female bride-to-be. The speech also contains expressions of the utmost respect for the family of the male bride-to-be and sincere appreciation for their good intentions towards the female bride-to-be. The welcome also includes an enthusiastic acceptance of all the offerings presented by the male bride-to-be's family, along with the exchange of traditional verses. One example of such a verse is as follows.

Duduk kamarian mambaca buku
[Sitting in the evening, reading a book]
Malihat pesawat turun manukik
[Watching the plane descending sharply]
Berhubung kami handak baisi cucu
[Since we want to have grandchildren]
Kami manarima lamaran keluarga Muhammad Taufik
[We accept the proposal from Muhammad Taufik’s family]

Furthermore, if the wedding date has not been determined after the welcome speech from the female side, it is followed by the determination of the wedding date. In this session, the address is also represented by a woman who is usually an elder female member of the bride's family. This woman does not necessarily have to have a specific background, but usually, if she is an elder and respected member of the family, she is more likely to be requested to give the speech, especially within her family circle.

5. Closing and group photo

In the closing session and group photo, the event was once again guided by the master of ceremonies, who expressed gratitude by saying Alhamdulillah as a form of thankfulness that the Baantaran event has been successfully and solemnly carried out. Furthermore, the master of ceremonies also extended gratitude to all parties involved, both from the families of the groom and bride, as well as to all the invited guests who took the time to attend and participate in enlivening the Baantaran event.

The Impact of Women's Role in the *Baantaran* Tradition

From the observations conducted, it can be seen that the series of Baantaran tradition events consist of several stages such as the opening, recitation of the Quran, speeches from the groom's side, speeches from the bride's side, and closing remarks. All of these events are led by women. The women involved in the activities come from both the groom's and bride's families, with various backgrounds. However, based on the interviews conducted, the majority of the women involved are ordinary housewives, whose primary duties revolve around managing their homes, children, and husbands. Additionally, the groom's side brings various dowry items and gifts, all of which are also carried by women.

Upon closer examination, the willingness of women to participate in the Baantaran event demonstrates that they possess the ability to socialize within their community. They are capable of taking on responsibilities beyond their roles as homemakers. Notably, participating in the Baantaran tradition demands that they have the courage to appear in public and to lead the event, ensuring its smooth execution.

Despite these demands, those involved are also expected to have a deep understanding of Banjar traditions related to Baantaran. They must be knowledgeable about the event's proceedings, the significance of each dowry item, as well as the use of poetry (pantun), speeches (papadah), and traditional advice that is passed down through generations via the Baantaran tradition. The involvement of women in the Baantaran tradition has been long-standing, serving as evidence that women in Banjar culture hold significant roles and influence. Throughout the Baantaran event, women have control over determining the amount of dowry money and the types of items to be given to the bride, and even the selection of the wedding date – all of which are determined by the bride's parents. The groom or men, in this context, play a supportive role.

In conclusion, despite the rapid changes in modern times, the execution of the Baantaran tradition in Banjar society is still predominantly led by women, from start to finish. This phenomenon underscores the understanding that women can hold appropriate positions in portraying the cultural essence of their community. Women, often seen as a minority, can indeed contribute to the preservation of cultural heritage through their unique groups. Furthermore, women can exert influence not only within the family but also within the social and cultural spheres. Therefore, women, in practice, can play a significant role in preserving, continuing, and practicing the Baantaran tradition to ensure its sustainability and its place as part of Banjar's cultural identity.

CONLUSION

Therefore, based on the discussions regarding women behind Baantaran, a feminist analysis of women's roles in preserving Banjar cultural traditions leads to the conclusion that within the Baantaran tradition, women play a crucial role in every aspect, from the opening to the recitation of the Quran, speeches from the groom's side, speeches from the bride's side, and the closing remarks, with women guiding the entire sequence of events. This can also be seen as evidence that women can have capabilities beyond being solely responsible for managing homes, children, and husbands.

Furthermore, the tangible impact of women's involvement in the execution of the Baantaran tradition is an effort to safeguard Banjar cultural heritage, ensuring its preservation and continuation in the face of changing times. Moving forward, this research is expected to provide valuable insights into the importance of women's roles in preserving culture, particularly the culture of South Kalimantan's Banjar. It encourages active participation by women in all aspects, including the social and cultural spheres. Additionally, this research can pave the way for further studies on women's contributions in different contexts. Implementing these recommendations will require cooperation between the government, the community, and non-governmental organizations in Banjar. It is also crucial to respect and uphold traditional values while promoting gender equality and women's rights. Thus, the Baantaran tradition can remain vibrant and relevant, reflecting positive developments in Banjar society.

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Intersectionality of Race, Gender, and Class in Sherri L. Smith's *Flygirl*

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Abstract. This research explains the representation of intersectionality of race, gender, and class experienced by the main character, Ida, as a woman of color in 1940s America. The purpose of this research is to explain the critical position of the author that determines the motives she wants to convey. Using Stuart Hall's theory of representation, particularly the discursive approach, this research is conducted by connecting the narrative text of the novel with the context to derive meaning. The results of the study show that Ida experiences intersectionality in education and work, which makes Ida perform racial passing to be accepted by society. Through Ida, the author shows her critical position by rejecting the intersectionality experienced by women of color. The author's disapproval of intersectionality is based on the American Declaration of Independence, which protects all people's rights regardless of race, gender, or class.

INTRODUCTION

Literary works are not just entertainment, but they can also be a tool to express information, thoughts, or ideologies from which we can take meaning and moral values. Literary works can develop people's minds and awareness and potentially change their behavior [1]. Literature is a warning tool that can reveal the ugliness of society and its impact on individuals and others. In this case, readers are warned of unacceptable actions. Therefore, literature can teach moral values and can institutionalize social change. The meaning of literature relates to human experience in real life because a literary work reflects life [2]. Based on the phenomena, literature can be a tool to voice the forms of injustice that often occur in society and to spread an agenda or motive by the writer. The problem of injustice includes the relation of racial, gender, and class discrimination toward women of color.

The problem of intersectionality is also expressed through literature. Intersectionality is a combination of sources of oppression such as race, gender, and class in various settings [3]. Intersectionality discusses the consequences of various forms of discrimination that can contribute to creating layers of inequality between races, women and men, and also class. An example of intersectionality is women of color, often excluded from society. It happens because women of color have more than one problem that cannot stand alone, such as her problem of being "women" and being "colored."

For women of color, the first problem that they face is racism. Racism is a belief, action, or attitude that attack subordinate individuals or group based on their race [4]. It can be seen in white people who practice their force of being white by segregating black people through bigoted demonstrations that dehumanize them as humans peer downward at blacks and treat them as non-persons [5]. Apart from racism, women of color also experience gender discrimination. So, being born as a woman can be

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030011-1–030011-9; https://doi.org/10.1063/5.0241871

unfortunate too because a woman is still challenging to consider in society. Most people still believe women should be responsible for household and childcare rather than working outside the home like men [6]. Being a woman of color means facing double trouble as society gives her a lower status than a man, and then she must face the racial issue of being a part of black people. Not only that, if a woman of color is in the lower class, she does not have the opportunity to realize her dream like the other white woman. It happens because a lower-class woman of color has limitations in her life, such as not having enough finances and because of her racial minority.

In the early 1960s and 1970s, African-American women's experiences were shaped by race, gender, and class, resulting in a lack of space for solving the problem of social inequality because of the complex problems they faced. Intersectionality is a way to understand and analyze the complexity of injustice experienced by a person, which is formed by many factors and influences each other [7]. Thus, the three interrelated problems (race, gender, and class) can be the focal point of this research.

The story of *Flygirl* is the main focus of this study. This novel tells the story of Ida Mae Jones, who comes from a black family, less well-off, and lives in Louisiana, South America. Ida works as a maid in a white family house to raise money to achieve her dream. Ida has a passionate desire to become a pilot. Unfortunately, Ida's eagerness to fly meets with many obstacles. She fails to get a license when she is doing a test in Tuskegee, and it happens because she is a woman. In addition, Ida's mother also does not support her daughter's desire to become a pilot. She thinks that it can endanger her daughter. However, Ida has big ambitions to raise money to go to Chicago to get her license because it does not look at a person's gender and skin color.

Flygirl by Sherri L. Smith describes the setting during World War II. The American army opened an enrollment of female pilots to help during the war. However, it is for white women only. It makes Ida go back and forth to register until she finally gets the courage to pretend to be white and fakes her license to be a WASP (Women Airforce Service Pilot). Ida is doing it to realize her dream of becoming a female pilot from the black race. She wants to prove that women of color can have the same opportunity.

The research uses the representation theory by Stuart Hall. The term representation produces meanings in the form of concepts in our minds through language. Hall [8] argues that representation uses language to say something meaningful by involving signs and images so that others can understand it. The representation is the meaning in the novel that is presented to the reader and shows the critical position of the author.

One of the approaches in representation theory is the discursive approach. The discursive approach is understanding the discourse as the context in which representation is produced. The contextual factors are such as historical, cultural, and social conditions. Hall [8] clarifies that the discursive approach is more concerned with the effects and consequences of existing political representations. The discursive approach examines how discourse generates knowledge about power, rules, and constructs identity, and defines how certain things can be represented. Discourse is the meaning that can be regulated. Hall [8] states that Foucault defines discourse as a group of statements that provide language to speak about how to represent knowledge about particular topics at particular historical moments. By using this theory of representation with a discursive approach, I reveal the representation of intersectionality of race, gender, and class towards women of color through *Flygirl* and the critical position of the author as the motive and agenda.

Before this study, several studies about racism, gender, and class discrimination have been done. Some of them are *"Constructing Identity: Race, Class, Gender, and Sexuality in Nella Larsen's Quicksand and Passing"* by Andrew Walter Davis [9], *"The Representation of Three Characters in The Help"* by Frida Eriksson [10], and *"Racial Passing in American Racism in Sinclair Lewis' Kingsblood Royal"* by Calvian Nugroho Pangerti [11]. The first research focused on constructing the protagonist's identities in both novels. The second and third research are more focused on racism only. Differences from the three researches, this study focuses on the author's position in viewing the problem of the intersectionality of race, gender, and class in *Flygirl*, and the motive that she wants to convey to the readers. So, the context is needed in this research by relating the text to society's social structure and conditions when this novel was produced.

METHODS

The research is categorized as qualitative research because the data analyzed in this study are taken and collected from sentences, dialogues, and many statements from *Flygirl*. This research uses representation theory by Stuart Hall (1997) with a discursive approach to find the critical position of the author.

The data sources in this study are primary and secondary data. The primary data is from the novel *Flygirl*. In getting the primary data, I read carefully to understand and highlight several dialogues, sentences, and statements that imply the injustice in race, gender, and class and the intersectionality experienced by Ida as the main female character in the novel. Furthermore, the secondary data are taken from books or journals that explain the condition of the United States in the 20th century related to the intersectionality of race, gender, and class. The data is also about the author's background, including the socio-cultural context that shapes her view. With these data, I find the context of creation in *Flygirl*, such as the relevance of the issues about intersectionality race, gender, and class from 1940 to 2008 when the novel was produced. After making a critical interconnection between primary and secondary data, finally I found out the author's motives for creating this novel.

INTERSECTIONALITY IN GETTING EDUCATION

This point explains the intersectionality of race, gender, and class in terms of education experienced by the novel's main character, Ida Mae Jones. Ida needs help to get the education to have a license to pilot an airplane. Since she lives in Louisiana, there are no opportunities for women of color to pursue further education after leaving school. Most of them work as domestic servants in white families [12]. Therefore, it is difficult for Ida, a woman of color and her low class, to achieve her dream.

Women of color like Ida are often marginalized. Marginalization in the Merriam-Webster dictionary is a term used to refer to the position of a person or group in a marginalized and powerless situation. Women of color with the intersectionality of race, gender, and class are considered less able to rid themselves of the marginalization they receive [13]. Because of the marginalization, Ida works as a housemaid in a white family. She aspires to earn money to go to Chicago for an education and a pilot license [12]. Ida does not get the opportunity in her city, Louisiana. Previously, Ida did a pilot test in Tuskegee. However, she fails because she is a woman [12]. This situation places Ida in a position of intersectionality not only in her race and class but also in her gender. Sidiki & Aboubacrine [14] explain that Westerners have strategies to exploit, marginalize, and discriminate against people of color based on their skin color. Also, the patriarchal attitude is when someone prioritizes men over women [15]. That is why women of color are marginalized and have limited freedom.

Her mother disapproves of Ida's desire to go to Chicago. She does not want Ida to get a license and do work that could endanger her safety. Apart from that, their economic constraints were also one of the reasons why their mother opposed Ida's wishes. That is because if they want to get a license to fly an airplane, their family has to spend money too [12]. Ida's mother supports her daughter in continuing to do her regular daily job as a housemaid in a white family rather than having to pursue her dreams which she dreams of. All of this makes Ida feel that she has no support from anyone and has to fend for herself to achieve her goals. The experience of intersectionality in the 20th century in America does not get much attention because those who claimed injustice it is a black woman or woman of color who has two or more problems. If someone is only faced with one problem, it is easy for him to get what he wants [16]. The passage "Short end of the stick" in Smith [12] reflects society's treatment of people of color and women. It illustrates Ida's indifference as a person of color and woman. So, as a woman of color, she does not get any relief and tends to be the most backward society. Feelings like this are an attitude of marginalization that makes women with colored skin increasingly marginalized. They also do not receive assistance from any party. This results in no opportunities for women of color to obtain education or employment. Injustices like this will continue to happen to them if they do not do anything to fight this discrimination.

Flygirl by Sherri L. Smith has a setting in Louisiana in the 1940s and 20th century. This novel reflects how a woman of color experiences intersectionality in her environment, making it difficult for her to get what she wants, such as education. In Boukari [17], entitled *20th Century Black Women's Struggle for Empowerment in a White*, in Louisiana in the early 20th century, traditionally, black women had little access to education and could only work from home. Women of color can only receive education to do household chores well, not to study at higher education to elevate their race and class. He also explains that various community groups that act as providers of 25 education funds in the South oppose education for people of color. One of Tuskegee's trustees, Baldwin, stated that African Americans only needed to learn the science of manual labor and the limits of their "natural environment." It is against the education of people of color. Due to the intersectionality between race, gender, class, and the divisions experienced by women of color, most do not get the same education as white people. It caused most of them not to continue their higher education, and they ended up in lower-class jobs. Therefore, if a woman of color wants to achieve her dream of getting the education she wants, she has to go to a place that values her existence more.

This novel was published in the 2008 21st century, which, of course, contains specific aims and objectives that the author wants to convey. Until now, inequality based on race, gender, and class is still the leading cause of societal discrimination. In his article, Acuff [18] explains that black women are still sidelined in education. They are excluded from the research field, and no one wants black women in the education field. Then, as Quoted by Arao [19], many black women still experience sexism, especially those with children who find it difficult to get an education, and what they do is just to look after the house and raise their children. Meanwhile, the report from the United Nations for Human Rights [20] titled *Realisation of the Equal Enjoyment of the Right to Education by Every Girl,* about the problem of cost, which is one of the factors women cannot continue their education to a higher level. That is because the parents live in poverty and cannot afford to pay for their daughter's schooling. It is also exacerbated by gender bias, where parents prioritize men's education so that they have better careers in the professional field. Patton et al. [21], in their article entitled *Why We Can't Wait: (Re)Examining the Opportunities and Challenges for Black Women and Girls in Education (Guest Editorial),* explain that in recent years, there has been a surge in programs aimed solely at supporting black men in higher education. It ignores the existence of black women in terms of education.

Based on the context above, Ida represents how difficult it is to be a woman of color who is hindered by her race, gender, and class in getting an education. The issues of the intersectionality of race, gender, and class experienced by women of color in achieving education have existed since the early 20th century and are outlined in the novel *Flygirl*. This issue is still relevant to readers in the 21st century because educational injustices are still caused by a person's race, gender, and class.

INTERSECTIONALITY IN GETTING A JOB

This point explains the intersectionality of race, gender, and class in a job that Ida experiences. As we know, Ida has the ambition to be able to fly a plane by working as a pilot. She wants to prove that a woman of color can get a job commensurate with white people, even though she is from a low class. Ida realized her desire by becoming a member of the Women Airforce Service Pilot (WASP), a program for women to help fight during World War II in the 1940s.

Thomas, as Ida's brother, forbids Ida's desire. He thinks that fighting on the battlefield and protecting the country and family is a man's duty. At the same time, women like Ida only need to be at home, making sure everyone in the family is okay [12]. It explains the patriarchal actions carried out by Thomas. Thomas still feels that Ida, as a woman, must listen to him and obey whatever Thomas says. Thomas felt that men were obliged to protect their race from all threats, and women only needed to be at home to look after their families without doing anything else. In this way, this represents the traditional gender role played by men towards women. Women of color were considered less capable than men of defending their race against outside threats.

The people around Ida do not support her desire to develop and fight the injustices that women of color receive in the field of work. It can be seen from Jolene's statement, "Men do the fighting, Ida Mae. Women take care of the home. You can be proud of that. It is enough. Too much, sometimes, but it's more than enough." [12]. The statement explained that women of color should be resigned to remaining in their positions and should not take the risk of putting up a fight that might harm them. Quoted from Mullenbach [22] stated that when World War II occurred in America, many factories needed female workers. However, they refused to hire women of color and preferred to recruit only white women. Therefore, Jolene thinks it is useless if women of color want to do jobs that are "unusual" to them, such as Ida's desire to be able to work as a pilot during World War II. Her environment expects Ida not to cross the line and stay where she is now.

The Women Airforce Service Pilot (WASP) registration is open then. Ida wants to join the program to help Thomas in the war. However, Jolene broke Ida's wish by warning her that their training ground in Texas would make things difficult for Ida since Texas is a Jim Crow [12]. It means that in Texas, people of color are not very accepted there. So, it would be difficult for black people to come to Texas because of the segregation.

As we know, Ida is a mulatto that has a lighter skin than other black women. With that privilege, she still dares to register as a WASP using her father's license and doing a racial passing by pretending to be a white woman. Racial passing is used by people who change their racial identity to be accepted in an environment with a majority race. It means that people of color (nonwhite) represent themselves as white [23]. When a person does racial passing, they will change all about their past identities.

Since Ida is doing the racial passing, she must change all of her ways of behaving. It includes the way of speaking, speaking style, appearance, and behaviors of black people. That way, the racial passing that Ida did would be successful and not be caught by other people. Ida changed her appearance from looking like a maid to becoming a classier woman. It is Ida's way of fighting the intersectionality of her race and class. That way, no one will realize that Ida is an ordinary maid who pretends to be an upper-class white woman.

When Ida registered and accepted as a WASP, she informed her mother and her family. Ida confessed to her family that she registered as a WASP by pretending to be white. Of course, her mother did not agree and was disappointed with Ida's decision. Ida's mother said that any accessories on Ida's body would not change the fact that she was part of the colored race. According to her, Ida could not pass and become a white race like her husband. Ida's mother thought the racial passing would seriously harm her daughter [12]. Ida's mother is afraid that her daughter might be caught lying, which would become a big problem for her. The character of Ida's mother represents the anger of black race people over the existence of racism and injustice that they have so far received. White people in the South often harass, persecute, and marginalize black people. However, they did not want blacks to leave the South because later, they would have nothing to turn them into backbreaking and low-paying jobs [24].

Ida's mother also worries about the cost that Ida might have to spend on the program while their family still really needs money for their daily living expenses. Her mother regretted not forbidding Ida to keep doing that from the start [12]. It represents Ida's Mother leaning towards traditional gender roles in terms of work, which requires women to stay at home and not do dangerous outside work. It shows the sentence, "Or mothers like mine, who want their daughters to have a normal life" [12]. From this, Ida does not receive support to escape intersectionality, not even from her family.

The racial passing that Ida does makes her separate from her family and her community [12]. That is because if someone has done racial passing, they have left their old identity and cut ties with those who were related to them for a long time. The other consequence is that if Ida becomes a WASP and bad things happen, it will be hard for her family to hear about her. Moreover, if Ida's secret is revealed, white people will not bother themselves to take care of women of color. Even if they did tell, it would take a lot of money to be able to take care of it. Ida's family comes from the lower class with a mediocre economy. However, Ida remains adamant that this is the only way to fulfill her long-standing wish.

As Ida did, racial passing is mostly done by people of color in America to have a better life. African Americans primarily practiced the existence of racial passing itself around the late 18th and mid-20th centuries. When they pass, they are declared white and must leave their families, friends, and communities with no thought of returning to their places of origin [25]. After being able to become a white person with a new identity, those who do racial passing are sure to get an advantage in their life. Passing in the old century frees a person from subordination, oppression, and slavery (performed by the white race to the black race). It even gets special rights to access social and economic opportunities [26]. However, it is also possible that there are sacrifices and losses that they have to make for the consequences of the racial passing that they have done.

Ida is finally doing training for WASP in Texas. She lied about being a white woman and has not been caught. However, being a white woman still does not give her respect when male soldiers surround her. Male military instructors are tough on women as if they do not deserve to be there and help in the war. The sentence "The kitchen is safer than the sky" illustrates the patriarchal attitude of the instructor. There is also an explanation that, at that time, the military was not intended for women, which was indicated by the absence of women's-only toilets. It represents the environmental conditions in America during World War II, where women were still considered unsuitable to join and help on the battlefield. The military instructors tried to bring down the female pilots so they would fail and not continue their activities as WASPs. This attitude shows that women may still be considered inferior despite working outside. They still think about the stigma that shows women should stay home and do household chores.

Smith [12] explains that female pilots are deliberately only used as "testing tools" by male soldiers. They gradually test women to do heavy work that can harm women, aiming that men can do it more if women can. It is an example of the placement of women in the military still below men and, of course, in a low position even though they are both army pilots. Besides, if women have tried, struggled, and sacrificed their best, their efforts tend to be underappreciated in helping men's work. Especially if Ida, as a woman of color, is honest about her lies, society will not accept her. White women will not feel this because they only have one injustice and do not feel what it is like to be hobbled by other people's rules [12].

While working as a pilot in WASP, Ida got an offer to work as a pilot in Jenkin's company. However, Ida refuses it because she realizes she is a woman. Many people still underestimate her in this job. On top of that, she is a woman of color pretending to be white. It will put her in danger if Ida's identity is exposed [12]. The quote above shows that post-World War II, society began to accept gender equality. Of course, in this case, the priority is white women, which makes women of color one of the backward ones. Ida cannot continue to lie about her identity because no matter how hard she fakes to achieve her desires, which are hindered by race, gender, and class, she is still a woman of color who is not recognized by society [12].

The intersectionality that Ida experiences in her job is in line with the reality at that time. Mullenbach [22] explains in her book *entitled Double Victory: How African American Women Broke Race and Gender Barriers to Help Win*

World War II, that at the start of World War II, the American government held a particular training program for women that aimed to train women to have skills that could help in warfare. One of them is that women are trained in aviation, such as engine repair and maintenance. During this training, the women also received higher pay than their usual job, domestic work. However, after completing the training, women of color still experience difficulties getting jobs according to what they have learned. It happens because society is still racist towards them and considers black women incompetent. The skills of women of color do not guarantee their lives will be accessible in getting a job because their race is still the main determining factor. It caused women of color to remain in the same position and place. On the other hand, some women of color could qualify to work in the military during World War II. It only happens temporarily. Because when the war is over, women of color will be back where they belong. They will return to work with low-paying household chores. It is the same as when Ida finished her job as a WASP and had to give up her uniform and return to being a poor woman of color working in Mr. Wilson. It shows Jim Crow laws that existed in 20th-century American society. This law mentions acts of racism by separating white and black people.

Furthermore, there is context relevance when the novel *Flygirl* is published. It is in the environment of American society in the 21st century. In America, issues of race, gender, and class are still the main topics, especially in work. Women of color still face discrimination and inequality in terms of employment and wages. They tend to be sidelined for professional jobs and only given low-wage jobs. It happens because of the intersectionality of race, gender, and class. Lloyd et al. [27] explain that into the 21st century, there is a continuing trend of black women working in minimum wage service jobs despite advances in professional employment for black women since the 1970s. It has resulted in the employment and economic position of black women being disadvantaged and has carried over into the 21st century. In addition, the intersectionality of race and gender also affects black women in occupational segregation. According to Lloyd et al. [27], "occupational segregation" aims to describe the differentiation of jobs for women and minority groups in different fields of work, even though they have the same education and experience as white men. It keeps jobs segregated by race and gender, and women of color tend to be in lower-paying jobs than white women and black men. Lloyd adds that the wage discrimination and undervaluing of jobs for women of color are based on the long history of racial and gender discrimination against people of African descent in the United States. Therefore, if there has been progress in employment for women of color, it has not completely eradicated the discrimination and unfair treatment they are likely to receive in the field of employment. Women of color cannot take advantage of their race or gender. Black men can use their gender, and white women can use their race to establish equal employment relationships with white men.

The *Flygirl* novel represents a natural phenomenon about the intersectionality of race, gender, and class during World War II. People with colored skin are considered lower class; if she is a woman, it will be more difficult for her to get equal rights. However, if someone wants to continue fulfilling his desires, he must sacrifice everything he has. One of the ways that the character of the novel, Ida, does is to become part of the white race to be accepted by society and realize their ideals.

CRITICAL POSITION OF THE AUTHOR

The critical position shows the author's purpose and motive for the intersectionality of race, gender, and class in *Flygirl.* To find the ideological position of Sherri L. Smith as the author of *Flygirl*, I will relate the author's background to the social context when the novel was published.

Sherri L. Smith wrote *Flygirl* and published her novel in 2008. *Flygirl* is a historical fiction novel set during World War II in the 1940s. This year is a time when racism against black people is still rampant. White people think that people of color, especially women, belong to a lower class. Therefore, women of color are often restricted in their rights and activities. Besides race and class issues, patriarchal culture is still strong in America. Women are often sidelined in the field of education and employment. Moreover, if a woman of color comes from a lower class, she will not be given the same educational and job opportunities as men or white women.

Ida, the novel's main character, represents the struggle of women of color against intersectionality. In realizing her dream, Ida does not receive support from her family. They think Ida's wishes will harm her race, especially since she is a woman, and her low class will make it difficult for her if something that requires a lot of money happens. Ida's character in *Flygirl* represents how marginalized women of color struggle to realize their dreams, which society opposes. In *Flygirl*, Ida does racial passing to fight the injustice she has received. However, she does not find support from her family. Racial passing at that time was not approved because someone had to leave their community. Racial passing to be white is used to get a better life since society leans more toward white people.

In an interview on the YouTube channel Literary Aviatrix [28], Smith said she wrote *Flygirl* inspired by a radio documentary about the Women Airforce Service Pilots (WASP). It is an organization of female pilots who served to assist the military during World War II. When World War II occurred, WASP was tasked with towing targets for aerial gun practice, conducting flight trials of new aircraft, or conducting demonstration flights. Smith then combined the prejudices faced by African Americans at that time and juxtaposed them with the prejudices faced by women. Smith was born in New Orleans, Louisiana, as a black woman with no privileges in her life. The story of her mother, who lived in New Orleans from the 40s to 50s, is one of her inspirations. Smith wants to show readers that women of color can do the same work as men, even though she faces intersectionality.

Smith disapproves of injustice towards women of color when Ida does racial passing to be accepted by society. Ida can not be herself because the white and black races were separated then. It represents the segregation of Jim Crow laws that separated the white and black races in the 1940s. Tischauser [29], in his book entitled *Landmark of the American Mosaic Jim Crow Laws*, explains that Jim Crow is a term used to legalize the separation of each individual based on race, gender, class, or religion within existing boundaries and is first recognizes in the Southern United States. It is a system of prejudice and discrimination, reflecting the attitude of some white people in South America who do not want anything related to black people. Smith uses a woman of color in *Flygirl* because she is valuable and deserves recognition. In their article, Sesko & Biernat [30] mention that black women are often less visible than other groups (black men or white women) and struggle more to be seen and heard by society. In addition, black women also have no power because of their low class. It shows in a study that black women had the highest poverty rate of all other racial and gender groups [31]. It results in black women being more likely to be marginalized from society.

Based on the story in *Flygirl,* Smith opposes layered discrimination against women of color. Through Ida's character, Smith shows that not only white men or women from the upper class can achieve the goals they want. The Declaration of Independence in America 1776, "We hold these truths to be self-evident, that all men are created equal, that they are endowed, by their Creator, with certain unalienable rights, that among these are life, liberty, and the pursuit of happiness." (US 1776). Based on that, the equal rights of American citizens have been regulated since 1776, and race or skin color should not be a barrier to realizing someone's wishes. However, due to Ida's state of intersectionality, Ida has to be willing to sacrifice everything for what she wants. So, Smith wants to show the readers that women of color should be able to fight for their rights to equality, freedom, and justice without any hindrance.

CONCLUSION

Based on this study of the representation of intersectionality of race, gender, and class in *Flygirl*, it can be concluded that Smith represents the intersectionality experienced by Ida in two ways: intersectionality in education and intersectionality in the job. Ida represents how the woman of color struggles to achieve her dream amidst the racial and patriarchal society.

Using the representation theory from Stuart Hall (1997), I found the discourse of intersectionality represented by Smith in her novel. *Flygirl* takes place in the United States during World War II in the 1940s. At this time, women of color experienced many discriminations and injustices. It is because of the Jim Crow Law that is still the legal law for American society at that time. Jim Crow separated white and black people. Also, in the 20th century, American society was patriarchal. One example is institutional discrimination against women, where position or even salary depends on a person's gender. It seems like women should not cross the line to be equal to men. It indicates that apart from their race, women of color also receive unfair treatment because of their gender. Additionally, when women of color are in the lower-class condition, they become more powerless. Therefore, Ida does the racial passing by pretending to be a white woman to change her life into a better position to fulfill her desires.

The result analysis of the intersectionality of race, gender, and class in *Flygirl* also shows that woman of color experience marginalization because of their race, gender, and class. Woman of color who has brighter skin can use this condition to plunge into the white community. Being white will allow her to elevate her social status. So, for women of color, being white also elevates her class from low to upper class.

Smith's critical position in this novel is to resist discrimination against women of color by conveying her motives through Ida, who does racial passing. However, she finally regrets her actions. She regrets this action because women of color can struggle more to show their abilities than having to lie about being white to be accepted. However, the actions taken by Ida as a woman of color can impact reducing unfair treatment such as racism, gender, and class discrimination by society. Through this novel, Smith is trying to fight against the limitations and injustices experienced by women of color. Smith wants to show the readers that discrimination against race, gender, or class is an issue that still requires more attention and deserves to be eliminated because the USA Declaration of Independence states that everyone has the right to have their way, regardless of race, gender, or class.

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Digital Culture Transformation of the Covid- 19 Pandemic Era in Ambon City

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Abstract. This paper aims to see how the impact of the covid pandemic on the transformation of digital culture in society in Ambon City is. The Covid pandemic has become an escalation of the transformation of digital culture and is the main marker for the creation of a conservative culture towards a digital culture. Although digital transformation has occurred, not all people in Ambon City are ready to face the transformation of digital culture. The lack of readiness of the mindset of the people of Ambon City is one of the triggers for individuals who are not ready to face the transformation of digital culture. The will to shift the mindset and explore the digital world has not grown well. The people of Ambon City do not yet have the urge to accept the existence of new technology and have the idea that technology is here to be studied in a disciplined and consistent manner. This research uses a literature study approach in elaborating the research topic. In the end, this study states that the impact of the covid pandemic has created a shift in conservative culture towards a digital culture. Thus, cultural changes in the midst of social life must be anticipated through a program to strengthen digital literacy.

INTRODUCTION

Digital transformation is part of a larger technological process. Digital transformation is also a change related to the application of digital technology in all aspects of life in society.

Acceleration of digital transformation is not only related to technical aspects of technology, but also cultural aspects. Digital culture is a prerequisite in carrying out digital transformation because the application of digital culture is more about changing the mindset in order to adapt to digital developments. "The people who survive are not the strongest or the smartest, but the ones who can adapt." In essence, how the community participates in changing or utilizing the old culture into a new culture that is more efficient.

Digital culture presents information technology that has changed people's culture in terms of establishing communication by sending letters or sending SMS. But since the presence of information technology has finally changed the culture in society in terms of establishing communication, done via email or platforms. This cultural change has a positive impact on society because it can establish communication without the boundaries of space and time. But this technological progress can also be viewed negatively when people rarely establish face-to-face communication, so it is feared that it can distance us from the people around us.

The transformation of digital society blurs the distinction between reality and virtuality between humans, so that it appears as new phenomena such as individualization, transparency, cognition, which become prominent trends and characterize aspects of culture. Although the Indonesian people have been undergoing digital transformation, the Covid-19 pandemic has also accelerated the transformation of digital culture. As a result, these factors have made people's daily activities highly dependent on the role of information technology. This means that advances in information technology have played an important role in changing people's behavior and lifestyles [1]

The digital transformation that has occurred has shaped many new orders in social life, including the way of dressing, changes in lifestyle and changes in style in language. The way people dress today has been heavily influenced by culture that is often found on social media with a more fashionable and modern style of dress. Meanwhile, for lifestyle changes, technological advances make it easier for people to get various information on the internet. Without realizing it, the lifestyle of a person or group has changed due to exposure to information from the internet. As for the change in style in language, many have found that local languages are rarely used but mostly use

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030012-1–030012-6; https://doi.org/10.1063/5.0241575
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Indonesian as the national language and even prokem language, which is a variety of takbaku Indonesian commonly used in the Jakarta area, has been widely used in areas that exist throughout Indonesia. This forms a new way for people to behave, interact, think and communicate in a community environment.

This is also experienced by the people in Ambon City. But what distinguishes it is that the people in Ambon City still adhere to a strong cultural tradition so that they are not ready to face the transformation of digital culture. Talking about the cultural traditions of the people in Ambon City, this is a sacred thing so that this culture plays a very important role in being a filter and providing an image of resilience to balance the changes that occur, including the transformation of digital culture. The will to shift the mindset and explore the digital world has not grown well. The people of Ambon City do not yet have the urge to accept the existence of new technology and have the idea that technology is here to be studied in a disciplined and consistent manner.

People in Ambon City with a culture that is still attached as an example of a family culture in establishing communication. When people are introduced to information technology in terms of establishing communication through email or social media platforms, it is feared that people will rarely establish face-to-face communication so that it keeps us away from people around who are family and relatives. In addition, some people in Ambon City are worried about, among others; First, lifestyle changes are becoming more consumptive. This can be seen from the increase in people's online shopping habits during the pandemic. Second, the change in language style by the millennial generation who really worships prokem language as their daily slang, so that local languages are rarely used. Third, the presence of digital culture is not taken lightly by some people in Ambon City. People see and pay close attention to digital security, especially regarding the existence of personal data and privacy. Fraud often occurs as a result of misuse of personal data by irresponsible individuals with technological sophistication. They take advantage of other people's personal data for profit.

Another digital transformation facing society today is related to processes in work and business. Workers who work now have to wear masks when they are in the office and keep their distance. In addition, workers who WFH must adapt to the conditions at home. Meanwhile, business owners who previously opened stores are now turning to online systems. It is very important to be creative, not only creative but also innovative to carry out sustainable development. It is very necessary that the mindset must change, not only everything must be digitized but also a personal culture that must be built.

Ieke Wulan 2022 quotes [2] explained that Indonesia is currently entering the era of revolution 4.0. In this era of the industrial revolution 4.0, there are fewer activities that are physically tied to geographic locations. Because all human activities are converted from manual to digital. The new order is formed by the digital era which requires humans and technology to coexist and collaborate. Humans must be ready to transform digitally. The real evidence is that the COVID-19 pandemic that has afflicted all countries in the world affects all social life. The covid pandemic has become an escalation of digital culture transformation and is the main marker for the creation of a conservative culture towards a digital culture.

Thus, the covid pandemic has caused a spontaneous cultural change in society. This means that the COVID-19 pandemic has changed many social and cultural values which have an impact on changing people's mindsets, interactions and behavior in everyday life.

However, not all observers agree that the COVID-19 pandemic has accelerated digital transformation. Because there are those who think that the Covid-19 pandemic is seen as only encouraging remote work systems, using video conferencing, and increasing network capacity, so it has not been categorized as a digital transformation process [3]. However, there are several main components in building a digital culture, namely, participation, remediation, and bricolage [4]. However, information technology has encouraged the creation of a more dynamic digital culture [5]. However, digital culture has changed traditional culture which then encourages new forms of creative expression and offers new perspectives for intercultural communication [6].

The description of the background of this writing problem gives encouragement to the author to seek factual information and further describe how the impact of the covid pandemic on the transformation of digital culture is. Meanwhile, the limitations and implications in this study only focus on the strengthening of digital culture as a result of the Covid-19 pandemic and the various efforts that must be made to deal with the transformation of culture from conventional to digital.

METHOD

This study uses a literature review technique by observing and analyzing all information on the research topic. In this context, the literature study is then combined with previous research to be able to explain the phenomena that occur.

In research, researchers will perform several stages to elaborate research topics including; First, the researcher observes and analyzes various information related to the research topic. Especially the theory that will be used with various previous studies. Second, collect various literatures relevant to the research topic in order to explain the phenomena that occur. Various literatures were collected for reference in the form of scientific journals, research papers, and other supporting information. The aim is to combine findings with the same theme as preliminary studies with contemporary studies [7]. Thus, this research is to reduce the knowledge gap and provide more relevant information to the research topic.

RESULTS AND DISCUSSION

Digital Transformation in the Era of the Covid-19 Pandemic

The modern era is identified with the era of digital society. Every human activity will be driven through a series of digital technologies. This technology is operated by pressing several digits (numbers) which are arranged in various sequences. The relationship that is built between individuals is a digital exchange relationship, every human being only performs a series of transactions or interactions through digital symbols. Trading transactions, communications, everything is digitally driven. Each individual will have a digital identity that is able to recognize who he is, every human being has been given a serial number: through an identity number (e-KTP), mobile phone number, telephone number, bank account number, ATM number, electricity account number, telephone account, water account , PIN (Personal Identification Number) ATM, all use a digital system.

Human interaction is driven by all-digital technology: computers, internet, ATM machines, telephones, mobile phones, and so on, are all driven digitally. We can buy something just by swiping an ATM card and pressing a few PIN numbers, as well as to pay hotel room bills, buy tickets, and so on. Remittances can be made in seconds by simply pressing a few digits of the value of the money to be sent and a few digits of the destination account number. Not money sent, but just a series of numbers moving from one account to another [8].

The things mentioned above have happened long before the COVID- 19 pandemic hit the whole world, even in Indonesia, especially in Ambon City. The fact cannot be denied that people in Ambon City already know what is called technology but are not ready to face the transformation of digital culture. The will to shift the mindset and explore the digital world has not grown well. The people of Ambon City do not yet have the urge to accept the existence of new technology and have the idea that technology is here to be studied in a disciplined and consistent manner. This means that not all matters relating to digital transformation are well received by the people of Ambon City.

Things that can be accepted by the people of Ambon City with the digital transformation in the use of information technology include; *First*, technological developments or advances that have an influence in various fields of human life, for example in the social and cultural fields. This can be seen from the way the people of Ambon City communicate which continue to experience drastic changes. Previously, we knew that many people communicated by sending correspondence or sending messages. But since the presence of information technology has finally changed the culture in society in terms of establishing communication. This means that currently the people of Ambon City are used to establishing communication via email or using social media. Especially on social media, the public has been able to use this platform to stay in touch with each other or just discuss family issues.

Second, the way people dress today is influenced by culture, which is mostly found on social media. Nowadays it can be found easily, in a more modern way of dressing and can reach various groups, especially the millennial generation. Of course, this way of dressing must be adapted to the dress code in Indonesia, because not everything can be directly applied to the character of the Indonesian people. Third, lifestyle changes. Advances in technology have made it easier for everyone to find various information on the internet. So that without realizing it, lifestyles or groups begin to change due to exposure to information that comes from social media. However, this change can be both positive and negative. Some examples of positive lifestyle changes are diligent exercise, maintaining a healthy lifestyle, reducing meat consumption and so on. While negative lifestyle changes such as drug use to promiscuity. *Third*, changes in style in language that are starting to be found. Another symptom in the style of language is often encountered the use of foreign languages in a conversation. This mix is usually used by the millennial generation by combining Indonesian and English.

This is not the case with acceptance of new technologies in finance. As we know that before the covid pandemic hit the world and Indonesia in particular Ambon City, financial transactions had experienced extraordinary developments. Advances in technology have allowed for various new functions for mobile devices that support several financial services such as bill payments, transfers to accounts, remote payments for purchases of goods and services as well as for top-up balances. [9] and [10]. For example, people can easily make payment transactions using only smartphones and internet networks through a payment service application which we know as mobile payment. A cashless mobile payment method can increase financial inclusion [11] because mobile payments reduce barriers for the public in accessing financial services, so that people can easily make small payment transactions (micropayments) without using money [12]. In fact, the massive use of mobile payments also occurs in Indonesia, especially in Ambon City. However, it turns out that there is still minimal research that discusses why people are still reluctant to accept and use mobile payment as an application for mobile payment services.

In the midst of the Covid-19 pandemic that occurred, especially in Ambon City, people had to change their lifestyle in terms of social interaction, one of which was in terms of the payment model. One of them is conducting transactions, people are required to use non-cash payment instruments (cashless). The Ambon City Government has appealed to the public to be able to maximize non-cash payment instruments (cashless) in buying and selling transactions. The Ambon City Government continues to detail in as much detail as possible the things that are considered to be potential media for the spread of the virus, to be disseminated to the public. Cash exchange has potential, so making transactions with non-cash payment instruments is a wise attitude that can be done together. But not all shops or stalls and traditional markets know about the cashless payment method, there are still those who don't know and have not used it so they still use the cash payment system.

People in Ambon City already know the cashless or non-cash payment system, but do not understand how to use cashless or non-cash payment applications, so most people are still considered complicated. In addition, cultural factors are factors that are strongly attached to the people of Ambon City making the decision not to easily accept the new technology offered. The existing phenomenon shows that long before the Covid19 pandemic occurred, the people of Ambon City were already familiar with fintech but some people had not decided to use non-cash transactions. This happens because people think of this as something complicated and not in accordance with the culture of the community that is embraced as well as the influence of personal factors which are a person's habit pattern which is influenced by the closest environment in making a decision.. The digital age is shaping a new order in which humans and technology coexist and collaborate. The digitalization process requires every human being to be ready to transform digitally, and the Covid-19 pandemic has become an escalation of digital culture transformation in society, making

people's daily activities highly dependent on information technology.

The COVID-19 pandemic has become the main marker of the creation of a cultural change from conservative to digital culture in the style of Indonesia's digital society. However, not all observations agree that the COVID-19 pandemic has accelerated digital transformation. Because there are those who think that the Covid-19 pandemic is seen as only encouraging remote work systems, using video conferencing, and increasing network capacity, so it has not been categorized as a digital transformation process [3]. Even so, the change in digital culture that continues to strengthen must be anticipated immediately through a program to strengthen digital literacy. The Covid-19 pandemic has pushed remote working systems, using video conferencing, and increasing network capacity, so it has not been categorized as a digital transformation process [3]. Digital culture has changed traditional culture which then encourages new forms of creative expression and offers new perspectives for intercultural communication [6].

Furthermore, the digital transformation process has been supported by various government programs in the national agenda. By strengthening this digital infrastructure, it is certainly necessary to strengthen digital-based human resources, so that people can more easily adapt to digital culture.

Digital Culture Opportunities and Challenges

The development or progress of technology that is increasingly rapidly, has an influence on various fields of human life. Technology that continues to develop can have a negative or positive impact on society. Technology can be seen as positive when it brings great benefits and helps human activities, and vice versa if it has a negative impact on society.

Technology is developing rapidly, covering various fields of human life. Nowadays it seems difficult to separate human life from technology, even it is a human need. Early technological developments that were previously part of science or depended on science, now science can also depend on technology. For example, with the rapid development of computer technology and space satellites, new knowledge is obtained from the work of the two technology products.

Digital transformation is the process of converting all non-digital activities into digital ones with increasing the effectiveness and efficiency of related activities. There are many technologies that can be used to support all human activities. Call it, the easiest is the presence of gadgets as a means of communication and information retrieval. This ever-evolving technology cannot be seen as always having a negative or positive impact on society. Technology can be viewed positively when it brings great benefits and helps human activities. However, technology can also be seen as negative if it has a negative impact on society, for example changes in values that lead to negative things or so on.

But since the presence of information technology has finally changed the culture in the community in Ambon City in terms of establishing communication. This means that nowadays people are used to communicating via email or using social media. Especially on social media, the public has been able to use this platform to stay in touch with each other. Thus, this cultural change has had a positive impact on society because it can establish communication without boundaries of space and time. But this technological advancement can also be viewed negatively when it makes people in Ambon City rarely communicate face-to-face, so it is feared that it can keep them away from the people around them. In addition, people assume that with technology there will be a moral decline among citizens, especially among teenagers and students. The progress of economic life, which places too much emphasis on fulfilling various material desires, has caused some people to become rich in material things but poor in spirit. Delinquency and deviant acts among teenagers are increasing the weaker the authority of existing traditions in society, such as mutual cooperation and mutual assistance. These things are the reasons for people in Ambon City in making decisions to accept new technology. They see more of the presence of information technology from the negative side.

From the description above, it can be concluded that the willingness to shift the mindset and explore the digital world has not grown well in the people of Ambon City. Thus it can be said that the digital transformation process has formed a lot of new orders. For this reason, the success of digital transformation is very dependent on the readiness of the community to go digital. One of them is through the digital literacy movement. This digital literacy program will train the public on digital ethics, digital security, digital culture and digital skills.

The Urgency of Digital Literacy

The condition of digital literacy of the Indonesian people is still far from perfect to be able to bring Indonesia into a good digital society. The reason is that social media users in Indonesia are still at the stage of being able to use digital devices, but tend to have not been followed by good information management skills to become creative content creators. Although most people still tend to be at the stage of being able to only use digital devices, the ability to use digital media critically is starting to form in various levels of society.

Reactive nature often occurs because people lack an understanding of digital literacy. So, when getting information, it will indirectly be reactive or respond without any further in-depth verification process. This kind of nature will certainly be very dangerous when the information obtained is a hoax to hate speech. The recipient of the message will certainly be carried away to put forward an emotional attitude rather than an attitude for more in-depth verification. For example, when receiving information, our society still puts forward an excessive emotional attitude. In fact, it turns out that the information is prank content (settings). A reactive attitude that is widely digested by the Indonesian people as a result of the presence of digital culture. Of course, this negative nature cannot be eliminated immediately, because a process of strengthening and understanding digital literacy related to digital culture is needed.

CONCLUSION

The Covid-19 pandemic has made the digital transformation process work faster. As a result, this digital transformation process increasingly makes the public have a high dependence on information technology and social media. This then makes the public must be able to adapt to the new culture that has become the hallmark of information technology. In addition, the way of doing economic transactions during the Covid-19 pandemic has made business units switch to digitalization. This change has certainly shifted the old conservative culture towards a digital culture.

Thus, the impact of the COVID-19 pandemic has become the main marker of the creation of cultural change from conservative to digital culture in the style of Indonesian digital society. Even so, the change in digital culture that continues to strengthen must be anticipated immediately through a program to strengthen digital literacy.

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Representation of Liberal Feminism in *Ketika Cinta Bertasbih* and *Cinta Suci Zahrana* by Habiburrahman El Shirazy

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Abstract. The novel represents ideology and reflects the author's sociological knowledge and experience. The novels *Ketika Cinta Bertasbih and Cinta Suci Zahrana* represent Habiburrahman El Shirazy's ideology, as well as reflect on his knowledge and experiences about education abroad (Egypt), Islamic boarding schools, and religious values. This paper aims to discuss the position and role of women as reflected in Habiburrahman El Shirazy's novel *Ketika Cinta Bertasbih and Cinta Suci Zahrana* as a reflection of social reality. This research is a literature study with qualitative methods and descriptive analysis. The theoretical framework used is liberal feminism. The data analyzed is in the form of discourse in the two novels that focus on liberal feminism discourse. The study results show that the authors place women as subjects, not objects, in both novels. The author gives individual freedom and autonomy to female characters in determining their way of life, especially regarding the dimensions of education and spouse. The female character in *Ketika Cinta Bertasbih*, Anna Althafunnisa, was educated in Egypt, while her parents gave her son autonomy in choosing a mate. Anna can refuse Azzam's proposal and choose the man she loves, Furqan. Meanwhile, the female character in *Cinta Suci Zahrana*, Dewi Zahrana, is also pursuing higher education and lecturing. Customary law requires women to marry. Therefore, the family gave Zahrana the freedom to choose a partner, although the choice ultimately fell on her own students. Based on the study of the two novels, it can be concluded that individual women have the freedom to fulfil reason, self-satisfaction, and individual autonomy. Intervention from the family and other external factors can be minimized so that women are free from the construction of an oppressive or unfair gender role. The findings of this study indicate that Habiburrahman El Shirazy can provide ideological criticism of the general perspective, which has so far been a public discourse that novels written by male authors about the world of Islamic boarding schools tend to perpetuate patriarchal ideas. Habiburrahman El Shirazy rejected patriarchal ideas because he gave women the freedom to follow the ideology of liberal feminism.

INTRODUCTION

Habiburrahman was a prolific author in the 1920s. The novel Ayat-Ayat Cinta exploded on the market, especially after it was filmed. Habibburahman's novel is considered to encourage people to practice polygamy, because the main character is polygamous. Habiburrahman raised the theme of love wrapped in religion and it brought a breath of fresh air to the understanding of the theme of love in accordance with religious beliefs. Habburrahman captured this phenomenon as a means of preaching through stories. Habiburrahman modified the social conditions that existed in society and his imagination so that literary works were not merely imaginary works that discussed the theme of love but provided teaching to society, according to the opinion of Wellek and Warren [1] dulce et utile. As a member of society who formally underwent religious education in Egypt, Habiburrahman tried to include religious teachings in the theme of love which is popular with readers.

Habiburrah's success in publishing novels Ayat-Ayat Cinta 1 followed by the publication of his other novels, namely Ayat-Ayat Cinta 2 (2004), Pudarnya Pesona Cleopatra (2004), Di Atas Sajadah Cinta (2004), Dalam Mihrab Cinta (2007) Ketika Cinta Bertasbih 1 (2007), Ketika Cinta Bertasbih 2 (2007), Ketika Cinta Berbuah Surga (2008), Bumi Cinta (2010), Cinta Suci Zahrana (2011), Ayat-Ayat Cinta 2 (2015), Api Tauhid Cahaya (2015), Bidadari Bermata Bening (2017), Kembara Rindu (2019). Almost all of Habiburrahman's works became best sellers and were adapted into films.

The theme of love is wrapped in deep religion Ayat-ayat Cinta which gave rise to this controversy, Habiburrahman answered with other works, one of which was Cinta Suci Zahrana. Habiburrahman tried to convey his ideology, that he did not place women in a weak position, but his decisions were based on religious beliefs. That's why these two novels (Ketika Cinta Bertasbih 1 dan 2, serta Cinta Suci Zahrana) can represent Habiburrahman's views from the perspective of liberal feminism.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030013-1–030013-8; https://doi.org/10.1063/5.0242000
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

According to Teeuw (in Yuleaneta [2]) the image (representation) of Indonesian women in novels is a downstream reality, while the reality of Indonesian women in everyday life is an upstream reality. Habiburrahman captures and combines downstream and upstream realities through his works.

In general, according to Tong [3] there are several streams of feminism, namely liberal feminism, radical feminism, Marxist and socialist feminism, psychoanalytic and gender feminism, existentialist feminism, postmodern feminism, multicultural and global feminism, ecofeminism. This research focuses on liberal feminism. The view of liberal feminism originates from the National Organization for Women (NOW) which considers the source of liberal feminism to be the wrong view of society which considers women's subordination based on customs and legal obstacles and their success in the public world [3]. It was further explained that to achieve this, it is necessary to obtain education to be equal to men. Therefore, discussing liberal feminism cannot leave discussing gender. It makes sense that Tong states that the general goal of liberal feminism is to create a just and caring society in which freedom flourishes. A just society means one that cares about gender equality. Quoting Roland Martin and Wollstonecraft, Tong [3] stated that emphasizing education is a matter of pride for women that can be compared with men. This struggle for education will be revealed in this article.

Fakih [4] divides gender into five types, namely subordination, marginalization, stereotypes, violence, and workload. Subordinadi emphasizes the secondary importance of women. Women are considered second only to men. Marginalization is marginalization in the economic field. Women are considered secondary, so in school opportunities men often take priority. Stereotypes are negative labels and those who most often receive negative labels are women. Women are considered whiny, unintelligent, unable to lead and only suitable for domestic activities. Violence is an invasion of a person's physical and mental psychology. Workload occurs when women carry out public activities but are also required to do domestic work. These five gender roles are closely related to the struggle for women's rights in the public sector.

Novelty (newness) in this research refers to the research gap, namely that this research aims to reveal the author's representation in responding to the horizon of readers' expectations regarding his first work which is considered to place women in an unfavorable position. Previous study of the novel Ketika Cinta Bertasbih 1 dan 2 dan Cinta Suci Zahrana studied each novel individually. In this research, Habiburrahman's three novels were analyzed using the same theory, namely liberal feminism theory.

Searching online, especially articles in journals, found various scientific papers discussing the novel 8from religion. Moh. Adi Amzar Muhammad Nawawi [5] discusses the use of the Al-Qur'an and Hadith in novels Ketika Cinta Bertasbih by Habiburrahman El-Shirazy. [6] Lukman Hakim (in studying Ketika Cinta Bertasbih 2 with semiotic studies, which consider film Ketika Cinta Bertasbih 2 as a representation of post-traditional Islamic feminism. [7] Ghulam Arif Rizal highlighted the politeness of Anna's language, the moral messages and religious values conveyed by the character Anna. Some are interested in educational and moral aspects in the novel Sutrimah [8], Fitria [9], while Lestari P [10]. highlighting the social and religious aspects of the novel Cinta Suci Zahrana by Habiburrahman El Shirazy. Subarjo, [11] discusses the character Anna who is depicted as avoiding negative impressions and her position is equal to men according to her function and position. Lukman Hakim [6] discusses stereotypes of women in deep patriarchal culture Ketika Cinta Bertasbih along with other Islamic novels such as Geni Jora, Perempuan Berkalung Sorban dan Surga yang Tak dirindukan, Setangkai Bunga di Taman Pujangga dan Cinta dalam Diam.

Novel Cinta Suci Zahrana also widely studied individually, including Nurani Martania [12] entitled "Existential Feminism Study Cinta Suci Zahrana", The result of the freedom of female characters in determining the direction and goals of their lives, is that women can also do what men do. Cinta Suci Zahrana discussed from a stylistic perspective by Sinta Wira Sasmi, Nurizzati, Ismail [13] Indonesian Language and Literature Study Program FBS Padang State University. The language styles of simile, metaphor, allegory, parable, personification, eponym, antonomasia, irony, cynism, sarcasm, satire and paranomasia are found. Budiyanto [14], title "Sociological Analysis of Literature Cinta Suci Zahrana", sociological aspects of kinship, love for family and friends, and the opposite sex, morals of being helpful, generous, loyal friends. Mulyadi [!5] highlighted "Representation of women in films Cinta Suci Zahraza", shows that gender ideology has formed a patriarchal culture in society and created a male dominated culture, a culture that is dominated by and prioritizes men, giving rise to injustice.

The research method used in this research is a qualitative research method with a feminist literary criticism perspective. Qualitative research according to Semi [16] is research carried out without prioritizing numbers, but prioritizing the depth of appreciation of the interactions between concepts that are studied empirically. The qualitative descriptive method produces in-depth descriptions because it is sharpened by qualitative analysis.

DISCUSSION

The Struggle of Female Figures in Education and Career

Discussion of characters *Ketika Cinta Bertasbih 1 dan 2* and *Cinta Suci Zahrana* The focus is on female characters because it describes how far the women in the three novels went to fight for their right to freely choose their career and soul mate.

The female characters discussed in the novel are characters *Ketika Cinta Bertasbih 1 dan 2* is the character Anna. Anna is a female character whose presence in the novel is very prominent. Anna grew up in a boarding school environment. His father, Kiai Luthfi, is the leader and selector of the Islamic boarding school. Since childhood, Anna was introduced to and invited to attend religious events. The movement of the novel Kala Cinta Bertasbih culminates in Anna. Anna studied higher education in Cairo. Leaders of big lodges like Kiai Luthfi sending girls far abroad is part of respecting the dignity and worth of women, especially in the field of education. Habiburrah in his work *Ayat-ayat Cinta 1 dan 2* also gave rise to the character Aishah who also studied higher education in Türkiye. From here, Kiai Luthfi is a representation of Habiburrahman who values education for women.

As explained in the introduction to this article, Novels and Films *Ayat-ayat Cinta 1* dan *2* received sharp criticism from Indonesian novel readers and film viewers, that *Ayat-ayat Cinta* accused of providing an example of the ease of polygamy. Therefore, Habiburrahman answered this with several works, including: *Ketika Cinta Bertasbih* and *Cinta Suci Zahrana* which features a highly educated female character who chooses her own soul mate.

Anna Altafunnisa is told as the character of a graduate student, Al Azhar. She is the daughter of Kiai Lutfi Hakin, a boarding school leader in Semarang. Anna is described as a beautiful, intelligent and gentle character.

> *Pada saat yang sama Pak Kiai Luffi punya anak gadis yang sangat cerdas. Dan sangat cantik. Sungguh sangat cantik. Kecantikannya ibarat permata maknun yang mengalahkan semua permata yang ada di dunia. Aku berani bertaruh kecantikannya bisa mengatasi Eliana. Ini lho Mas. Sebab kecantikan seorang perempuan di mata lelaki itu relatif. Dan untuk kecerdasannya aku berani bertaruh, tak banyak gadis seperti dia. Aku tahu persis, sebab aku pernah belajar pada ayahnya selama satu tahun. Jika Eliana bisa bahasa Prancis dan Inggris. Maka Putri Pak Kiai Lutfi ini bisa bahasa Arab, Inggris dan Mandarin. Saat di Madrasah Aliyah dia pernah ikut program pertukaran pelajar ke Wales,U.K.* (*Ketika Cinta Bertasbih 2* : 106)

Anna Altafunnisa is described as a beautiful, religious and intelligent character. His choice of Al Azhar and leaving his family is a representation of liberal feminism. Even the freedom given by her father is also a representation of liberal feminism. Anna is fluent in three languages which enabled her to take part in a student exchange program to Wales, U.K. Her intelligence made Furqan fall in love and ask her to become his life partner. Anna is a perfect woman according to the views of Indonesian society. Beauty standards are subjective and can change over time. Many people in Indonesia also value diversity and believe that beauty comes in various shapes, sizes and skin colors. Everyone has the right to feel beautiful without having to meet the standards that society or the media may impose. Anna's figure is described as physically perfect and has various advantages in the academic field which symbolize her intelligence. This is an added value for Anna's figure, gentle, beautiful and intelligent, which other women don't necessarily have. *Ketika Cinta Bertasbih* also tells the story of a male character (Azzam) who supports the female character's struggle to gain independence and get an education. Azzam helps Anna, who is reviled by Cairo people for helping a Caucasian woman. Based on these advantages, Anna has become a figure idolized by men, including Furqon and Azzam.

> *Namun lamaran dari Furqan, Mantan Ketua Umum PPMI, dan kandidat M.A. dari Cairo University, ia rasakan agak lain. Tidak mudah baginya untuk mengatakan "tidak", seperti sebelum-sebelumnya. Juga tidak mudah untuk mengatakan "ya."* (KCB: 151)

Anna chose to study at Al Azhar to develop herself and develop her father's Islamic boarding school. Therefore, Anna chose to teach at her father's Islamic boarding school and did not leave the Islamic boarding school after getting married. In fact, remaining at the Islamic boarding school was a condition put forward by Anna to her future husband.

Novel Cinta Suci Zahrana raises the theme of women's struggle in determining their career and soul mate. Zahrana's struggle began at school. Her father wanted his child to go to boarding school, but Zahrana wanted to go to high school. Zahrana understands that when she goes to high school she will be able to freely choose the college she wants. "Defeating" his father with the right arguments was not an easy matter. His father, who was the mosque administrator, wanted his son to go to boarding school. However, Zahrana's explanation was able to break her father's strength.

Likewise, when she graduated from high school, her father wanted Zahrana to enter FKIP, to become a teacher. The ideals that many simple village people like his father aspire to. However, Zahrana wants to become a doctor.

> *"Wah Pak, kalau Rana jadi dokter mulia kita Pak. Oh senangnya kalua punya anak dokter." Mata ibunya berbinar-binar. Tapi ayahnya menanggapi dengan dingin. "Senang-senang, nggak dipikir biayanya dari mana! Mbok yo uteke dienggo ojo perasane wae sing dienggo!"* (CSZ:5)

Her father's refusal did not make Zahrana give up. For his father, a schoolboy like his father would not be able to pay for his son's studies at the Faculty of Medicine. Zahraza racked her brain and found a major that was challenging and she liked, Faculty of Engineering, majoring in Architecture. Zahrana was able to accept her father's reasons and transferred her dreams to the Faculty of Engineering. Zahrana gave a reasonable explanation so that her father agreed for Zahrana to enter the Faculty of Engineering. Zahrana's persistent efforts can be seen in fighting for her ideals. Her father could not refuse Zahrana's wishes, because Zahrana had agreed not to enter medical school.

> *Yang penting pesan ibu, tutukno sekolahmu. Sekolaho sak duwur-duwure yo Nduk, ben ora asor uripmu*

Zahrana's mother is a figure who always supports her child's dreams. Her mother's message really encouraged Zahrana. His father's position as a school boy meant that his father was often insulted and humiliated at work. This makes the mother always want her child to succeed. The case of harassment at her father's job also sparked Zahrana's enthusiasm to succeed in her studies. Zahrana studied hard to get a scholarship and lighten her father's burden.

Zahrana always has dreams that are different from her father's dreams. He wants to work in the field he likes. After graduating from college, Zahrana was hired to work on campus. An offer that would make anyone proud if they accepted it. However, the offer was countered by his father's opinion.

> *…Kalau kamu tetap ngotot ingin mengajar di Jogja, itu artinya kamu sendiri yang minta agar kami mengikhlaskan kamu. Seolah-olah kami tidak memiliki anak lagi.* (CSZ:12)

Zahrana's hard struggle from the start started with her family. Zahrana's father's pride was not in his success in higher education, but in wanting to have children who memorized the Koran. Even when Zahrana graduated and was offered to teach at the place where she studied, her father was not proud. Zahrana was given an ultimatum to choose for herself, remain as her father's child, or work in Jogja but be considered not the child of her father and mother. Efforts to escape poverty by getting a good job are not in line with his parents' wishes.

Zahrana is described as a dynamic character. Even though she achieved her dreams with a strong struggle, Zahrana also gave in to her father in choosing a job. Zahrana faced a serious conflict. On the one hand, he wants to become a lecturer in a classy place, on the other hand, his father thinks he is not available if he accepts the offer. Zahrana experienced the hardest inner conflict when deciding on her choice. He didn't want to be seen as a disobedient child. Therefore, with a heavy heart he told his supervisor not to accept the offer and chose to accompany his elderly parents. Zahrana's supervisor helped provide recommendations for private universities near Zahrana's house and introduced her to friends who were leaders at those private universities.

> *"Berikan memo ini untuk teman saya di Fakultas Teknik Universitas Mangunkarsa Semarang. Namanya bu Merlin. Semoga ilmumu bisa bermafaat"* (CSZ:14)

At her workplace at Mangunkarsa University, Zahrana can have a career. Even though she compromised with her father's desire not to leave Semarang, Zahrana was still able to choose a job that suited her dreams. His research and scientific writings are recognized worldwide. Zahrana also continued her Masters studies to develop her knowledge. Zahrana's struggle since childhood to choose the education she wanted is a representation of liberal feminism. Zahrana already knows what to strive for, the school she wants and the job that suits her field of knowledge.

Women's Struggle in Choosing a Soulmate

Anna chose Furqon over the teacher at her father's cottage because Anna already knew Furqon. Another consideration is that Furqon is the former general chairman of PMII and an M.A candidate from Cairo University. Mature considerations made by intelligent women. However, to protect her marriage, Anna put forward conditions for her future husband.

> *"Saya punya syarat yang syarat ini menjadi bagian dari sahnya akad nikah. Artinya farji saya halal diantaranya jika syarat saya ini dipenuhi oleh Mas Furqan." Kata Anna di majelis musyawarah itu.*
> *"Apa itu syaratnya?" Tanya Furqan.*
> *"Pertama, setelah menikah saya harus tinggal di sini.*
> *Saya tidak mau tinggal selain di lingkungan pesantren ini.*
> *Kedua, saya mau dinikah dengan syarat selama saya hidup dan saya masih bisa menunaikan kewajiban saya sebagai isteri Mas Furqan tidak boleh menikah dengan perempuan lain!" Dengan tegas Anna menjelaskan syarat yang diinginkannya* (KCB2:29)

The conditions put forward by Anna were to protect herself from polygamy which is often carried out by men. In Islamic boarding school environments, polygamy is often practiced because it does not violate religion. Polygamy can be practiced by Muslim men provided they are economically capable and treat their wives fairly. Many people think that fairness is difficult for humans to do. Therefore, Anna provides an example of a family that does not practice polygamy.

> *Saya hanya ingin seperti Fatimah yang selama hidupnya berumah tangga dengan Ali bin Abi Thalib tidak dimadu oleh Ali. Dan saya ingin seperti Khadijah yang selama hidupnya berumah tangga dengan Rasulullah juga tidak dimadu. Sungguh saya sama sekali tidak mengharamkan poligami. Tapi inilah syarat yang saya ajukan. Jika diterima ya akad nikah bisa dirancang untu k dilaksanakan. Jika tidak, ya tidak apa-apa. Silakan Mas Furqan mencari perempuan lain yang mungkin tidak akan mengajukan syarat apa-apa!" Papar Anna panjang lebar.* (KCB 2: 31)

According to the Furqon family, the conditions given by Anna were unreasonable, but Furqon agreed. Anna and Furqon's wedding was held lively. Anna didn't know about Furqon's venereal disease, because Furqon was still hiding it. Disharmony in Anna and Furqon's household occurred because Furqon did not carry out his obligations as a husband.

Anna's marriage didn't last long because Furqon never touched Anna. Furqon couldn't bear to spread the venereal disease he contracted as a result of promiscuity with foreign girls in Cairo. Furqon didn't even tell Anna or her family. After getting married, Anna found out that Furqon had a venereal disease.

> *”Kau sangat jahat! Kau begitu tega mendustaiku dan mendustai seluruh keluargaku! Bahkan kau mendustai seluruh orang yang hadir saat akad pernikahan kita! Sebelum menikah pegawai KUA itu membacakan statusmu perjaka! Ternyata kau dusta! Lebih jahat lagi, ternyata kau mengidap penyakit yang dibenci semua orang, dan kau tega menyembunyikannya dariku! Kau jahat!”* (KCB 2: 311)

Furqon was the man Anna chose among several men who proposed to her. Anna felt like she knew Furqon better than some of the men who proposed to her. It turns out that Furqon wasn't honest with Anna. Anna's choice of Furqon was wrong. Anna and Furqon divorced. Divorce is an act that is not liked by Allah, but does not violate religion.

Anna, who determines her soul mate herself, has failed to maintain it because of Furqon's big lie. Anna is not afraid and is not ashamed to divorce. However, Anna is traumatized by her own choice. Anna left the choice of her mate to her father.

> *”Anna agak trauma dengan pilihan Anna Bah. Anna sudah berjanji pada diri Anna sekarang Anna serahkan pada Abah dan Ummi siapa yang akan mendampingi hidup Anna. Sekarang Anna sudah tidak sedikitpun mempertimbangkan fisik lagi.* (KCB 2: 402).

The statement “Anna agak trauma dengan pilihan Anna Bah” shows that her own choices will not always make her happy. Her father freed Anna to choose her own soul mate, even with the conditions and life example that Anna wanted. It turned out that Anna thought her own choice was wrong. For the next match, Anna handed it over to her father.

Anna's life journey finally ends with Azzam. Azzam, who asked Kiai Lutfi for help in finding a mate, instead got married to his son, Anna, the girl he wanted to be his wife. When she was about to accept Furqon's proposal, Anna imagined Abdullah, the young man who helped her when Anna was cursed at by people in Cairo. Anna was criticized for helping a Caucasian girl who was not wearing a hijab. The local people did not want Anna to help the girl. Anna didn't think that the Abdullah who had helped her was Azzam, the person her father was going to marry her. On the other hand, Azzam also doesn't know that he will be matched with Anna, the girl he loves. Azzam once felt jealous of Furqon and felt inferior to Furqon who could edit Anna.

> *Kedua insan itu bertasbih menyempurnakan ibadah mereka sebagai hamba-hamba Allah yang mengikuti sunnah para nabi dan rasul yang mulia. Malam begitu indah. Rembulan mengintip malu di balik pepohonan. Rerumputan bergoyang-goyang bertasbih dan bersembahyang. Malam itu Azzam dan Anna merasa menjadi hamba yang sangat disayang Tuhan*. (KCB 2: 402)

After Azzam and Anna went through a long and difficult conflict, Azzam and Anna finally got married. A marriage full of happiness. Azzam and Anna have completed their worship by getting married. Their marriage seemed to be approved by the universe, so “rerumputan bergoyang-goyang bertasbih dan bersembahyang”.

The big problem that Zahrana is fighting for (*Cinta Suci Zahrana*) is a soul mate. After successfully fighting for education and work according to his dreams, the problem of a soul mate cannot be underestimated in Javanese culture. The preoccupation with studying and developing her career made Zahrana forget that the culture where she lived required women to marry.

> *“Saya katakan anak itu mementingkan dirinya sendiri, kesenangannya sendiri. Yang ia pikirkan bagaimana meraih perhargaain ini, gelar ini dan itu, ngisi seminar ini dan itu. Itu saja yang ia pikirkan. Dia tidak pernah mikir kedua orangtuanya tak lama lagi akan mati. Kami semakin tua. Dan dia masih lajang saja, tidak juga berumah tangga….”* (CSZ:43)

The big challenge that must be fought for is getting married in accordance with the religious and cultural demands of Java where Zahrana lives. Women over 30 years old are stereotyped as spinsters. This stereotype is also a burden on Zahrana's parents. Stereotypes of old women are not only from their parents, but also from the people around them. Zahrana's elderly dean even sent Vice Dean 1, who had helped Zahrana, to propose to her. The Dean felt that it would be easy to get Zahrana because Zahrana was a spinster. Zahrana knew about her dean's reputation for playing with women. Zahrana also wants to fight for her idealism of marriage based on love. Therefore, he politely refused. Zahrana's refusal had long consequences. Before being fired, Zahrana resigned from campus and taught at STM Pondok. Terror text messages from the former dean attacked him repeatedly, but Zahrana did not reply. The former dean carried out verbal violence by sending text messages.

> *“Apakabar perawan tua?”*
> *“Kelapa itu semakin tua semakin banyak santannya. Banggalah jadi perawan tua”* (CSZ:224)

According to Fakih [2] violence in the concept of gender is an invasion of a person's physical and mental psychology. Openly referring to women as spinsters is not just violence, but also harassment. Zahrana wanted to marry based on love with someone who matched her, but instead received psychological violence from educated people like her dean. However, out of respect for the dean who was once her leader, Zahrana did not reply to the SMS sent by her dean. Zahrana still values manners as a younger person.

The next challenge came from colleagues, lecturer friends at his old place of work. The predicate of being an old maid is also considered by young people to be used as a mistress or second wife. Pak Didik, her former colleague, proposed to her as his second wife. Zahrana just realized that old maids were looked down upon by people like that. It was unimaginable that Zahrana received a long email from Mr. Didik proposing to her as his second wife. On the basis of wanting to fight for love, Zahrana deleted the email and never considered it existed.

Zahrana tries to find a mate by asking Mrs. Nyai for help. The match offered is an Aliyah graduate who sells crackers around. Zahrana felt "disrespected" because the traveling cracker seller who came was old and far from handsome. When he felt sad and down, a second traveling cracker seller appeared again whose name was the same as what Mrs. Nyai said. Zahrana istikhoroh to get guidance from Allah about her soul mate. Istikhoroh is an action that always appears in Habiburrahman's novels when a character has to make a choice. After istikhoroh firmly married

Rahmat. However, when the wedding day arrived, Rahmat was hit by a train. Zahrana, who already liked Rakmat, was very sad, and even wanted to die with her husband.

In his confusion, he received a visit from a doctor who was Hasan's mother, a student who was still supervising his thesis even though Zahrana was no longer teaching at Mangunkarsa University.

> *"Kalau begitu saya terima, tapi dengan syarat."*
> *"Apa syaratnya?"*
> *"Akad nikahnya nanti malam bakda Shalat Tarawih di masjid. Biar disaksikan oleh seluruh jamaah masjid. Maharnya seadanya saja."...*
> *Setelah shalat magrib Zahrana mendapat telpon dari bu Zul.*
> *...*
> *Suara di hand phone Zahrana lalu berubah.*
> *"Bu Zahran aini asan. Saya setuju dengan syarat ibu.* (CSZ:267-269)

Mrs. Zul fulfilled her son Hasan's wish to propose to Zahrana. Zahrana feels that she has no special relationship with Hasan. Nevertheless, Zahrana wanted to emphasize Hasan's desire to marry her. Hasan seriously likes Zahrana and wants to marry her. Zahrana was willing to marry Hasan on the condition that the marriage be held that same evening after tarawih prayers and witnessed by residents, Zahrana's neighbors. Hasan accepted these conditions and the night after tarawih prayers, Zahrana and Hasan got married. This condition is to protect him from failure to marry.

Marrying Hasan was her choice. The result of the struggle to find the mate he likes. Even though Zahrana is older than Hasan, Zahrana wants to be called "dik" and Zahrana calls Hasan "mas". In her happy state, Zahrana still respects Hasan as her husband. Proof that Zahrana respects her husband is asking permission and discussing all decisions that will be taken.

> *"Jika benar Bu Zahrana, eh maaf Dik Zahrana diberi beasiswa penuh oleh Fudan University, maka saya dukung penuh. Dik Zahrana sebaiknya ambilPhD, saya yang akan ikut. Kan kuliah di Malaysia baru beberapa bulan. Sayab pindah saja ikut kuliah di Fulan. Selesai S3 semoga Dik Zahrana bisa mengajar di sana, saya teerus lanjut sampai selesai S3, setelah kita berdua mendapat gelar doctor, kita pulang. Kalau tidak ada universitas yang mau menerima kita, kita dirikan perguruan tinggi sendiri.* (CSZ:272)

Zahrana remembers a scholarship offer from a professor in Beijing. The offer was conveyed to her husband. Zahrana said that if her husband didn't allow it, she didn't force him. In this case, Habiburrahman does not direct his female character as a strong and powerful woman, but still respects her husband as the leader of the family. She will discuss or ask her husband for permission to determine his further education and career. However, unexpectedly, her husband allowed it, even her husband planned to follow Zahrana to Beijing and take a master's degree there. Her husband's suggestion made Zahrana even happier, because after graduating from her doctorate, her husband suggested that she look for a job there and wait for her husband to take his doctorate, so that they would return to Indonesia as a doctoral couple. The answers and suggestions from Zahrana's husband, who is still young and still a bachelor's degree graduate, are the answers that readers really hope for. Even though Hasan is still young, his way of thinking is very wise. Habiburrahman wants to show that no matter how high women's education is, it will be harmonious if you know where it can develop, as Tong argues [16]. Zahrana is very happy. Zahrana got his holy love.

CONCLUSION

Female characters in the novel *Ketika Cinta Bertasbih 1 dan 2* and *Cinta Suci Zahrana* carried out two important struggles in his life, namely fighting for education and his soul mate. Anna Althafunnisa is beautiful and intelligent. Anna studied for a master's degree at Al Azhar, leaving her father and mother behind. Anna chose to go to school far from her family to develop herself and develop her father's Islamic boarding school.

Anna chose her own soul mate because she wanted to be happy with the man she chose. But Anna's choice was wrong. Furqon, who had a venereal disease, did not open up to him and finally divorced. Divorce was chosen by Anna consciously because Anna could not accept Furqon's lies. Anna was traumatized about choosing her own soul mate, so Anna handed over her choice to her father. This surrender does not mean that Anna is not free to *choose* her soul mate, but Anna is sure that her father's choice will be good for her. It turned out that, unexpectedly, Anna was matched with the man who had previously been expected to propose to her. The man was Abdullah Azzam who helped him.

Zahrana in *Cinta Suci Zahrana* also fights for education and his soul mate. Zahrana's character has struggled since childhood for her dreams. Zahrana always opposed her father, because the education her father chose was different from *her* wishes. Since high school until choosing college, Zahrana has struggled and gone against her father's wishes. After graduating from the Faculty of Architectural Engineering, Zahrana's struggle to work in Jogja as desired was broken by her father with two options of remaining in Jogja by being expelled from the family or working in Semarang. Zahrana doesn't want to be considered a disobedient child and works in Semarang.

Zahrana's biggest struggle outside of work is the problem of her soul mate. Zahrana is over 30 years old, making her father and her surroundings consider her an old woman. Zahrana was addressed by the dean, an old man who liked to play with women, Zahrana rejected him. Zahrana received verbal violence from her former dean. He also felt humiliated because he was proposed to by a colleague who would become his second wife. Zahrana felt slapped, so she ignored it. He asked Mrs. Nyai to help him find a mate. Zahrana was introduced to a student who graduated from Aliyah who worked as a cracker seller. After istikhoroh, Zahrana was determined to marry a cracker seller, but her future husband died on her wedding day. Zahrana was confused and finally Zahrana was proposed to by a former student. Zahrana's pure love ended with Hasan. Even though Zahrana is older than Hasan, Zahrana respects her husband with great love

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Struggling to Protect the Earth: Gunarti's Role in Preserving the Kendeng Area, Central Java Province, Indonesia

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Abstract: This research examines Gunarti's role in preserving the environment in Kendeng area. Kendeng area contains karst as the best cement material in the world, which is the reason for the Indonesian government to improve the welfare of farming communities in the Kendeng area. This is very contradictory to the meaning of prosperity understood by Gunarti, as the female character of Samin. *Sikep* teachings as the teachings of Samin's ancestors have been always adhered to and have raised Gunarti's awareness of preserving nature. The results of the research show that various efforts were made by Gunarti to implement ancestral teachings by teaching *Sikep* to the younger generation of Samin. In addition, there are some of teachings taught by *Sikep* teachings such as through homeschooling, mobilizing mass farmers' actions, and leading resistance to building a cement factory in Kendeng area in order to preserve the environment in the Kendeng area.

INTRODUCTION

Indonesia is an agricultural country evidenced by the fertile state of natural resources with the majority of the population farming. In this agricultural context, land is something that is of great value, not only in an economic context, but also in a sociological field. Land for farmers is the main source of production and wealth. Land ownership carries high prestige because without land ownership, farmers only function as cultivators. Shareholders in traditional agrarian societies are in lower level than land owners. This is because one measure of the social status of villagers is determined by land ownership. In addition, there are social and religious positions.

After the fall of President Soeharto on May 21 1998, which was marked as the era of Indonesian Reformation, Central Java Provincial Government together with Pati Regency Government attempted to improve the economic welfare of agricultural community. However, they invited PT. Semen Gresik to invest in the Kendeng area. There were two reasons why the Kendeng area was offered to PT. Semen Gresik, these were: a) Kendeng area had the best karst (cement material) content in the world; b) Kendeng area had water sources that can supply the needs of cement factories. Administratively, the location for the construction of cement factory by PT. Semen Gresik in Kendeng area requires 1,500 hectares of land in four sub-districts in Pati, there are: Sukolilo, Kayen, Tambakromo, and Gabus [1].

The construction of a cement factory in Kendeng area received resistance from farmers, one of whom was led by a woman from the Samin ethnicity named Gunarti. The main reason for the rejection was that the construction of a cement factory would cause various environmental damages and loss of water sources which are important for farmers. The presence of PT. Semen Gresik in Kendeng area triggered agrarian conflict between the government and the agricultural community led by Gunarti. The central and regional government officials used their power to suppress farmers. When the farmers under Gunarti's leadership became increasingly pressured, they fought back at all costs.

The Meaning of Welfare and Environmental Sustainability

The guarantee of the basic rights of Indonesian citizens to obtain a decent living has been regulated in the 1945 Constitution (amendment) Chapter in cultivating agricultural land. Land for farmers is the main source of production and wealth. The issue of land control has been regulated by the government through Law Number 5, 1960 concerning Basic Agrarian Principles (UUPA) in which excessive land control is not permitted. The government's regulation of maximum limits aims to ensure that people achieve economies of scale in agricultural production.

Farmers in Kendeng support their families by farming. The agricultural products produced, firstly will be consumed by themselves, then the rest will be sold to the market to earn money. Then, this money is spent to meet other needs that are not produced by farmers, such as clothing, household items, agricultural tools, fertilizer, etc. The government's efforts improve the welfare of agricultural communities in the area through industrialization policies

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030014-1–030014-6; https://doi.org/10.1063/5.0241593
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

by building a cement factory in Kendeng area. However, it made farmers anxious because they are worried about damage for Kendeng area, which has been the basis of their life [2].

In this case, Gunarti as a Samin ethnic female character is very obedient to the teachings of her ancestors called *angger-angger pratikel*. The content of these teachings, one of them is about earning prosperity, states that humans must always protect the environment and preserve nature. Therefore, Gunarti will protect all agricultural areas in Kendeng area by leading farmer resistance to reject the construction of cement factory in Kendeng, Pati Regency [3]. The planning to build a cement factory in Kendeng area is clear evidence that the welfare rights and environmental sustainability of farmers have not been fully protected by the government as stated in the 1945 constitution. Under the pretext of improving farmers' welfare, very fertile agricultural areas will be converted into agricultural areas industry.

For Gunarti, converting agricultural areas into industrial areas is the same as killing all farmers, especially the Samin ethnic group whose livelihood relies on the agricultural sector. Therefore, the right to a life worthy of obtaining economic resources through the agricultural sector must be maintained. As long as the government considers that the measure of development success is through industrial sector policies, Gunarti will continue to lead and struggle the farmers' resistance for environmental sustainability. Gunarti's life principles have made her respected, honoured and admired by farmers, especially female farmers in Kendeng area. This is proven by the formation of an alliance of female farmers called Environmental Care Women's Group or *Simbar Wareh*.

EFFORTS TO PRESERVE THE ENVIRONMENT

Internalization of Ancestral Traditions

Gunarti is the daughter of Wargono, a Samin elder in Sukolilo Village, Pati, Central Java, Indonesia. Sukolilo Village is one of the villages in Kendeng area [4]. The term Samin comes from the name of his ancestor, namely Ki Samin Surosentika. For the Samin community, the figure of Ki Samin Surosentika is considered the King of the Land of Java with the title Prabu Panembahan Suryongalam (light of the universe). The story of Ki Samin Surosentiko and his teachings in the form of *Sikep* teachings are full of life values and are still conveyed through oral tradition today because they cannot read and write. Parents' reluctance to send their children to school is not because they cannot afford to pay for school. However, they are fulfilling their promise to uphold their ancestral culture. For Gunarti and the Samin ethnic group, their dream is being farmers and maintains their ancestral cultural traditions as the best as possible.

Sikep teachings for Gunarti have become life belief in the form of basic teachings (commandments) in various forms, as follows: a) Basic ethical principles, they are the basic principles of ethics include taboos against being envious, jealous, easily angered, easily offended, or hating others, making accusations without evidence, or insulting fellow inhabitants of nature. These teachings are basically universal religious teachings, and implementing these teachings determined by oneself is not because of the symbol of being a follower of a particular religion or group, b) Basic principles of interaction, they are the basic principles in interaction are taboos, for example: accusing and stealing, c) Basic principles of character, they are basic teachings in character, for example: you must know your own, be harmonious [5].

From Sikep teachings, it can be seen that preserving nature is included in the basic principles of ethics. Gunarti considers that insulting fellow inhabitants of nature, for example destroying the natural environment in Kendeng area, means violating ancestral teachings. Gunarti as Samin's female character always reminds Samin's younger generation that they are the successors of *Sikep* teachings through homeschooling. Gunarti's routine activity as a Samin woman is working on agricultural land. At night, Gunarti teaches Samin ethnic children at home to learn the moral values held in the Samin community [6]. By using the media of songs (*tembang*) and games (*dolanan*), the ethics of *saminan* and attitudes towards nature are socialized to their children. [7]. Therefore, all ancestral traditions will always be placed in the minds of every young generation of Samin. Awareness of the importance of Kendeng area is for agricultural activities then binds all farmers and everyone because Kendeng belongs to everyone. It is not just people around the Kendeng area. They are all obliged to preserve the Kendeng area.

Organizing Mass Farmer Action

Gunarti's leadership in mobilizing mass farmer action is even more interesting to reveal considering that in the context of social movements, women's participation, especially among rural farmers, is relatively small. The historiography of social movements shows the dominant role of men and the relative absence of the role of women in them [8]. Gunarti's interest in getting involved in the resistance movement began with involvement in meetings of the Kendeng Mountains Concerned Community Network (JMPPK) which responded to the entry of the cement industry into Kendeng area. Realizing the big threat the cement industry poses to the lives of local people and the environment, Gunarti is trying to encourage women's involvement. This step was taken based on the idea that the struggle would not achieve results if it only involved men. Women would feel a greater impact from the loss of water sources because women use more water, and environmental problems are a problem shared by men and women. Based on this idea, Gunarti visited from village to village in Sukolilo District, Pati Regency, Central Java Province to meet the women aiming to explain the importance of preserving the Kendeng Area and the threat of mining to agricultural sustainability. Gunarti decided to carry out this task considering it impossible given to men who he believed would have difficulty conveying information to women. It is believed that conveying information via women, especially mothers, through *grenengan* will be faster and more effective. There are sixteen villages in Sukolilo District and around 12 villages Gunarti visited to meet women and explain the threats that accompany the presence of cement industry.

Gunarti has proven to be able to raise awareness from women who were initially passive and apathetic to women who are insightful and militant. Gunarti organized women with a meeting in front of the Kedu Village prayer room, planned to be a lime mining location and was attended by around two hundred women. This meeting was rumored by pro-mining groups as an act of disrespect by the Samin people towards places of worship. This slanted issue has raised concerns among women, but it has not deterred Gunarti. Furthermore, the efforts to mobilize the masses of female farmers were carried out on May 2, 2009 at the house of Gunarti's older brother, Gunretno, in Kaliyoso Village, Pati Regency. During this meeting, they discussed and agreed to establish a forum for women who were concerned about the protection of the Kendeng Mountains. The discussion was called the Environmental Care Women's Group or *Simbar Wareh*, taken from the name of a threatened spring in the Kendeng Mountains.

The name *Simbar Wareh* is a combination of the names Simbarjoyo spring and Wareh Cave. The use of the name *Simbar Wareh* also has a tactical meaning to establish ties between the two sub-districts because Wareh Cave is located in Kedumulyo, Sukolilo District, while Simbarjoyo is in Jimbaran, Kayen District. This name also contains symbolic meaning. *Simbar Wareh* means watering, and *wareh* means water, hence the meaning of *Simbar Wareh* is that being able to pour water which can cool the atmosphere, and also provide a clear path for the struggle against cement factories [9]. The name *Simbar Wareh* is considered suitable for the situation currently developing in the Kendeng area. The presence of a cement factory has heated up the situation and raised pros and cons in a society that previously lived in harmony. It is hoped that *Simbar Wareh* can extinguish the fire of disputes caused by the cement industry. The figure appointed as head of the *Simbar Wareh* group was Sriwati, a young lady from Sukolilo considered as a cadre formation step even though the backbone and driving force was still Gunarti. The aim of establishing *Simbar Wareh* is building awareness of the environment and striving for agricultural sustainability in Kendeng area [10].

Gunarti's character can also be illustrated, for example when carrying out an action in front of the Central Java Governor's Office, wearing all black clothes reflecting the characteristics of Samin and a black hat. Gunarti gave a speech that the arrival of the residents was intended to remind the Central Java Government about their rejection to mines and cement factory. The rejection was based on reasons to save the earth and the environment as Mother Nature which has provided a livelihood for residents. In her speech, Gunarti also said, "The earth and nature support humans sincerely, we want to save Kendeng Mountains, so that the lives of our children and grandchildren will be more sustainable." It was also emphasized that "it has been proven... cement factories cannot make people prosperous for three generations, but agriculture has been proven since ancestral times to be able to provide food for the community and make people prosperous" [11].

Gunarti believes that the promise by the cement industry in the form of providing employment opportunities will only be temporary. The benefits that will be obtained are not commensurate with the environmental costs that must be paid in the form of loss of natural resources. Instead of bringing prosperity, Gunarti firmly believes that the cement industry will bring disaster and misery. Gunarti stated: "Even if a cement factory has not yet been established, it will create a heated atmosphere and the community will be divided, especially if it is actually established". Gunarti's awareness among women has succeeded in creating awareness of the crisis situation that is currently threatening. Gunarti has changed the movement against the cement industry, which initially only involved and was dominated by men, into a movement that involves women's active role in it. Kendeng women farmers, who were previously busy with household matters, moved out into the public sphere by being actively and bravely involved at the front line in resistance actions against the presence of cement factories and limestone mining. Gunarti has transformed passive women into very active and militant movement actors. This transformation was made possible thanks to the emergence of Gunarti as a motor building motivation and mobilizing women's involvement in the movement [8].

Fighting Against Cement Factories

Gunarti's leadership in fighting the cement factory was carried out in a non-violent way through the use of symbols that were close and familiar to the lives of farmers. This action was held with the aim of seeking sympathy and support from the wider public for the aspirations that they were carrying out. This method is seen as being able to complement and strengthen the resistance movement against the presence of cement industry. It took through legal channels which seemed to be long, winding and often reach dead ends because they hit walls of power, and with results that did not match their aspirations and hopes. Gunarti and the Samin women often use various environmental elements to symbolically express their intentions in their actions. In a protest action launched at the Pati Regent's Office, Samin women's representatives from Sukolilo Pati who were received by the regent handed over sugar apple and tailings plants. The act of symbolically handing over the sugar apple plant was intended to remind the regent that during his time in office he was seen as only pursuing wealth for himself. They consider that granting permission for limestone hill mining in the Kendeng area by the regent will result in potential resources in the Kendeng area being depleted with the tailings plant as a symbol. In the Javanese context, linguistically, the word *sat* means exhausted or dry [12].

For Gunarti and Samin women, it is believed that mining the limestone hills in the Kendeng area for the cement industry will destroy soil fertility and eliminate groundwater reserves which are a source of life for the Samin community. In April 2015, nine Samin women staged a unique protest. They beat mortars as a sign of danger in front of the State Palace in Jakarta. This action was intended to call attention to President Joko Widodo to cancel the regional government's decision to allow the construction of a cement factory and mine in the Kendeng Mountains [13]. The sounding of mortars is a cultural action that attracts attention and contains strong symbolic meaning.

Another form of non-violent resistance that is unique and more reckless is perhaps the action of casting the feet of Rembang farmer women. This foot casting incident was a continuation of the live action in a tent that was set up in front of the entrance and exit of heavy equipment for the construction of the Indonesian Semen factory. This tent living action began on June 1, 2014 and until April 13, 2016 it had lasted for 664 days. The action of casting feet with cement was first carried out by Samin women on April 12, 2016 or a year after they sounded mortars in front of the State Palace. This was similar actions continued the following day (13 April 2016). In this action nine women from the Samin ethnic group cemented their feet at the National Monument (Monas). Those who carried out this action were Sukinah, Sutini, Giyem, Karsupi, Deni, Surani, Ambarwati, Murtini, and Ngadinah.

This action was taken as a final way to meet with President Joko Widodo and express their objections to the development of the cement industry in Kendeng area. They would continue to cement their feet until President Joko Widodo is willing to meet and accommodate their aspirations. They were determined to voice the desire that "President Joko Widodo must dismantle the shackles of cement which is destroying nature and threatening the survival of farmers along the Kendeng mountains in Rembang, Pati, and Grobogan, Central Java" [14]. Regarding this action, Deni Yulianti, one of the women who carried out the foot cast with cement who came from Grobogan Regency stated the reason, "I hope the president can provide justice to all of us as fairly as possible and pay attention to the condition of the entire community there with the impact of the factory. When cement factory is built in Kendeng Mountains, one must consider the consequences. We here do actions like these, we fight cement with cement, casting feet. We cannot talk as cleverly as they do, and we do not have guts as great as they do" [14].

After cementing their feet for two days, Presidential Chief of Staff Teten Masduki and Minister of State Secretary Pratikno met the protesters and promised to organize a dialogue with President Joko Widodo. Teten Masduki's promise was carried out on August 2, 2016. A total of 17 residents of the Kendeng area were received by President Jokowi who was accompanied by Teten Masduki, Johan Budi, and one of the leaders at the Presidential Office. This meeting resulted in several points of agreement, these are: a) The need to create the carrying capacity & capacity of the Kendeng mountains through Strategic Environmental Studies (KLHS); b) The Strategic Environmental Study will be coordinated by the Presidential Staff Office considering that the Kendeng problem is cross-ministerial and cross-regional (5 districts, 1 province); c) the Ministry of Environment and Forestry acts as chairman of the steering committee; d) During the implementation of the Strategic Environmental Assessment process which has a duration of 1 year, all permits are terminated; e) Ensuring that a healthy dialogue process (deliberation) occurs during the Strategic Environmental Study [15].

The agreement was apparently violated, hence the situation escalated again. A number of Samin women again held a foot cementing action in front of the State Palace in Jakarta on March 13, 2017. This action was triggered by the issuance of a new environmental permit for PT Semen Indonesia issued by the Governor of Central Java, Ganjar Pranowo. The issuance of new permits was seen as support for the continued operation of the cement industry. On the first day of action, it was reported that as many as 10 people cast their feet with cement in boxes each measuring 25 x 25 cm square. They wrote their demand in front of the box, "Reject the Cement Factory". Furthermore, they also wrote an ancient Javanese sentence which means "Mother Earth has given, mother earth has been hurt, mother earth will judge." This poem entitled "Mother Earth" is often sung by Sukinah, a woman from Rembang, when carrying out the action of cementing her feet. According to Gunretno, these song poems were prayers specifically created to remind humans to always preserve nature. The Samin people believe that the earth is a mother who must be cared for, looked after, and must not be harmed. The earth has given to human life, thus people must not hurt her. Concerning to them, if Mother Earth is hurt, her anger will rise and she will take revenge for human actions that have damaged her [16].

The involvement of Kendeng women in the second action of casting feet with cement received wide coverage. As explained in the previous chapter, the second volume of foot casting with cement sparked a wave of solidarity and support, especially after the death of Supatmi, one of the women who carried out the action. Solidarity and support came from various groups including student activists, human rights activists, and environmental activists. Support actions were not only held in Jakarta, but also in various places in Java, Sumatra, Sulawesi, and Papua. In fact, solidarity and support for the Kendeng farmers' struggle against the cement industry and lime mining also flowed from abroad, one of which came from Germany involving a number of activists from environmental and human rights institutions. The Samin women's involvement was not only limited to acts of resistance using cultural media through demonstrations, drumming, long marches, and casting their feet with cement. They were also actively involved in lobbying various institutions, decision makers and influential people.

Lobbying and hearings involving Kendeng women were carried out at regional and central government institutions. On 18–20 November 2014, women from Rembang lobbied various institutions in Jakarta, such as the Corruption Eradication Commission, the Ministry of Environment and Forestry, the National Human Rights Commission, the National Commission on Violence Against Women, National Police Headquarters, and the Supreme Court. Through lobbying activities and hearings, they conveyed their complaints and asked for support for resolving disputes with the cement industry [15]. Hearings at the National Commission on Violence Against Women made this institution pay attention and continued to follow developments in the actions carried out by Samin women. In response, National Woman Committee carried out a series of monitoring activities in the form of: a) Documenting complaints from 9 Kendeng women who experienced acts of violence to National Woman Committee on 19 November 2014; b) Following the progress of the action of casting feet with cement carried out by 9 women Kendeng in front of the Palace on 9 April 2016; c) Monitoring the struggle through legal channels d) Conducting fact- finding in the field in September 2016 to absorb the aspirations of various parties, especially women farmers, plus environmental activists, state institutions, miners and limestone mining employees, as well as working directly at mining sites in Rembang and Grobogan areas. National Woman Comittee appreciated the struggle of Kendeng female farmers in saving the environment and encouraged the government, especially the Governor of Central Java, to stop the planned presence of the cement industry which has the potential to damage the environment, economic life and social harmony in society [17].

CONCLUSION

The construction of a cement factory by PT. Semen Gresik in Kendeng area is considered to be destroying environmental sustainability by Gunarti as a Samin ethnic female leader, because it contradicts the meaning of welfare and environmental sustainability taught by her ancestors. Preserving nature is included in the basic ethical principles in Samin's teachings, which Gunarti always reminds Samin's younger generation through homeschooling. In addition, apart from internalizing ancestral teachings in Samin's younger generation, Gunarti’s efforts also carries out to resist the cement factory by mobilizing the masses of farmers, especially women, and leading the resistance against the construction of a cement factory in Kendeng area. Gunarti's leadership in fighting the cement factory was carried out in a non- violent way through the use of symbols that were close and familiar to the lives of farmers.

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Etnoscience and Local Wisdom *Malangge* Tanjung Raya Maninjau in Biology Learning

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Abstract. Biology learning cannot be separated from the environmental context, including local wisdom. The Malangge tradition is an activity for residents who do not have durian trees or people who pass by in the area, gather, are free to enjoy the durians in the community residents who have durian. The purpose of this study is to analyze and reconstruct scientific knowledge from the Malangge tradition. This study uses an ethnoscience-based qualitative approach with interview and observation methods. Durian that falls from the tree tastes sweeter than durian that has been ripened/picked from the tree because it has undergone fermentation. This is related to local wisdom in learning biology.

INTRODUCTION

Biology learning cannot be separated from the environmental context, including local wisdom. Local wisdom is knowledge, views, life strategies, cultural values, experiences carried out by the local community or certain communities that are wise, full of wisdom, of good value, embedded and followed by members of the community. These values, wisdom and wisdom will be very strongly attached and ingrained in certain communities and these values have gone through a long journey of time, throughout the existence of that society.

Local wisdom also has a very close relationship with scientific knowledge. Scientific science will explain how a local wisdom is carried out from generation to generation with various manifestations. This depends on the background of a population, landscape, and specific challenges.

Ethnoscience is an activity of transforming between genuine science which consists of all knowledge about the facts of society that comes from hereditary beliefs and still contains myths and scientific science. The scope of ethnoscience includes the fields of science, agriculture, ecology, medicine, even including flora and fauna[1]. The birth of ethnoscience is inseparable from the knowledge found by trial and error and the lack of ability to translate the findings into scientific knowledge. This is because the starting point of ethnoscience is at the local to regional level as a form of knowledge resulting from trial and error[2].

Science learning in schools in general is still centered on the material in books. Students are still not familiar with science learning which really reveals the cultural reality around it. Not many of the material content being taught has been integrated with culture. Reflecting on this condition, it is necessary to develop learning methods, one of which is the approach used. The application of science learning with an ethnoscience approach requires the teacher's ability to combine original knowledge with scientific knowledge[3]. Science learning that is able to bridge the mix between student culture and scientific culture in schools will make the student learning process more effective. The cultural tradition that will be discussed in this journal is the culture in West Sumatra, namely the Malangge Tradition.

The tradition of harvesting durian and malangge is a unique tradition from the Nagari Koto Malintang Agam, West Sumatra. Durian is one of the fruits that is famous for being a favorite and the fruit that has the most delicious taste. The Nagari Koto Malintang Maninjau, West Sumatra, is one of the most durian-producing villages in West Sumatra. Almost all residents in Nagari Koto Malintang have Durian Trees. This tree has been around for a long time, having previously been planted by their ancestors. In Nagari Koto Malintang, they still adhere to culture, customs and habits that have been passed down from generation to generation. Niniak Mamak still plays a very important role, is respected, continues to teach through language about the environment that must be maintained, preserved and Niniak mamak continues to supervise the procedures that existed before. From several traditions[4].

The data comes from an interview with the Secretary of the Wali Nagari Koto Malintang who stated that Malangge is a tradition that has existed since ancient times or has been passed down from generation to generation

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030015-1–030015-5; https://doi.org/10.1063/5.0241919
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

in the Koto Malintang area and is still being carried out today. In addition, interviews were also conducted with the Principal of SD M Koto Malintang and the science teacher at SMPN 2 Tanjung Raya. Further results will be explained in the discussion in this journal. Based on this background, this study aims to analyze and reconstruct community knowledge (indigenous science) about the Malangge tradition into scientific knowledge.

METHOD

This study uses the method of literature review and field observation (interviews and note-taking techniques). The study material studied was culture in Indonesia, where researchers took samples from the Tanjung Raya Maninjau Region (Koto Malintang, Koto Gadang and Koto Kaciak). The sources used were traditional leaders, village government and the community to obtain comprehensive information about the Malangge tradition in Tanjung Raya Maninjau. The process of reconstructing local (indigineous local) knowledge is focused on community beliefs and the rules that apply to Tanjung Raya Maninjau.

RESULTS AND DISCUSSION

Learning science with an ethno-science approach is a learning process that links cultures through exploring students' original views on culture, then translating them into scientific knowledge[3]. The application of this kind of learning process has the potential to develop a learning process that is generally still teacher centered (teacher centered learning) into a student centered learning process (student centered learning). So that it can increase students' appreciation of culture and create a contextual and meaningful learning atmosphere[5]. One way that can be applied is with ethnoscience, because ethnoscience deals with knowledge originating from culture which can act as a basis for building reality that emphasizes cultural relations with the latest scientific knowledge.[6]. Ethnoscience encourages students to know and study natural science through the use of the surrounding environment[7]. Ethnoscience is knowledge derived from the norms and beliefs of certain local communities that influence the interpretation and understanding of nature[8].

Ethnoscience relating to the classification of societies, the cultural systems, culture-related physical phenomena and to dig up the past and incorporate the values and the knowledge society. In addition, ethnoscience is a system of knowledge including an explanation of the natural world, which has practical applications and is used for predictive purposes[9]. Another meaning of ethnoscience is local knowledge form of a particular language and culture that reflects not only as a systematic body of knowledge, methods, processes, products or how the investigation, but also as a way of thinking. Weber, et.al., (1995)[10]conclude ethnoscience as historical thinking of society in organizing local knowledge of nature, a community group, holistic reasoning in various sectors of science and technology, the idea of a dynamic concept of the concept of culture as well as materials that are useful in the development of culture. Ethnoscience includes a historical assessment from a particular community or society in the setting of nature and culture, the culture of a particular reference or culturally bound, a holistic approach towards the inclusion of the various subsystems of knowledge and technology, assessment of Western knowledge systems and comparative cultures. Ethnoscience also means indigenous knowledge system[6].

Culture as a form of local wisdom is an identity for a region. In general, local wisdom can be interpreted as something that is carried out and followed by community members[11]. Almost every region has a distinctive culture with the uniqueness of each. One of them is the Malangge Tradition in Tanjung Raya Maninjau, West Sumatra.

Malangge is a tradition or routine agenda carried out by the residents of Koto Malintang. Malangge tradition is held during the durian harvest season. Malangge is an event where all residents who don't have durian trees or people who pass by in the area around the durian garden, gather, are free to enjoy durian in the parade of residents who have durian. Malangge participants are not limited in age from adults to children, this Malangge tradition usually starts from 05:00 in the morning until 07:00 in the morning[4].

Nagari Koto Malintang, Tanjung Raya sub-district, Agam district, is located on the edge of Lake Maninjau, Agam Regency, West Sumatra. Nagari is one of the durian-producing nagari. According to the Secretary of the Wali Nagari Koto Malintang, Malangge is a tradition that has existed since ancient times or has been passed down from generation to generation in the Koto Malintang area and is still being carried out today.

This malangge tradition is a tradition during the durian fruit harvest season, aiming to distribute sustenance to residents who don't have durian trees, so from the time of the dawn call to prayer (5 o'clock) to 6 o'clock in the morning, anyone may be malangge in the durian garden, and may take the durian. Even though the owner of the durian is also in the garden, anyone who finds his durian at Malangge time can take it, and after 6 o'clock Langge Lapeh begins to replace the tipak (distribution to the owner of the durian fruit). The person who picks the durian at 5-6 in the morning is called malangge and the owner of the durian tree is also called the person who gets langge. In the following, we present the results of direct observations through

Based on the results of interviews with several informants, it was found that according to the Principal of SDM Koto Malintang, durians that have just fallen are tastier than those that have been ripened, because if they have been ripe there is already another process, in the Koto Malintang area this is very taboo Once you climb or take an unripe durian from the tree to ripen, the goal is to maintain the quality of the durian, which is known to be delicious in this area. According to the science teacher at SMPN 2 Tanjung Raya, Koto Kaciak also has a malangge tradition, the difference is that in this area there are no certain hours, and durians that can be bought are durians where the owner does not exist, or the owner has donated the durian can be bought.

Through interviews too, we get the result that the durian that falls directly tastes better, because if it has been fermenting for a few days or our language catches a cold, and there is already contact with oxygen too, the gas also increases so that the durian that falls directly is sweeter compared to ripened durian.

Learning with an ethnoscience approach is based on the recognition of culture as a fundamental (fundamental and important) part of education as an expression and communication of an idea and the development of knowledge[12]. Based on the results of observations and interviews about the Malangge tradition, indigenous knowledge of the local community (indigenous science) has local wisdom values that are still maintained today. Community knowledge can be reconstructed into scientific knowledge (science) as presented in Table 1.

TABLE 1. Reconstruction of Original Science to Scientific Science

Indigenous Science Society	Scientific Science
It is forbidden to pick durians, climb, take durians from the stems, residents are only allowed to wait for the durians to fall	The maturity level of the fruit greatly affects the taste of the fruit. Fruit that is still young or immature usually has a higher water content than ripe fruit, but the sugar content of young (unripe) fruit is lower than that of ripe fruit, while the content of vitamin C and total acid in young fruit is higher. The age of fruit picking must be paid close attention to in order to maintain the quality of the fruit produced, so the fruit that is picked must be at a sufficient level of maturity. With increasing age of the picks fruit, soluble solids and starch content will increase and acid levels will decrease during fruit development. Tirtawinata (2020) Before the durian falls, the meat is still dominated by carbohydrates. After it falls, a fermentation process occurs which will turn the carbohydrates into sugar so that the durian flesh will taste so delicious. This explains why the durian that falls from the tree will taste better than the fruit that is picked directly from the tree whose maturity level is uncertain.
The traditional tradition of the Koto Malintang community in harvesting durian is by planting durian seeds. Because if it is planted then it will grow, develop and eventually bear fruit.	The original phenomenon of the community contains plant conservation values. According to Campbell (1972) conservation is the preservation, management and care of natural and cultural resources. This explains that the attitude of the people who apply the concept of harvesting durian is to plant it is a form of plant conservation effort. This is very important to maintain the balance of nature.
Choose nan rancaknyo 'choose the good one' comes from the word smart. In Minang language, the word rancak means good, beautiful, beautiful. During the harvest season, the seeds are taken	This phenomenon can be understood that the community knows that to get good results, they must plant superior seeds. According to the Big Indonesian Dictionary (KBBI), the

Indigenous Science Society	Scientific Science
from durian seeds which are considered smart. The rancak that is meant here is good, not wormy, the fruit is big and tastes good. The selected seeds are then polybaged.	meaning of superior seeds are seeds that are resistant to pests (disease) attacks, bear fruit quickly, produce lots of results and can be used widely (usually taken from fruit or parts of fertile and ripe plants that are ready for use). replanted and from good bulls). According to Imelda (2015)[13], that the seeds to be used as seeds should be selected from seeds that meet the requirements such as original from the parent, fresh, old, not wrinkled, and not attacked by pests and diseases. According to ding, et al (2015)[14]seed or seed size also affects growth, the larger the seed size, the better the viability, vigor and growth of the seedlings. Selection of plant seeds is very important to produce high quality plants.
The traditional tradition of the Koto Malintang people to harvest the next durian is "Insert". The value contained in the data above is economic value. The community plants durian trees by inserting and meeting with the aim that all sides of the land can be used, other plants are planted.	This phenomenon can be understood that the community optimizes land to optimize economic value, besides that ecologically it can be beneficial to the environment. This is a type of intercropping plant. The intercropping cropping pattern is very popular among small-scale farmers in the tropics and sub-tropics, because (1) it provides a balanced supply of nutrients, energy and protein, (2) maximizes profits and uses environmental resources, (3) as a control against weeds, (4) reduce the risk of farming, and (5) maintain soil fertility. The durian tree planting technique must pay attention to the size of the tree's spacing, this is because the size of the durian tree is relatively large and has many lateral branches. The ideal planting distance is 8.5m x 8.5m to 10m x 10m. The land planted with durian trees is cultivated by means of intercropping, after the seeds are planted in the land, the farmers also plant other plants such as cocoa plants between the durian trees.[13].

CONCLUSION

Malangge is a habit or routine agenda carried out by the residents of Koto Malintang. Malangge is held during the durian harvest season. Malangge is an event where all residents who don't have durian trees or people who pass by in the area, gather, are free to enjoy durian in the parade of residents who have durian. Malangge participants range from adults to children and start at 05:00 in the morning until 07:00 in the morning. Durian that falls from the tree tastes sweeter than durian that has been ripened/picked from the tree because it has undergone fermentation. This local wisdom has the potential to be used as a source of biology learning.

ACKNOWLEDGMENTS

Thank you to the Secretary of Wali Nagari, the Principal of SD M Koto Malintang and the Science teacher of SMPN 2 Tanjung Raya who have provided information to researchers about the Malangge tradition in Tanjung Raya Maninjau.

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Digital Marketing Development to Improve Community Competence

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Abstract. Digital Marketing is a solution for business people, especially in Karanganyar Regency. However, the use of digital marketing is still lacking due to a lack of information obtained by the public. In this way, community service was carried out by researchers and village officials . The purpose of this activity is to improve people's skills and competencies in implementing Digital Marketing for their products. Apart from that, to increase the choice of media for selling their products. The method used in this service is training and mentoring. In counseling and training matters discussed include materials from resource persons, discussions, forums and questions and answers. The methods for implementing the community service program are as follows: determining targets, proposing, data collection, implementation, reporting and publication. The result of this activity is that all participants are able to use social media to sell. Not only that, after getting the material and hands-on practice, the development of community knowledge broadened and increased after participating in these activities.

INTRODUCTION

The number of internet users in Indonesia is ranked 6th in the world as internet users. According to the market research institute e-Marketer, the population of Indonesian netters reached 83.7 million people in 2014. In 2017, e-Marketer estimates that Indonesian netters will reach 112 million people, beating Japan in 5th place, which has slower growth in the number of internet users. Projections of world internet users from year to year are predicted to continue to increase [1]

The very rapid development of Internet technology has had an impact on the procedures for introducing and marketing products by utilizing Digital Marketing, with the development of the Internet and Digital Marketing making it easy for customers to get information about products as well as ease in making buying and selling transactions [2].

Digital Marketing is a way that business owners can use to market or promote a product through online media such as websites and marketplaces so that they can reach consumers and potential customers more broadly and quickly. Simply put, digital marketing is a term that tries to describe integrated marketing services that are used to attract attention and involve consumers online [3]. Online media that is currently widely used to market products is utilizing social media, examples of social media that are popularly used by users include Instagram, Facebook, and Youtube [4].

A good promotion can be done by doing market research and analysis. Today is an era where the Internet is an inseparable part of social life. The completeness and clarity of information is one of the factors that triggers public trust in an institution. Promotions that have been carried out so far are now marketing products through exhibitions and through Facebook social media owned by trading business owners, so the level of product recognition is still low because the reach of the promotion area is also short. By implementing an internet brand, it is expected that the level of knowledge of product innovation, promotion and product sales will increase [5].

The increasing number of internet users is certainly an opportunity for business owners to be able to use it as a sales potential. With this internet technology, humans can do many things, such as socializing or communicating with other humans at close or far distances, reading books, obtaining various information needed, and even being

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030016-1–030016-6; https://doi.org/10.1063/5.0242519

able to shop online. So that with this technological change, humans can carry out activities such as selling inside and outside the home, because marketing communications that originally could only be done face *to face* (*conventional*) can now also be done *screen to face* (*internet marketing*) [1]

According to [6] Digital Marketing is the use of the internet and the use of other interactive technologies to create and connect dialogue between companies and consumers who have been identified. They also argue that e-marketing is part of e-commerce.

According to [7] digital marketing includes branding that uses various web-based media such as blogs, websites, email, adwords, or social networks. Through marketing, promotions are easier, faster, and cheaper, and it's easier to measure the products that will be sold.

Digital Marketing is an important aspect that must be mastered by economic actors today, especially people with livelihoods as traders who sell products and services. This is supported by statistical data which states that there are 170 million social media users in Indonesia with a growth of 13 million or 8.5% from April 2019 to January 2020. Of these, 88% use YouTube, 88% use Whatsapp, 87% use Facebook, and 89% use Instagram (Kemp, 2020). Seeing this data, it can be concluded that the opportunity for Digital Marketing is still very large [8].

Digital marketing is basically something related to ideas that are poured in the digital world, the thing that becomes a measure of success is when the products it offers are became the subject of discussion by the public. Online digital marketing can be distributed at a faster rate and a wider reach than traditional marketing communications. Digital media allows consumers to explore deeper information needed to make decisions before making purchases. In addition, consumers can interact quickly with sellers regarding the products offered [9].

Social media can be used to help people market their products. Social media applications with instant messaging models, for example WhatsApp and social networking sites, for example Facebook, offer facilities to be able to interact between sellers and buyers. These social media applications have the aim of disseminating information about consumer experiences in using or consuming certain products and brands, so that they can attract the attention of other potential consumers which of course can lead to increased profits for society..

Through the development of digital marketing, the community is expected to be able to open up business opportunities, namely from business ideas to how to market them independently and sustainably. So that by creating new business opportunities, it will help reduce unemployment, improve living standards and help the Indonesian economy.

METHOD

The implementation of Community Service (PKM) activities uses the knowledge transfer method to PKM partners through the form of training and mentoring. Training is carried out by conveying basic knowledge material in using social media for product marketing and providing assistance to partners to ensure partners are fully able to use it in a sustainable manner.

The method used in this service is training and mentoring. In counseling and training matters discussed included material from resource persons, discussions, forums and questions and answers, the activities were carried out on Thursday 26 April 2023.

The method of implementing the community service program is as follows:

1. Stage of Determination of Service Goals.

   The stage of selecting community service targets must certainly consider many things, one of which is the needs of teenagers, namely students who are the object of service.
2. Proposal Stage.

   After the proposing team has made initial observations and has identified problems with the object of community service, a theme or title can be determined. Furthermore, based on this theme, a community service proposal was prepared which was submitted through the related parties.
3. Data Collection Stage.

   Data collection, namely collecting data at the service location by conducting consultations, observations, interviews, and documentation by determining the data collection strategy that is deemed appropriate to determine the theme or focus and deepen the data in the next data collection process.
4. Stage of Implementation of Community Service.

   The stage of implementing community service is the stage of implementing training. On. At this stage the proposing team conducts training activities according to related themes, shares opinions, and identifies the desired material needs and offers a sustainable community service program in the future.
5. Service Result Reporting Stage.

At the time of reporting the results of community service, this is a report on a series of activities ranging from pre-service surveys to activity reporting.

6. Publication Stage.

The results or reports of community service activities will be published as the output of this community service activity.

RESULTS AND DISCUSSION

The training was held in the hall of the Commerce, Industri and Labor Office or Karanganyar Regency for two days. There were 50 training participants with an average productive age, namely women from the Karanganyar Regency community aged 20 to 50 years. In providing a description of the material, the implementation team used the help of media presentations in the form of infocus and the Miracast tool to display *smartphone displays* on *the Big Screen*. Implementation of training activities carried out.

The material provided is in the form of a basic introduction to Digital Marketing, the importance of Digital Marketing, the advantages of Digital Marketing, and the challenges of using Digital Marketing. Only after that was given the opportunity to practice creating product content on social media Instagram, Whatsapp and TikTok. These three media were chosen because they represent what is still hot in society in general.

As well as assumes digital content creation marketing is quite difficult, they also feel that they are not capable of marketing so that the content offered to consumers is less attractive which results in less attractive products. Another 25 percent of participants had never used their social media as a marketing tool. They are reluctant to try it because they do not understand how to create content and use media as a marketing tool.

The training activities are filled with various sub-topics from the basis of digital marketing, benefits, challenges and implementation strategies. The initial sub-topic that was introduced and explained was the development of digital marketing trends and the reasons for this. The presentation of this sub-topic provides a new picture for district actors in Karanganyar regarding digital village product marketing activities.

In material for using the Story feature on Whatsapp social media as its digital marketing implementation. Showing examples of Whatsapp stories created by participants are as follows.

FIGURE 1. Example of Participant Whatsapp Stories

By utilizing *WhatsApp* by placing a photo on the status page and sending the photo to contact people, you can even create a sales group there.

Instagram tutorials are also presented in the use of the view feature. This function serves as an analysis that provides a lot of data related to audience demographics, follower engagement, and other useful metrics for understanding the target audience.

FIGURE 2. Example of Instagram stories

Advertising through Instagram is a social media that is often used by the public, especially teenagers who are very actively used to spread the latest information about selling products. Instagram is an application on a smartphone that is used to share photos and videos. Photos and videos that have been uploaded can be accompanied by text or a description that describes the photo or video. Instagram is one of the social media that can be used as an advertising medium and to interact with consumers, so that consumers can see the types of goods/services being offered as well as ongoing promotions.

The next material is the use of Digital Marketing on the Facebook application, which is an example of sales made by activity participants on Facebook social media.

FIGURE 3. Examples of stories on facebook

With Facebook by entering a picture or photo of the item to be sold and clicking *tag* or post to *the wall* or front page of friends in one community, then the ad will spread quickly. Community members by opening *Facebook*, the ad will appear by itself, friends in the community who have been tagged or sent earlier will immediately be able to see the marketing.

Seeing the development after using social media in the form of *Facebook, WhatsApp, Instagram*, then researchers are interested in further developing it by creating a website to place online advertisements. Ads on the website about household appliances, clothes, groceries, etc. and how to order. This is able to answer market questions and increase the company's credibility in the eyes of customers. when compared to foreign sellers, the business is the most superior in terms of presenting product material because the website appearance is attractive, complete, and clear.

One of the success factors in doing business as stated by the speaker is using technology. Technology provides solutions and opportunities in the midst of limited capital and other means. Various businesses owned by the speaker, are growing one of them because of the support of technology. It was argued that business owners don't need to have a lot of employees, don't need to have a big shop, so they can save various operational costs.

Once the online business materials are available, there will be an exchange session. In this exchange session, the entrepreneurs presented the problems they faced in their companies and then discussed with the speakers the next steps and efforts to overcome these problems. This session identified several problems faced by traders in Sayang Village, such as the company's location in an alley. The owner of this company suggested that the company could grow, but the location is down an alley. The results of discussions with informants show that online business is not a problem, even though the business location is in an alley. Technology support actually facilitates marketing, even though the place is in the alley. The most important thing is that the location is accurate and legible on *Google Maps* . There must also be a banner that makes it easier to find a place to eat/restaurant even though it is in an alley.

In addition, it was known from this exchange session that some of the problems faced by traders in Sayang village were due to competition from newcomers who had innovation and used technology. Other problems include capital issues, product marketing and advertising, *off-road business locations* that are less well known to the general public, and job shortages due to villagers.

CONCLUSION

Based on the implementation of community service carried out the steps implemented, the following conclusions can be drawn. After participating in this activity, participants improve their digital marketing skills marketing and opportunities to increase sales on social media mass media. In addition, the participants also learned about a new way of selling, namely using WhatsApp, Facebook, Instagram, which are easier for remote communities to use and do not require a large quota. In terms of the method used, in general the participants were able to take part in the activities from implementation to mentoring well. After the community service activities were carried out at the partner's place of business, it was not possible to know quantitatively the results of partner sales through digital marketing, but based on the partner's perception that partners experienced an increase in demand and improved changes in sales.

Suggestions for future charitable activities are to create *a website* which, in addition to providing information about entrepreneurs and the products being sold, can also function as a means of business and communication.

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The Representation of Female's Ideal Body in Sarai Walker's *Dietland*

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Abstract. This study investigates the issue of women's ideal body in Sarai Walker's *Dietland*. This research aims to find out how the ideal body is represented in the novel and how the author creates the discourse of the ideal body. The method used is descriptive qualitative. The theory applied in this analysis is the theory of representation by Stuart Hall and the theory of the male gaze by Laura Mulvey. The results show that the female's ideal body discourse is represented through a male gaze. As a result of the gaze that objectifies women, women tried hard to become thin to give pleasure to men to stare at. Plum has to modify her body so that her body becomes a body that gives pleasure to the male gaze. Plum also projects the value of the male gaze to other women. Eventually, she gazes at other women like men stare at her. It also found that Walker's interest in representing the ideal body discourse infuses the concept of body acceptance through Plum's character, who ultimately accepts her body as it is.

INTRODUCTION

Gender differences between men and women create gender stereotypes. Men are expected to be the initiator of aggressive actions and protectors of women and children. Meanwhile, women are expected to be emotional caregivers and givers, willing to subdue their desires to please men and to take care of children [1] . One consequence of gender stereotypes of female femininity is the concept of beauty standards. The ideal body is one of the traits of beauty standards. The ideal body image is the phrase that refers to body size that symbolizes beauty and success in achieving optimal physical determined by certain cultural groups [2].

The difference in ideal body type shows that the ideal body is a cultural production that changes across time and culture. The ideal body types have varied depending on the standards of beauty and desirability in various civilizations throughout history [3]. In spreading the concept of the ideal female body, the media plays an important role. A novel is one of the influential media in socializing the idea of women's ideal body. Women will learn to interpret their own bodies through representation in a novel. Therefore, research on the representation of the ideal body in the novel is essential.

One novel that represents the ideal body discourse is *Dietland* by Sarai Walker. It is the debut novel by Sarai Walker, a fat-positive activist living in the United States. *Dietland* tells the story of Plum, a 300-pound woman obsessed with being thin. Plum's obsession is because people mocked and humiliated her for having a fat body. Then, the environment where she works, the TV shows, and magazines always represent women with thin bodies. It influences her in interpreting her body image. The media, the environment, and the people around her influence Plum's journey from a negative body image to a positive one. Therefore, this research assumes that Plum lives in a society with values that objectify women or a male gaze perspective. To prove this assumption, this research will use the theory of representation by Start Hall and the theory of the male gaze by Laura Mulvey.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030017-1–030017-10; https://doi.org/10.1063/5.0241625
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Stuart Hall's Representation Theory

This research uses Stuart Hall's theory of representation. Hall (1997) explains that representation is an essential part of the process of producing and exchanging meaning between members of a culture which involves the use of language, signs, and images to represent something [4]. Through language as a representation system, meanings are produced and exchanged by members of society. Representation as a system has two processes. The first is mental representation, and the second is language.

Hall (1997) reports that mental representation is a concept we have in our minds, which we use to interpret something. After a concept is formed in our heads, to interpret and share the concepts in our heads with others, we need language. The required language is a common language that both parties understand. Language is used to exchange meanings, concepts, and thoughts so that the community has the same concept of meaning about something.

Hall (1997) proposes three types of approaches. The first is the reflective approach. The second approach is intentional. The third approach is the constructionist approach. According to the constructionist approach, meaning is formed through a representation system consisting of concepts and signs [4]. The constructionist approach is suitable for analyzing literary work as it closely connects to the condition of society. This research uses the discursive model to find how discourse is formed and how knowledge in discourse production is related to it. Hall states that Foucault uses the term representation as the production of knowledge through what he calls discourse (1997: 23). Foucault (1981) emphasizes the role of discursive practices in shaping subjectivity and identity [6]. These practices include not only what is said but also how it is said, who has the authority to speak, and who is silenced or excluded. Discursive practices help construct social norms and individual identities.

Laura Mulvey's Male Gaze

Besides using representation theory to analyze the novel, this research also uses a supporting theory to assist in the analysis. The theory used is the male gaze by Laura Mulvey. Mulvey, in her essay entitled *Visual Pleasure and Narrative Cinema* in 1975, reveals the phenomenon of female characters in Hollywood films. Using Sigmund Freud's psychoanalytic theory, Mulvey explains the phenomenon of the male gaze. It is a condition where women in the media are seen through a heterosexual male perspective and represented as passive objects [7]. Mulvey alludes to the term scopophilia, which is the pleasure obtained by making other people the object of sexual fantasies through the gaze. She argues that to avoid male castration, men try to fight it by making women become passive objects to fulfill their desires.

In addition, Mulvey also operates the theory of the mirror stage by Jacques Lacan to analyze the spectator. Mulvey likens the audience to a boy going through a mirror phase. It means that the child's self-identification mistakenly assumes that the reflected self is himself, even though it is his shadow. These values make up his ideal ego. In the case of the audiences, they as a peeping tom, who tries to overcome their shortcomings with images in the film? Mulvey argues that with the male gaze, women, besides being the erotic object of the film's character, also becomes an erotic object for the spectator in the auditorium. Male spectators will be eager to see women as objects to satisfy their desires. In the case of the female spectator, Mulvey argues that they must learn to identify themselves with the male protagonist, so they must have his perspective, which is the male gaze perspective. Eventually, women desire to be seen by men by forming an ideal woman in themselves.

METHOD

This type of research is qualitative. Denscombe [8] states that qualitative data is data in the form of spoken and written words and visual images, which are observed and produced. In collecting data, the researchers use the close reading method. After the data is collected, it will be divided into two types. The first is primary data. It is taken from the conversation, narration, and events in *Dietland*, which discusses the female ideal body. The secondary data are the supporting data, all information or facts about the ideal body in The United States around the twenty-first century. This data is taken from articles, books, journals, and the internet. After the data are collected, the next stage is data processing. Hall's theory of Representation, particularly the Constructionist Approach, is used to analyze the data. This approach has two models, and the researchers choose the discursive model by Michel Foucault to reveal the construction of the ideal body discourse in the novel. It aims to find the discursive formation of the ideal body in the story. Besides the theory of Representation, this research also uses the theory of male gaze by Laura Mulvey as the supporting theory. The analysis is carried out through the characters and events that occur in the novel. After connecting the discourse of the ideal body in *Dietland* with the discourse of the ideal body in The United States culture, we will find the ideological position of Sarai Walker, who is part of the United States culture that produces the discourse of a female ideal body.

RESULTS AND DISCUSSION

The Representation Of Female Ideal Body Through The Male Gaze

Dietland is a story about women's struggle to have a body shape or size that is under society's standards. In *Dietland*, Plum tries various ways to be skinny because the standard of beauty is thin women, as the media consistently portrays. Being skinny is necessary to attract the attention of men. In patriarchal culture, women emphasize physical appearance, while men focus more on physical strength. It is gender roles that form the basis of stereotypes about the personal attributes of women and men [9]. Physical appearance affects women's social opportunities more than men's, so women are under more pressure to conform to beauty standards or beauty ideals [10][11]. Eventually, women are often judged not by their quality but by their appearance. The consequence of this evaluation is that women become the objects of the male gaze.

Mulvey (1975) argues that women in the media are the object to be looked at while men are the ones that look. Through media, representation, and experience, women learn to take a perspective of the male gaze. When people consume media that contains the perspective of a male gaze every day, they unconsciously believe that the idea is accurate. As women get the gaze of a man, they eventually internalize this value so that, in the end, they objectify themself. In addition to objectifying themselves, women subconsciously project the views they usually get onto other women, so they see other women using a male perspective.

This phenomenon occurs in the main character in *Dietland*, Alicia Kettle (Plum). Therefore, to analyze how the male gaze phenomenon affects Plum's body image and relates to the construction of the ideal body discourse in the novel, this research will use Mulvey's theory of Visual Pleasure or the male gaze as a supporting theory. So, it will be found how the construction of the ideal body discourse is represented in the novel. This discussion will be divided into several sub-chapters.

Men Gaze at Women

The way men view women can be seen in the following excerpt. The quotation shows that Plum often gets contemptuous because she gets such stares so often. Plum is used to responding to the embarrassing feelings she gets with silence. She never returns that insulting gaze, but Verena's program becomes a tool that evokes Plum to return the insulting gaze. The insulting gaze men give to Plum occurs because Plum's body that is not like the acceptable body for females. So, they judged Plum's body, even committing violence when Plum returned the stare with harsh words.

> *I looked at the man who'd made the comment and said, "I'm too much woman for you. From the looks of you, you probably like to diddle little boys." The two guys next to him, the friends, his white-guy posse, laughed.*
> *They shouldn't have laughed.*
> *The fist of the man who'd made the comment came flying at me* [12]

Lorber and Martin (2013) state that members of a social group influence and push one another to create socially acceptable—and similar-looking—bodies by criticizing, rewarding, and punishing people of diverse body proportions, shapes, weights, and musculature. This idea means that the insulting and violent stares the man gave Plum are forms of making body standards acceptable in society. It indicates that by men's standards, the ideal body type of a woman is not a fat woman.

In social life, obese people are often the target of insulting humor from friends, co-workers, family members and strangers in public. In addition, they get less respect from others [13]. Plum also experiences this. In addition to being the target of insulting and degrading humor from strangers, Plum is often judged by a man just by her appearance instead of her qualities. Plum could not easily find a man to love her because of her fat body. So, she joined Verena's program. Verena's program is a blind date program. Through this program, Plum dated four men. All men gaze Plum by making Plum an object to be judged and seen. So, when they find Plum fat, they will immediately reject Plum.

> *Once I opened it, I saw standing before me Preston, a generic white guy with brown hair, around thirty years old. And there it was: the stare. "Hello. You're...uh. Is Plum at home?"*

"I'm Plum," I said, hating the sound of my name.
"No you're not." Preston laughed [12].

The first man who goes on a blind date with Plum is Preston. Plum predicts Preston's negative response when he sees her figure. Because the standard of the ideal woman's body is thin, people always expect women to be thin. Preston also hopes someone thin for his date.. Plum, who gets Preston's gaze feels down and helpless. This helplessness is marked by the fact that Plum hates to say her name.

In the male gaze concept, Mulvey contends that pleasure in looking is divided into two. They are the active male and the passive female (Mulvey, 1975). It means that the active agent or the one who sees is male while the one who is seen is female. The result of the gaze is women become helpless because of the gaze of men. The spectator in this case is Preston as an active male or a staring male. It means that Preston makes Plum to be the object of his gaze. Plum is an object to be looked at and judged by Preston to live up to his expectation that beautiful women are thin women. Preston's pleasure will be achieved when the woman he gazes at matches his expectations. This notion means that the active gazer is Preston, who controls and desires Plum. After being rejected by the two boys, Plum goes on a third date with Alexander. He is a blind man, so he cannot see Plum's physical appearance. On this occasion, Plum pretended to be Alicia, a skinny woman with weight loss surgery.

"Does your body look, uh, normal?"
"With clothes on, yes. Naked it's another matter. I have scars all over my body. I've been reconstructed, you see. Imagine Frankenstein."
"It's not a pretty sight, Alexander, but what does it matter to you?"
"The thought of it is unappealing, I must admit, but I appreciate your honesty, Alice." [12].

Plum realizes her wish to become a thin woman by pretending to be Alicia. Plum wants to predict what will happen when she does a weight loss surgery later. She estimates what other people think of her thin body, which has undergone surgery. By asking what Alexander feels about her body, which has many surgical scars, Plum tries to see what might happen if she becomes thin by surgery. Alexander's response, which says the word 'unappealing,' reminds Plum that although she has achieved her dream of being thin, she is not entirely accepted. Eventually, Plum begins to doubt her wish to be Alicia.

A cross-sectional national survey obtained from the general United States population shows that women with white ethnicity tend to be the most likely patients to undergo weight loss surgery. Additionally, it was discovered that most Americans had unfavorable attitudes toward weight loss surgery. This negative attitude can create a social atmosphere that is challenging for those having weight loss surgery [14] .

Plum's encounters with the men who mistreat her become Plum's awakening. This incident leads Plum to self-awareness. Assisted by the program Verena had planned, Plum managed to get through the self-negotiation phase. Plum's encounters with the men who mistreat her become Plum's awakening. This incident leads Plum to self-awareness. Assisted by the program Verena had planned, Plum managed to get through the self-negotiation phase.

Because I'm fat, I know how horrible everyone is. If I looked like a normal woman, if I looked like you, then I'd never know how cruel and shallow people are. I see a different side of humanity. Those guys I went on the blind dates with treated me like I was subhuman. If I were thin and pretty, they would have shown me a different side, a fake one, but since I look like this, I know what they're truly like."[12]

Women Gaze at Themselves

Fredrickson and Robert, in objectification theory, reveal that women who live in cultures that objectify women are typically socialized to internalize the observer's viewpoint as the primary perception of their physical selves [15]. Because of the male gaze that women often get both through the media and everyday experiences, this perspective is finally internalized and is considered true, that the concept of the ideal woman's body is a thin body.

Before joining the Verena program, Plum internalized the views of men so that she observed herself the way men saw her. In other words, Plum objectified herself. Girls' self-objectification typically resulted from two main factors: internalizing media representations of traditional beauty standards and sexual objectification they may come across in their daily lives [16]. The ideal body is thin, so Plum joins the diet program she knows from television program called the Baptist Plan.

"You're not coming to visit me because of a diet?"
"I can't, Daddy. You'll be proud of me when this is finished, I promise." I was his only child. He had married again, but his new wife couldn't have children, so I was his only hope for grandkids. If I was fat, no one would want to marry me [12].

From the scene above, it can also be seen Plum feels that she cannot marry if she is not thin. It means that Plum wants to be skinny to attract the attention of men. So there will be men who want to marry her. It shows that women are inferior figures and men are superior figures. Because to be considered attractive by men, women must follow the standards set by men regarding their opinion of how women should look. The fact that Plum thinks dieting will change her future indicates that Plum feels helpless and she will feel empowered if she has succeeded with her diet.

According to Bartky, having a feminine body, which is a body that is socially constructed through appropriate practices, is important to a woman's sense of herself as a woman. Women feel that it is important to feel themselves as subjects who wanted and are sexually desired. Therefore, women want a feminine body because of the threat of desexualization (Bartky, 1980). Realizing that diet programs are not effective for weight loss, finally, Plum, who is now in her late twenties, decided to undergo weight loss surgery.

The surgery would make my stomach the size of a walnut; afterward, I'd only be able to eat spoonfuls of food each day for the rest of my life. That was the horrible part, but the miraculous part was that I would lose between ten and twenty pounds a month [12].

Plum realizes that having fat loss surgery has a downside. However, she is more attracted to this weight loss technique because she will lose weight drastically and instantly. Plum's ideal body weight is 125 pounds or about 55 kg. In 2016 the ideal size for an American woman 20 years and older is less than 5 feet 4 inches (about 63.7 inches) with an average weight of 170,6 pounds [18] (Marcin, 2020). Plum's ideal body is lower than the average American woman's weight. Based on research by [19]MacNeill & Best, (2015), women who suffer from eating disorders think that the ideal body image is a body that is categorized as underweight.

The fact that women objectify themselves is the form of being defined from a male gaze perspective [9](Mckay, 2013). As a result of the male gaze that women always get, she finally gazes herself too. It means that women evaluate themselves. This phenomenon is related to Michel Foucault's concept of disciplinary power. Foucault uses the term Panopticon which is prison architecture to explain the concept of disciplinary power. The circular prison and the warder in the middle make the warder easy to keep watch over the prisoners at all times.

Foucault argues that without requiring physical violence, it only requires stares; an inspection gazes to make individuals feel monitored until the individual unconsciously monitors himself [20]. The convict takes over police duties knowing that they can be observed from the tower at any time. Specifically on disciplining women's bodies, Bartky state that women also watch over themselves because they know that men are watching them with their invisible eyes. For example, a woman checks her make-up, a woman feels she is fat, a woman monitors her body, and a woman monitors what she eats. This supervision, according to Bartky, is a form of obedience to patriarchy. Women are aware of supervision so that whatever she is, she is a body designed to please and excite men [17].

Women will always feel watched in the shadow of a body representation that is considered normal or ideal, which is a thin body. [17]Bartky argues that in the institutionalized regime of heterosexuality women must make themselves objects and prey for men. In a contemporary patriarchal culture, the panoptic view of men is present in women's consciousness. Women are constantly in men's eyes and under men's judgment [17].

Plum eventually escapes seeing herself as a complete human being, a complete woman, not as an object to be arranged and observed. It happens when Plum is about to perform the surgery and seen her uterus via ultrasound, this incident awakens her to realize that her body is a completely female body just like any other woman's. In the end, she realized that she had seen her body as an object that was only used to make men like her and women jealous of her body.

Foxy, hot, fuckable. Whatever it was called, that's what I'd wanted—to be hot, to elicit desire in men and envy in women. But I realized I didn't want that anymore. That required living in Dietland, which meant control, constriction—paralysis, even—but above all it meant obedience. I was tired of being obedient [12].

The phrase 'to elicit desire in men and envy in women' is proof that Plum has been objectifying herself all along. She positions herself as an object that can be gazed at and evaluated by both men and women. In the end, Plum realizes that she does not want to be an object anymore. Being an object means being controlled by the subject. In this case, it is the man who becomes the subject who has the power. Because the value of how women should look is a form of gender inequality so women are emphasized on appearance to satisfy men. Plum realizes she is become an obedient object through the normalization. An example of the normalization is extreme in order to get ideal body.

Women Gaze at Other Women

Women know and internalize the look so that they 'survey' themselves and other women, by men's standards. [21]Beauvoir (1967) argues that women find the meaning of the words beautiful and ugly through praise and reprimand. Through pictures and words they understand to be pleasing means to be beautiful. Women are more likely to project an internalized view of objectification of other women. In short, women who experience self-objectification are more likely to objectify others, especially other women [22].

From the views she got from other people, Plum understood what kind of a woman she has looked like in order to be called pretty. Finally, she projects the value of the beautiful woman onto other women. The way Plum gazes other women can be seen through thus quotation:

> *I wished she hadn't sat down next to me, since we looked like two Humpty Dumptys seated together. During the part of the meeting where we were supposed to chat with our neighbor, Janine spoke as if the two of us were the same. She even invited me out for coffee after the meeting, but I said I was busy. I had never had a fat friend and I didn't want one* [12].

In this quotation, it can be seen that Plum avoids interacting with fat women. Plum's rejection of Janine is proof that Plum projects her knowledge that women must be thin. Thus, upon seeing Janine, Plum immediately judged her body which was like Plum's body. Janine, who tries to befriend Plum, doesn't get a good response because Plum doesn't want to be friends with fat women. just as Plum hates herself, Plum dislikes Janine because of her body appearance.

Just like how men differentiate between fat women and thin women. Plum, who internalizes the male gaze values, also evaluates fat and thin women differently. It can be seen from Plum's meeting with Kitty. Kitty is the senior editor of Austen Media and works for a magazine called Daisy Chain. Plum works as her ghostwriter, replacing Kitty who is in charge of replying to thousands of messages from Daisy Chain readers.

> *"She was a mesmerizing presence, probably better viewed from afar. With the afternoon sunlight streaming in through the windows, casting her mostly in silhouette, the sight of her—Medusa-like red curls atop a slender body—made me think I was hallucinating or looking at something drawn by Edward Gorey.* [12].

The quotation above reveals how Plum views Kitty. Plum describes the appearance of Kitty as something attractive and charming. This is because Kitty has an ideal body, which is a slim body. Because Kitty is so charming, Plum assumes kitty is like an unrealistic painting from Edward Gorey. Not only Plum, but also women who work at Austen Media also internalize the value of thin ideal body. All the women who work in the Austen media are skinny, including Kitty. They all avoid getting fat. They looked at fat women as a bad thing.

> *"If Kitty or any of the women on her staff were given the choice between looking like me and losing an arm or a kidney or even dying, they'd probably choose death or dismemberment," I said* [12].

For people who work in media companies, appearance is an important point. Every day they face pictures of skinny and sexy women on the covers of their magazines. The concept of their ideal body will be following what they often see. Therefore, women who work in Austen media are obsessed with having a thin body and hate being fat like Plum. Plum considers that all women should have a thin body. That was why she had the preconceived notion that all of Austen Media's staff would choose death over having a body like her. Based on research conducted by [23]Balcetis et al., (2013) it is proven that awareness about the concept of ideal body shape adversely affects self-esteem among women, regardless of their actual body weight and shape. This means that since a woman understands the concept of the ideal body, she will continue to observe herself and observe other women.

In the end, Plum changed her perspective on judging women. After joining the Verena's program, Plum begins to realize that she did not meet the beauty standards. Plum's meeting with the women in the Calliope house, house of feminist women, awakened Plum's awareness. She aware that being different from beauty standards is okay. She begins to learn to see other women through their qualities instead of their appearance. This can be seen in Plum's encounter with Sana, a woman who has burns on her face.

> *"Do you think we're the same?"*
> *"In the ways that matter, yes. We're different in a way that everyone can see. We can't hide it or fake it. We'll never fit society's idea for how women should look and behave, but why is that a tragedy? We're free to live how we want. It's liberating, if you choose to see it that way."*[12].

Previously, Plum has always seen herself as isolated. It is because she did not fit with the social idea of the female body that should be. Sana was in the same case as Plum. She is not meeting the beauty standards. The difference is that Plum struggles with her body, while Sans with her face.She has burns in her face. Through Sana, Plum realizes that not meeting society's standards of how women should look is liberating. It depends on how Plum sees this problem. If she accepts her body as it is then she will see this as something positive. After the process of negotiation and meeting people who have a positive perspective on body, Plum begins to be indifferent to what people think about her body. Eventually, Plum doesn't need someone's validation about her body.

The Ideological Position of Sarai Walker

Dietland novel is produced by Walker in the United States society in the 21st century. So that this novel will contain the production of knowledge about the ideal body of women which represents the discourse of The United States's ideal body in the 21st century. Walker is a writer who made her debut with the *Dietland* novel. She grew up in California and Utah, The United States which idealizes a thin body. This affects Walker's concept on the body image.

Through an interview with Huffpost media, Walker revealed that she was a dieter who thought that her life only began when she was thin. The idea to write *Dietland*, Walker revealed, arose in 1999, when she watched the movie *Fight Club*. Then she poured the idea into her short story when she was doing her MFA at Bennington in 2002. This short story about a fat woman who worked in a teen magazine was developed into a *Dietland.* This novel was written in 2008 and published in 2015.

In the process of writing her novel, Walker was influenced by the concept of an ideal body that changes from time to time. In the early 1910's, women in The United States idealized a body like the fictional character, the Gibson girl, because at that time the media displayed the figure of this beauty symbol. Then the concept of the ideal body in contrast changed in the 1920s, in which a woman's body that was considered attractive was a flat body. This year was affected by the World War II. Meanwhile, in 1950-1960, Hollywood played a role in spreading the concept of a body that was considered attractive.

On the one hand, in 1960 popular ideal body is curvaceous woman with a small waist. On the other hand, in this year, there was a movement called the first wave which became the forerunner of the self-acceptance movement. In this year, there was a protest against discrimination toward fat people in Central Park. This movement continues until there is a second wave, where in 1990, the body is prioritized to be healthy by exercising comfortably. While the third wave started in the 2010s, with the popularity of the *Instagram* application, allows women to show their true body shape or size.

Walker became one of the people who promote body positivity. She worked as a writer and editor on a new edition of the feminist health book *Our Body Ourselves* in 2005. Besides being active in promoting the fat acceptance movement, Walker is also a feminist who criticizes the objectification of women in the media. This can be seen through Walker's interview with National Public Radio (2015). In this interview, Walker discusses the novel *Dietland* but specifically expresses her opinion about the objectification of women. This can be seen in the quote below:

> *So, in the case of women, the way we present ourselves is always to this sort of invisible male eye. It just becomes something that's part of how you function in life. It just becomes something that's part of how you function in life. And I think in Dietland part of what Plum does is try and — or the other women try and help her — step out of that, which really shakes her life to its foundation, in a way. To say: I'm not going to see myself as the sexual object, I'm going to try and see myself as I am* [12].

Walker argues that women have always been the object of the invisible male. This means that women will always be the objects to be seen through the eyes of men. The objectification of women that causes self-objectification is a form of internalizing the male gaze perspective. The internalization of the male gaze value is the result of the concept of how women should look which is often shown in the media. Walker gave also her opinion on this issue. This can be seen in the quote below.

> *There's a lot of emphasis placed on "You look pretty," "You look cute." ... That's a tremendous amount of your value and your worth as a person, is how you look. But I think if we just look at our culture — we look at advertisements, we look at magazines, TV shows, movies — I mean that's really what's in our face all the time* [12].

The text above shows that Walker believes that women from a young age are always taught about women's gender roles. This means that women are expected to care about their appearance. It is a women's value to be beautiful. Women are appreciated when they are beautiful. The dictation of how women should be seen continues and is conveyed through the media that has become a culture in the United States's advertisements, magazines, TV shows, and movies.

Mulvey exemplifies the phenomenon of objectification of women in Hollywood movies. The films Only *Angels* Have *Wings* and *To Having and Not Having*, open with the woman as the object of the combined gaze of the audience and all the male protagonists in the film (Mulvey, 1975). A study report called *Rewrite Her Story* aims to see how women are represented in films and television shows. The research conducted on shows from 20 countries, including The United States, showed that depictions of women in leadership were depicted as sexual objects or with nudity compared to men [24]. This narration shows that The United States shows still have the male gaze perspective.

The fact that the main character is an agent of writer to convey her knowledge, then the character is influenced by the background of the author. So that the main character's view will be closely related to the author's view. As a writer, Walker projects her life experiences onto the character Plum. So, what happened to Plum in the novel will show Walker's ideological position. In the end of the novel, it is described that Plum does not preserve her desire to be thin. She decided not to follow society's standards of how women should look. Plum's decision occurred because she had followed the Verena Program, the new Baptist Plan. Through this program, Plum has gone through a process where she negotiates the possibility of her staying with her actual body—A fat body. The result of the negotiation is Plum accepts her fat body, which means Plum has value of body acceptance.

Plum's view of body negotiations shows Walker's position about the discourse of growing up ideals in The United States. Instead of fully accept the concept of ideal body by trying to get the ideal body, Walker make new concept, which is the concept of body acceptance. Walker's view can be seen through this quotation:

> *I think it's great to focus on healthy eating and exercise, but to say, as people in the health at every size movement do, you can be healthy at any size. You know, exercise, eat healthy; whatever size you are, that's what you are, because body shaming just doesn't work. And those kind of anti-obesity programs I think are really harming children because it's stigmatizing them.* [12].

Walker contends that getting the ideal body with healthy food and exercise is a good thing. But it would be great if everyone could eat healthily and exercise regardless of the size. This concept means that Walker rejects the stigmatization of fat people which will lead to body shaming. In Western societies in the twenty-first century, slenderness is typically connected with pleasure, prosperity, youth, and social acceptance. While being overweight is associated with being unmotivated, lazy, and out of control [25]. According to Walker, this stigmatization will not help them live healthier. In fact, it will make them obsessed with being thin, which then causes psychological diseases such as eating disorders and depression.

Walker's position can be seen through Walker's attitude which does not completely reject the concept of the ideal female body that The United States society adores. She, however, believes that all body shapes and sizes can be healthy and that avoiding stigmatization will increase body satisfaction. Walker's enthusiasm for spreading the concept of a diverse body so as to create acceptance of all sizes of the female body is in line with the rise of the fat acceptance movement in the United States in 2015, the year the novel was released. This year, plus-size fashion ceased to be minimized and pushed for more appearances in the media. This year also, the fashion industry for plus-size women is growing. For example, Melissa McCarthy, a designer who supports all sizes of women's bodies, creates Melissa McCarthy Seven7 clothes. In addition, in the modeling field, Ashley Graham, a plus size model, has become a model for various underwear in The United States [26].

CONCLUSION

The concept of the ideal body in the novel is represented through the male gaze. There are three events described in this analysis. They are how men gaze at women, how women gaze at themselves, and how women gaze at other women. This research finds that male-gaze women contain objectification. These findings showcase that men only see women as objects without agency. Because women are only seen as objects to satisfy men's desires, appearance is essential for women. As a consequence of this view, women will judge themselves using the way men judge women. This notion means that women will internalize the opinions they get from men on them. In the end, women will objectify themselves. This objectivity does not stop at the level of self-objectification but continues how women judge other women. Women who have internalized the male gaze values will project the values to other women. This perception influences women's way of gazing at other women from the men's point of view.

Plum's position in negotiating the ideal body concept shows Walker's position as the author. Walker, who grew up in The United States, shows the phenomenon of the perfect female body through her novel. The fact that Walker is a feminist and fat-positive activist shows that Walker is trying to reassure the concept of body acceptance by creating Plum's character in her novel.

This research could be flawed because the study object is only one novel from the United States. Future researchers need to research with more literary works to delineate the experiences of women from various countries regarding ideal body image. Similar research needs to be conducted in various languages to disseminate awareness of body shape acceptance and avoid soul-crushing body shaming.

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Exploring The Marginalized Voices: An Analysis of Woman's Powerlessness in Damar Kembang Through Experiential Meaning

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Abstract. This article is aimed to reveal the powerlessness of the female characters in Muna Masyari's *Damar Kembang*. As one of Muna Masyari's works, *Damar Kembang* tells about the life of Madurese women by using Madurese culture as the background story. By applying Halliday's theory of Systemic Functional Linguistics focusing on experiential meaning. Experiential meaning, alongside with logical meaning, belongs to ideational metafunction, which construes human's experience through language. By analyzing the grammar of experiential meaning, which centers on the element of process, this research attempts to reveal how women were positioned in Madurese society. This study employs qualitative approach and text observation technique in the data collection. The data were the process types used in all clauses, both simplex and complex clauses, produced by the narrator and by the female characters in the novel. From the analysis of the types of process used in the clauses, this study reveals that women were positioned inferior. They have no power, even to determine their own marriage life.

INTRODUCTION

Literary work is one of the media that can be used to depict a condition of the social culture of a society. Through a literary work, like novel or short story, a reader can get information about the life of the people presented in the story. Through a literary work, a writer can also uncover social problems occurring in a society [1]. Muna Masyari, an Indonesian female writer originally from Madura, exposes the life of Madurese women in her works. including their culture and social life in her works [2]. For example, *Damar Kembang*, one of Muna Masyari's works, tells about the life of Madurese people, more specifically the marriage life. Madurese people applies patriarchy system, which positions men as superior, and women as inferior. As an inferior, women do not have authority to make decision, even for their own life [2].

In literary text, language is used by the author to present the stored knowledge or experience of the characters who belongs to certain society or community . This is in line with Halliday's statement that "language construes human experience"[3]. It expresses the speaker's feeling, thought, experience, and imagination. Therefore, from the language used or the clauses produced by the characters or the narrators of literary text, readers can get a picture about the reality of the community or the society presented in the literary text, including the culture, environment and the characteristics of the people [4].

In Halliday's theory Systemic Functional Linguistics language is viewed as a social semiotic system, which has three metafunctions, i.e., interpersonal metafunction, ideational metafunction, and textual metafunction, each of which exposes different function and realities (meaning). Under the interpersonal metafunction, language functions to expose social realities in connection with the interaction between speaker and hearer or writer and reader. Meanwhile, in ideational metafunction, language reveals physical-biological realities and experience. Moreover, the textual metafunction language is used to show semiotic or symbolic reality through the creation of text in context [3,5].

In this study the reality of Madurese women in their marriage life in Muna Masyari's *Damar Kembang* is explored by using Halliday's concept of experiential meaning, which is part of ideational meaning. The analysis is focused on

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030018-1–030018-4; https://doi.org/10.1063/5.0241827
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

one female character in the novel; that is *Marinten,* a blater's wife. *Marinten* is not the main character; however, through her story the writer of the novel clearly presented the role and position of Madurese woman in their marriage.

Experiential meaning refers to the kind of meaning that describes speaker's ideas, feeling, and thought [3,6]. In other word, it is related to what is communicated by a speaker. Experiential meaning is realized through transitivity system covering three elements of clause, i.e. process, participant, and circumstance [3,6,7]. Process includes the action constructed in the clause, which from traditional point of view is verb. This refers to verb of the clause. There are six types of process; they are material process, mental process, and relational process, behavioral process, verbal process, and existential process. The participant of a clause involves the subject and the object of the clause. This element appears in different name, depending on the process involved in a clause. The last element, circumstance, includes the surrounding and the setting of process involving the participant [3].

METHODS

In accordance with the aim of the study, this study applied descriptive qualitative design inasmuch as it attempts to describe and interpret a phenomenon in detail through a textual analysis [8]. The data was taken from a novel entitled *Damar Kembang [9].* Since the study focused on only one of the female characters, i.e., *Marinten* - the Blater's wife, all the clauses related to her were analyzed in term of the process types used.

Data collection was carried out through documentation method, by doing some steps, namely reading the novel, sorting out and selecting clauses relevant to the Blater's wife, and note taking. After all the relevant clauses were gathered, the process of analysis was done by applying Halliday's transitivity framework to identify the process types used in the clauses. The last, the result of the analysis was interpreted to reveal how the female character, the Blaters wife is positioned in the marriage life.

RESULTS

Based on the analysis on the 30 clauses produced to narrate *Marinten,* it is found out that all the process types, except existential process, are used in the clauses. Nevertheless, the frequency of the occurrence of each clause is different, presented in table 1 below.

TABLE 1. Distribution of process types

No	Type of process	Total occurrence	Percentage
1	Material	7	24
2	Mental	13	44
3	Relational	4	14
4	Behavioral	5	17.7
5	verbal	1	0.3
6	Existential	0	0

The distribution of process types in table 1 above shows that Marinten is dominantly associated with mental process. This process takes 44% of the total number of clauses. Another process which occurs in the second highest frequency is material process, found in 7 clauses, or 24% of the total occurrence. The number of occurrences of relational and of behavioral process is slightly different; they are 14% and 17% respectively. Meanwhile, relational process only appears once. No clause contains existential process. Each of the process type is explained further in the following sub sections.

Material process

Material process construes 'doing and happening' which answers the question 'who does what to whom'. This process type consists of element of actor, process, and goal (3,6,10). As shown in table 1 this process type appears the in 7 clauses related to Marinten as participant. In the clauses containing material process narrating Marinten, all the action verbs refer to domestic works, like *making a cup of coffee*, *serving a cup of coffee, and turning on the stove.* The following data exemplifies the use of material process.

(1) *Seperti biasa tanpa melontarkan pertanyaan aku kembali ke belakang memeram perasaan,* ***menyalakan*** *tungku,* ***menjerang*** *air,* ***memasukka****n kopi ke cangkir* (9)

(2) *Ketika aku* ***mengantarkan*** *kopi yang masih mengepul, dia sudah masuk ke kamar* (9)

In data (1) the clause contains three action verbs, namely *menyalakan, menjerang, and memasukkan*. All the verbs include into the steps of making a cup of coffee, which was for the husband. Then, data (2) the clause contains action verb *mengantarkan*. The two material process clauses contain action verb referring to domestic works. Furthermore, the recipient of the clause in data 2, that is *dia who refers to Marinten's husband.* From data (1) and (2) *,* it can be seen that the material processes construing act of doing were performed by Marinten to serve her husband.

Mental process

Mental process refers to "the process of sensing", related to the speaker's/the writer's consciousness about his experience of the world (3). In other words, the clauses containing mental process encodes the meaning about feeling and thinking. Among the process types used in the clauses narrating Marinten, this process appears the highest frequency. The following data represents the use of mental process taken from the novel.

(3) *Senja itu aku melihat suamiku pulang dengan tampang kalut seperti sarung bantal kusut*
(4) *Di kepalaku bersemburan tanya, apa yang dia pertaruhkan di gubeng tadi? ….*
(5) *Ingatanku langsung melesat pada tiga petak tambak kami*

The mental processes in data (3), (4) and (5) are expressed through the verbs of *melihat, bersemburan tanya,* and *teringat.* All the mental clauses above have Marinten as the senser. However, they have different phenomenon. In data (3) the phenomenon is *suamiku* (Marinten's husband). This means that by stating the clause Marinten was perceiving her husband's condition. The adjunct *dengan tampang kalut seperti sarung bantal kusut* explains further about how Marinten thinks about her husband. Then, in data (4) the mental verb *bersem*buran *tanya,* which means that she was wondering about, indicate that Marinten did a cognitive process related to the phenomenon *apa yang dia pertaruhkan.* Lastly, in data (5) the mental process involved is the act of *recalling.* Similar to the previous data, this mental verb includes into cognitive process.

Relational process

Relational process is associated to the process of identifying and characterizing. It is divided into two kinds, namely attributive and identifying. This process occurs four times. The following data is the clause using relational process type.

(6) *Pada saat itulah aku bak sejumput kapuk yang terbang lepas dari cangkangnya dalam sekali tiup*
(7) *Sampeyan salah satu isi rumah ini, jadi mulai sekarang sampeyan bukan miliknya lagi*
(8) *Saat itulah aku seperti kehilangan ruh*

The verb of relational process in data (6) and (7) is categorized as identifying. Identifying relational process means that "one entity id being used to identify another" (3). In data (6) Marinten is identified as *a pinch of kapok* (a very light material used as pillow filling). The clause explains the condition of Marinten after knowing the fact that her husband has given his belongings as betting items. Likewise, in data (7) the verb used in the relational clause belongs to identifying category as well. It is since the clause identifies Marinten as one of the objects or things that become part of the house. Differently, in data (8) the relational clause includes into attributive. Clause in data (8) presents the condition attributed to Marinten condition, that is *she was like a dead people (she lost her soul)*

Verbal process

The next type of process found in the collected is verbal process, which takes only one occurrence. This process is related to the process of saying. This process is realized by verbal groups like ask, say, command, talk, and consult. The following data is the clause containing verbal process.

(9) *Aku bertanya dengan nada tak suka, melihat mereka masuk rumah seenaknya*

The clause in data (9) contains verbal process, i.e., *bertanya*. The sayer of the clause is *aku,* that refers to Marinten. Stating the clause Marinten demanded an answer about the situation, in which two men entered her house. In this case, Marinten acted as the owner of the house, which means that her position was superior to the two men.

DISCUSSION

The writer of the *Damar Kembang* dominantly uses mental process to construct the role and position of the female character, Marinten, in her marriage life. Through mental process the writer describes the state of mind and psychological event. The mental process clauses narrating Marinten presents her feeling and thinking about others. The highest occurrences of mental process indicates that during her marriage life the acts Marinten did mostly are feeling and thinking about her husband. She did not have the right to say or do something.

Then, the lower number of material process clause indicates that Marinten had neither the role to do physical action nor the role to make something to happen. The verbs used in the material process clauses indicate that the role of Marinten in the marriage is only in the area of domestic works.

The next is the use of identifying relational process shows that Marinten was considered only an object, that can be exchanged or given to others. The attributive relational clause presents that Marinten was powerless without her husband. The clause depicts Marinten as a dead person without her husband.

CONCLUSION

Using transitivity framework to analyze the clauses narrating Marinten, a female character in the novel *Damar Kembang,* the study revealed that Marinten, a Madurese woman, has a weak position in the marriage. The less use of material process in the clauses produced by and referring to Marinten shows that in her marriage life Marinten perform less action. Meanwhile, the mental processes which occur dominantly shows her passiveness and powerlessness. She had no bravery to voice her want. Lastly, the relational processes identifies Marinten as the husband's property, which can be used as an exchanged object. Moreover, Marinten is described to have no power without her husband.

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Gender Mainstreaming in the Rural Development Planning Process (Case Study on the Role of Women Farmer Group (KWT) Rengganis in the Empowerment Program in Pakis Village, Panti District, Jember Regency)

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Abstract. Gender mainstreaming is a national development strategy by taking into account the needs, experiences, and problems of women and men in every process of planning, implementing, and monitoring development evaluation. This development strategy is applied in all sectors, including agriculture. Improving the quality and quantity of agriculture can be done through optimizing farmer groups as the center of economic growth of rural communities. The Rengganis Peasant Women's Group is the only farmer women's group in Village, Panti District, Jember Regency. KWT Rengganis' superior products are processed local food from purple tubers including tuber flour, pastries, chips and brownies, however, the lack of representation of KWT Rengganis in decision making has made the proposal to develop processed local food products never realized. This study aims to analyze the development process in the empowerment of KWT Rengganis and recommend gender-responsive empowerment strategies. This research was conducted using the Gender Analysis Pathway (GAP) method. Gender Analysis Pathway is one of the gender analysis to identify gaps in access, control, participation and benefits in the development planning process and recommend gender-responsive development strategies. The results showed that the existing development program in Village is still not gender responsive. This can be seen from the internal government that has not received technical guidance on Gender Responsive Planning and Budgeting (PPRG) so that existing empowerment programs are still gender neutral and tend not to be in accordance with the concept of empowerment itself. Development planning in Village has involved women in it, however, only from PKK representatives. Access to KWT Rengganis is very minimal only represented by its members who are also part of the PKK members so, this representative does not carry the interests of KWT Rengganis.

INTRODUCTION

Gender is not kind of problem, as long as it does not cause gender injustice but the strong patriarchal culture makes women often a marginalized group. Several studies show that women in third world countries tend to be more vulnerable to being marginalized and experiencing gender injustice (*World Economic Forum*, 2020). The international community's attention to gender issues is carried out by formulating approaches to realize gender-friendly world development. This effort is carried out through conferences of countries in the world. The first women's conference was held in *Mexico City* in 1975 to discuss the position of women in development. The results of this conference resulted in the concept of *Women In Development* approach which was influenced by liberal feminist thought with egalitarian principles. The second conference, held in *Copenhagen* in 1980, had the aim of reviewing the progress of implementing the results of the first conference and producing a new approach, namely *Women And Development (WAD)* although, in the concept of the first approach women have had the opportunity to participate in development

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030019-1–030019-5; https://doi.org/10.1063/5.0242027
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however, women are still often discriminated against and denied their rights. *The Women And Development* approach emphasizes that even though women have been involved in development, women should have an equal position with men regarding their positions and rights. Criticism then arises against the second approach, WAD which has a weakness that this concept tends to sharpen the gap between women and men and cannot explain how relations and functions are equal between the two.

Subsequent conferences resulted in a more gender-inclusive approach. This approach was produced through the forum of the world women's conference held in Nairobi in 1985. The *Gender And Development* (GAD) approach is based on the concept of socialist feminism so that the GAD approach tends to emphasize equality between men and women not only in terms of reproduction but also productivity. This approach also criticizes the concepts of WID and WAD which demand women's involvement in development only and does not see how women discriminate in that involvement. The refinement of previous approaches is the presence of the *Gender Mainstreaming* development approach, the term *Gender Mainstreaming* first appeared in the world women's conference held in Beijing in 1990, this approach emphasizes that knowledge and understanding of the importance of the needs of men and women should be the foundation in various institutional policies. The United Nations through *the International Convention on Elimination of All forms of Discrimination Against Women (*CEDAW) conference further made the *Gender Mainstreaming* strategy a campaign to promote gender equality in the world.

Indonesia as one of the participating countries of *CEDAW (International Convention on Elimination of All forms of Discrimination Against Women)* has ratified Law No. 7 of 1984 concerning the elimination of all forms of discrimination against women and then, in 2000 *Gender mainstreaming* was established as the foundation of development policy in Indonesia, ratified through Presidential Instruction No. 9 of 2000. The basis of this regulation then becomes a reference in preparing the National Medium-Term Development Plan (RPJMN) , RPJMD (Province), RPJMD (District) is no exception to the RPJMD of Jember Regency. Jember Regency is one of the agencies receiving the Parahita Ekapraya award (an award to government agencies that have committed to implementing gender mainstreaming). One form of commitment to realize the acceleration of gender-responsive development in Jember Regency, the district government has made efforts to improve understanding of government institutions in Jember Regency through socialization and technical guidance on PPRG (Gender Responsive Planning and Budgeting). PPRG is given to OPD (Regional Apparatus Organization) and village governments throughout Jember Regency. PPRG aims to make village development budgeting responsive to gender by always paying attention to the needs and problems of men and women in every existing development process. The development process in the village consists of development planning, development implementation and monitoring development evaluation. Village development planning is a joint consultation process between the village government and all existing community entities. The village development planning forum is actually a forum to accommodate the aspirations of all village communities so that its implementation must present all elements of the community. KWT Rengganis is one of the community entities in Village, Panti District, Jember Regency, however, the lack of representation of KWT Rengganis in decision making at the village consultative forum is very minimal, making the proposal for the development of processed tuber products by KWT Rengganis never realized. Based on this phenomenon, researchers want to examine how the development process in the empowerment of KWT Rengganis using PUG glasses, namely identifying Access, Control, Participation and Benefits (APKM) in the development process in the empowerment of KWT Rengganis in Village, Panti District, Jember Regency, this is important to prepare empowerment programs that are directed, focused, targeted and in accordance with the commitment of Jember Regency.

METHOD

The location of the research was carried out in Village, Panti District, Jember Regency. The location determination in the research was carried out deliberately or *purposive method* with the consideration that Village is one of the villages that has a KWT Rengganis entity that is active in various activities within Jember Regency.

This study used descriptive qualitative research method. The selection of this method aims to describe in detail a condition as it is, so as to provide an exact picture of how the implementation of gender mainstreaming in the development process at the village level.

The method of determining informants in this study was carried out using the *purposive method.* The informants in this study amounted to 6 people consisting of 1 key informant, namely the head of KWT Rengganis, 4 main imformants, namely PPL Desa, Head of Village, and 2 members of WT Rengganis and 1 additional informant, namely the section of PP and PA DP3AKB Jember Regency.

Data collection methods used in research include in-depth interviews, observation and documentation. The data analysis method was carried out with Gender Pathway Analysis and Miles Huberman Analysis. Data validity tests are performed by source triangulation and engineering triangulation.

RESULTS AND DISCUSSION

Gender Mainstreaming

Gender mainstreaming is an alternative strategy in complementing the previous strategies, namely Women *In Development, Women And Development and Gender and Development.* The strategy was first declared at the Fourth World Conference on Women in Beijing in 1995. Gender mainstreaming is explained as a strategy in order to achieve gender equality and justice carried out through the planning and implementation of gender-responsive policy programs. Presidential Instruction No. 9 of 2000 clarifies the definition of gender mainstreaming as a strategy built to integrate gender into an integral dimension of planning, drafting, implementing, monitoring, and evaluating national development policies and programs.

According to Santoso (2016) there are four main indicators in assessing whether development programs have made gender the mainstream in it. The four aspects observed are Access, Participation, Control and Benefits (APKM) in every development process. Access describes whether a development intervention has provided equal space for obtaining information on the intervention. Participation is how men and women are present in development interventions. The control explained whether men and women had equally influenced development interventions and benefits, looking at how development interventions had provided equal benefits to both parties. These four aspects are then analyzed in each development process, namely planning, implementing and monitoring the evaluation of the development itself. This study discusses gender mainstreaming of the empowerment of KWT Rengganis in the development planning process, namely in the Musrenbang process.

Empowerment

Empowerment is one of the development models that brings changes in the development paradigm by prioritizing human values, namely *people centered*, *participatory*, *empowering* and sustainable. Through empowerment, it aims to increase the independence of community groups not only in the economy but also in social, cultural, voting and opinion rights to independence in their political rights. Women's empowerment is one of the efforts to improve women's ability to access various resources in their lives and is considered to be an effective step in alleviating women as a marginalized group. According to Sugiarto (2020), the position of rural women has been given access in the public sphere to raise the issue of women's empowerment, however, it tends to be minimal in influencing decision making. This is due to the dominance and patriarchal culture that is still strong in rural areas. Therefore, Sugiarto also said that in order to increase the role of women in decision making and convey their aspirations, a special forum is needed for village women in exploring village problems and potentials so that women are able to convey aspirations and influence development decisions in the village. Related to this research, the empowerment in question is a village government development policy in the field of community empowerment which aims to improve the welfare of community groups, one of which is the farmer women's group.

DISCUSSION

Gender Mainstreaming in Development Planning Process in Village

Village development planning according to Minister of Home Affairs Regulation No. 114 of 2014 is a stage of activities organized by the village government involving the Village Consultative Body (BPD) and community elements in a participatory manner to discuss the allocation and utilization of village resources to achieve village development. The stages of implementing development planning in Village begin with deliberations (musdus), tilik dusun (musdes) and musrembangdes. Based on Permendagri No. 114 of 2014, musrembang implementation guidelines must be attended by elements of the community with a composition of 30% women. The following are the results of the analysis of the implementation of gender mainstreaming in the implementation of musrenbang desa ferns:

Table 1 Analysis of Access, Control, Participation and Benefits in Development Planning

		APKM Identification in Planning Building	What KWT Earn
Access	-	Obtaining information	√√
	-	Know the flow of development planning	√√
Participation	-	Presented in forums	√
	-	Propose ideas in forums	√√
Control	-	Obtaining the right to speak and speak	√
Benefit	-	Conveying women's institutional aspirations (KWT)	√

√ : Obtaining √√ : Not obtaining
Source : Primary Data 2023.

a. Access

Understanding Access according to Santoso (2016) is a space given to men and women in development interventions, furthermore Susanto also explained that access in development planning can be known through how to deliver information (distribution of invitations) both to men and women. In the implementation of musrenbangdes in Village, 30% of musrenbang members are representatives of the female element. The female element who was present at the musrenbang of Village was attended by 25-30 cadres of the PKK of Village. PKK cadres are considered to have represented women in conveying their aspirations in the forum, but in reality the female element in Village is not only PKK. One of the female elements in Village is KWT Rengganis. KWT Rengganis is considered to have been represented by PKK members who are also part of KWT Rengganis. PKK and KWT are actually two different groups so that the aspirations conveyed do not carry the interests of the needs of KWT.

b. Participation

Participation is the participation of all parties, both men and women, in development interventions, furthermore, participation is described by how the level of attendance with the analysis of the question "who does what" which is to see which parties act in a development intervention. Access to participate in murembangdes was not obtained directly by KWT Rengganis but was considered represented by the PKK because some KWT members were also PKK cadres. The participation of KWT Rengganis members who received invitations only attended the forum without bringing the interests or aspirations of KWT Rengganis. The proposal submitted by KWT Rengganis for product development through the establishment of selling stands at stands in village tourism is only submitted in non-formal forums, not through development planning forums. Participatory principles and the issue of inequality between men and women in village development practices are often overlooked, as happened in the development planning forum in Village it appears that women's rights and access are not a priority to exist in village development planning forums. This is also in line with what was conveyed by the Ministry of Women and Child Protection (2017) in its module entitled "Women's Leadership in Villages", the fact is that many rural women are often faced with the problem of lack of opportunities to access village development planning and implementation

c. Control

Control is the power to make decisions, control is an indicator that shows whether men and women have equally influenced decisions in development interventions by identifying the question "Who owns whom". Women are actually part of a political entity that has power and influence in social and political circles, however, it is very difficult to manifest in public spaces, or in other words, women actually have power in influencing development but are often constrained by strong patriarchal culture. Musrembang Desa presents 30% of women in it, namely from PKK cadres. The PKK, which is considered to have represented women's elements, in fact has needs and ideologies that do not fully represent other women's elements. It can be seen that no proposal or interest of KWT was submitted. Representatives of KWT Rengganis members who are also PKK members do not influence decision making or in other words do not convey their proposals or ideas. The presence of PKK cadres who are also part of the KWT is in fact still unable to access resources in development. This is also an indication that the presence of women in public spaces alone is not enough and must be followed by courageous, critical knowledge so as to convince the forum. In line with Tokan at all's (2020) research, the most fundamental weakness faced by rural women is generally the lack of education, organizational skills and experience so that they fail to convey their aspirations in village development forums.

d. Benefits

Benefits is a description of how benefits are obtained from men and women for development interventions, this analysis explains whether benefits are skewed by one party only or have been evenly obtained by all parties. The identification of benefits to development interventions can be analyzed through the question of "who gets what". Musrenbangdes aims to accommodate the aspirations of the community and discuss them for the management and allocation of resources for village development. Based on this understanding, benefits are not obtained by KWT Rengganis in conveying ideas in the forum because access is very minimal.

Women have basically been given space to participate in exerting their influence on development, however, at the Village planning forum, the space given in exerting influence in the management of development resources is not obtained by all women's groups, while other women's groups are still very minimal, seen by participation in the musrenbang fram that does not convey their proposals. In line with Nurhalimah's research (2018) that women's participation in rural communities has a level that is allowed and listened to, however, there is very little ability to strengthen the view that it is worthy of government consideration.

Gender Gap in Internal Government Institutions

The internal gap of the Village government can be seen from the unknown concept of PPRG (Gender Responsive Planning and Budgeting) This is because there is no Bimtek carried out at the village apparatus level. Bimtek that has been carried out is at the sub-district OPD level. The formulation of programs in the field of community empowerment does not refer to the concept of empowerment and is still gendernetral. Another thing that causes gender inequality in the external sphere is due to the stereotype that the stages of activities in development planning such as hamlet deliberations and village deliberations are only intended for men. The PUG strategy that has been implemented but until now has not all been implemented as expected depend to Santoso (2014) sometimes lies in the structure of government that is not gender responsive and apparat that is not yet gender sensitive. Based on the gap in Access, Control, Participation and Benefits (APKM), as well as gaps from internal and external government institutions, measurement indicators in reducing gender gaps in community empowerment programs can be done by 1) ensuring that 30% of women's representation comes from all women's groups in the village. 2) internal government parties are expected to understand and follow PPRG's technical guidance.

CONCLUSION

Based on the discussion above, the development process in Village, Panti District, Jember Regency begins with the planning, implementation, and ends with the evaluation monitoring process. The development process carried out in Fern Village has integrated PUG but it is still not optimal. This is evidenced by the lack of access, participation and control of women's groups in village development planning forums. Another thing can also be seen from the lack of budgeting in the implementation of community empowerment, especially in women's groups. Increasing understanding of gender in development can be optimized by the Village government through socialization forums and technical guidance on PPRG.

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Duolingo's Technology Acceptance Model in Indonesian Context

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Abstract

This study aimed to measure the technology acceptance model (TAM) of the Duolingo application from the perspective of EFL students in Indonesia. Here in Indonesia, Duolingo has become a popular platform that provides students with course and exercise features to learn English skills or sub-skills better. Hence, this study tries to re-confirm its potentiality through the use of the Technology Acceptance Model (TAM) framework by proposing 3 aspects of measurements: 1) Perceived Ease of Use (PEU), 2) Perceived Usefulness (PU), and 3) Interest (IT). Those 3 criteria were checked whether or not they have a strong connection or effect with the student's intention to use the Duolingo application (IU). 101 participants were involved in this study, and they assuredly had experience in using Duolingo for learning English starting from less than one month until more than one year. After the data were gathered, the Structural Equation Modelling (SEM) analysis was used to measure Indonesian EFL students' Duolingo acceptance through Smart PLS software. Thus, the result exposed that Perceived Usefulness (PU) and Interest (IT) had a significant effect on the Intention to Use (IU) Duolingo based on the overall participants' responses. Meanwhile, Perceived Ease of Use (PEU) did not have a significant effect on the Intention to Use (IU) Duolingo. It can be argued that the Duolingo application is useful and interesting for learning English, and Indonesian EFL students had the intention to use it more. However, it is not with the ease of use the app that needs future investigation to conduct.

Keywords: Duolingo, English Learning, Technology Acceptance Model (TAM)

INTRODUCTION

Duolingo is newly known as a language learning application or platform that can be used by people of all today's generations. This application was released in 2012 by offering 27 different languages around the world. This application is available on devices such as Android, iOS, and Windows. This application is claimed to be a personal language tutor who can motivate users through activities such as in-game elements (gamification) that can promote language acquisition. In addition, Duolingo also offers an English test to assess English language proficiency, English for business, and school. To use this, users can create an account for free. After creating an account, users can select a language to learn and start learning activities. If users already have experience with the target language, they can take a placement exam to advance to the top level. Learning in Duolingo is broken down into units such as "Basic" where users get basic vocabulary such as food, and family, and also the material offered will be more advanced such as the past perfect and the past subjunctive [1].

One feature offered by Duolingo is gamification. Gamification refers to a game-based mechanic that uses game-based thinking to consider, motivate, and solve problems related to learning activities [2]. The gamifications offered in Duolingo are rewards or Lingot (given to users when they complete their language lessons or skills), Leader-boards (boards that show the user's performance compared to other users), leveling system (levels are used to compete with other users), badges (accomplishment tokens earned by users) [3]. Apart from that, Duolingo also has features like Duolingo for School where this feature can be used as a resource for teachers. They can organize classes and have students enroll in a specific class to do regular Duolingo lesson-based assignments. The next feature is Duolingo labs which include stories, podcasts, and events. Lastly, Duolingo stories provided short funny stories to help increase students' language skills [4]. These features are essential in learning especially for English. [5] argued that gamification plays a certain part in English learning where gamification can be used to help for instance vocabulary learning, etc.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030020-1–030020-10; https://doi.org/10.1063/5.0246863

Several researchers have explored the usefulness of Duolingo in English learning. First, [6] stated that Duolingo has contributed to improving students' vocabulary, pronunciation, and simple language structure. Next, [7] declared Duolingo had a positive influence on developing listening skills in English. Also, [8] found that interactive reading assessment could lead to L2 learners' reading competence improvement. Last, [9] successfully claimed the enhancement of EFL students' speaking proficiency in Saudi Arabia as well as improving their overall language skills. In short, Duolingo's application can improve students' a variety of skills and sub-skills of English, such as listening, speaking, vocabulary, grammar, and pronunciation. Duolingo surely offers new dimensions and attractions like a game that can make students enjoy learning English. This application is fully supported by technology-based learning that can be used by both teachers and students.

In the Indonesian context, Duolingo is prevalent and most used by many students at the secondary or university level to master English either inside or outside of the classroom. Duolingo application is used by them to learn English for various academic purposes. Plenty of Indonesia's researchers have conducted studies on Duolingo to prove its significance with certain results. Studies from [10], [11], [12], and [13] showed positive changes or effects on Indonesia's EFL students' listening and speaking skills. Another study exposed the implementation of Duolingo for boosting EFL students' reading skills, such as from [14], writing, such as [15], or grammar, such as [16]. [17], [18], and [19] also researched the Duolingo with findings that this application gave positive changes or effects on students' vocabulary mastery. In addition, the Indonesia Ministry of Education through its International Students' Mobility Scholarship Program (IISMA) has allowed the Duolingo Test as one of the language requirements besides TOEFL or IELTS [20]. It showed how famous this app in Indonesia. [21] and [22] highlighted that Duolingo can be a good alternative for students and teachers, especially in motivating students in learning English. It can be noted that the use of Duolingo in Indonesia is increasing and has been widely used by EFL students in Indonesia.

However, some literature provides negative insight into the Duolingo application. Duolingo is difficult to use due to the internet problems [23]. It is understandable since Duolingo is an online learning application, so it requires connectivity to the internet to be implemented in class. Next, the study from [24] exposed that the display of Duolingo seems too monotonous, and collecting a "heart" on a mission is quite challenging. This means students must be aware not to lose the "heart" to create an opportunity to fill another question. On the other hand, if students use Duolingo and get many badges frequently or easily, they will get bored [25]. In short, Duolingo also has adverse sights that is experienced by Students when they learn English in particular lesson.

To parse this status quo, the researchers felt necessary to research the Duolingo application in Indonesian EFL students' context. The best way to examine whether or not Duolingo provides more benefits than rebuffs is by measuring Duolingo's Technology Acceptance Model (TAM) first. The Technology Acceptance Model (TAM) is a highly effective tool for determining users' initial thoughts about a certain new technology. Studies on the adoption of technology can also look at a wide range of phenomena, from smaller user groups to wider user acceptance, such as particular apps, cellphones, or any new technology [26]. Additionally, he reaffirmed that there are other ways to examine technology acceptability, including the normative or value dimension, the behavior dimension, and the attitude dimension. The favorable results of an evaluation process that are connected to a specific user's intention to perform can be used to infer technology acceptance [27].

In line with some Duolingo's Technology Acceptance studies, Indonesian EFL students have the option to accept, disregard, or reject the item or Duolingo's technology in full. With the help of this model, users' adoption of the new system may be better understood. TAM is regarded as the most theoretical model that researchers employ when developing certain technologies [28]. In addition, there has not been much research done on TAM and the Duolingo app, particularly in Indonesia. The researchers only found study of TAM on Duolingo from [29] in Turkey students' scope. Their research had explored 15 possible hypotheses. The findings showed perceived behavioral control, attitude, subjective norms, satisfaction, and perceived usefulness become a significant effect on the students' continuance intention to use Duolingo (MALL). Another study accomplished [30] had also investigated TAM on Duolingo in India students' context, however this study focused on Spanish not English.

Due to the points above, in this research, the researchers propose three criteria or aspects to measure in this TAM, which are Perceived Ease of Use (PEU), Perceived Usefulness (PU), and Interest (IT). Those 3 criteria will be checked whether or not have a strong connection or effect on the Indonesian EFL students' intention to use Duolingo (IU). The hypotheses for this research are:

1) H1: Perceived Ease of Usefulness (PEU) has a significant effect on Intention to Use (IU) Duolingo
2) H2: Perceived Usefulness (PU) has a significant effect on Intention to Use (IU) Duolingo
3) H3: Interest (IT) has a significant effect on Intention to Use (IU) Duolingo

Therefore, this research may reveal how easy Duolingo is to be utilized by students (PEU), how useful the application is according to students (PU), and how interested the students are towards this application (IT) that can affect their Intention to Use (IU) of Duolingo Application. Hopefully, it can be known the factors that contribute students in Indonesia to accept or reject toward Duolingo's technology for learning English.

LITERATURE REVIEW

Duolingo

Duolingo is an English learning application that can be used to improve students' English skills. In the Indonesian context, Duolingo is used by various levels and purposes, such as lower, upper secondary, and university level. Besides, Duolingo is also used for teachers to present English lesson or exercise in the classroom. According to Li and O'rourke cited in [31], Duolingo was first developed in 2011 by Professor Louis Von Ahn and his doctoral student Severin Hacker with the intention of serving as a personal teacher that students may contact whenever and wherever they need to help with language learning, and currently, Duolingo is one of the most popular free language learning apps with 39 language courses available for learners.

This Duolingo application has easy way to use. The users simply need to register using a Google, Facebook, or email address, then they will meet the application's mascot, the green owl. The application does not include any advertising banners, and there is no fee for the educational materials. According to Chik cited in [32], in Duolingo application, learners are predisposed to accept the mandated linear language learning method and content when they enroll in a Duolingo course. There is minimal interaction with other students and no question skipping (without losing heart) for each class. In simple way, users are learning language with fun activities and gamification approach.

Technology Acceptance Model (TAM)

In order to predict and explain the adoption of productivity apps by knowledge workers, such as word processing, email, and graphics tools, TAM was first established by [27]. The Technology Acceptance Model (TAM) integrates the concepts of technology and acceptance. Acceptance refers to the relationship between the technology and the questions it poses to particular people or groups [33]. Over the period of more than 20 years since its birth, the application fields for TAM and its numerous modifications and advancements have extended in multiple directions. Today, it is used not just in course management systems but also in multi-disciplinary research, such as education. TAM has emerged as the leading scientific paradigm for studying how effectively educators, students, and other stakeholders accept educational technology [34].

According to some literature, TAM has become a beneficial framework for exploring particular new technology development or creation. Originally, the TAM's framework concentrates on the 2 criteria: Perceived Ease of Use (PEU) and Perceived Usefulness (PU), however according to [35] cited in [34], researchers may postulate or decompose the model to certain variables related to the objective of their study. Researchers have started developing and testing more complex models seeking to explain the information they made [36]. One of them is the study by [36] about conceptualizing and measuring the optimal usage of the e-learning system. Their study showed that the students' experience and their usage of the e-learning environment presented a significant connection by the integration of their affective state and their technology acceptance.

Duolingo's Technology Acceptance Model

Three independent variables of 1) Perceived Ease of Use (PEU), 2) Perceived Usefulness (PU), and 3) Interest (IT) are the main emphasis of this Duolingo application research's Technology Acceptance Model. Based on the anticipated increase in Duolingo users within the Indonesian EFL student population, behavioral intention has been added as the dependent variable or also known as intention to use (IU). Subsequently, perceived ease of use (PEU), perceived usefulness (PU), and interest (IT) are classified as exogenous variables for Structural Equation Modelling (SEM) analysis, whilst intention to use (IU) is regarded as an endogenous variable.

Perceived Ease of Use (PEU)

When people use technology, they will feel as though they are using systems that are easy to use or require little effort on their part. This is known as perceived ease of use. It refers to the state of not having to struggle or exert a lot of effort to use technology. However, consumers are more likely to embrace programs that they view as easier to use than those that they see as neither easy nor difficult [35]. Perceived simplicity of use has an impact on the intention to use the technology claimed by [37]. It is possible to argue that people's intentions to utilize technology are influenced by perceived ease of use, since the more people find technology to be user-friendly, the more inclined they are to do so.

Perceived Usefulness (PU)

Perceived usefulness, according to [35], is the degree to which people accept using technology to enhance their performance at work. If technology is applied profitably, it can be beneficial. On the other hand, the inclination to adopt technology is positively correlated with its perceived usefulness [38]. One may argue that technology becomes profitable to employ when it is viewed as useful. In this instance, technology can help people perform better at work.

Interest (IT)

Interest is more likely to be a valence-based, content-specific motivating feature. This has to do with people's innate ideals and sentiments [39]. But it's crucial to take action, and learning English is one of those things [40]. Interest encompasses motivation or general components of motivation, as well as particular motivational strategies involving the pursuit of novelty [41]. Interest is a crucial element that can reduce students' intention to use MOOCs, according to research by [42].

Intention to Use (IU)

The degree to which someone intends to carry out a specific activity is known as their intention to use [43]. There are a number of things that can influence how strongly someone intends to do something. Researchers looked at how Duolingo's perceived usefulness, humor, and simplicity of use affected its goal in this study.

METHOD

In this study, the researchers used Technology Acceptance Model (TAM) by [27] that focused on measuring the three criteria previously mentioned, which were: 1) Perceived Ease of Use (PEU), 2) Perceived of Usefulness (PU), and 3) Interest (IT). Those criteria would be checked whether or not had connection or effect on the Intention to Use (IU) the Duolingo according to Indonesia EFL students. There were 101 participants who were involved in this study. The participants were for sure Indonesia citizenship, and they were categorized as EFL students who had used or currently been using Duolingo for learning English with a range of less than one month to more than 12 months (see figure 1).

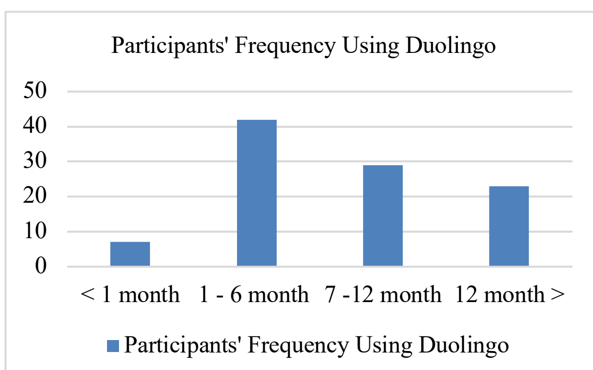

Figure 1. Participants' Frequency

The instrument used in this research was close-ended questionnaire that consisted of 17 items. It was adapted and modified from [35] and [44]. Due to invalid data, one item of question in Perceived of Usefulness (PU3) were deleted. Thus, the total data calculation was only involved 16 items.

Table 1. Close-Ended Questionnaire

Aspects	Statements	Sources
Perceived Ease of Use (PEU) in English Language Learning	1. Learning English by using Duolingo would be easy for me.	[35]
	2. English learning grammar activity with Duolingo would be clear and understandable.	
	3. Duolingo is flexible to be used for English learning activity.	
	4. I would find Duolingo easy to use.	
	5. It would be easy for me to become skilful at using Duolingo.	
Perceived of Usefulness (PU) in English Language Learning	1. Using Duolingo will allow me to quickly understand English.	[35] and [44]
	2. Using Duolingo would improve my ability to learn other English skills (speaking, listening, writing, and reading).	
	3. Using Duolingo for learning English makes learning more fun and engaging. *(*invalid data*)	
	4. Using Duolingo would make it easier my English learning activities.	
	5. Using Duolingo would increase my English score in my study.	
Interest (IT) in English Language Learning	1. Using Duolingo would be well suited for the way I like to learn English.	[44]
	2. Duolingo would be a good medium to provide the way I like to learn English.	
	3. Duolingo gives me an overall learning grammar with playful experience.	
Intention to Use (IU) the Duolingo Application	1. I want to use Duolingo for learning English.	[44]
	2. I will use mobile devices on a regular basis for learning English in the future.	
	3. By unique and interesting features provided, I will choose Duolingo as the application for learning English.	
	4. I think that using Duolingo would be a good way to learn English.	

In this study, the data was collected through the utilization of close-ended questionnaire that was previously stated. The researchers transferred the 17 items of close-ended questionnaire instrument to the google form (online) format or service. It is for effectiveness and efficiency data distribution and collection. At the end, the data had been responded by 101 participants from first July to End August of 2023. Next, after the instrument was distributed and collected, the researcher analyzed the data through the use of Structural Equation Model or SMART PLS software.

Partial Least Square (PLS) was applied to measure and test the research model. Researchers use Smart PLS to process data. After the researchers gathered the data, the researchers used several calculations. To see the analysis of construct validity values, researchers used Cronbach's Alfa, Coefficient Rho, and Composite Reliability (CR). Meanwhile, for construct validity, the researcher used the Average Variance Extracted (AVE) value. For analysis of discriminant or convergent validity, researchers used the Forner Larcker criterion and Heterotrait Monotrait (HTMT). After seeing the validity and reliability of the construct, the researchers bootstrapped to find the path coefficient of the PU, PEU, and IT variables for IU's variable.

FINDINGS AND DISCUSSION

Descriptive Statistics

Table 2 showed the descriptive statistics for all of the constructs in this research model. It indicated that participants have good perceptions of the use of Duolingo in learning English in perceived of useful, perceived of usefulness, interest, and intention to use. Thus, this application supports them in learning English.

Table 2. Descriptive Statistics

Constructs	M	SD
IT	0.938	0.941
IU	0.941	0.942
PEU	0.930	0.933
PU	0.902	0.906

Constructs' Analysis Validity and Reliability

The researchers conducted the adequacy of the measurement model which was assessed by using the validity and reliability indicator tests before carrying out the hypothesis test. Reliability can state the extent to which the variable construct is declared free of errors and has consistent results. Validity refers to the extent to which the constructed variable can differ from other variables [45].

Table 3 showed the constructs' analysis validity and reliability. It is shown that almost all of the items exceed the limit of 0.7. In the results of each Cronbach alpha, it can be seen that each construct variable has a value that exceeds the limit of 0.7. However, a value of 0.7 can be used as a threshold [46]. Composite reliability also has a value greater than 0.7, where the value is from 0.93 to 0.96. It can be concluded that the reliability value for the variable construct is above the threshold, valid, and can be used.

Table 3. Item loading, Reliability, and Convergent Validity

Construct	Item	Outer Loading	Cronbach's Alpha	Composite Reliability	AVE
Interest	IT1	0.921	0.938	0.960	0.889
	IT2	0.961			
	IT3	0.947			
Intention to Use	IU1	0.912	0.941	0.958	0.851
	IU2	0.950			
	IU3	0.903			
	IU4	0.923			
Perceived Ease of Use	PEU1	0.916	0.930	0.947	0.781
	PEU2	0.878			
	PEU3	0.860			
	PEU4	0.919			
	PEU5	0.843			
Perceived Usefulness	PU1	0.859	0.902	0.932	0.774
	PU2	0.904			
	PU4	0.894			
	PU5	0.860			

Researchers conducted two subtypes of validity, namely convergent validity and discriminant validity. In convergent validity, a set of construct items relates to the same basic construct. This can be assessed based on the value of the Average Variance Extracted (AVE). If the latent variable has a value greater than 0.5, it means it can explain more than 50% of the variance of its indicator [45]. From the result of this research, the AVE value of each construct greater than 0.5.

Next, to test the discriminant validity, the researchers used the Fornell-Larcker test (Table 4) and the Heterotrait-monotrait ratio of correlation (HTMT) (Table 5). In Table 4, it can be seen that rho A and VIF values exceeded 0.7. In the Fornell-Larcker test, the square root value of AVE (Table 3) exceeds the inter-latent construct to achieve discriminant validity. Thus, on the HTMT test, it is shown that all constructs have scores below 0.9. It can be concluded that the convergent validity and discriminant validity of each construct are stated to be valid.

Table 4. Fornell-Larcker

Constructs	rho_A	VIF	IT	IU	PEU	PU
IT	0.941	3.640	0.943			
IU	0.942	-	0.844	0.922		
PEU	0.933	4.291	0.833	0.767	0.884	
PU	0.906	3.427	0.785	0.823	0.822	0.880

Table 5. Heterotrait-Monotrait Ratio of Correlation (HTMT) Values

Constructs	IT	IU	PEU	PU
IT				
IU	0.898			
PEU	0.890	0.816		
PU	0.853	0.889	0.898	

Analysis of Structural Model and Testing of Hypothesis

The researchers used bootstrapping on Smart PLS to see the significance between variables. Table 6 showed the path coefficients and levels of significance in the structural model. The T-value must be greater than 1.96 and the p-value must be lower than 0.05, so it can be said that the variable is statistically significant [47]. In this study, it was shown that the T-value and p-value for interest were 4.993 > 1.92 and 0.000 <0.05, which means interest has a significant effect on the intention to use Duolingo. Next, the T-value and p-value of perceived ease of usefulness are 0.252 < 1.92 and 0.800 > 0.05. It means perceived ease of usefulness has no significant effect on the intention to use Duolingo. Lastly, perceived usefulness has a T-value of 3.845 > 1.992 and a p-value of 0.000 <0.05. It means, perceived usefulness has a significant effect on the intention to use Duolingo.

Table 6. Path Coefficient

Path	Original Sample (O)	Sample Mean (M)	SD	T-Statistics	*p* Values	Results
IT → IU	0.531	0.522	0.106	4.993	**0.000**	Unsupported
PEU → IU	-0.029	-0.019	0.114	0.252	**0.800**	Supported
PU → IU	0.430	0.430	0.112	3.845	**0.000**	Supported

Figure 2 showed the coefficient determination R2 values of each variable. It explained that 53.1% of the variance in interest and 43% of the variance in perceived usefulness. In contrast, perceived ease of usefulness has -3%.

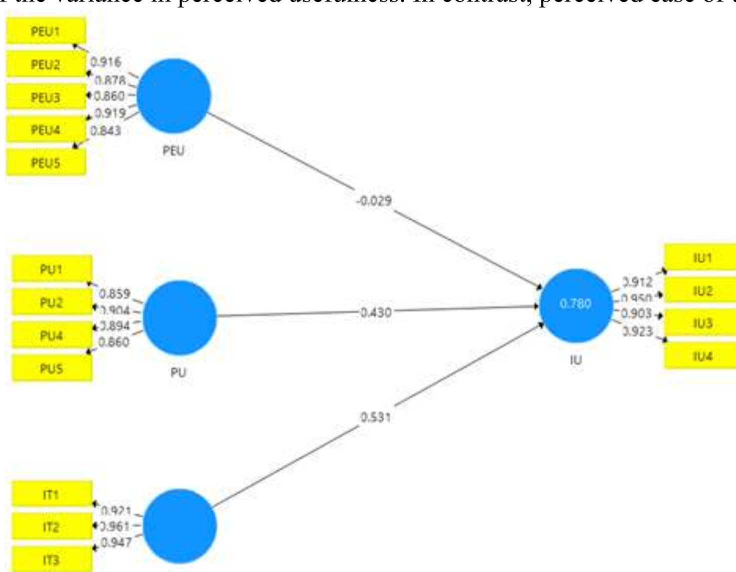

Figure 2. Path Coefficient With R^2

DISCUSSION

This study has successfully measured the technology acceptance model of Duolingo which is used by Indonesian EFL students for learning the English language. Based on the result above, it can be seen that only two criteria of Perceived Usefulness (PU) and Interest (IT) showed a significant effect on the Intention to Use (IU) Duolingo application. In contrast, one criterion or Perceived Ease of Use (PEU) aspect showed a different result. These findings have the same result from [47] and [48] who showed that perceived usefulness and interest affect intention to use the technology in their contexts of research.

The researchers tried to elaborate on the data above. First, in line with Perceived Usefulness (PU), the researchers argued that Duolingo is a beneficial application, which can make the effective learning process. This made Indonesia EFL students felt that Duolingo could be an alternative for English learning activities, and it would help them to enhance their English level. Students only need their devices, and the steady network to study, thus they seemed to highly accept this technology from this criteria due to its benefits and English learning expectations. [20] supported this by stating Duolingo can support the learning process and increase the students' grades as well. Next, in terms of Interest (IT), the researchers believed that Duolingo provides features and games that could boost the Indonesian EFL students' interest. This claim is supported by [4] who stated Duolingo has a lot of fun features, that attract students to use it. This might be the key factor that made Duolingo was accepted by Indonesian EFL students for learning English.

Last, about Perceived Ease of Use (PEU), Indonesian EFL students tend to reject this criterion or aspect. It can be known by the scores of $0.252 < 1.92$ and $0.800 > 0.05$ in the T-value and p-value data. The researchers assumed that Indonesian EFL students had difficulties when using the Duolingo app due to the practicality cause, for instance how they understood the game play or features presented in the application. Besides, technical requirements such as network disruption or internet unavailability may also create problems in utilizing Duolingo [49]. It is known in Indonesia, the internet connection is often trouble because of weather, poor signal, etc. Even in the capital city like Jakarta, the internet speed is only ranks third based the level of internet penetration across country [50]. When students are disturbed by those issues, students might feel unhappy and influenced by their convenience while using this Duolingo application. However, this assumption needs to be investigated more, so it can be found the complete and holistic reasons for the Perceived Ease of Use (PEU) factor.

CONCLUSION

In conclusion, Duolingo is an application that surely can be used for English learning activities. In the Indonesian EFL students' context, Duolingo has become fairly popular which creates positive expectations for them to use the application for better learning English. However, based on research results, only Perceived Usefulness (PU) and Interest (IU) showed positive effects on the desire to use Duolingo for English learning purposes; Perceived Ease of Use (PEU) did not.

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Factors, Impacts, and Efforts in Preventing Early Marriage Culture on Women's Reproductive Health: Literature Review

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Abstract. In 2022, the prevalence of child marriage in Indonesia will be 8.06 percent, consisting of dispensation for marriage and child marriage. Early marriage can cause new problems, for example in the aspect of reproductive health, because the reproductive organs are not yet mature enough to carry out their functions. The aim of this research is to determine the factors, impacts and prevention of early marriage. This study uses 30 articles obtained from searches using Google Scholar. The inclusion criteria are articles from 2019-2023 analyzing factors, impacts and efforts to prevent the culture of early marriage on women's reproductive health, while the exclusion criteria are reviews and duplication articles. Early marriage can be influenced by several factors, namely cultural factors, beliefs, upbringing, economy, and social environment. The impact of early marriage is the health of the mother and the health of the baby. Efforts that can be made to prevent early marriage are by creating opportunities for education and skills training, as well as empowering women, which is expected to encourage women to make their own choices in making the decision to marry.

INTRODUCTION

Marriage is something done by humans and has become a pattern in society with the aim of creating the formation of a legal family, both in terms of religion, state law, and laws that apply in the customs of each region. In marriages that occur between men and women are expected to be able to help each other, love, and carry out obligations as husband and wife. The relationship that has been created between men and women after marriage is expected to bring happiness in the world and the hereafter when married [1]. According to UU No. 1 of 1974 pasal 1 states that the definition of marriage is a birth bond between a man and a woman as husband with the aim of forming a happy and eternal family or household based on the Almighty Godhead. Then, pasal 7 also states that marriage will be considered valid if the age of the man has reached 19 (nineteen) years and the woman has reached the age of 16 (sixteen) years [2]. Thus, if there is a marriage carried out by someone who has not reached the age limit, it can be called an early marriage.

One of the social problems that still often occurs in society is early marriage. In 2022, the prevalence of child marriage in Indonesia is at 8.06 percent. "The data on the prevalence of marriage is twofold, related to marriage dispensation and child marriage Early marriage is considered as a solution to the existing problem. In reality, early marriage is not a solution, but it can lead to new problems, such as the emergence of health problems. This is because the reproductive organs are immature to carry out their functions [1]. In 2018, in Indonesia it was recorded that 1 in 9 girls in Indonesia had married. The age of marriage is under 18 years which is estimated at around 1,220,900. The data places Indonesia in the top 10 countries for child marriage [3]. The problem of early marriage is still high supported by the existence of a culture that is still held by people with different beliefs in each region [4]. In this case,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030021-1–030021-5; https://doi.org/10.1063/5.0241796

culture will directly have an impact on early marriage which will later result in reproductive health problems, especially women.

Maternal Mortality Rate

The maternal mortality rate (MMR) caused by adolescent marriage is still relatively high in Indonesia and compared to neighboring countries. The Maternal Mortality Rate (MMR) in Indonesia is still higher. Maternal deaths include 3T factors (late decision-making, getting transportation and handling at health care facilities) and 4T (too old, young, many and close to the distance of pregnancy) [5]. Adolescents, as a transitional period between childhood and adulthood, face various risks especially related to their genital organs. If they lack guidance from parents and the environment, these risks can lead to dishonorable behavior, dropping out of school, and promiscuity that can also lead to marriage at a young age [6]. Legally, child marriage is legalized by Law No. 1 of 1974 concerning marriage [7]. The law states that girls may marry when they are 16 years old, as stated in pasal 7 (1), "Marriage is only permitted if the male party has reached 19 (nineteen) years, and the female party has reached 16 (sixteen) years." And in pasal 26 UU R.I No. 23 of 2002 concerning Child Protection, states that parents are obliged to protect their children from early marriage [8]. Marriage at an early age has an impact on reproductive health. One consequence is the emergence of complications during pregnancy and childbirth, which are the leading causes of death for girls between the ages of 15 and 19 in developing countries [9]. Early marriage refers to a marriage that takes place between a man and a woman where both are still below the minimum set by law, and the bride and groom are not ready either physically or emotionally. However, for some reason, dispensation was granted by the Office of Religious Affairs to perform the marriage. In addition, the bride and groom also do not have enough mental maturity and are not financially ready. [10]. Marriage is a precious and meaningful moment for every individual, because it is a time when two different people come together as husband and wife to form a happy family in all aspects of life, both physical and spiritual, with the promise to accompany each other throughout life. Things that affect early marriage come from within a person, namely physical, psychic, interest and motivation, and information obtained. The needs of women or adolescents such as material needs in the form of money and clothing, sexual related to puberty can influence adolescents to carry out marriage even though they are still immature. In addition, faster adolescent sexual experience is also a factor causing early marriage [11].

Factors For The Occurrence of Early Marriage

Early marriage is also caused by external factors. External factors are things that influence the occurrence of marriage at an early age that comes from outside the individual. Community environments such as promiscuity and lack of concern between individuals are also contributing factors. Environmental factors are a factor causing early marriage in adolescents with the assumption that they do not want to lose their partners. Other factors that cause early marriage are the economy and parental education [12]. Cultural factors also influence early marriage. Like marriage at an early age which is usually done by many women but rarely men do it. Some of this is due to the assumption that women do not need to go to high school because later they will become housewives who have to take care of children and husbands every day. Early marriage that occurs in the community is a culture that has long been practiced. Society considers that if the child does not marry immediately, it is considered unsalable [13] This is in line with research conducted by [14] That there is a value of a woman's price, namely "pameo" which means "the older the less saleable". This perception still cannot be erased from the minds of Indonesian people, especially in rural communities [11][15]. This is in line with cultural research on marrying off their children at a young age so as not to become spinsters [16][17] . One of the cultures of early marriage is the Silariang culture (elopement) which still occurs in Kareloe Village, Bontoramba District, Jeneponto Regency which has been carried out for generations [18]. The culture of marrying children at an early age is also still prevalent in South Kalimantan Province, especially in rural areas [19]. Marrying at a young age is a culture or custom that is still carried out in some regions for the reason that children have been arranged since childhood and so that family relations between the two families are not broken [8]. Getting married at a young age is a common thing to do and not a taboo, for example girls who get pregnant out of wedlock. Generally, parents whose children get pregnant first before marriage, demand children to get married immediately. The main goal is not to become a conversation in the surrounding environment [20]. Society still believes in myths about virginity being seen as important, and women are considered a lower group than men. This condition results in a lack of respect for women in education, employment, and social structure. In the context of the household, women do not have the freedom to make decisions freely, and their duties are limited to taking care of the household. The statement reflects the gender inequality that occurs against women both in terms of marriage and married life [21]. Gender roles support discriminatory values and norms against women and there is indeed a relationship between gender status and early marriage in adolescents Gender gap related to early marriage [22]. Gender gaps related to early marriage Gender injustice can cause women to feel insecure, unable to make decisions, and unable to resist decisions [23].

Marriages that occur at an early age have negative consequences for the young woman as well as the baby conceived if the young woman becomes pregnant. At a young age, the reproductive system is not yet fully mature and is not ready for pregnancy, which can harm the health of both mother and baby. Reproductive health problems such as one example is KTD (Unwanted Pregnancy) [24]. Young women who experience early pregnancy face disruptions in the growth and development of their bodies. This can result in several conditions that may occur during early pregnancy, such as high blood pressure (hypertension). Hypertension during pregnancy can cause preeclampsia, which is characterized by an increase in blood pressure, the presence of protein in the urine, as well as damage to the function of other organs. Pregnancy at a young age has a high risk when giving birth. Women who are under 18 years old and pregnant, and after giving birth, have a high risk of death. This is because their bodies are not physically and biologically ready to face the process of giving birth [25][26]. The reproductive process occurs when males and females engage in sexual intercourse. Reproductive health includes aspects of sexual health that aim to improve the quality of life and relationships between individuals. In the context of human development, reproductive health services are very important [27]. Unpreparedness of the reproductive organs during pregnancy can result in the risk of death of the mother and baby. Then, the impact caused is the risk of anemia during and bleeding during childbirth. This is due to lack of knowledge related to the importance of taking Blood Added Tablets [18]. Lack of knowledge of adolescents related to reproductive health is the cause of early marriage [28]. In addition to having an impact on reproduction, early marriage has an impact on psychological, physical, and behavioral or daily life. The most pronounced psychological impact is feelings of pressure and stress [29]

Efforts To Prevent Early Marriage

Efforts that can be made to prevent the occurrence of early marriage that has become a culture in some regions are to create educational opportunities and skills training. Education taught can be in formal or informal forms containing the impact of pregnancy on adolescents and Sexually Transmitted Diseases (STDs) and counseling related to early marriage to adolescents [17]. This is also in line with research conducted by [30]. Related to the importance of conducting counseling on early marriage, reproductive health, and gender for students and students to suppress the occurrence of early marriage. Counseling can also be given to parents to be a provision to guide their children at home [31]. Then, it can also provide counseling guidance for parents related to early marriage [32]. The next step that can be taken to prevent early marriage is to conduct education related to reproductive health [33]. This is useful for reducing the incidence of early marriage. Empowering women can also be done so that they can make their own choices to make marriage decisions [34]. The delivery of information can be supported by other media to attract adolescents to capture knowledge about early marriage and reproductive health, such as video media and educational comics [35]. In addition to education at home and at school. The community environment can also provide education related to reproductive health in collaboration with cadets, midwives, and local health centers. Teenagers can also play an active role in cadet reef activities to fill their free time [36]. In addition, efforts to prevent early marriage involve increasing knowledge through information dissemination and socialization. When a someone experiences sensing of an object, he will gain understanding. The result of such understanding is called knowledge. A person obtains sensing through the five human senses, with the eyes and ears being the main source of knowledge obtained. [37]. Reproductive health, especially women. The impact of early marriage includes immature reproductive organs that will be at risk of maternal and infant death during childbirth and low knowledge about the importance of consuming Blood Added Tablets will be at risk of anemia in childbirth. In addition, it also has an impact on psychology in the form of pressure and stress. Efforts to prevent early marriage that can be done are by creating educational opportunities for adolescents, conducting socialization, education, and counseling for adolescents and parents related to early marriage and reproductive health.

CONCLUSION

In addition, it also has an impact on psychology in the form of pressure and stress. Efforts to prevent early marriage that can be done are by creating educational opportunities for adolescents, conducting socialization, education, and counseling for adolescents and parents related to early marriage and reproductive health. Reproductive health, especially women. The impact of early marriage includes immature reproductive organs that will be at risk of maternal and infant death during childbirth and low knowledge about the importance of consuming Blood Added Tablets will be at risk of anemia in childbirth. In addition, it also has an impact on psychology in the form of pressure and stress. Efforts to prevent early marriage that can be done are by creating educational opportunities for adolescents, conducting socialization, education, and counseling for adolescents and parents related to early marriage and reproductive health.

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Design of The Plantation Women's School to Develop Natural Potential-Based Life Skills

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Abstract. Harjomulyo Village is located near the Sumberwadung plantation in Silo Sub-district, Jember Regency. The village has an area of 38.44 km^2 with an altitude of 700 meters above sea level. Based on these geographical conditions, Harjomulyo Village has excellent potential in the agricultural and plantation sectors. Some commodities produced in this village include coffee, bananas, and papaya. Despite its abundant natural potential, the community still faces many problems, especially in the education and economic sectors. Based on the education sector, the illiteracy rate in Harjomulyo village still reaches 16.60%, meaning that illiteracy is still very low. Based on the economy, the Harjomulyo community is still classified as soft and uneven, with 6,144 people still categorized as poor. Based on identifying these problems, a solution is packaged in the "Sekolah Perempuan Perkebunan" program. The purpose of this program is to provide a forum for women in Harjomulyo Village to improve their literacy skills through i lliteracy training and improve community life skills through training in papaya leaf eco-print, banana leaf bags, and coffee aroma therapy candles, as well as increasing the capacity of women in managing and improving the quality of their families.

INTRODUCTION

Women is a term that refers to human individuals of the female gender. In various cultures and societies around the world, women have diverse roles, including as mothers, wives, workers, leaders, and many more. Women also have equal rights with men in terms of education, employment, and social life, in accordance with the principle of gender equality. However, in many places, women still face challenges and discrimination based on gender that need to be continuously advocated for in order to achieve full equality. Gender equality is a principle that supports equal rights and opportunities for all individuals, regardless of their gender [1].

Gender equality in Indonesia refers to the social and cultural roles that influence the destinies of men and women. Despite biological differences, culture often creates distinctions in tasks and social expectations. Gender-based discrimination still occurs, particularly in specific aspects of life. For instance, women are often faced with the choice between a career and family, with social pressure regarding their roles. The perception that being a homemaker is better than being a career woman, along with the stigma against career women, can hinder their aspirations. Some women have to juggle between two roles: tradition (managing the household) and transition (pursuing a career based on their education and skills) [2].

Community service and empowerment are two crucial aspects in advancing a community and society. Community service activities involve tangible contributions made to the community by individuals, groups, or institutions with the aim of improving their well-being and quality of life. On the other hand, empowerment is a process that equips community members with the skills, knowledge, and tools they need to take control of their own lives and influence positive changes in their environment. Both community service and empowerment activities are essential elements in sustainable development and enhancing the quality of life for communities. They create strong connections between learning, practice, and the application of knowledge in daily life [3].

The role of women in life is incredibly important, from nurturing families to contributing to social and economic life. Women play an irreplaceable role in shaping family and societal values. Gender equality is key to ensuring that the roles of women in life are fully recognized and appreciated. The roles of women in life encompass a diverse range, from being mothers and wives to leaders and professionals. Women's roles in life play a crucial part in advancing society and achieving progress collectively. In every aspect of life, women bring valuable contributions

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030022-1–030022-5; https://doi.org/10.1063/5.0245097

that enrich and strengthen their communities and families. Recognizing the roles of women in life is a crucial step towards gender equality and social justice. The roles of women in life should not be underestimated, as they have a significant impact on the development and progress of a nation. Appreciating the roles of women in life is a first step towards building a more inclusive and fair society. The roles of women in life reflect the diversity and extraordinary abilities possessed by half of the human population [4].

The empowerment of women holds significant importance in the social, economic, and political contexts. Women's empowerment is a key step towards gender equality, which is a fundamental human right. It entails providing women with equal opportunities as men in various aspects of life, including education, employment, leadership, and decision-making. Economically empowered women have the potential to become productive members of the workforce. They can contribute to the economic growth of a nation by being workers, entrepreneurs, and active consumers. When women have access to education, employment, and economic resources, family well-being improves. This can help alleviate poverty and enhance the overall standard of living for families [5].

Women's empowerment enables them to make better decisions regarding their own health and education as well as that of their children. This has a positive impact on the health and education of future generations. When women are involved in politics and leadership, more diverse and inclusive perspectives can be represented in public decision-making. This creates a government that is more responsive to the needs of the entire society. Women's empowerment can also change existing social norms and reduce gender-based discrimination. It allows communities to progress toward a more inclusive and fair culture. Empowering women provides them with opportunities to develop their potential, achieve their dreams, and reach their life goals more effectively. Women's empowerment is not just about granting rights to women but also about building a fair, sustainable, and inclusive society for everyone. It promotes economic growth, social development, and greater progress for the entire community [5].

Pendidikan plays a central role in shaping the future of individuals and society. One form of education that has a significant impact is education in plantation girls' schools. These schools play a special role in providing educational opportunities and empowerment to women living in plantation areas or those interested in the agricultural and plantation sectors. Plantation girls' schools are not just places of learning; they also serve as avenues for changing social, economic, and cultural paradigms in agrarian communities. They help overcome the barriers often faced by women in the agricultural sector, such as limited access to resources, restricted educational opportunities, and persisting gender inequality. This introduction will explain why plantation girls' schools are highly relevant in efforts to achieve gender equality and sustainable development [6].

METHOD

The implementation method of the Plantation Women's School is carried out openly while still considering the safety and comfort of all parties involved. A summary of all the stages of the program along with the annual targets to be achieved is outlined in the following roadmap.

Translation:
National SPP :
Formed the national SSP
Formed the collaboration of new partner
SPP can be an example for the surrounding village
Center of SPP:
Increasing the SPP based on ICT
The SPP continuous Program
Forming a new learning group
Participants' independence in continuing the programme
Woman Plantation School :
There exist curricula in non-formal education for woman
The number of group study at least two
Increasing the knowledge, attitude, and competency of SPP participant
Having a life skill of SPP participant
There exist non formal department for SPP alumni
There is a support from village for the continuous program
Increasing the Competency of Ormawa PPK
Increasing the Capacity of Ormawa PPK

FIGURE 1. Roadmap Plantation Women's School

The direct implementation of the program is based on the results of real field surveys, indicating that Harjomulyo Village is suitable for conducting training activities. The Plantation Women's School is established in Harjomulyo Village, targeting women from various backgrounds, including housewives, members of the PKK (Family Welfare Movement), members of PEKKA (Women-Headed Household Empowerment), and female plantation workers. The implementation stages of the Plantation Women's School program are divided into three phases: preparation and identification of potential, community issues, and needs; training and preparation; and measurement and evaluation.

Translation:

Flow of the implementation of PPK Ormawa 2023

ASE Science Education Student Club

Step 1 (June-July)
Preparation
the community understands the concept of women's plantation schools
-preparation of a plantation girls' school in harjomulyo village
-planning the activities of the women's plantation school
-establishment of the management of the plantation school for women

Step 2 (July-October)

Implementation
Communities actively run women's plantation schools
-training and provision of skills in processing superior commodities in Harjomulyo villageof the women's plantation school
-establishment of the management of the plantation school for women

Step 3 (October)

Report
the community gained new life skills
-measurement of implementation of women's plantation school
-report preparation -sustainability of the women's plantation school programme in harjomulyo village

planning the activities of the women's plantation school

FIGURE 2. The implementation stages of the Plantation Women's School

The preparation and identification phase are carried out through direct observation in Harjomulyo Village, interviews with village officials, interviews with the community, and literature studies. The second phase is the training and preparation phase. Training is conducted with established study groups based on the most common commodities in Harjomulyo Village. The third phase involves determining the target audience. In this case, four study groups are formed, each consisting of 20-25 participants. The first group is composed of illiterate women and focuses on literacy programs. The second group comprises women with low education levels and focuses on eco-printing. The third group consists of school dropouts and focuses on making aromatherapy candles. The fourth group is made up of widows and focuses on training in making bags from palm fronds. There is also a combined group aimed at all participants from the study groups, which focuses on providing counseling on domestic violence prevention and sexual harassment.

The fourth phase is the planning of the intervention, which includes planning the activities to be carried out. This is done by involving the target community to ensure that the program aligns with their needs. The fifth phase involves initiating internal and external partnerships. The sixth phase involves formulating success indicators and measurement methods. The seventh phase is the program implementation, involving a chairman and 14 members of the Ormawa PPK (Plantation Women's School) implementation team, along with support from Ormawa's management, supervising lecturers, and relevant stakeholders in a series of program activities. The eighth phase is ensuring support from the village authorities. The ninth phase involves mentoring the study groups or target groups through training. The tenth phase is monitoring and evaluation. The eleventh phase is a workshop to present program results with stakeholders. The twelfth phase is an audience with the village government to present program results. The thirteenth phase is data processing and program result reporting. The fourteenth phase is planning program sustainability. The fifteenth phase is data updating.

RESULTS AND DISCUSSION

The Plantation Women's School program forms four study groups, with each group consisting of 20-25 participants. The first group consists of illiterate women and will focus on literacy programs. The second group comprises mothers with low education levels who will concentrate on eco-printing. The third group consists of school dropouts and will focus on making aromatherapy candles. The fourth group is composed of widows who will focus on training in making bags from palm fronds. Additionally, there is a combined group aimed at all participants from the study groups, which will focus on providing counseling on domestic violence prevention and sexual harassment. Through these four study groups, the community can improve its quality of life.

Women's empowerment can also change existing social norms and reduce gender-based discrimination. Through literacy training, it provides women access to education, knowledge, and empowerment [7]. Access to education is a fundamental human right and serves as the foundation for individual and societal development. However, often illiterate women do not have adequate access to age-appropriate educational opportunities. They may have faced social, economic, or cultural barriers that hindered their ability to learn how to read and write. Literacy training for illiterate women is a crucial first step in empowering them. With the ability to read and write, these women can more easily access information, participate in economic activities, communicate effectively, and contribute to decision-making in their families and communities. It also opens doors to further educational opportunities, improved well-being, and greater personal development [8].

Through training in eco-print making, aromatherapy candle crafting, and banana leaf bag creation, which are part of the Plantation Women's School program, women can enhance their skills and life proficiency. The resulting products are derived from the potential found in Harjomulyo Village, enabling participants to utilize natural materials by selecting and gathering plants and natural materials of their preference, creating unique designs, and producing beautiful artworks. Participants not only gain technical learning experiences but also creative empowerment that allows women to express themselves. With the skills acquired from the training, they can independently or collectively sell their produced items in production groups. This not only creates additional income sources but also provides women with confidence and a sense of achievement. When women engage in such training, they can also discover forms of therapy and emotional support. Creative activities like these can help alleviate stress, improve mood, and instill a sense of accomplishment. Additionally, working in production groups can foster positive social relationships, reduce feelings of isolation, and provide support from fellow women.

This allows the community to progress towards a more inclusive and equitable culture. Empowering women provides them with the opportunity to develop their potential, achieve their dreams, and pursue their life goals more effectively. Women's empowerment is not just about granting rights to women but also about building a society that is fair, sustainable, and inclusive for everyone [9]. The Plantation Women's School is not just a place for learning but also a platform for changing the social, economic, and cultural paradigms in agrarian communities [10]. They help overcome the barriers often faced by women in the agricultural sector, such as limited access to resources, restricted educational opportunities, and persisting gender inequalities. This introduction explains why the Plantation Women's School holds significant relevance in efforts to achieve gender equality and sustainable development.

CONCLUSIONS

The Plantation Women's School is the right solution to demonstrate the role of women in the eyes of society in shaping and advancing communities. Gender equality is the key to ensuring that the role of women is fully recognized and appreciated. Women's empowerment also plays a significant role in improving community welfare. Women's empowerment can also change existing social norms and reduce gender-based discrimination. This helps communities progress towards a more inclusive and fair culture. By recognizing the role of women and providing them with equal opportunities, we can achieve better economic growth, more positive social development, and greater progress for the entire society.

ACKNOWLEDGMENTS

We gratefully to the University of Jember for organizing beneficial activities like this. Furthermore, we also extend our thanks to the science education professors who provided advice and support in composing the full paper, as well as related parties.

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The Development of Trends in Literary Criticism: A Systematic Review Using Bibliometric Analysis

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Abstract. Research in the field of literary criticism has been widely published in WOS-indexed journals. However, the popularity of literary criticism as an area of scholarly inquiry creates challenges for researchers wishing to identify new topics for original research. This study examines the development of trends in research relating to literary criticism in the period 2012–2021, using bibliometric analysis to conduct a systematic review of the field. We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework to select articles that met the criteria. We also employed VOSviewer to help visualize the relationship between keyword "co-occurrences" according to cluster, overlay, and density. The results demonstrated that novels were the most widely critiqued literary works in the last 10 years. As complex literary works, novels contain complex depictions of characters, backgrounds, and conflicts and thus represent rich texts for literary analysis. In addition, novels are dynamic in their depiction of extrinsic elements, such as politics, culture, and religion. This study found that literary critics were most concerned with the topic of character in novels. Although character is an intrinsic element of the novel, the co-occurrence of the keywords "character" and "novel" was consistently close. Moreover, this research identified that the study of female characterization in novels constitutes a recent trend in literary criticism.

INTRODUCTION

Literary criticism is the critical study of literary works [1]. Similarly, according to Hudson [2, p. 269], literary criticism is the judgement of literary works. Based on these two definitions, critical assessment is conceived as a form of judgement (assessment) regarding the characteristics of literary works. In making an assessment, critics may also look beyond the content of specific literary works to broader themes. Thus, as Eagleton [3, p. 107] observed literary criticism can actually constitute a metacritical activity, encompassing various concerns outside of the literary work.

Research in the field of literary criticism is widespread and has been published in various journals internationally. An overlap between literary criticism and other disciplines is also increasingly common. In the Google Scholar category of Humanities, Literature, & Arts, 5 out of the 26 subcategories relate to literature: American Literature & Studies; Drama & Theater Arts; English Language & Literature; Humanities, Literature, & Arts (General); and Literature & Writing. A search for the keyword "Literary Criticism" on the Web of Science database for the period 2012–2021 produced 5,118 research articles.

Reviews of outstanding works of literary criticism have helped to reveal the value of this research. Thamarana [4] conducted an overview of various approaches to literary criticism, observing that phenomenology is a particularly widely used method, especially among existentialist critics. Another important influence within the field of literary criticism, challenging the individualist stance of the existentialists, is structuralism. According to structuralist theory, all systems, including literary works, generate meaning through the conventional, structural relations existing between their component parts. Furthermore, Stern [5] reviewed various approaches to literary criticism from the perspective of consumer research, considering how techniques borrowed from literary criticism might be applied to the analysis of advertising texts. She found that content analysis and semiotic analysis may be utilized alongside the consideration of consumption history to provide insights into consumer behaviour. In addition, Trexler and Johns-Putra [6] reviewed literary studies on climate change or, more generally, ecocriticism in literature, finding that fictional representations of climate change function not only as a background to literary narratives but as a means to explore the relationship between climate change and psychological and social conditions.

In contrast to the reviews considered above, Thomas [7] used bibliometric analysis to provide an account of 20th-century literary criticism associated with the epistolary form produced between 1900 and 1991. The findings indicated an increase in the number of studies concerning the epistolary form after 1988 and confirmed that the majority of

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030023-1–030023-11; https://doi.org/10.1063/5.0241859

research on this subject was published in English-language journals. However, no explanation was offered regarding the increase in attention to epistolary literature that began in 1988.

Based on this literature review, research about literary criticism has typically taken the form of an overview, namely, the type of literature study that describes the characteristics of the literature through a survey [8]. Only one bibliometric analysis relating to the field of literary criticism was identified, and it was published in 1993 and related specifically to research articles written between 1900 and 1991 on epistolary literature. To date, little attention has been paid to the body of extant research in the field of literary criticism, especially with regard to the use of bibliometric analysis. Therefore, the aim of this study is to utilize bibliometric analysis to provide a systematic review of existing research in the domain of literary criticism. Moreover, through the use of bibliometric analysis, this study aims to map the development of new ideas and trends in research relating to literary criticism [9].

Bibliometrics can be regarded as a method for broadening the scope of the traditional literature review [10]. Bibliometric analysis is used for at least four purposes in relation to a research topic, namely, (1) to obtain an overall picture, (2) to identify research gaps, (3) to acquire new ideas for research, and (4) to situate worthy contributions within the field [11]. In addition, bibliometric analysis can play an important role in ensuring that a researcher's article is ultimately published in a journal [12]. Currently, bibliometric analysis uses software such as VOSviewer, providing visualizations relating to the analysis of a research topic [13]. The bibliometric analysis method employed in this study involved three steps. First, we used the Web of Science database to review journals and articles that publish literary criticism research articles. Second, we built a network based on keywords using VOSviewer. Finally, we analysed the development of topics and research trends in literary criticism.

METHOD

This study aims to review the development of trends in research related to the field of literary criticism. It is intended to help literary researchers understand the evolution of literary criticism over the last 10 years. This study utilized a bibliometric approach, adapting the procedures used by Huang et al. [14], VOSviewer was adopted to help visualize and analyse clusters based on the collected citations.

There are several steps in this study. The bibliometric analysis procedure based on Huang et al [14], are as follow:
Step 1. Data Collection.
It consist of Journal selection and paper downloading
Step 2. Building Keywords Co-occurrence Network
Step 3. Topic Development analysis
It consist of recognizing core topics and change based on network density distribution change over time
For the article screening process, we used the Preferred Reporting Items for Systematic Meta-Analysis (PRISMA) flowchart [15]. We employed PRISMA as a roadmap to describe the screening treatment of articles and their findings [16]. PRISMA is a guide for reporting literature searches in systematic reviews [17]. We followed these guidelines to ensure that the articles analysed described the development of trends in literary criticism in accordance with the purpose of this study. The PRISMA application procedure can be seen in Figure 2.

The data we collected for bibliometric analysis came from the Web of Science database. The keywords we used included "literary criticism", "literary appraisal", "poetry criticism", "novel criticism", and "drama criticism". The criteria for the data collection process are shown in Table 1.

TABLE 1. Article Criteria

Criteria			Explanation
Inclusion	Publication Time	Year 2012–2021	We reviewed literary criticism research in the last 10 years. We did not include 2022 as it is the present year.
	Language	*English*	The common language facilitates visualization.
	Abstract	Contains the concept of literary criticism	We read the abstract of the articles to identify whether the articles were related to literary criticism.

Exclusion	Article Type	*Research article*	We focused on analysing research trends in literary criticism published in international peer-reviewed journals. A greater awareness of existing trends ensures the relevance and quality of future research.

RESULTS

Step 1: Data Collection

The data we collected from the Web of Science database used the keywords "literary criticism", "literary appraisal", "poetry criticism", "novel criticism", and "drama criticism". The time span we chose was from 2012 to 2021. Based on this search, we identified 5,118 articles with 3,282 duplicate articles. We subsequently reduced the number of articles by 251 because some did not meet the exclusion criteria, namely, they could not be categorized as research articles. Finally, we screened the remaining articles by checking their suitability in accordance with the inclusion criteria. We found that 16 articles did not match the specified publication time, 68 articles were not in English, 972 articles were not literary criticism, and 46 articles were excluded from inclusion. Hence, we ultimately identified 483 articles that met the criteria.

Based on the screening results, we identified several journals that had published many research articles in the field of literary criticism in the last 10 years. The journal that published the most research articles in this field was *Literature and Theology*, which published 100 articles. As its title suggests, this journal, published by Oxford University Press, focuses on the study of literature and theology, and thus literary criticism forms a central part of its output. After *Literature and Theology*, the *Cambridge Journal of Postcolonial Literary Inquiry*, published by Cambridge University Press, published 73 articles on literary criticism. This journal focuses on the field of postcolonial studies. The top 10 journals that published articles relating to literary criticism in this period can be seen in Table 2.

TABLE 2. Journals Publishing Literary Criticism Articles

NO	JOURNAL NAME	THE NUMBER OF LITERARY CRITICISM ARTICLES
1	*Literature and Theology*	100
2	*Cambridge Journal of Postcolonial Literary Inquiry*	73
3	*Cambridge Quarterly*	53
4	*American, British and Canadian Studies*	42
5	*Critical Survey*	41
6	*Lit: Literature Interpretation Theory*	37
7	*CounterText: A Journal for The Study of The Post-Literary*	34
8	*New German Critique*	26
9	*Criticism: A Quarterly for Literature and the Arts*	17
10	*Colloquy: Text, Theory, Critique*	14

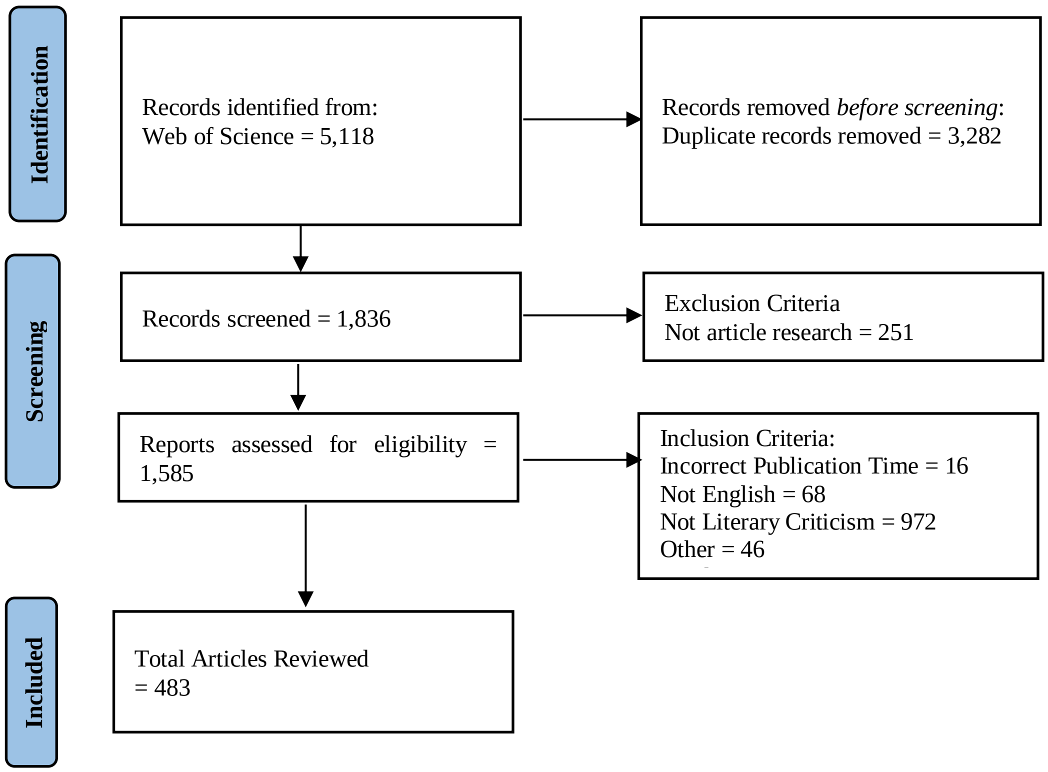

FIGURE 1. Article Selection Using Prisma

This data also identifies the number of articles relating to literary criticism published each year, which can be seen in Figure 3. From 2013 to 2018, the number of published articles in this field significantly increased. However, a sharp decrease occurred in 2020 due to the COVID-19 pandemic. Furthermore, Figure 4 illustrates the number of articles published per year according to country. The largest number of articles concerning literary criticism was published in the UK, where more than 20 articles have been published since 2014. Other countries that published a significant number of articles in this field were the United States and Romania.

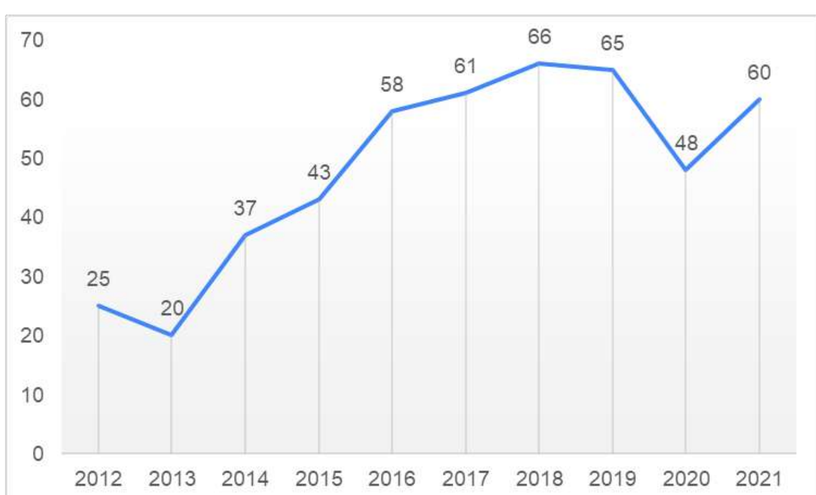

FIGURE 2. Number of Publications Per Year

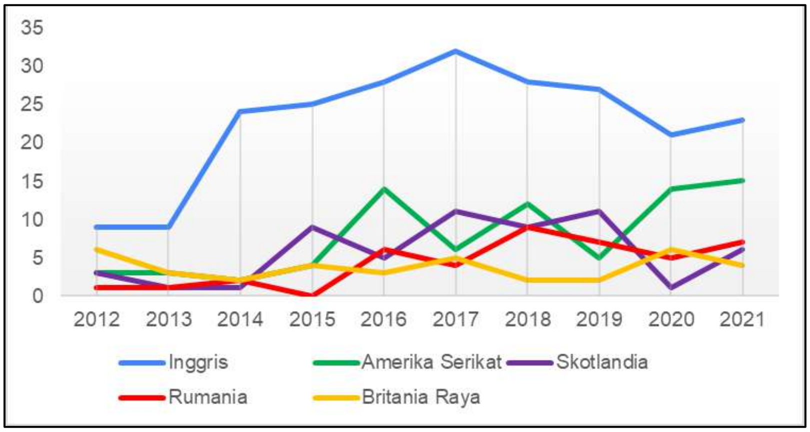

FIGURE 3. Number of Publications Per Year According to Country

Step 2: Building A Keyword Co-Occurrence Network

The keyword "co-occurrence network" helps to reveal the relatedness of keywords in the form of network visualization. The visualization describes the relation between keywords; if the distance is close, the relation between the keywords is stronger. To identify and analyse research topics relevant to literary criticism, we thus needed to build a keyword co-occurrence network. The co-occurrence of keywords served as a means of identifying common research topics. As shown in Table 3, we provided the top 10 keyword co-occurrences to facilitate the analysis of research topics.

For the analysis of the keyword co-occurrence network using VOSviewer, we used the minimum number of occurrences of a term criteria of 7 terms. From 11,404 terms, we obtained 301 terms that met the minimum requirements. Using VOSviewer, we identified popular research topics in the field of literary criticism based on the compiled keyword co-occurrence networks and examined the development of the topics based on the time of publication, as shown in Table 3.

TABLE 3. Keyword Co-occurrences

NO	TERMS	OCCURRENCES
1	Novel	165
2	History	65
3	Writing	65
4	Poetry	61
5	Character	61
6	Experience	51
7	Culture	39
8	Representation	39
9	Tradition	38
10	Structure	36

Step 3: Topic Development Analysis

We used VOSviewer, which is an application designed to build bibliometric maps, to analyse the development of trends in literary criticism. The application maps keywords based on co-occurrences that have been collected from the co-citation network. VOSviewer may be used to visualize data in different ways, such as network, overlay, and density visualization [18]. In this analysis, we considered the development of trends in literary criticism in three separate phases. In addition, we examined the trends based on clusters, overlays, and density, which were also in line with the co-occurrence network keywords visualized using VOSviewer.

Research Topics in Literary Criticism

We reviewed frequently occurring topics in literary criticism in three phases based on publication data per year as shown in Figure 3, namely, (1) 2012–2014, (2) 2015–2018, and (3) 2019–2021.

1. 2012–2014

Figure 5 illustrates that novels and poetry were the most critiqued literary works during this period. The surrounding co-occurrence keywords represent topics relevant to the critique of novels and poems. The keyword "novel" is close to the topics of "genre" and "character", while "poetry" is close to "reading" and "bible", reflecting the focus of research in relation to these literary forms.

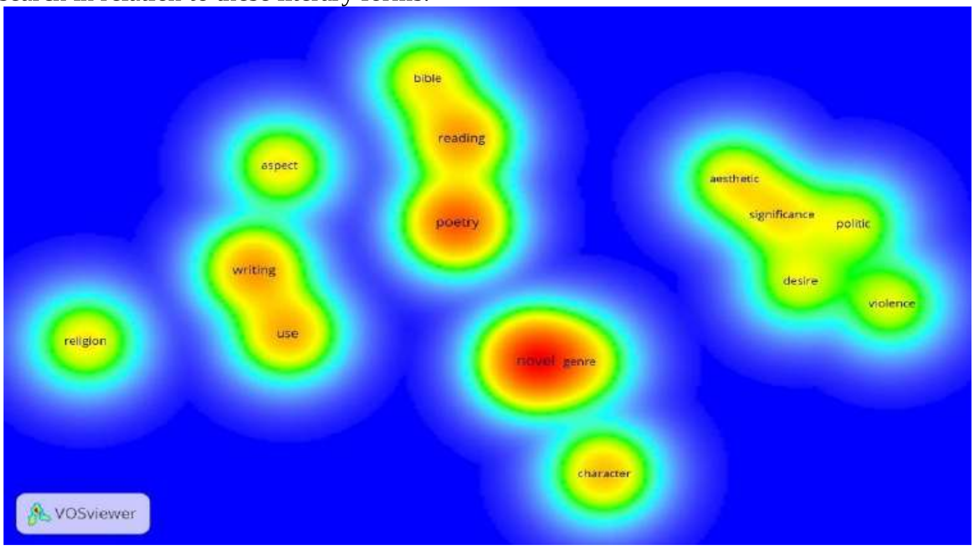

FIGURE 4. Research Developments Regarding Topics in Literary Criticism in 2012–2014

2. 2015–2018

Figure 6 illustrates that novels were the literary works most widely critiqued in this period. "Character" is the closest keyword associated with the novel. Significantly, the network visualization indicates a close relationship between the keywords "character" and "woman", which suggests that the consideration of female character was a central concern for the scholarly analysis of novels during these years. In addition, Figure 6 demonstrates that poetry and drama were also the subjects of literary studies in this period, although not as frequently as novels. The keyword "poetry" has a close relationship with "culture", suggesting that critiques of poetry were often discussed in the context of culture. The keyword "drama" is closely associated with "history" and "politics", indicating that critiques of drama often employed a historical or political approach.

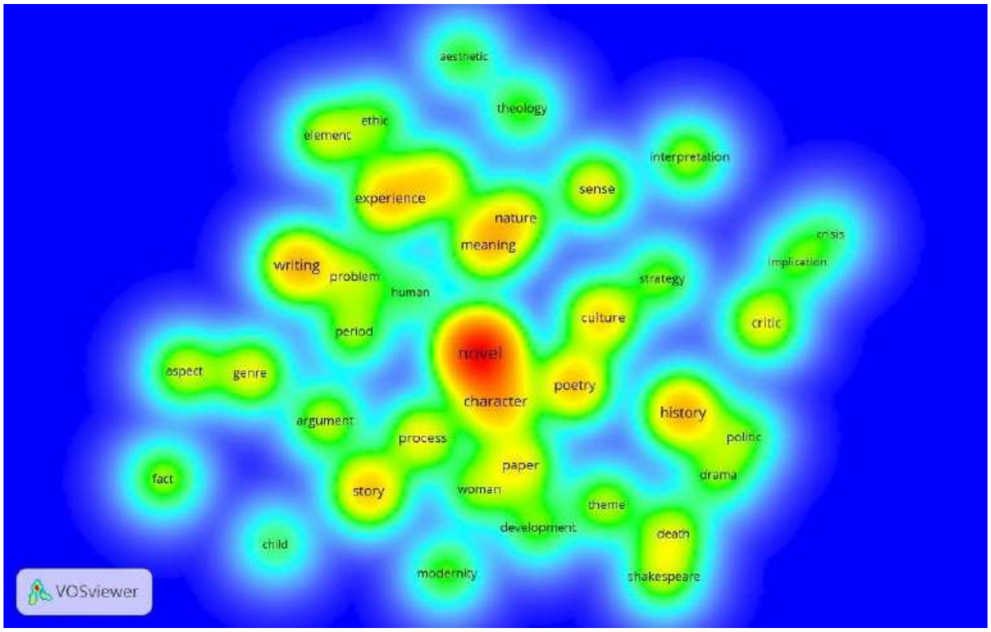

FIGURE 5. Research Developments Regarding Topics in Literary Criticism in 2015–2018

3. 2019–2021

In 2019–2021, novels and poetry were again the most critiqued literary works. The keyword “fiction”, which also refers, in a general way, to literary works, also appears in the visualization in Figure 7. The density visualization in Figure 7 illustrates the novel’s dominance as the most critiqued of literary works. The closest topics surrounding the keyword “novel” are “woman”, “Shakespeare”, and “history”, indicating that novels were frequently critiqued in relation to these three topics. The density visualization also reveals that the keyword “poetry” is most closely associated with “death”, “argument”, “understanding”, “process”, and “tradition”. This suggests that literary criticism concerning poetry attempted to understand and reveal the creative process in the context of tradition.

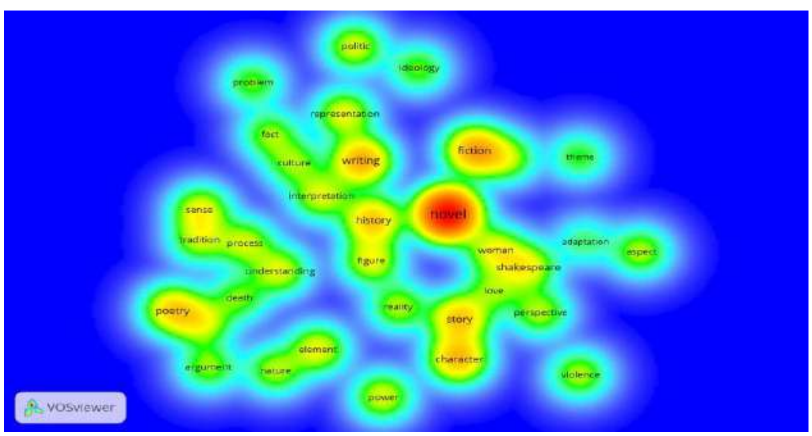

FIGURE 6. Research Developments Regarding Topics in Literary Criticism in 2019–2021

Research Trends in the Field of Literary Criticism

Figure 8 illustrates research trends in literary criticism from 2012–2021. We created three visualizations of the data, constructing cluster, overlay, and density networks based on the strongest co-occurrences. We identified four clusters constituting distinct topics in the field of literary criticism, which are represented in the visualizations by the colours green, blue, red, and yellow. In the overlay network, red indicates the most recent research topics. From the visualized clusters, we observed four trends in research relating to literary criticism, namely, novels, history, writing, and poetry.

1. Novel

Literary criticism concerning novels most frequently featured topics related to characterization, such as identity and character. Significantly, a co-occurrence with the keyword "woman" also appears, suggesting that women were often the focus of literary criticism about novels in relation to the topics of "character", "identity", "violence", or "power". Moreover, the overlay network, which can be seen in Figure 8b, demonstrates that "woman", "protagonist", "power", and "reality" were topics in the most recent research and mostly appeared in articles published since 2018. In the density visualization, which can be seen in Figure 8c, the strongest keyword is "novel", which is, indeed, at the centre of this cluster. After "novel", "character" is the next strongest keyword, indicating that the critique of novels was primarily concerned with character. Moreover, in this cluster the keyword "woman" is coloured yellow, indicating that this topic featured significantly in published research. If the keyword "woman" is related to "character", this cluster illustrates that studies concerning female characterization in novels, such as those by DiMiele [19], Iancu [20], and Stanton [21] constituted a trend in literary criticism.

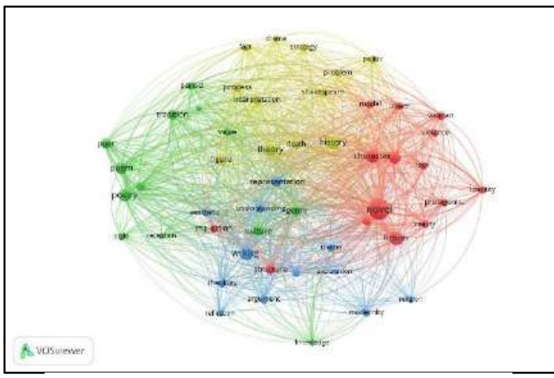

FIGURE 7A. Cluster Network

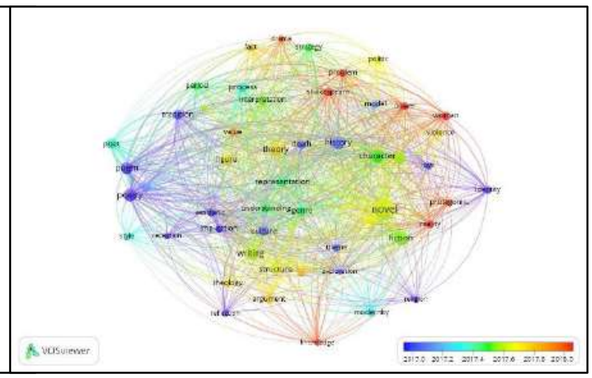

FIGURE 7B. Overlay

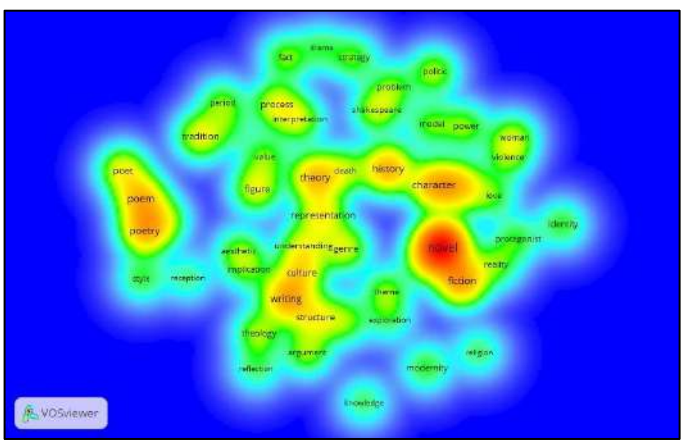

FIGURE 8C. Density ***Network***

2. History as a Topic in Literary Criticism

As the strongest keyword in its cluster, "history" represents a second key trend in the field of literary criticism. The presence of the keyword "drama" in this cluster suggests that historical context was relevant for the critique of drama. In addition, the keyword "Shakespeare" also appears in this cluster, confirming that literary criticism encompassed the study of historic dramatic works. The visualization further reveals that the themes of "politics", "death", "problems", and "facts", viewed from a historical perspective, were relevant to the analysis of drama. Moreover, the overlay visualization in Figure 8b illustrates that among the keywords in this cluster, "problems", "Shakespeare", and "drama" had most recently been topics in literary studies. In the density visualization, the strongest keyword besides “history” is “Shakespeare”. These findings imply that Shakespeare’s works are currently being re-examined using historical approaches, as in the research by Al-Shetawi [22], Homem [23], and Markidou [24], constituting a second trend in the field of literary criticism. According to Pasco [25], literary works function as historical archives. Thus, the reappraisal of Shakespeare’s works may represent an attempt to gain a deeper understanding of the historical context in which he was writing.

3. Writing as a Topic in Literary Criticism

The third cluster describes the role of writing as a topic in literary criticism. This cluster is different from the other three clusters because it does not specify the type of literary work being critiqued. Instead, this cluster documents the broader consideration of writing itself as a focus of literary studies, such as in the research by Zhelezceva [26], Dodd [27], and Armand [28]. “Representation”, “argument”, “reflection”, “exploration”, “theme”, and “aesthetic” were key topics in literary studies about writing. Moreover, the keywords “theology”, “religion”, and “modernity” also emerge in this cluster. Thus, this analysis suggests that researchers have considered the role of representation, exploration, reflection, argument, and understanding in connection with the issues of modernity, religion, theology, theme, and aesthetic in literary criticism. The overlay visualization illustrates that among the keywords in this cluster, “theology” and “argument” were most frequently cited in recent years, especially in 2017. In the density visualization, “representation” is the strongest keyword besides “writing”. Therefore, the analysis of this cluster reveals that theological representation in literary works constituted a third trend in the field of literary criticism.

4. Poetry

The final cluster describes the terms in which poetry is discussed in literary criticism. According to the visualizations, poetry was more closely scrutinised from the perspective of style than other literary works. Thus, the critique of poetry was typically performed based on the poet’s style of writing. The emergence of co-occurrences such as “culture”, “genre”, “tradition”, and “period” indicates that writing style cannot be separated from these contexts, as is reflected in the writings of Dick [29] and Jessen [30]. The overlay visualization illustrates that these studies were mainly published in 2017, with the keyword “value” appearing most recently. The density visualization indicates that “tradition” is the strongest keyword in this cluster. Therefore, according to the three visualizations, poetry was typically appraised within the context of tradition and with the intention of determining its value.

CONCLUSION

According to the visualization results presented above, novels were the literary works most consistently reviewed in the field of literary criticism during the years 2012–2021. Compared to other literary works, novels provide a wealth of material for critical inquiry. This is due to the characteristics of the novel itself, which is narrative in nature and consists of various characters, conflicts, and settings. The novel also encompasses various genres, such as romantic, fantasy, political, and religious [31]. These characteristics make novels complex literary works that deal with human experience and real-life settings, facilitating multiple critical perspectives.

The critique of novels was most related to characterization. Character is an intrinsic element of the novel, and thus, it is natural that the topic of characterization has received significant critical attention in the field of literary criticism. However, its appearance in every phase of the visualizations and its close association with the novel needs further consideration.

In considering the role of character in the novel, critics require a specific focus. Based on the results of this bibliometric analysis, we recommend the topic of female characterization in novels as a relevant concern for future research in the field of literary criticism for three reasons: first, the keyword “woman” appears in the same cluster as “novel” and “character” (see Figure 8a); second, the density visualization (see Figure 8b) reveals that the keyword “woman” has emerged most recently in literary studies, even though it is followed closely by “novel” (see Figure 7); and third, relatively few critical works have focused on the topic of female characterization in novels (see Figure 8c).

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Unveiling Female Heroism: Analysis of Mama America in *The House of Broken Angels*

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Abstract. In this qualitative exploration, we delve into the multifaceted character of Mama America, a central figure in *The House of Broken Angels,* investigating themes of familial bonds, cultural heritage, and human resilience. At its core lies Mama America, a character whose strength and wisdom are pivotal in weaving the intricate fabric of this literary masterpiece. The study rigorously dissects the textual data through meticulous analysis of Mama America's character, scrutinizing her actions, dialogues, and interactions within the narrative. Complementing this approach with feminism and Jung's archetype theories, with a specific focus on the archetype of the Great Mother as a female hero for protection and nurturing, the Amazon archetype, and the anima, deeper insights are gained into her multifaceted role as a female hero. The findings reveal Mama America as a multi-dimensional heroine, embodying emotional resilience and wisdom, serving as a linchpin in shaping the intricate familial dynamics portrayed in the novel. Her character emerges as a symbol of women's heroism in literature, embodying the archetype of the Great Mother, and underscoring the importance of diverse and empowering female figures, such as those in the Amazon archetype, in shaping societal narratives and cultural discourse. In conclusion, Mama America's character represents a captivating exploration of female heroism in literature, enriching the narrative and discourse within the broader context of gender representation.

INTRODUCTION

Feminism, a powerful and multifaceted social and political movement, has shaped the discourse surrounding gender equality and women's rights. Rooted in pursuing equal opportunities, representation, and empowerment for all genders, feminism has evolved over the years, encompassing various waves and schools of thought. From the suffragette movement of the late 19th and early 20th centuries to contemporary intersectional feminism, this ideology continues to challenge societal norms, advocate for reproductive rights, wage equality, and combat gender-based violence [1]. Its historical journey spans various waves, from the early suffragette movement that fought for women's voting rights to the contemporary landscape of intersectional feminism. These waves reflect the evolving strategies and goals of feminists, but their core commitment to dismantling gender-based inequalities remains constant. Feminism has been instrumental in challenging and changing deeply ingrained societal norms and expectations. As it remains a dynamic force, feminism's impact resonates through diverse aspects of society, from literature and politics to workplace dynamics and social justice initiatives.

One key aspect of feminism is its influence on literary criticism. Feminist literary theory has revolutionized how literature is analyzed, bringing attention to gender roles, power dynamics, and the representation of women in literature. This critical approach focuses on uncovering and challenging gender roles, power dynamics, and the representation of women in literary works. Scholars in this field employ feminist theories of language and gender,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030024-1–030024-7; https://doi.org/10.1063/5.0241624
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

conducting close readings and textual analyses to reveal the intricacies of how women are portrayed and marginalized in literature [2][3]. Furthermore, the development of feminist criticism intersects with other critical theories, encompassing postmodernist, ecocritical, and Marxist perspectives, adding complexity to gender analysis and the exploration of language and identity in literature. [4][5][6], Feminist literary theory has played a pivotal role in reshaping how literature is perceived and analyzed, extrapolating issues of gender, identity, and representation in literary works.

Feminist perspectives on female heroism redefine traditional hero archetypes by emphasizing collaboration, intuition, and communal connections, challenging conventional notions of heroism. Intersectional feminism highlights the interconnected nature of social categorizations, acknowledging that the experiences of female heroes vary based on factors such as race, class, and gender. The heroine's journey proposes a distinct narrative arc for female heroes, emphasizing collaboration, intuition, and communal connections. In Western classical literature and African literature, the subject of heroines garnered little interest, with the emphasis traditionally placed on strong and resilient male heroes [8]. Female counterparts were often seen as inferior. However, heroines have gained significant recognition in contemporary literature, increasing the desire to document their exploits and experiences [9][10]. The concept of women as relational heroes suggests that their portrayals often emphasize connections to others and impact on communities, challenging the solitary hero archetype. Third Wave Feminism explores the diversity of women's experiences, while post-feminism addresses contemporary challenges and opportunities women face in a post-feminist era. Collectively, these perspectives contribute to a nuanced understanding of female heroes, emphasizing the complexities of their experiences and their diverse roles in redefining societal expectations.

Regarding the discourse surrounding female hero archetypes, the intersectionality of feminist theory and Jungian archetype theory underlines commonalities, highlighting the intricate interplay of gender, psychology, and collective symbolism. Feminist theories aim to uncover gender inequality and challenge societal patriarchal roles. In contrast, Jungian Archetype theories delve into universal psychological structures and collective symbolism. In Jung's Archetype theory, the Anima represents the feminine aspect within male psychology, appearing as various images, including female figures pivotal for male growth and integration [11]. This means the anima plays a crucial role in the psychological development of a man, as integrating these qualities can result in a more balanced and complete personality. Conversely, the concept of Animus mirrors the masculine aspect within female psychology. It includes characteristics such as logic, assertiveness, rationality, and power. Integrating the animus is crucial for a woman to attain a well-balanced personality. When we explore female hero archetypes, both feminist theory and Jungian Archetype theory converge in their endeavors to depict women's power and positive roles in narratives. Archetypes like the heroine or female savior permeate diverse myths and stories across cultures, symbolizing women's courage, wisdom, and strength. Feminist theory highlights the significance of these archetypes in challenging traditional gender roles and promoting narratives that celebrate female self-reliance and strength. In contrast, the Jungian archetype theory offers a conceptual framework for understanding recurring symbols as representations of universal and collective unconscious elements, consequently underlining their significance within the human psyche. Collectively, these perspectives provide light on the persistent and transformational influence of female hero archetypes in literary works, fostering more profound responsibilities and contributions of women in narrative composition.

In *The House of Broken Angels,* Big Angel's life as a Chicano man in the United States is a rich exploration of Chicano identity and familial relationships. This narrative backdrop allows us to delve into the intersection of feminist and Jungian perspectives on identity and personal growth. The novel *The House of Broken Angel* focuses on Big Angel, a Chicano man in the United States. The narrative revolves around Big Angel's life, from waking up late for his mother's funeral to navigating family conflicts and relationships. For Big Angel, Mama Amerika becomes the mainstay for the development of his family's life in America. Big Angel continues to reminisce about his mother during his days of illness. As Big Angel grapples with his illness, his wife Perla and daughter Minnie provide care and support. Amidst the complexities of family dynamics, the story delves into Big Angel's reflections on his father, Don Segundo, and the challenges of crossing the border into the USA for a new and better life. This novel captures the essence of Chicano identity through the lens of Big Angel's experiences and the intricacies of his relationship.

This study delves into the intricate character analysis of Mama America in *The House of Broken Angels* through the lens of Jungian Archetypes and feminist perspectives. Mama America, the matriarch of the De La Cruz family, serves as a linchpin in the narrative, embodying a multifaceted female hero. In a Chicano family, women often navigate a patriarchal system. Chicano women, in particular, find themselves contending with dominance as they strive to prioritize family matters. By applying Jungian Archetypes and feminist theories, this research aims to unearth the depths of her character, scrutinizing her actions, dialogues, and interactions within the narrative. The finding focuses on three key sub-sections related to Jungian Archetypes. Firstly, it explores her role as a distinguished female hero who embodies feminine strength, examining her physical toughness, intuition, emotional resilience, and healing abilities. Secondly, it delves into her portrayal as the Great Mother archetype, emphasizing her nurturing, life-giving, and protective qualities and how she contributes to the narrative's exploration of family dynamics, cultural identity, and the immigrant experience. Lastly, the study likens Mama America to Amazonian archetypes, highlighting her strength and courage as she enforces discipline, challenging conventional depictions of female heroes. This analysis aims to provide a nuanced understanding of Mama America's character within the broader context of Jungian Archetypes in literature.

The urgency of conducting this study lies in the necessity to address and redefine gender representations in media, particularly in the context of female heroine especially in Chicano literature context. The current gap in research suggests a lack of exploration in applying Jungian Archetypes specifically to female characters in this context [13], [14], [15], [16], [17]. Susilowati [13] emphasizes the inspiring 1920s American women's struggle against patriarchy, underscoring the importance of appreciating and protecting women from oppressive violence. Rini [14] examines the heroine's characteristics, utilizing gender role stereotypes and highlighting specific traits, challenges, and inspirational aspects of the heroine. Within the academic landscape, numerous studies also delve into the exploration of literary heroines and their journeys. Sari [15] investigates the heroine's journey in Suzanne Collins's *The Hunger Games*, carefully examining the protagonist's evolution within the narrative. Another noteworthy contribution comes from Nurdayanti, Natsir, and Lubis [16] who conduct an archetype analysis. Meanwhile, Yang [17] offers a unique perspective in the study of *My Antonia* with the lens of Jung's archetype theory. These works collectively contribute to the scholarly understanding of the heroine's role and self-realization in literature.

This study seeks to bridge an existing gap in research by employing Jungian Archetypes to analyze female heroines, offering fresh perspectives on their significance in challenging established gender roles and promoting female empowerment. Through this analysis, it contributes to a more profound understanding of gender representation within the realms of literature and media. By delving into the archetypal characteristics and journeys of these heroines, this research aims to unravel the complex interplay between female empowerment and traditional gender norms. Ultimately, it serves as a valuable contribution to the ongoing discourse on gender dynamics and female agency in literary and media contexts.

Distinguished Female Heroes Embodied with Feminine Power

This section delves into the concept of female heroes with feminine power, emphasizing the fusion of courage and feminine traits that characterize these heroines. These heroines embody physical toughness and exhibit intuition, emotional resilience, and the ability to heal. Their adventures are guided by a sensitivity to their surroundings and relationships, underpinned by a profound respect for nature and creativity. In her adventures, her sensitivity to situations and relationships guides his steps. By respecting nature and creativity, feminine power becomes a unique source of empowerment, producing a heroine who leads with distinctively female agency. The story reveals how Mama Amerika is seen as 'badass'. Big Angel stated, *"Grandma América—she had been a trip. She had managed to be sweet as she kicked everybody's ass."* [18]

In the paragraph, Mama América is described as a heroine with a unique character. The phrase "*she had managed to be sweet as she kicked everybody's ass"* encapsulates the essence of her character's complexity. Grandma América not only highlights her strength and ability to face challenges (*"kicked everybody's ass"*), but also maintains a side of gentleness and kindness (*"sweet"*). In the context of the Jungian concept, this can be interpreted as integrating feminine and masculine archetypes. Strength and assertiveness, often associated with the masculine side, are combined with gentleness and kindness, which are the hallmarks of the feminine. Thus, Grandma América is not trapped in rigid gender stereotypes but instead creates a complex and multidimensional heroine character. This analysis may also reflect Grandma América's social role in the narrative. His ability to "*kick ass"* indicates that he has a significant influence or impact in the surrounding situation or environment. In addition, the combination of strength and gentleness creates a universal character that can be connected to experiences and values that cross different cultures. In the concept of Jung Archetype, the heroine can be seen as anima [19]. Here is a representation of the female aspect in the psychology of a man. In the context of heroines, anima can be connected to feminine forces that promote growth, creativity, and psychological integration. Thus, in the paragraph, Grandma América is not only presented as a conventional heroine but as a character that reflects the complexity and integration of traits often identified in the Jungian concept of the heroine's archetype [9]. Heroines are frequently the source of inspiration, knowledge, and transformation. Anima emphasizes the importance of feminine characteristics and influences the self-realization and individuation in the character.

The depiction of female heroes in the narrative takes on a poignant and reflective tone when associated with the theme of death.. Mama America will always be remembered as a figure who had affection for her family. The following narrative is when Big Angel's family had to bully his mother's eyes. A loving mother is a mother who continues to mourn her passing. However, the feminine figure is also reminiscent of death for Big Angel's family.

> *All of them looking at Mamá's urn and realizing the same thing at the same moment: We are now the oldest generation, and we are the next to die. They looked back and were shocked at Big Angel's appearance, even though they saw him daily*. [18]

The text captures a moving moment in which female characters are confronted with their role as the next generation and the inevitability of their own death. The focus on Mamá's urn serves as a symbolic reminder of the generational shift and the passage of time. The realization that *"We are now the oldest generation, and we are the next to die"* reflects a deep awareness of the temporary nature of life. This moment is a powerful exploration of the anima, the feminine aspect in the individual, as it goes deep into themes of nurture, connection, and the cyclical nature of life. Urn, which is often associated with death and warning, becomes a focal point for these female characters to confront their own femininity in the context of death.

The disbelief in Big Angel's appearance, despite his daily presence, serves as a metaphor for broader societal attitudes towards aging and the evolving roles of women, especially in cultures where women are traditionally associated with nurturing and caregiving. It becomes a reflection of wider societal attitudes towards aging and, in particular, the shifting roles and expectations placed on women. In many cultures, women have been predominantly associated with nurturing, caregiving, and maintaining family bonds. However, as the older generation, they often face the reality of becoming the matriarchs of their families. This transition can trigger a profound re-evaluation of their roles and responsibilities, not only as caretakers but also as leaders and decision-makers. The disbelief in Big Angel's aging mirrors the resistance to acknowledging these changes and highlights the complex interplay between societal expectations, gender roles, and the passage of time in Chicano literature.

The text highlights the interconnectedness of life and death, with urn Mamá as a concrete reminder of the inevitable cycle. This triggers reflection on the anima not just as an internal feminine aspect of the individual but as a collective experience shared by these female characters. Shared realization adds a layer of unity among women, emphasizing their related destiny as part of the larger context of the family and society. This text dives into anima and femininity by exploring themes of death, aging, and the cyclical nature of life. Moments of shared realization create bonds among female characters and spark more profound reflection on their roles in family and generational contexts.

Great Mother Embodied Female Heroes as Protector and Nurturer

The archetype of the Great Mother is a powerful and enduring symbol that represents the qualities of nurturing, protection, and guidance associated with the feminine. Throughout literature and mythology, the Great Mother figure plays a pivotal role in shaping narratives and characters. In this section, we will explore how the Great Mother archetype is embodied by female heroes who serve as protectors and nurturers in the *House of Broken Angels*. This archetype highlights the universal and idealized version of motherhood, showcasing the nurturing and selfless qualities that these female heroes often exhibit.

In this narrative, the character known as "Mamá América" emerges as a powerful embodiment of the Great Mother archetype, symbolizing the nurturing, protective, and transformative aspects associated with this archetype. The term "Mamá América" evokes a strong maternal presence deeply rooted in cultural and symbolic contexts. Within the framework of Jungian psychology, Mamá América represents the Great Mother, a figure encompassing qualities of nurturing, life-giving, and safeguarding.

> *She had managed to join Father in the afterlife before Mamá América could go over to wrestle him back from the American's clutches.* [18]

Mamá América represents the archetype of the Great Mother, describing not only the quality of keeping but also the strength and toughness associated with the maternal figure. The phrase "wrestle him back from the American's clutches" adds an interesting layer. This implies struggle or conflict, perhaps on a deeper archetypal level. It can be interpreted as Mamá América represents a protective force that opposes external influences or threats, perhaps related to American values or influence.

The fact that she managed to join Father in the afterlife before the intervention assumed by Mamá América shows a narrative in which the heroine navigates complex challenges and overcomes obstacles, even within the realm of the afterlife. This picture is in line with the concept of the journey of the hero Jung, in which the character undergoes tests and transformations. The interplay between life, death, and struggle between characters reflects deeper archetypal themes, reflecting universal aspects of human psychology. The use of archetypes, in accordance with Jungian theory, helps to access the elements of the collective unconscious that correspond across different cultures and individuals. Furthermore, the use of archetypes in literature facilitates the transcendence of cultural and linguistic barriers. Stories that incorporate archetypal aspects possess the capacity to evoke a profound response among the individuals of diverse cultural origin since they tap into collective human encounters and universal motifs. The presence of archetypes in literature enables it to function as a conduit between different cultures, facilitating the development of comprehension and compassion among diverse readerships [9].

In the realm of maternal qualities, the ability of a proficient mother to exhibit love and care towards her children is regarded as crucial. However, it is equally essential for her to possess the capacity to enforce appropriate discipline when necessary and cultivate an environment where her children reciprocate with compassion and respect. Jung's [19] research indicates that an influential mother establishes clear expectations and boundaries while offering guidance and support. During this phase, the mother archetype displays a dual nature. On one hand, she seeks to preserve and uphold the current state of affairs within the family. Simultaneously, she embodies a transformative aspect, emphasizing dynamic elements within the psyche that drive personal growth and evolution. Within the great mother archetype, this transformative function is particularly significant, as it facilitates a transformative process, enabling individuals to evolve from a lower state to a higher form of being or existence. The interrelationship between the two aspects of the mother archetype contributes to the richness and complexity of characters and narratives in literature or mythology, providing a lens through it to explore themes of growth, transformation, and the enduring influence of maternal figures.

An Amazon Heroes Demonstrating Strength and Courage

The Amazon Heroes archetype stands as a powerful and timeless symbol, representing remarkable strength and bravery often personified by female characters. These heroes defy established gender norms and societal expectations by proudly displaying exceptional physical abilities, unwavering resilience, and unwavering determination. In this section, we will delve into the significance of the Amazon Heroes archetype, examining both examples and defining traits that underscore their fearlessness and indomitable spirit. This archetype serves as a celebration of female empowerment, emphasizing their capacity to excel even in domains traditionally dominated by men.

In *The House of Broken Angels*, the character 'Mama Amerika' embodies the qualities of an Amazonian archetype, showcasing remarkable strength, courage, and a willingness to challenge traditional gender norms. This depiction of female heroism transcends conventional expectations, portraying power and authority within the domestic sphere and reshaping narratives surrounding women's leadership and strength. Jungian psychology's observations on the Amazon archetype align with Mama Amerika's assertive and formidable character, emphasizing her role as a matriarchal figure who combines traditional authority with an action-hero dynamic. The character 'Mama Amerika' in the novel *The House of Broken Angel* is also likened to Mexican mothers in America. These mothers describe a mix of chatty mothers typical of Mexicans and disciplined American mothers. Big Angel remembers his mother as a figure who liked to enforce discipline in his family.

> *Freakin' Moms, laying down the law and order with her slipper. La chancla. Every vato feared the chancla. A million bug-eyed, pissed-off Mexican mamas whacking the bejesus out of their kids, holding one arm and flailing ass with the free hand, the whole time dancing in a circle as the homie tried to run away but couldn't get out of her grip*.[18]

The narrative above depicts a female figure often considered as a fairly unconventional but strong figure. References to *"Freakin' Moms"* who use authority with sandals, specifically *"La chancla,"* add a touch of humour but also emphasize the role of assertiveness and discipline. The scene of a million Mexican mothers exuding a fierce attitude and providing intense discipline suggests a collective picture of women's power and authority. In Jung's observations, the 'Mama Amerika' figure depicts characteristics similar to Amazonian archetypes. The strength and courage shown in enforcing discipline align with the warrior aspect. The willingness to challenge the status quo, seen in setting rules with sandals, further aligns with the adventurous spirit associated with Amazonian archetypes.

In literary studies, the Amazon Heroes archetype offers a captivating portrayal of female heroism that defies conventional gender roles and thrives in domestic settings, presenting mothers as a formidable collective force equipped with qualities typically attributed to heroic figures. This archetype, inspired by Jung's observations, reimagines women as warriors and adventurers, embodying strength, courage, and a fearless determination to challenge established norms. Drawing inspiration from Jung's insights, this archetype reshapes the narrative by portraying women as warriors and adventurers who internalize qualities such as strength, courage, and an unyielding determination to disrupt the status quo. It challenges prevailing gender norms and reimagines women as heroic figures who embody a fearless spirit of defiance against established conventions.

In *The House of Broken Angels,* the character of 'Mama Amerika' stands as a powerful symbol, embodying a fusion of American strength and the traditional Mexican [10] mother figure, showcasing a unique blend of qualities that challenge and redefine the conventional roles of maternal figures. Different from the stereotypical American mother, often characterized as 'silent' and emphasizing child independence with a focus on strict discipline, Mama Amerika embodies a different ethos. She draws from the Mexican tradition, where oral and physical strength are expressions of genuine love and care. This unique blend of American and Mexican influences in her character challenges and redefines the traditional roles of maternal figures, adding depth and complexity to the narrative's exploration of familial dynamics and cultural identity.

> *And Moms getting all formal as she lectured, every word coming down with the whacks on the ass: Usted-va-a-aprender-quién-es-la-jefa-aquí! It was all "thee" and "thou" when the Old Ladies started smacking you. And once the poor criminal escaped, Moms launched that chancla like a guided missile and beaned him in the back of the head.* [18]

This narrative portrays the mother figure with a strong Amazon archetype. According to Jungian psychology, the Amazonian archetype is often associated with strong, assertive, and sometimes aggressive female figures. They embody qualities traditionally considered more masculine, challenging social norms. In this narrative, the mother appears to be the enforcer who establishes and maintains authority. Its use of formal language and emphasis on the words "thee" and "thou," adds a layer of traditional or ancient authority. It doesn't seem like just a mother; She is a matriarchal figure, a queen in her territory. *Chancla'*s use like a guided missile is a nice touch. Like an action hero, this adds a dynamic element to the character. The image of how he hits the *chancla* on the back of the head of a runaway criminal is not only funny but also reinforces his assertive demeanour. He is the guardian of order and respect in his territory. The picture 'Mama Amerika' picture fits the female heroes in the Amazon archetype. The mother not only gives affection; She is a force not to be underestimated, mixing traditional authority with the touch of an action hero.

Within Chicano literature, the examination of various archetypes plays a pivotal role, often interwoven with the theme of female empowerment. In Luis Alberto Urrea's novel "The House of Broken Angels," we encounter various archetypes, such as the Great Mother archetype [19], personified by the character Mama Amerika. This archetype embodies not only nurturing but also resilience and strength, providing a multifaceted representation of maternal figures. Additionally, the narrative introduces the Amazon Heroes archetype, featuring female characters who display exceptional courage to challenge societal norms. These archetypes add intricate layers to the story, enriching the portrayal of gender roles and promoting the empowerment of women within the context of Chicano literature [10]. The exploration of these archetypes underscores the significance of diverse and empowering female figures, transcending conventional boundaries and contributing to the broader discourse on gender representation in literature.

CONCLUSION

This study on Mama Amerika in *The House of Broken Angels* serves as an exploration of the archetype of a female hero within the context of Chicano literature. Her character embodies the complexities of female heroism by blending nurturing qualities with strength and resilience, ultimately challenging conventional gender roles and enriching the narrative. As the matriarch and grandmother to the protagonist, Big Angel, she holds a key role in the narrative. Mama Amerika represents a connection to the family's history, embodying strength and resilience. Her presence contributes to the exploration of themes such as family dynamics, cultural identity, and the immigrant experience. Throughout the novel, Mama Amerika's character provides insights into the challenges and triumphs of the De La Cruz family, adding depth to the overall story. Mama Amerika appears as a paragon of feminine heroism in this epic work, portraying archetypal powers reminiscent of the Amazonian ethos. Her characters transcend conventional boundaries, weaving narratives celebrating the power of nuances inherent in the feminine spirit. As the curtain closes on this literary work, Mama Amerika stands as a testament to the immutability of the heroine's resonance, leaving an indelible imprint on the narrative landscape and the reader's collective imagination. To conclude, analysis of *The House of Broken Angels* underscores the existence of diverse and empowering women figures in literature and society, positioned as a challenge to established gender duality.

ACKNOWLEDGEMENTS

We would like to thank LPPMI (The Board of Research, Community Service, and Innovation) Universitas Teknokrat Indonesia for The Research and Publication Grant 2022 & 2023.

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Rituals in Using Community at Banyuwangi: A Gender Perspective?

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Abstract. The Using community, Banyuwangi, has a variety of local wisdom and cultural treasures, both sacred and profane. This paper aims to discuss the rituals of Using people, especially in the context of a gender perspective. This study uses ethnographic methods with theoretical concepts of multicultural feminism. The study results show that cultural treasures in the form of rituals are generally perceived as "the world of men". However, this is only partially the case. The Barong Ider Bumi ritual in Kemiren reflects more on the role of men. In contrast, in the Seblang ritual in Olehsari and Seblang in Bakungan, the role of women as "ritual dancers" is quite significant because women become the "center" of all supporting elements of the ritual. Meanwhile, the Keboan ritual in Aliyan and the Kebo-keboan ritual in Alasmalang are quantitatively dominated by the male role as kebo ('buffalo'), but the "center" is precisely one woman, Dewi Sri, who is protected by the buffalo and indirectly controls them. Magic or supernatural rituals are generally identical to the world of men, but that is not the case with Lintrik-type magic. Lintrik's primary function is compassion and fortune-telling. Unlike other types of magic (for example, Witchcraft, Magic, and Kanuragan), almost all Lintrik magic perpetrators are women. The results of the study of these rituals show that women have an essential role in some of the sacred cultural treasures of Using. These findings can break the common perception that identifies the sacred world as the world of men. Thus, cultural feminism gains legitimacy in the context of Using local wisdom, Banyuwangi.

INTRODUCTION

Every ethnic group in Indonesia has cultural treasures in the form of ritual institutions that contain values, both in nature tangible or *intangible*. Likewise with the people of Using, Banyuwangi, East Java, who are *indigenous people* heir to the Blambangan Kingdom, who lives on the eastern tip of Java Island. As an agrarian society that has a social character *aclak, ladak,* and *bingkak*, and have an egalitarian social structure [1][2][3][4], they are attached to traditional institutions inherited from their ancestors, both those related to the individual life cycle and those related to the social realm. Rituals that still exist in the digital era are the *Barong Ider Bumi* ritual, the *Seblang* ritual, the *Kebo-keboan* ritual and the *Lintrik* ritual.

In fact, such rituals do not only exist in the Using community, but also in other ethnic communities in Indonesia, namely in Javanese, Madurese, Sundanese, Batak, and Papuan communities [5], with their respective local versions. The general view in various parts of the world [6][7][8][9], rituals are close to the realm of men, the realm of masculinity. Moreover, rituals are related to physical strength and courage to take risks. When related to community characteristics, Balinese and Minangkabau women have an important role in the local cultural context. Meanwhile, in other ethnic groups, men's role is more dominant. However, there are rituals in Indonesia that are completely carried out by women, namely the *neteske* (baby birth) ritual. In this ritual, the *dukun bayi* (female religious leader) leads this ritual [10].

Meanwhile, in Ethiopian-African society, women play an important role in the Shimgelina ritual. This ritual is carried out as an effort to reduce conflict [11], while in Gujarat-India there is a Ngoma ritual. Ngoma is a tradition of singing, dancing and beating drums where the drums are the main music. Ngoma was practiced by African slaves living in India. In the Ngoma ritual, women are the main element because they act as drum beaters [12]. On the other hand, the “menarche” ritual in Malawi [13] creates a collective consciousness of women by regulating the bodies and

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030025-1–030025-7; https://doi.org/10.1063/5.0241667
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

behavior of individual women, and ultimately strengthens women's role in society. The menarche ritual marks femininity and gender in girls. Therefore, in Malawi,

A ritual descent into the subconscious can produce a new orientation of consciousness and increase feelings of unity and well-being [15]. A number of contemporary Western feminists are redefining their spiritual beliefs and creating ritual practices to reinforce feminine values in their lives. Proponents of feminist spirituality believe that the personal and spiritual dimensions of women's lives are interrelated. Experiences of transcendence and oneness are often preceded by healing and personal empowerment for many women [15] [16][17].

Regarding ritual phenomena in the context of gender, it is necessary to conduct studies using the concept of multicultural feminism, not liberal, radical, Marxist-socialist, gender-psychoanalysis, existentialist, postmodern, or ecofeminism [18]. The concept of multicultural feminism is more appropriate because it is related to cultural phenomena. Feminist theory in general and multicultural theory in particular have had a huge influence on various academic fields since the 1990s [19]. By asserting that women's perspectives are valuable, feminist theorists challenge the notion that knowledge production is independent of knowledge producers and is objective or free from social influence. Instead, all knowledge is placed in a context and must take into account the position of the producer, as well as the position of the recipient of the knowledge [19]. Multicultural feminism is not an idea, an abstraction, or a philosophical ingenuity. The relationship between multicultural feminist theory lies in the daily experiences of humans who love, live, laugh, cry and think [18][19][20].

The issues raised by feminists and multiculturalists regarding the nature of personal identity, the boundaries between public and private life, and respect for cultural differences are important, but should not replace old questions about authority, democracy, freedom, and justice [21]. Even in religious contexts, whatever the future of feminist rituals, gender-specific meanings of religious rituals will remain, at least until gender loses its determining power as a marker of difference in our world [18][22]. It is within this network of social relations that feminist production occurs. Layered on these social coordinates are norms, values, expectations, motivations, history, and language practices, filtered through culture, all of which give multicultural feminism a unique importance in knowledge production [23][24].

This paper aims to discuss the rituals of the Using community, especially the *Barong Ider Bumi* ritual, the *Seblang* ritual, the *Kebo-keboan* ritual, and the *Lintrik* ritual, in the context of a gender perspective. This research uses ethnographic methods, with the theoretical concept of multicultural feminism.

RITUALS: MAN'S OR WOMAN'S WORLD?

Barong Ider Bumi Ritual

The *Barong Ider* Bumi ritual is in Kemiren Village, known since the 1830s, introduced by Grandfather Buyut Tompo, so it is popularly known as Barong Kemiren. Meanwhile, other barongs are often performing arts, nicknamed Barong Using or Barong Banyuwangi, because they are popular among the Using people of Banyuwangi. However, in general the substance *performance*These barongs can be said to be the same (with the embodiment/prototype of the winged lion). There is little difference, that Barong Kemiren is interpreted more from the perspective of traditional rituals (sacred), while Barong Using/ Banyuwangi is interpreted from the perspective of entertainment or performing arts (profane).

In the Barong Ider Bumi ritual procession, the Barong is the most prominent "figure" and attracts the attention of residents, in addition to other supporting "figures", namely actors with chicken properties (*pitik-pitikan*) and perpetrators with tiger property. This series of processions was also attended by arts groups *mocoan, samroh, kuntulan, jaran kecak,* and *angklung paglak.* After touring the village and visiting several sacred places, continue *ngalap berkah* (party with all the residents as an expression of gratitude). This means that in the *Barong Ider Bumi* ritual, the performers are predominantly male, while the Barong performing arts tend to be balanced between male and female performers.

The sacred meaning and function of the *Barong Ider Bumi* ritual (compared to other barongs) is not only related to representation *dhanyang* The great-grandparents of Cili are the ancestors of Kemiren residents, but are also related to conventions like ritual art in general, namely certain elements of space and time that have become “pakem” (standards, conventions). The following is information related to this.

TABLE 1. Comparison of Barong Rituals and Barong Performing Arts [25]

No.	Information	Barong Rituals	Barong Performing Arts
1.	Origin	- Solution to *pagebluk* - An integral part of the Ider Bumi ritual - Eyang Buyut Tompo	- Unrelated *pagebluk* - "Creation" of various local arts - By artists
2.	Procession	- Daytime: integral to the Ider Bumi parade - In the evening: Barong dance drama performance	- There is no procession - In the evening: Barong dance drama performance
3.	Owner	- Descendant of Tompo's Great-Grandfather	- Not hereditary
4.	Place implementation	- Kemiren Village - Prohibited in Olehsari Village	- In various places
5.	Execution time	- Starting on the 2nd day of *Idul Fitri*. - For 2 days: 1st day *slametan* at the grave of Cili's great-grandfather & Village Hall; 2nd day procession (afternoon) & Barong dance drama performance (evening)	- Free day - Over night
6.	Perpetrator	- Male dominant	- Balanced between men and women

Seblang Ritual

As noted by Singodimayan [26], Seblang is thought to have emerged since 1770, starting with Sayu Wiwit, a *Blambangan* princess. However, Singodimayan [26] also reminded that documentation related to Seblang was only carried out in 1930, especially Seblang in Olehsari Village (originally called Ulih-ulihan). For the people of Olehsari Village, Seblang is the earliest ritual institution and pre-Hindu cultural heritage. It is thought that this ritual has Balinese cultural influences, or at least is reminiscent of dance *shangyang* from Bali [25].

Apart from shamans and their spells, Seblang ritual institutions are also closely related to *dhanyang*. *Dhanyang* understood by the Olehsari people as ancestral spirits *mbahureksa* local area. In the Seblang ritual system, there are times when there are meetings or communications between humans and spirits or *dhanyang*. Tabalong [27] calls them "*remarkable* encounters". These encounters can occur, either directly or indirectly. Direct encounters, apart from being experienced by shamans and charmers, are also experienced by mediators *cruelty* and the Seblang dancer [25].

As is known, Seblang is not only in Olehsari, but also in Bakungan. Both aim at repulsion and fertility. In both rituals, women are the center of the ritual elements and also the main actors. Both rituals have similarities and differences. The following is the explanation.

TABLE 2. Comparison of Seblang Rituals in Olehsari and Bakungan [25]

No.	Information	Seblang Olehsari	Seblang Bakungan
1.	Dancer criteria	- Seblang descendants - Teenage girls (virgins) - Can appear a maximum of 3 times in a row	- Seblang descendants - Old woman (no longer menstruating) - Performs as long as she can
2.	Time implementation	- After Eid al-Fitr (*Idul Fitri*) - For a week	- After the Eid al-Adha (*Idul Adha*) - Holiday last night
3.	Procession	- Beginning *kejiman* - Ended *ider bumi* - Don't bring a *keris*	- There isn't any *kejiman* - Beginning *ider bumi* - Draws a *keris*
4.	*Omprok* ('crown')	- Made from woven bamboo. - Accessories: flowers, banana *pupus*, areca nut *pupus*, pineapple *pupus*, mirror	- Made from animal skin. - Completeness: *mori*, flowers from plastic, leaves from plastic
5.	Perpetrator	- Women are the center and main actors	- Women are the center and main actors

Kebo-keboan Ritual

Like *Seblang*, *Kebo-keboan* is also a rite for rejecting balak and fertility, so it is carried out after the rice harvest and before planting time, precisely in the month of Suro. Term *Kebo-keboan/Keboan* it is quite impressive to imagine buffalo plowing mud-stained fields or buffalo soaking in a puddle of murky water. The *Kebo-keboan* ritual is carried out in Aliyan Village and Alasmalang Village, but the two tend to have many similarities. The nuance of fertility in an agricultural context reflected in the *Kebo-keboan* ritual is stronger than in *Seblang*, because of the presence of figures *kebo/keboan/kebo-keboan* ('buffalo') and the figure of Dewi Sri. Figure *kebo* played by humans with various accessories like those worn by buffalo when plowing rice fields, complete with mud stains and murky water in puddles. The character of Dewi Sri is played by a charming and still virgin girl. Ritual processions cannot be separated from shamans, spells, *slametan*, and *kebo* which *trance*, and ending with *ider bumi* and *ngurit* (sowing rice seeds) [25].

The *Kebo-keboan* ritual represents the activities of agrarian communities, activities in the rice fields, generally related to men's activities. In terms of quantity, the majority of *Kebo-keboan* ritual performers are men, while in terms of quality, the controlling actors are women, namely Dewi Sri (Goddess of Rice). The controlling actor is meant as the party who is the subject or has indirect power. This means that the men who play the role of buffalo act based on the hegemonic power of Dewi Sri. The following is the explanation.

TABLE 3. Comparison of Kebo-keboan Rituals in Aliyan and in Alasmalang [25]

No.	Information	Keboan Aliyan	Kebo-keboan Alasmalang
1.	Origin	- Name: *Keboan* - Crop failure and the emergence of supernatural creatures resembles a buffalo damaging crops - Great Grandmother Wongso Kenongo went to Raden Pekik	- Name: *Kebo-keboan* - Crop failure, famine (*paceklik*), and *pagebluk* which is understood as a form of disturbance carried out by evil spirits - Great Grandmother Karti to Mbah Pon

No.	Information	Keboan Aliyan	Kebo-keboan Alasmalang
2.	Perpetrator	- Keboan: adult man (free number, does not have to be a descendant of Mbah Buyut Wongso Kenongo) - Handler/*Pawang* (ritual leader) - Dewi Sri (virgin, charming, not necessarily ancestral descendants, only one period) - *Gandrung* dancer - *Gamelan* musician	- Boan-keboan: men adult, has a lineage from Mbah Buyut Karti, 5-10 pairs - *Pawang* and *kiai* (ritual leader) - Dewi Sri (virgin, charming, descendant of Mbah Buyut Karti, only one period, will lightly partner) - Dayang (guard and accompanist of Dewi Sri) - Farmer - *Buldrah* (carnival leader *ider bumi*) - *Modin Banyu* (taking care of water for the ritual location) -
3.	Time Implementation	- Suro month - For 2 days (Saturday- Sunday)	- 10 Suro (because Mbah Buyut Karti was the first time perform the ritual on that date) - For 1 day
4.	Place Implementation	- Mud puddles in four sides of the village (east, west, north, south) and village hall	- 4 corners of sacred villages and 1 center of villages (Watu Loso, Watu Gajah, Watu Tumpang, Watu Karangan, and along the main road of Krajan Hamlet)
5.	Equipment	- Offerings - Mud puddle - Gate - (There isn't any *sanggrah*) - Train - *Keboan* equipment	- Offerings - *Songsong* (grand umbrella) - Palanquin - Agricultural equipment
6.	Procession	- *Slametan* at the grave of Mbah Buyut Wongso Kenongo - The traditional ceremony begins when all *keboan* has trance - Dance with *gandrung* dancers - *Ider bumi* (when passing through puddles mud, para *kebo* wallow and dance with residents) - *Ngurit* (sowing rice seeds) is carried out in one of the intersections road - Awareness *keboan f*rom trance by the handler (*pawang*)	- *Slametan* opener (*ater-ater*) give each other between families) - “Planting” secondary crops in along the village road - *Slametan* clean village (led by *pawang* and *kiai*) - *Ider bumi* (led *buldrah*) - *Goyangan* (process control *keboan* so it doesn't run wild) - *Ngurit* (sowing rice seeds) - Awareness *Kebo-keboan* from trance by the handler (*pawang*)
7.	Main actors	- In terms of quantity, the majority of perpetrators are men - In terms of quality, the controller is a woman, namely Dewi Sri (Dewi Padi)	- In terms of quantity, the majority of perpetrators are men - In terms of quality, the controller is a woman, namely Dewi Sri (Dewi Padi)

Lintrik Ritual

Lintrik is one of a kind *ngelmu* grace that is believed and practiced in Using and Javanese communities, or other communities. *Ngelmu* another type in Banyuwangi is *Sihir, Suwuk, Cekek, Racun, Santet (Merah dan Kuning), Pathek, Rapuh, Kanuragan, Pesensren, Seret, Susuk, Pengirut, Pelaris, Sikep, Welas, Sarat,* and *Ajat* [28][29]. Even though it is not as popular as Jaran Goyang, Semar Mesem, or Sabuk Mangir, the term Lintrik has become an icon in itself in the supernatural world, especially in relation to women. In Banyuwangi, especially in the Using community, Lintrik represents the mystical power exercised by women. The more popular term is Lintrik craftsman, not Lintrik shaman. Apart from the representation of female shamans, Lintrik is unique in its mystical mechanism, namely using lintrik cards or ceki cards. This is a cultural mechanism carried out by Using women.

As explained by Minakjinggo [30] that "*Rata-rata hang dadi dhukun Lintrik iku pecake dadi Gandrung utawa sepurane (pecake senuk)*" (In general, Lintrik shamans are former Gandrung dancers or, sorry, former prostitutes). This Lintrik history has strong and intertwined implications between the background of someone who joined Lintrik, personal experiences while being a Gandrung dancer or prostitute, and future follow-up in the practice of helping others with *ngelmu* Lintrik.

If referring to the concept *magic* from Frazer [31][32], Lintrik can be categorized as a science that combines *homeopathic magic* and *contagion magic*. In Frazer's concept, *homeopathic magic* (imitation magic) assumes that similar objects will influence each other, whereas *contagion magic* (contagious magic) assumes that objects once in contact will continue to have a relationship. *Ngelmu* Lintrik is a combination of *homeopathic magic* by using photos of the person concerned (this is the most dominant) and *contagion magic* by using objects or belongings of related people, which can be used for charity, as a guide to finding lost items, or to predict someone's whereabouts and intentions.

Lintrik is *ngelmu* compassion that can be used for various purposes, especially related to romantic relationships between men and women. The history of Lintrik is inseparable from the background and past lifestyle of Lintrik artisans, generally from infatuated dancers and prostitutes. Even though it can be used for love (bonding or tying up romance), looking for lost items or people, bestselling, and as a means of fortune telling, Lintrik is better known as a male charmer with certain goals, including economic goals.

Lintrik is a representation of women because it requires patience in rituals and using cards, so the perpetrators are female shamans because men are not painstaking (*sing omes*). *Ngelmu* Lintrik becomes a cultural expression for women and a discourse against men in the field *ngelmu* based on local wisdom Using. In the context of Using culture, lintrik can be interpreted as a cultural mechanism based on local wisdom and knowledge that is multipolar and culturally multivalent.

CONCLUSION

Based on a study of rituals in the Using Banyuwangi community, it can be concluded that the world of rituals is not completely identical to the world of men. In the Barong Ider Bumi ritual more reflects the role of men, while in the Seblang ritual, both in Olehsari and in Bakungan, women are the "center" of the entire series of rituals. Meanwhile, the Kebo-keboan ritual, both in Aliyan and in Alasmalang, is quantitatively dominated by the role of men, but the "center" in control is the woman, namely Dewi Sri. Rituals *magic* or supernatural is generally synonymous with the world of men, but for the Lintrik type the role is dominated by women. Thus, women have an important role in some of Using's sacred cultural treasures. These findings can break the general perception that identifies the sacred world as the world of men. In this way, cultural feminism gains legitimacy in the context of local wisdom in Using, Banyuwangi.

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Hijab Restricts Men: An Analysis of Patriarchal Bargain in the Contemporary Salafism Movement

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Abstract: This study examines women's strategies for negotiating patriarchy in the context of hijab in Makassar's Wahdah Islamiyah Organization. Following Kandiyoti's patriarchal bargain framework, this study focuses on how women (Muslimah) in Wahdah attempt to expand their sphere of influence by asserting their authority in the domain of religious practice in a patriarchal environment. The female population and local culture have become essential in managing Wahdah Islamiyah's comprehensive da'wa program based on gender segregation. Muslimah perceives the limitations of patriarchal da'wah within the context of hijab as an opportunity to play a more substantive role. The study finds that the hijab provides a platform for Muslimah to negotiate their authority. As a barrier, the hijab strengthens the role of the Muslimah in promoting Wahdah Islamiyah ideology. Men's ineffectiveness in spreading comprehensive da'wa in the context of hijab affects the authority concessions extended to women. This study's arguments are based on data collected through observation, interviews with male and female organizational administrators, and documentation. The stereotypical view that the hijab represents the subjugation of Salafist women in patriarchal classics needs to be reevaluated to demonstrate that the hijab reduces male dominance.

INTRODUCTION

In the last few decades, women's participation in the public sphere has begun to be taken into consideration, particularly in developing countries and regions where patriarchal systems continue to dominate [1,2,3,4]. Walby [5] defines patriarchy as a system of social structures and practices characterized by men's dominance over, oppression of, and exploitation of women. In the domain of religion, the connection between religion, patriarchy, and violence appears to have become a 'way of life' that is ahistorical, and eternal, and for its adherents, patriarchy is authorized and legitimized by God [6]. As Bayat [7] characterizes patriarchal figures, one is prominent in authoritarian regimes and movements, demonstrating the conservative nature of religion in authoritarian Muslim nations. When gender roles are legitimized through literal texts (Qur'an) and Sunnah (tradition) in the domain of patriarchy, the application of conservative. Odok [8] illustrates that the interiorization of women in Islam cannot be completely understood if the tradition of Salafism is ignored, considering that subjectification in Islam under Salafism is the adoption of a hierarchical gender dichotomy that is highly patriarchal.

One of the issues that have emerged in the transformation of the global Salafist movement today is the role of women in the broader public sphere [9,10,11,12,13,14]. This also indicates an evolution in the public role of Salafi women, who usually appear dysfunctional. This study focuses on the activism of women within the Wahdah Islamiyah salafism movement in Makassar City, Eastern Indonesia. Wahdah women's (Muslimah) active participation in developing practical da'wah spaces has contributed to the growth of Wahdah Islamiyah's comprehensive da'wah programs. The importance of activism cannot be denied by 'the patriarch'. The hijab as a space for gender separation, which is frequently identified as a form of restriction for women, is used by Wahdah women to gain authority and negotiate the dominating power of patriarchy. One way in which patriarchy and Islam are viewed stereotypically is through the doctrine of the hijab, which is associated with oppressive spaces [15][16].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030026-1–030026-10; https://doi.org/10.1063/5.0241631

Hijab and Patriarch

Hijab is a term in Arabic that refers to a barrier or divider between two objects, typically in the form of a curtain or cloth. Historically, the hijab originated as a veil or barrier to interaction between male guests and the prophet's wives in the prophet's home [17]. This was intended to prevent interference from people with ill intentions. Similarly, in reference to the hadith narrated by Bukhari [18], the term hijab carries the connotation of segregating men and women. The meaning of the hijab has undergone a significant expansion and contraction over time. Because the hijab is materially defined as mere clothing that covers women's private parts in Islam (the use of a head covering), it is interpreted narrowly. The significance of the hijab, which is associated with the headscarf, has actually expanded. The meaning of the hijab, which literally translates to 'covering' or 'limiting' has shifted to include restricting the rights, opportunities, and public roles of women. This change is brought about by patriarchy, which has an effect on discrimination against women [17].

The emergence of Islam altered the position of women within the constraints of patriarchy. Islam is the most vocal in its advocacy for justice and equality among humans, including the equal rights of men and women [19]. Specifically, the Prophet reformed the status of women in Arab jahiliyah society. The system of exposing women and murdering their offspring is gradually fading away. Similarly, in Islam, a person's renown is determined solely by their piety. However, Islamic cultural reform does not easily eliminate male superiority. Islam represents a change in time, Islam is considered a divider between before and after jahiliyah, although this does not mean that the two periods were completely separated psycho-socioculturally [20]. That what was a tradition in previous times is very possible to take, practice, and even develop. Therefore, in the Islamic community, it cannot be seen radically that there are no longer elements of practices carried out in the jahiliyah era, although with different levels and patterns [20].

After the time of Prophet Muhammad, the Islamic community confronted difficulties in preserving the authentic Islamic heritage [19]. Despite the fact that the ancient patriarchal order was swept away by the wave of Islamic reform, parts of it have persisted. The companions' interpretations of the verses of the Qur'an regarding the social relations of men and women contributed significantly to the rise of hierarchical and feudalistic patriarchal order and became the basis for gender relations in Islam, which occurred when men were placed not only as leaders, ruler but also as female controllers [21]. Similar to Masood's [15] emphasis on how religion and gender interact to produce systemic injustice. From a patriarchal perspective, the term *qawwam* is always presented in the study of gender relations because it is associated with masculine leadership. The issue of women's domestication is exacerbated by the intersection of patriarchal authority and the hijab-prioritizing principle. Instead of safeguarding women, the true meaning of the hijab in the Qur'an is frequently reduced and distorted, resulting in the interpretation that women are always subservient [17]. Consequently, the Hijab doctrine is frequently regarded through a restrictive lens. Western feminists characterize the hijab doctrine as a static, conservative practice that oppresses women because it contradicts Western ideas about modernity and gender equality [16], and Western media imposes and extends these associations to passivity, backwardness, and extremism [22].

The rise of hijab studies has led to alternative interpretations. The patterns of Islamic women's agency through the hijab seem to challenge the argument that women are passive victims and are a form of resistance to the patriarchal systems of power. The use of the hijab as a form of everyday resistance [7,23,24], the hijab has brought freedom and respect [25] and also demonstrates women's resilience [26]. According to Bruijn et al. [27], the agency approach has advantages in the development of social science, notably when it is able to embed other influences outside the structure, particularly in terms of how individuals and social formations negotiate the reality of their circumstances. Similarly, Hekman argues that feminists utilize agency as a means of resolving tensions between individuals and patriarchy, which is generally seen as a dominant and deterministic social structure [28].

In general, the role of agency played by women is an additional endeavor to interpret the dominant patriarchal discourse, which tends to eliminate women's role of agency and position them as victims. Gallagher [29] sees that experts tend to be preoccupied with seeing women's obedience solely within patriarchal boundaries, thus ignoring women's active agency which is founded on women's self-awareness. In the study of religious movements, the study of agencies is considered to have strengthened the ranks of religious women, as well as a response to overcoming the stigma that they are victims who are deceived when their beliefs are viewed as different from modern and secular conceptions of gender equality [30,29]. This paper contributes to the literature on the study of women's agency in hijab by presenting an aspect that has been underrepresented in previous research, which is the representation of hijab as gender segregation that imposes restrictions on men and provides women opportunities in negotiating patriarchy. Men are also subject to restrictions imposed by the hijab. This paper presents an explanation of the interaction between the genders that is not always presented dichotomously. Men and women are negotiable resources that can maximize options within patriarchal structures.

Patriarchal Bargain: Determination of Women Agency

Radical feminists embrace and implement classic patriarchy theory to explain women's subordination as a result of male dominance [31]. In the meantime, patriarchy research has advanced, as presented by Deniz Kandiyoti's study on patriarchal bargains [32]. Kandiyoti criticizes feminist perspectives that are too abstract and undifferentiated in describing patriarchy and have ignored variants of patriarchy in which rules and scripts in gender relations can be reinterpreted or renegotiated by women's efforts to strategize within the concrete constraints of patriarchal dominance. According to Kandiyoti: "… *women strategize within a set of concrete constraints that reveal and define the blueprint of what I will term the 'patriarchal bargain' of any given society, which may exhibit variations according to class, caste, and ethnicity.* The following idea by Kandiyoti is spectacular, not only because it offers a novel interpretation of the monolithic discourse of patriarchy, but it also demonstrates how women maximize security and optimize life choices with a variety of active and passive resistance options. The diverse responses of women in areas of oppression, such as autonomy and protest in Sub-Saharan Africa, and subjugation and manipulation in areas of classic patriarchy in the Muslim Middle East, South, and East Asia [32], show that attitudes toward male dominance vary greatly according to the objective opportunities available under each variant of patriarchy.

Patriarchal bargaining demonstrates that women are not only passive victims but also active participants who utilize the potential to obtain recognition within the existing boundaries (system). This implies that the strategy of women is not to directly challenge the dominant discourse, but rather to obtain recognition from within the system. Thus, patriarchal bargaining requires not only the consideration of women's resources and constraints but also their prospective benefits. According to Benstead [33], the notion of the patriarchal bargain provides a comprehensive framework for comprehending patriarchy, allowing scholars to analyze the varied outcomes observed in various manifestations of gender inequality. Ngunjiri [34] concurs that understanding patriarchy requires an understanding of how women strategize and surmount obstacles.

Nevertheless, the current development of patriarchal bargain studies, especially studies of religious movements, tends to only identify women as agents [11,13,10,9]. Women's activism in religious movements is considered a euphoric expression of women's 'victory' over stigmatization. Thus, agency as an innovative platform for women in religious movements has the effect of ignoring the existence of other actors, namely men in the bargaining process, who have a different understanding of playing the role of agent. Even when it comes to the male system, the research tends to focus only on structure and action guidelines when the male system creates opportunities and supports an environment in which women can adapt to the dominant context as a consequence of the global economy [35,36] or media technology [12]. This paper explores how men's participation is influenced by their awareness of the limited space in the context of hijab, on the one hand, and the inevitability of women's roles, which they cannot disregard, on the other. Patriarchal bargain analysis has facilitated women's activism inside the Wahdah Islamiyah movement, enabling the development of a comprehensive da'wah space. This activism has effectively prompted males to reassess and reconsider the limitations placed on women's roles and places within the movement.

Construction of the Hijab and Patriarchy in Wahdah Islamiyah

The emergence of Wahdah Islamiyah is intricately linked to the political context of the dominant regimeof the new order and the spread of transnational Middle Eastern ideologies that gained prominence during the 1980s [37]. YFM endeavors to advance the practice of da'wah by emphasizing the purification of Islam within society, taking inspiration from the religious interpretations of the three previous generations (shalaf as shalih). The da'wah activities of YFM underwent a significant transformation in the mid-1990s when they began to take the lead in employing educational platforms for their propagation activities. This involved the establishment of schools like pesantren utilizing the networks of Middle Eastern Salafi groups [38,39,40]. Contemporary Salafism, as identified by Fealy and Bubbalo [41], represents an innovative manifestation of the Salafist ideology. This particular kind of Salafism emphasizes a non-political approach, and faithful religious observance while exhibiting a marked intolerance towards any perceived departure from legitimate Islamic teachings, commonly referred to as *bid'ah.* In 2002, Wahdah Islamiyah transformed into a religious organization and began focusing on democratic issues that emerged after the reformation, including the gender issue. Gender is recognized as a sociocultural construction in which characteristics associated with the roles of men and women are inherent [42]. Connolly and Predelly reveal in Dzuhayatin [43] that gender issues are not only politically and structurally regulated but also operate systemically within religious social organizations. Gender construction has usually placed men in a position of superiority and women in an inferior position in playing their respective roles both in the private and public spheres.

In the early days of the Wahdah movement, one of the da'wah purification initiatives involved training women to be *shalihah*. In addition, women are provided with opportunities for self-actualization and religious education. Including their active participation in the advancement of the women's da'wah movement by establishing da'wah networks in educational institutions such as colleges. However, according to Ustad Qasim Saguni: "... In the movement, women are not allowed to act alone and must be accompanied by men who provide guidance and exercise control" (*Interview,* 2/9/2022). The establishment of patriarchal structures within Wahdah Islamiyah is evident in its emphasis on the significance of hijab, which is reinforced by the predominance of male leadership and the imposition of restrictions on women's autonomy. According to Ustad Rahmat, the Daily Chairperson of Wahdah Islamiyah, the discourse on leadership in the context of gender in Wahdah Islamiyah is divided into two categories: *First*, Wahdah Islamiyah consistently stresses that men have leadership qualities that are more prevalent in gender issues than women. *Second*, Wahdah Islamiyah provides women with leadership positions related to rights and responsibilities; however, women's leadership is on a restricted basis, which is women-specific leadership (*Interview, 5/8/2021*). Shari'a as well as rules that form patriarchal models and behaviors in Wahdah Islamiyah place men in a position of dominance over women in the religious social order and in the family as the smallest community.

At this point, the leadership discourse is intertwined with an understanding of the value of hijab, which are restrictions for women. Hijab understood by Wahdah is articulated in two meanings: First, hijab is a barrier or curtain that must exist as a space separator for men and women who have to speak for an interest. The principle is lived in the spaces of the assembly, among others in the assembly of knowledge, marriage, deliberation, and other gatherings that involve the interaction of two genders. This use refers to the separation of gender in the prayer room (mosque) which is widely implemented in the social space in Wahdah Islamiyah, where the special space for the management of women in Wahdah Islamiyah is the embodiment of the value of hijab. Currently, the discourse on leadership is intertwined with an appreciation of the value of the hijab, which are restrictions on women. Wahdah articulates two distinct interpretations of hijab: *First*, hijab serves as a physical partition or divider that is deemed necessary to establish spatial segregation between individuals of different genders who engage in communication for specific purposes. The notion is embodied within several contexts of collective engagement, including but not limited to knowledge sharing, marriage events, deliberative processes, and other forms of gatherings that entail the contact of individuals of different genders. This discourse refers to the practice of gender separation in the prayer space (mosque), which is then extensively implemented in Wahdah Islamiyah's social space. The existence of a separate area for women in Wahdah Islamiyah demonstrates the significance of the hijab. *Second*, the Hijab is an integral component of the clothing of women within the context of wahdah. Both men and women possess the inherent entitlement to fully cultivate their capabilities. However, a potential constraint arises in the form of the hijab, which can be understood as clothing designed to conceal the aura. The 'manhaj' of women's dress in Wahdah reflects a way of articulating a more restricted space, despite the fact that Muslimah dress is not merely symbolic. Based on the aforementioned discussion on hijab, it can be inferred that hijab serves as a form of restriction and a means of defining the presence of women, as hijab itself may be seen as a form of constraint.

COMPREHENSIVE DA'WAH: THE HIJAB CONFINES MEN

The involvement of women in the new Salafi context has emerged as a dynamic issue in the transformation of the global Salafism movement [14]. This also demonstrates a shift in the role of women in the Salafism religious movement from the old Salafi context (Wahabi), which presents an interpretation of the role of women that cannot be separated from the sociocultural context of patriarchal Arab society to a new context, particularly the participation of women in the development of da'wah. In the context of Indonesia, the process of reform has created opportunities for the re-emergence of cultural and religious identities, while also facilitating the inclusion of religious movements that were previously marginalized [44]. The correlation between the expansion of civil liberties and the existence of equality concerns, such as gender issues, has led to varying responses from the Salafist religious movement, with different degrees of implementation. The Wahdah Islamiyah movement and its Muslimah exhibit limited engagement with gender equality politics. Instead, Wahdah Muslim women primarily focus on the development of purifying preaching, accomplished through educational initiatives, cadre training, and addressing socio-religious concerns within society. The Muslimah Wahdah movement has been affected to some degree by gender issues [37]. As a transnational movement, Salafism has retained and disseminated global messages while adjusting to the local context [39, 45].

Wahdah Islamiyah's institutional transformation into an organization is a choice based on the need for da'wah administration in the modern era [46]. At the same time, it sparked contradictions between the discourse of Salafism and the concept of a modern nation-state state, causing other Salafi circles to deem Wahdah Islamiyah to have deviated from the Salafi standard [47]. For Wahdah, da'wah should be managed collectively in a collective political community, as a reference to the pattern of the Prophet's da'wah with the companions; there is a leader, there are labor units, miniatures of the Prophet's time, and such a pattern approaches an organization today. Wahdah was established as a community organization in Makassar on 1 Shafar 1423 H / 14 April 2002 M. The transformation of Wahdah Islamiyah has an impact on the segmentation of da'wah, which is comprehensive in that it affects all spheres of life, including the economy, education, environment, health, society, and even politics. Comprehensive management of the da'wah, not only in terms of the issues managed but also the actors involved, including women. Wahdah women are an integral part of the history of the Wahdah Islamiyah movement. They are primarily educated people who were born on several campuses in Makassar [37]. Despite adhering to the male-led da'wah orientation, Wahdah women have been active in coordinating meetings and holding limited forums to discuss their role in the da'wah movement from the beginning. They acknowledge that a larger female population than a male population is a crucial Da'wah objective. Moreover, their asset da'wah consists of three times as many female cadres as male cadres.

The base of educated Wahdah women enables them to present themselves in a confined space in order to obtain recognition. The hijab factor causes Wahdah women to be *sami'na wa atha'na* and to play a limited role in Wahdah institutions, despite the fact that women have had a special mission from early on. One is the segregation of gender space in the work area in the organizational body, where the position of the Lembaga Muslimah (Now, MWI), which was officially established in 2005, has not yet achieved autonomous status. Although it is under the control of the male administrative structure, gender segregation is the entry point for Wahdah women to gain momentum and interpret restrictions as a great opportunity to work on da'wah in the realm of women, which they believe cannot be carried out effectively if managed directly by men. This is interesting in relation to the following statement by Ustad Rahmat:

> *"The effectiveness of comprehensive da'wah in the context of hijab (restrictions) requires that women manage their own space, while da'wah must take place among Muslim women. Although it is possible for the Ustad to engage in da'wah in the domain of Muslim women, but only to a limited extent, particularly when it comes to private matters of womanhood, it is impossible to go further, particularly in the context of hijab. Even in our context, it was observed that some Ustad experience feelings of nervousness and difficulty in effectively communicating when they interact with Muslimah" (Interview, 5/8/2021).*

As a result, the hijab serves as a platform for women to negotiate their response to comprehensive da'wah. Moreover, what strategies do they employ to optimize the utilization of available space under constraints? Following is the Wahdah women's strategy in the realm of practice when negotiating for the more expansive sphere of influence.

Bringing The Sense Of 'Home' To The Outdoors

Wahdah Muslimah's limited involvement in the organizational structure does not prevent it from playing a functional role in women's da'wah affairs. Public da'wah aims to create social piety through a more Islamic social order [13]. The penetration of da'wah is based on the belief of Wahdah Muslimah that it is not sufficient to be a pious individual without also inviting other women to become pious. In promoting the purification of da'wah, the city of Makassar's larger women population [48] is a strategic market for da'wah. Muslimah Wahdah is actively engaged in direct community involvement for a minimum of one week, particularly among mothers. This involvement includes participation in *majlis ta'lim* (religious study circles), teaching dirosah al-Qur'an (Qur'an recitation classes), and management of dead bodies in Islam. The level of penetration is substantial since it is closely linked to a notable trend observed in urban neighborhoods over the past decade, which demonstrates an increase in women's religious activities. Diverse recitations conducted by the community are connected with the strengthening of religious expressions in today's urban millennium era, resulting in a diversification of da'wah. The proliferation of the term *syar'i* has been closely connected with the emergence of the hijrah trend, resulting in a significant impact on the growing movement of Muslimah da'wah.

Despite the public da'wah of women demanding the presence of Muslim women, household matters continue to be prioritized. The demands of Da'wah should not alter the essence of women. This phrase has become a persistent 'doctrine' within Wahdah Muslimah. Meanwhile, for Wahdah Muslimah, the only reason to leave the home is for da'wah-related activities. This condition requires Muslim women to be strategic in 'securing' the two domains that are their responsibility should they decide to take part outside. Particularly the significance of mothers in child development, as the Mother is the primary 'madrasah'. Ummu Khalid, Chairperson of Muslimah Wahdah, explained when I visited the Muslimah center office:

> *"This is why our office atmosphere is semi-home design, there is a kitchen, a children's playroom, and a child's mattress. Office activities cannot be separated from value and it is mandatory and meets the needs of an activist mother. That she cannot abandon her child, who still requires her extra attention, is a given. We provide supporting facilities to keep mothers and children closer, there is a daycare in the office area, specifically for children 2 years and over, children can only be left if they are free of breast milk, at the back of the office there is also an elementary school managed by Wahdah. We created the design in this manner so that the infant is as little as possible separated from the supervision of his mother, who is in the office. Our goal is how the values penetrate not only the mother but also the child, they must be able to sense the 'pulse' of the mother from the beginning, that the mother's interests follow the child's interests within her."* (*Interview, 25/3/2021*)

In these communities, children are usually involved in public activities. Therefore, Muslim women's activities in the field, such as the majlis they coordinate, are usually designed with a 'lesehan' sitting style which provides comfort for Muslim women. Those who have infants can put their infants to slumber more comfortably, in particular. At this juncture, the principles of family management and organizational management converge in Wahdah, where the husband-wife cadres are in the same movement circle, facilitating communication when discussing commitment and the value of struggle due to a shared understanding. The subject of the 'double burden' is a topic of interest as it pertains to the gendered sense of subordination experienced by women. However, it is worth noting that the phenomenon of the double burden may also be observed in males, specifically within the context of their roles as husbands. The notion of *ta'awun* is not limited to its manifestation inside the formal organization of Wahdah, but also extends to the promotion of this concept within the households of Wahdah cadres, particularly when the cadre holds the role of a Muslim woman administrator. Family resilience is one of the recommendations of the 2016 Muktamar III, which mandates the DPP Wahdah Islamiyah to devote attention to family development and family solidarity as a factor that supports the formation of internal cadre strength, which will impact the strength of external da'wah.

Strengthening Religious Understanding through Formal Education

The phenomenon of institutional transformation within Wahdah Islamiyah has consequential implications for the institutional framework pertaining to Muslim women. This implies that the primary emphasis is placed on Muslim women in terms of fulfilling the requirements for survival and sustainability. The presence of Muslim women in the community, with the aim of da'wah, cannot just rely on informal religious education acquired through informal gatherings. The utilization of coaching or regeneration inside the tarbiyah system appears to be insufficient for Wahdah Muslimah to establish themselves as 'qualified' in terms of knowledge, particularly when compared to Wahdah *ustad*. In accordance with Ummu Khalid, it is necessary to acknowledge the limited capacity of the Muslimah in this field.

Hence, Muslimah Wahdah advocates for its members to actively pursue formal education in the discipline of Sharia studies. At now, there exists a cohort of Muslimah cadres who have obtained several L.C. degrees, with a subset having successfully attained their master's degrees, while others are presently engaged in the pursuit of further academic qualifications. In general, They have obtained their degrees from Madinah International University in Malaysia, LIPIA Jakarta, and STIBA Makassar. Additionally, many of the cadres are non-religious graduates from public universities pursuing a second bachelor's degree in religious studies at STIBA. This is a consideration for the inclusion of Muslim women in the Shari'ah Council after the fourth Congress in 2021. It is an innovation because historically, the presence of a Muslim women's commission within the Wahdah Salafism movement was an 'anomaly', given that organizational culture positions the Shari'ah Council as a space of authority for the Ikhwan.

The presence of the Muslimah Commission cannot be separated from the organization's emphasis on the value of hijab. While Wahdah Muslimah's vitality is always governed by the signs of shari'a, which becomes a limitation, there will be a number of problems or obstacles potential in the sphere relating to shari'a. This is another reason why a Muslim Commission must be presented. This is consistent with what Ustadzah Armidah, Chairperson of the Muslimah Commission in the Shari'at Council: "… there are certain matters pertaining to Muslimah that cannot be adequately addressed or resolved by 'asatidz' due to the presence of the hijab, so Muslimah must be involved (*Interview*, 6/9/22). The other observation also applies to Muslimah participation in the Shura Council. The Shura Council is an institution charged with deliberation, governance, and strategic planning for the organization's central level. The strength of Muslimah in negotiating patriarchal areas within Wahdah Islamiyah lies in their increasing numbers of cadres and their participation in extensive activities. This influence is derived from their commitment to upholding the principles of shari'at.

Altering Da’wah Strategy with Colour Image

On the other hand, public acceptance of Wahdah Islamiyah's presence is still a challenge, and this cannot be separated from the appearance of Wahdah Muslim women who commonly wear black clothes and head coverings (niqab). Wahdah realizes that because their appearance is different from the majority of Muslim women in Indonesia, they are potentially considered exclusive and suspicious in society. Stigmatization of women who wear the niqab is associated with anxiety and exclusivity [49]. Wahdah Muslimah aims to change society’s perception of them without compromising their identity. After the 2016 Muktamar III in Jakarta, Wahdah Muslimah began to adopt a slightly distinct appearance. They reduce wearing dresses that are black in color. This phenomenon was affirmed through the release of a treatise in the form of an appeal to limit the use of black color women's apparel by Wahdah Islamiyah prior to the 2016 congress.

I have participated in various Muslimah gatherings, where it is observed that those at the Muslimah board level predominantly choose clothes in subdued hues. In addition to its restriction on the use of black, there is also a tendency to avoid vibrant colors. However, it is worth noting that at the grassroots level, black is still frequently employed due to its association with comfort. As Suriani said, “ .... I like the color black, it looks thick, I don’t worry about being 'see-through', we also have other colors, as long as it is not flashy, bismillah.....” (35 years). Wahdah is under no obligation to impose restrictions on its members regarding the selection of clothing colors, as long as the chosen attire adheres to the principles of Sharia law and adequately covers the aura. Although Ustadz Rahmat did not deny it, at the beginning of the movement, Ustad advised the use of black apparel for women, despite the fact that it was not written down, the reason that black seemed to cover the aura more effectively. Regarding the hadith narrated by Abu Dawud about the black Anshar women's clothing when they emerged resembling crows, it became a reference to the Shari'a of the Ustad addressing the use of black clothing for Wahdah women at the time.

The negotiation of Wahdah women through the color of their clothing is beneficial for advancing the more open da'wah of Wahdah Islamiyah. The actions of Wahdah Muslimah are intriguing because they represent a form of negotiation of Muslimah and the actual dynamics of modern Indonesian Muslim society. The color strategy also has a positive impact on Muslimah cadres' fashion business. Rumah Jahit Akhwat (RJA), one of the relatively large ‘brands’ of the Muslimah cadre in Makassar City, have begun selling multicolored apparel and niqabs, for instance. Thus, the dynamics of society and the existence of Muslim women are a necessity and a challenge for Wahdah in realizing the vision of phase II of the organization 2016-2030. Men namely policy elites will continue to be confronted with situations requiring them to legitimize the increased role of Muslim women due to these dynamics. The need for da’wah has the potential to further expand women's 'boundary' spaces. After Muktamar III, 2016 signified the beginning of a new chapter in the Wahdah Islamiyah Muslimah movement. In addition to the Muslimah clause that is already present in the AD / ART, Muslimah holds a leadership position comparable to that of other sectors led by men in the DPP’s organizational structure. The involvement of the Muslimah commission in both the shari'ah council and shura council serves to enhance the negotiating power of the Muslimah. The preceding explanation demonstrates that the context of hijab entails a mutually beneficial compromise for both men and women concerned. In the context of advancing the da'wah of Wahdah Islamiyah, Muslimah have the opportunity to show themselves because of hijab restrictions on men. At this point, the hijab establishes a gendered partnership.

Referring to Kandiyoti [32], various forms of patriarchy have presented different strategies for women, depending on the location of patriarchy, along with history and culture, including ethnicity, one of the factors that present bargaining opportunities. The Islamic perspective on the relationship between men and women corresponds to the values of Bugis-Makassar local wisdom, the milieu in which Wahdah Islamiyah was established and developed. The principle of gender partnership in the household in the local context of Bugis-Makassar culture is founded on *sibaliperri*, which means mutual support or *sipore'po*, mutual inconvenience, i.e. the same fate [50]. This principle demonstrates that men and women complement one another, and the partnership principle becomes a strength not only in the context of domestic sustainability but also in the context of organizing the social life of the community. Currently, men and women have essentially the same function, although in different areas. Reflecting on gender partnerships in Wahdah Islamiyah, where there is a confluence of interests with a supportive culture, expands the space for women to present themselves while maintaining awareness of signs of restriction.

CONCLUSION

The contribution of Muslim women to the Wahdah Islamiyah movement can no longer be considered merely as a complementary mission to the movement's da'wah, but also in terms of their ability to present themselves. On the one hand, the separation of work areas in the hijab concept restricts the role and authority because males hold positions of leadership. On the other hand, this component of hijab also imposes restrictions on males. The context of the Hijab has an impact on the ineffectiveness of patriarchal da'wah among Muslim women and must be responded to immediately by presenting Muslim women managing their own space. Men's limitations on the existence of the hijab's value are comparable to Muslim women's ability to present their opportunities amidst the growth of Wahdah Islamiyah's da'wah. It is imperative to highlight that the examination of patriarchal bargains shaping gender partnership patterns necessitates considering the context of the hijab. This context is influenced not only by external expectations but also by women's capacity to capitalize on opportunities and navigate their social environment in order to assume a greater position. Consequently, men are compelled to make concessions to accommodate this dynamic. While it is true that the present Salafism movement perpetuates patriarchal rule to some extent, it is important to note that the existing patriarchy is not the sole dominant force.

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Women's Struggle Against Patriarchal Values in it Ends With Us

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Abstract. Patriarchy which has become a social structure places women in a subordinate position where men are seen as the dominant party and have more power. This research aims to discuss how women struggle against patriarchal values which are represented in the novel *It Ends with Us* by Colleen Hoover. *It Ends with Us* tells the story of Lily Bloom who experiences domestic violence in her marriage and decides to leave her abusive marriage. The method used is descriptive qualitative. The collected data were analyzed using Hall's representation theory and Beavoir's women's struggle strategies to find out how Lily Bloom, Jenny Bloom, and Alyssa struggle against patriarchal practices represented in the novel and to find the critical position of the author, Colleen Hoover. The results of the research show that the three female characters struggle against patriarchal values by internalized otherness, by working, and by being an intellectual person. Colleen Hoover, as the author, appears to position herself on the women's side by encouraging women to struggle against patriarchal values.

INTRODUCTION

Patriarchy is a male-centered society. It prioritizes male perspective and experiences over other gender. Walby defines patriarchy as a social structure that supports men's domination by oppressing and exploiting women[23]. The phrase 'social structure' is important in her definition of patriarchy to emphasize that men and women are not being viewed and treated unequally because of their biology. Instead, me and women are being viewed and treated unequally because of the social construction of what it means by being men and women in society. The prioritization of men's needs, perspectives, and experiences causes the marginalization of other gender. Patriarchy is biased in the favor of men. It reinforces traditional gender roles and gender stereotypes that usually put women at disadvantage.

In the 21st century, patriarchal practices still continue. Despite the increasing number of women's employment, a survey done by Fortune found that there is only a small number of women who become the leader of the most prominent companies in the United States. Of 500 companies, there are only 44 companies that are led by women[13]. This number means, in spite of the increase of women entering the workforce, men are still dominating the higher positions in the company Another proof of the practice is A report by the Centers for Disease Control or Prevention (CDC) in 2016-2017. It informs that almost half of the women in the United States (47,3% women) have been abused by their intimate partners [17]. They are experiencing different forms of domestic abuse, such as being stalked, being physically and emotionally abused, and even being raped by their intimate partner. Men use violence against women to instill fear in their partners and eventually they gain power and control over their girlfriends or wives

However, women struggle to gain the equality that has been lost due to patriarchal values. in the United States the feminist movement has helped to ease the gender inequality which can be seen in the increasing number of women receiving higher education and women's employment[7]. Another struggle is through literary works. Literary works, as a cultural artifact, has a function to represent the condition of society[24]. Literary works such as novels cannot be separated from the influence of society because they are written by authors who are part of the society. One of the examples of literary works that reflects the women's struggle against patriarchy in the United States is a novel titled *It Ends with Us* by Colleen Hoover, published in 2016. The novel itself shows the life of Lily Bloom, the main female character, who

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030027-1–030027-8; https://doi.org/10.1063/5.0241598
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

experiences a dilemma and struggles to escape from her abusive marriage. The actions taken by Lili Bloom in this novel illustrate women's efforts to fight patriarchal values.

Based on the above conditions, the current research focuses on analyzing the representation of women's struggle against patriarchal values in *It Ends with Us*. Hall's representation theory and Beauvoir's strategy of women's struggle are employed in this research to analyze how women's struggle against patriarchal values which are represented through the dialogues and narrations of *It Ends with Us*. There are two questions formulated in the this research which are (1) how is women's struggle against patriarchal values represented in It End with Us? and (2) what is the critical position of Colleen Hoover as the writer of *It Ends with Us* towards the issue of women's struggle against patriarchal values?

Theory

A. Hall's Representation Theory

This theory allows the current research to understand how language can be used to represent various meaning and ideologies. According to Hall, the word 'representation' can be understood in two meanings. The first meaning is describing or depicting the portrayal or imagination of something within people's consciousness[11], as an example, one of the scenes in the BTS music video represents the feeling of hopelessness. The second meaning is symbolizing or substituting for a particular object. The example of this is the cross in the Christianity represents the suffering of Christ[11]. From the two meanings, representation can be understood as a process to produce or attach meaning to the concepts stored in people's consciousness through the use of language.

Hall further explains that the process of representation involves two representation systems which he calls as mental representation and language[11]. Mental representation refers to the conceptualization that people store in their consciousness. Meanwhile, language refers to the means to translate, produce, and exchange the meaning of the existing concept in our consciousness. These two systems play an important role in the process of representation. People from the same culture or community are more likely to have a shared conceptual map. However, to properly represent or exchange meaning of the concepts, they have access to a shared language. Therefore, when the two systems work together, the communication between the people can be more effective.

B. Women's Struggle

The belief of women are inferior to men exists due to society viewing women as an object or the Other to fulfill men's needs[4,22]. It causes an unequal dynamic between women and men which can lead to the oppression of women where they are being discriminated, oppressed, and victimized. In a patriarchal society, women are considered as the second class. This perspective constructs the stereotype that men are the superior gender group than women.

The term 'struggle' can be understood as fighting to achieve a goal[21]. Struggle means that humans are trying to overcome the challenge in their life. Women's struggle can be understood as women's action to fight the perpetrators who deny women's agency and reduce women to the status of the Other. There are four strategies to struggle that can be used by women to challenge the male domination[22]. Those strategies are as follows:

Women can work;
Women can be an intellectual person;
Women can participate in the transformation of society;
Women can refuse the internalized otherness.

METHODS

This research was conducted within the framework of gender studies which focuses on how women struggle against patriarchal practices The method used is descriptive qualitative. This method explains that data is in the form of words, either written and spoken, as well as visual images and the research object is described based on existing facts. The data were taken from novel It Ends with Us by Colleen Hoover, published by Simon &Schuster UK in 2016. From 36 chapters of the novel It Ends Us, there were only 9 chapters consisting the data about women's struggle against patriarchal values in It Ends with Us. Apart from that, other data were taken from articles, books, and internet sources related to the contextual background of women's struggle to fight patriarchal values in the United States and the contextual background of Colleen Hoover as the author of It Ends with Us. The analysis is based on Hall's representation theory and Beauvoir's strategy of women's struggle. When patriarchal practices persist in a time and place, resistance from those affected will arise in an effort to gain equality

RESULTS AND DISCUSSION

The Women's Struggle Against Patriarchal Values in *It Ends with Us*

The majority of the setting of the novel It Ends with Us takes place in the United States, particularly in the City of Boston. Boston is described as a place that symbolizes a better life as seen in the slogan "Everything is better in Boston" [14] which appears several times in the novel. It is also seen as a perfect city to for a restart as several characters in the novel move to Boston to start a new life. As an example, the main female character, Lily Bloom, chooses to move out of Maine to Boston. She decides to leave behind the bad memory of pain and abuse in her childhood and tries to create a good memory in Boston. However, her attempt to have a better life is face with some hardships. While she finds romance in Boston and achieves her dream to have a flower shop, she ends up in an abusive marriage. She is forced to understand why her mother never leave her abusive father by experiencing the abuse herself.

The craving to have power and control in patriarchal culture can be channeled through violence against women. It supports the superiority of men and perpetuates the culture of women's subordination. Furthermore, its existence is proof of how deeply patriarchal values is ingrained in society. Patriarchal values can be understood as a set of expectations to dictate the status and behaviors of men and women in society [8]. Patriarchal values can be seen in the bias towards rational traits over emotional ones, the admiration of women who become a mother, and the prioritization of family loyalty over other. Certainly, it reinforces the traditional gender stereotypes, gender roles, and family loyalty for men and women.

The women's struggle against patriarchal values in It Ends with Us is seen through the portrayal of Lily Bloom, Jenny Bloom, and Alyssa which is will be explained as follows:

The Struggle Against Gender Stereotypes

Gender stereotypes reflect general expectations of certain social groups or communities. It generalizes and simplifies the characterization of men and women in society[6]. The society attached which characteristics are deemed to be appropriate for men and women. As an example, men are expected to be dominant, assertive, rational, and strong while women are expected to be submissive, meek, nurturing, and emotional [25]. Gender stereotypes are shared by men and women in which they are expected to behave a certain way to be seen as a proper man and woman. However, it tends to affect women more negatively than men. As a result, women are often seen as an object of men's superiority.

Objectification is the result of reinforcing the gendered stereotypes of women which reduces women to a status of an object. The objectification of women happens early in the novel It Ends with Us. Ryle Kincaid becomes the main perpetrator of women's objectification in the novel. Since the beginning of their encounter, Ryle has been trying to seduce Lily and tempts her to have a one-night stand with him as seen in "He pulls his hands up behind his head and looks me straight in the eye, "I want to fuck you"[14]. He presents his proposition as a 'naked truth' to be seen as an appreciation of Lily's beauty.

> [1] He shoot me a look of innocence. "You asked for the most recent thought, so I gave it to you. You're beautiful. I'm a guy. If you were into one-night stands, I would take you downstairs to my bedroom and I would fuck you." I can't even look at him. His statement makes me feel a multitude of things all at once. "Well, I'm not into one-night stands" [14].

Data (1) shows a conversation between Lily and Ryle. It shows how Ryle objectifies Lily by reducing her to her physical appearance and to be a sexual object. In Data (1), Lily challenges the gendered stereotype of women as sexual objects and submissive by showing her disinterest to have a one-night stand. Another instance of women's objectification happens right after this one. It receives the same response as the first one with Lily stating her refusal to Ryle's proposition.

Despite having been rejected twice, Ryle's interest in Lily is not gone even after not seeing her for six months. At the beginning of the novel, Ryle is portrayed as someone who does not easily accept a rejection. In patriarchal culture, men have a thirst to maintain their superiority over others[2]. Control is a prominent tool for men to maintain their power. Ryle's inability to accept rejection is his way to hold as much control as he can. Tempting Lily to have a one-night stand with him has become a challenge that he needs to win.

> [2] “I still very much want to fuck you,” Someone gasps, and it isn’t me. Ryle and I both look at the doorway and Alyssa is standing there, wide-eyed. Her mouth is open as she points down at Ryle. “Did you just…” She looks at me and says, “I am so sorry about him, Lily.” And then she looks back at Ryle with venom in her eyes. “Did you just tell my boss you want to fuck her?” [14]

Data (2) shows the interaction between Lily, Ryle, and his sister, Alyssa. Six months after Lily and Ryle’s first meeting, they see each other again in Lily’s new flower shop. He continues to disrespect Lily’s opinion regarding the one-night stand by propositioning her for the third time. However, Alyssa chooses to interfere at the right time. As someone who is not involved in Ryle and Lily’s interaction, Alyssa can choose to not be involved in their business by being silent. As his sister, she can also choose to support Ryle’s intention in tempting Lily to accept his proposition. In spite of that, she chooses to show her disagreement towards Ryle’s behavior as seen in “she looks back at Ryle with venom in her eyes”[14]. Alyssa refuses to see other women being treated as sexual objects.

One of the strategies of women’s struggle is found through the actions of Lily and Alyssa in Data (1) and Data (2). Lily and Alyssa do not let the perspective of men to dictate how they should behave and how they should see themselves. It means that Lily and Alyssa are refusing their internalized otherness (Tong 2014). It is important to do because once they see themselves as the Other, they accept their status as sexual objects.

The Struggle Against Gender Roles

Gender roles refer to social roles associated with men and women that control the position of men and women in society [26]. The biological differences between men and women and gender stereotypes attached to each gender help determine what men and women should become. In a patriarchal society, Men are expected to be the head of their families and the primary breadwinners because they are associated with personalities such as strong and rational [25]. In contrast, due to their biology and being expected to be nurturing, women are expected to become a mother. Additionally, being expected to be submissive and being seen as an object, women are also expected to be loyal to their husbands.

Despite the increasing popularity of cohabitation, the majority of adults in the United States still consider marriage as an important stage in their life [15]. While there are benefits that people get through marriage such as companionship, more serious commitment with their romantic partner, and the feeling of safety, there is also negative part of marriage that can be experienced by women such as domestic abuse [12].

Throughout their relationship, there are three instances of Ryle being abusive towards Lily[14]. The first time happens before their marriage, while the second and the third time happens after they get married. In the first and second instances, Lily’s response to the abuse is asking Ryle to give her some space to think about what happened and choose to continue their relationship. Her decision is actually quite common in the victim of abuse. Many women, who become a victim, choose to stay in their relationship due to various reasons such as believing they are the ones to be blamed, believing their abuser is still a good person and can be saved, and they commit to stay married to their husbands for their entire life [5]. In the third instance, Lily chooses a different response.

> [3] “Ryle?” When he glances at me, he’s smiling. But when he assesses the look on my face, he stops. “I want a divorce” [14].

Data (3) shows a conversation between Lily and Ryle which portrays her decision regarding their marriage. Besides her own safety, the existence of their daughter also motivates Lily to divorce him. As someone who spends her childhood witnessing her father’s abusive behavior toward her mother, Lily understands that it was not the right environment to raise a child. Her decision to divorce Ryle is due to her desire to give herself and her daughter a chance to have a better life. This decision shows that Lily can refuse internalized otherness [22]. Because she rejects the status of the Other, she is able to prioritize herself over the happiness of her husband.

Another expected role of women is becoming a mother. The desire to become a mother is indirectly forced on women when they are still a child. Children in the United States are socialized into particular gender roles from a very young age. One of the examples of gender socialization to children is children's toys that are gendered. Many parents in the United States are doing gender socialization to their daughters by giving them toys like baby dolls, dolls house, and cooking toys[1]. This socialization is effective in influencing women’s desire to become a mother. When women are being taught that they are expected to get pregnant and become a mother, having difficulty conceiving can have negative consequences on women, especially on their mental health[20].

> [4] “Alyssa? Why do you work here?” “Because I can’t get pregnant. We’ve been trying for two years but nothing has worked. I was tired of sitting at home crying all the time. So I decided I should find something to keep my mind busy.”[14].

Data (4) portrays a conversation between Lily and Alyssa regarding Alyssa’s reason to work in Lily’s flower shop. It shows that Alyssa’s difficulty puts her in distress which causes her to cry all the time. According to Beauvoir, another way for women to struggle is by going to work[22]. Alyssa’s job in the flower shop helps her to overcome her situation.

The Struggle Against Family Loyalty

Glebova and Gangamma define the term ‘family loyalty’ as a sense of duty to cherish and prioritize the members of the family [10]. The loyalty of the parents toward their children can be understood as a commitment to taking care and providing for the needs of their children. Meanwhile, the loyalty of the children towards their parents can be understood as a commitment to return what the parents have given to them. Their repayment is not always in the form of something that has a monetary value, but it can also be in the form of a sense of duty to love, support, and respect their parents [18].

Another female character who experiences abuse is Lily’s mother, Jenny Bloom. Throughout her marriage with Andrew Bloom, Jenny never tries to leave or even report the abuse to authorities. By not reporting Andrew’s abusive behavior to the police, Andrew is still seen as a respected figure. Andrew needs a good image in public to keep his position as mayor of Plethora. The only people who know about Andrew’s abusive behavior are himself, Jenny, and Lily. Growing up seeing all the abuse, Lily never sees Andrew as a respected father figure as seen in “I spent most of my life hating him for being such a bad person” [14]. Jenny, as a wife and a mother, wants Lily to have a good relationship with her father. Because of this, she finds herself downplaying and not acknowledging his abusive behavior in front of Lily even after Andrew died and Lily has become an adult.

However, after knowing that Lily ends up in an abusive marriage, Jenny decides to talk to Lily about her experience as a victim of Andrew’s abusive behavior.

> [5] “The first time your father hit me, he was immediately sorry. He swore it would never happen again. The second time he hit me, he was even more sorry. The third time it happened, it was more than a hit. It was a beating. And every single time, I took him back. … Don’t be like me, Lily. I know that you believe he loves you, and I’m sure he does. But he’s not loving you the right way. He doesn’t love you the way you deserve to be loved” [14]

According to Beauvoir, one of the strategies for women to struggle is to be an intellectual person[22]. As intellectual people, women can promote changes for themselves and other people. Data (5) shows Jenny’s action as an intellectual person. By talking to Lily about Andrew’s abusive behavior, she tries to help Lily understand that any kind of abuse cannot be justified and she deserves to have a happier life.

The Critical Position of The Author

Colleen Hoover is an American author who writes fiction in the young adult genre. She becomes more popular after her book, It Ends with Us, is recommended by BookTok (Book TikTok) in 2020. She was born in Sulphur Springs, Texas on December 11th, 1979. After graduating from high school, she got married to William Hoover and started to have children when she was around 20 years old. She and her husband struggled financially, so she decided to get a job that could help her pay the bills. To support her chosen career, she attended college in Texas A&M Commerce and graduated in 2004 with a degree in the field of social work. Before starting to write her first book, she worked as a social worker in Child Protective Service (CPS).

Hoover seems to have a unique concept for her books. Most of her books explore dark themes such as sexual assault, toxic masculinity, and abusive relationship. As an example, the novel It Ends with Us itself explores the issue of domestic abuse. She has said in multiple interviews that the novel was written based on the abusive marriage of her parents, specifically her mother’s experience going through a difficult situation like domestic abuse. Additionally, her experience working as a social worker in CPS also had some influences on the writing of It Ends with Us[19]. As a social worker in CPS, she dealt with lots of domestic abuse and sexual abuse cases. Her mother’s story is reflected in the narration of It Ends with Us. For example, the first time Lily experiences abuse as an adult happened in her kitchen. This scene is similar to what her mother experienced in her marriage. She was abused for the first time by her husband in their kitchen.

Hoover has a close relationship with her mother. Her admiration of her mother can be seen in how she talked about her mother in the interview.

> "There was no resources for women to leave a situations like that," she continues, adding her mother divorced her father when she was 2. "She was able to get out of that relationship. And then from then on, I just remember growing up with a mother who was so strong and independent" [16]

To Hoover, her mother is one of the strongest women that she knows. Her mother is the closest person to her that had experienced the result of how men think that they are entitled to have power by dominating women through domestic abuse. She admires her mother's strength and determination to escape from her abusive marriage, despite the unavailability of resources, in order to have a better future for her and her two daughters. Hoover, revealed in the author's note of It Ends with Us, fashioned the characterization of Lily after her mother. They are intelligent, caring, and strong women [14].

> I look at Emerson and I look at Ryle. And I know that I have to do what's best for her. … I don't make this decision for me and I don't make it for Ryle. I make it for her. "Ryle?" When he glances at me, he's smiling. But when he assesses the look on my face he stops. "I want a divorce" [14]

The influence of her mother is prominent in Hoover's portrayal of Lily. Lily shares some similarities with her mother. Both of them end up in abusive marriages and they also have daughters. Lily and Hoover's mother are also motivated by the existence of their daughter when they decided to divorce their abusive husbands. Through her portrayal of Lily, she wanted to depict the image of strong women who are able to face their hardships.

The reinforcement of gender stereotypes and gender roles in patriarchal culture contributes to the objectification of women. Reinforcing the harmful gendered stereotypes has reduced women to their bodies and physical appearances. The objectification of women happens in many countries, including the United States. One of the examples is the video obtained by The Washington Post in 2016. The video shows the presidential candidate at the time, Donald Trump, with the Days of Our Lives star, Billy Bush, making lewd comments about one of the actresses of Days of Our Lives. Trump shared his view of women as sexual objects by saying "Grab them by the pussy, you can do anything" [9]. His comment caused an uproar among a lot of women. In response to his objectification comment, the pink pussy hat movement appears during the Washington Women's March [8]. Many women in the marches wear knitted hats with two ears that resemble a cat in the color pink. They proudly wear the hats to reclaim the term "pussy" that has been used to disrespect and shame women.

In writing her books, Hoover tends to write the issue that happens in real life [3]. The objectification of women is also found in the novel It Ends with Us. Lily is the female character who is directly objectified by Ryle on multiple occasions. While it is directed toward Lily, another female character is also portrayed to challenge the objectification of women.

> "I still very much want to fuck you." Someone gasps, and it isn't me. Ryle and I both look at the doorway and Alyssa is standing there, wide-eyed. Her mouth is open as she points down at Ryle. "Did you just …" She looks at me and says, "I am so sorry about him, Lily." And then she looks back at Ryle with venom in her eyes. "Did you just tell my boss you want to fuck her?" [14]

Even though Lily is the only female character who is fashion after her mother, Hoover's admiration of her mother characteristic is also influenced the portrayal of other female characters in the novel. Alyssa shows her caring and strong personality when by showing her displeasure toward her brother when he objectifies Lily in front of her. Alyssa's action is important and powerful to show that women are not alone in facing this issue.

Through the depiction of the female characters in It Ends with Us, Colleen Hoover is assumed as someone who sides with women. She positioned her characters to be able to face the difficulty of living in a male-dominated society even though it is not easy in real life. She wants to encourage women to struggle against patriarchal values and to encourage women to show their strength just like Jenny's message to her daughter, Lily "Be that girl, Lily. Brave and bold." [14].

CONCLUSION

There are several points in this discussion. First, the representation of women's struggle against patriarchal values in It Ends with Us shows that the female characters, Lily Bloom, Jenny Bloom, and Alyssa have struggled against the traditional gender stereotypes, gender roles, and family loyalty using three strategies of women's struggle. Those strategies are by refusing their internalized otherness, by going to work, and by being an intellectual person. Second, Colleen Hoover fashioned the female characters in the novel after the personality of her mother who is caring, intelligent, and strong. The critical position of Colleen Hoover towards the issue of women's struggle against patriarchal values is assumed to encourage women to struggle the hardship in a patriarchal society.

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Persuasive Communication in Religious Tolerance in Minority Areas in Indonesia

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Abstract

Tolerance is a mindset and behavior that forbids prejudice towards various groups or groups within a community. Religions that uphold the authenticity and veracity of Islamic teachings include Islam, which instructs people to constantly respect and tolerate others. One of the cities in Indonesia that the government has named a city of tolerance is Kupang. Kupang is a municipality which is also the capital of East Nusa Tenggara (NTT) Province, where the Muslim population, including converts to Islam, is only 5% (minority) among the non-Muslim community. The purpose of this study is to determine the effectiveness of communication in promoting religious tolerance in Indonesian minority communities. The research methodology is interpretive and qualitative. FGD, literature research, in-depth interviews, and observation were the methods utilized to acquire the data. Data analysis method for interactive models. The study's findings indicate that religious tolerance in Kupang is running very well. The relationship between Muslims and non-Muslims is harmonious, helping each other, mutual cooperation, and mutual respect for each community's worship processions and major religious events. Large religious events are mutually supervised and shared equally between Muslims and non-Muslims. Even though Muslims only make up 5% in the Kupang area, this does not mean they are a minority among the majority. However, it cannot be denied that conflicts have occurred due to misunderstandings between Muslims and non-Muslims due to a significant lack of communication. Overall nevertheless, Kupang's tolerance for many religions fosters a safe, peaceful, and harmonious environment.

INTRODUCTION

East Nusa Tenggara (NTT) has 4,683,827 residents, the majority of whom are Christians. The composition of religious adherents is 1,627,157 Catholics, 2,535,937 Protestants, 423,925 Muslims, and 5,271 Hindus (BPS NTT, 2022). Of the 20 districts and 1 city in NTT, there are 3 city districts that directly border the country of Timor Leste, namely Belu Regency and Rote Ndao Regency, which borders the Timor Sea (Timor Leste). Since 2015, Belu Regency has been divided into Malacca Regency. The composition of the population based on religion in Belu Regency (before it was expanded) was 316,480 Catholics, 25,055 Protestants, 9,716 Muslims and 425 Hindus. Meanwhile, Rote Regency has 112,501 Catholics, 2,033 Protestants, 5,141 Muslims and 75 Hindus. With this Muslim population, Belu Regency has 29 Koran instructors/teachers, four preachers, 30 khatibs and 7 ulama. Discovering the effectiveness of communication in promoting religious tolerance in Indonesia's minority communities is the goal of this study. The urgency of this research, academically, is to examine persuasive communication theory applied in minority areas, especially building relationships and religious tolerance. Meanwhile, the practical urgency is to provide an overview of religious tolerance through interaction and persuasive communication between the Muslim community and converts to Islam and the non-Muslim population.

There are many rumors circulating that Islam is radical, intolerant, and bigoted. Islam is full of violence, so it is far from peaceful. One of the cities in Indonesia that the government has named a city of tolerance is Kupang. Kupang is a municipality which is also the capital of East Nusa Tenggara (NTT) Province, where the Muslim population, including converts to Islam, is only 5% (minority) among the non-Muslim community. The city of Kupang is called a city of tolerance because it is known to possess a high threshold for tolerance.

Olson and Zanna define persuasion as a change in attitude resulting from exposure to information from other people. Sedlovskaya et al., wrote that the division of life into public and private spheres is a defining characteristic of modernity [1]. However, this active self-monitoring or concealment affects a large proportion of people with stigmatized identities who may experience negative consequences if the stigma becomes public. A segmented self

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030028-1–030028-5; https://doi.org/10.1063/5.0242355
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

(as opposed to an integrated self) can threaten one's well-being and is associated with vulnerability to depression. The goal of persuasive communication is to persuade or transform someone's convictions, dispositions, and conduct in order to act as expected by the communicator. Meanwhile, according to Fisher, persuasive communication is a tool to influence society and change the attitudes of its recipients. What needs to be paid attention to in communication is not only the words but also the condition of the communicator himself. According to Larson, persuasive communication means having equal opportunities to influence each other, informing the audience about the purpose of persuasion, and considering the presence of the audience. The term persuasion comes from the Latin word persuasion, which means to persuade, invite or seduce. Persuasion can be done rationally and emotionally, usually touching on the affective aspect, namely things related to emotional life, usually touches on the affective aspect, namely things related to a person's emotional life. Through emotional means, a person's aspects of sympathy and empathy can be aroused.

According to Aristotle, communication is built by three fundamental elements, namely the person who speaks, the material they produce, and the person who listens. The elements of persuasive communication consist of: 1) ***Persuaders***. 2) ***Persuadee***. 3) **Perception**. 4) **Persuasive Message.** Message is what the communicator says through words, gestures and tone of voice. It consists of the disposition when speaking, the arguments and considerations used, as well as the material presented. In a narrower context, the choice of words and nonverbal signs, together constitute the presentation/display of the message. In a broad concept, a message is anything that provides understanding to the recipient. So, in this case it includes words, movements, body, tone of voice, the recipient's reaction to the content of the message, the media, the source as a person, to actions and/or non-actions that occur in society. Messages are closely related to the response-stimulus, stimulus-response mechanism. Messages can be dynamic because of active actions from persuaders and persuaders. 5) **Persuasive Channels.** 6) **Feedback and Effects.** Individuals react to form certain attitude patterns [2].

Due to the presence of local wisdom as cultural capital and legacy, religious communities can coexist peacefully. Muslim, Hindu, and Christian religious adherents all hold the same progenitor to be their ancestry. Different religious groups coexist peacefully, even within a single household. Due to the presence of local wisdom as cultural capital and legacy, religious communities can coexist peacefully. Muslim, Hindu, and Christian religious adherents all hold the same progenitor to be their ancestry. Different religious groups coexist peacefully, even within a single household [3]. Hindus use community development initiatives to fortify their religious foundations and raise religious consciousness as part of their institutional strategy for preserving harmony. The research's findings suggest that Hindus should be more conscious of the need to preserve harmony among the variety of populations residing in outlying areas [4]. Science provides the best radar for the most ideal social development, enhanced by the philosophical underpinnings of culture and religion [5].

Rousseau's interpretation of soft power entails winning over the contemporary religious notion of soft power [6]. the idea that ethnic diversity can harm social cohesiveness by conducting an empirical investigation into the body of research on the connection between ethnicity and multiculturalism on a global scale. The analysis focuses on how Canadian society views various ethnic groups in order to gauge the extent of ethnic intolerance [7]. There is harmony and balance between Islam and the Jalawastu heritage. People's everyday lives make this evident. They both adhere to Islamic principles and uphold ancestors' customs. These rituals have endured for a very long time, even in this modern period, since people are loyal to their traditions [8]. Compared to students at Islamic boarding schools, Muslim students attending state schools and madrassas are noticeably more tolerant, and both student groups exhibit equivalent levels of tolerance [9]. Maintaining a multiple culture through multicultural education is crucial to preventing conflicts that cause disagreements and rifts [10].

The construction of mosques was controversial because certain religious and political elites saw mosques as instruments of political domination. After the elites of the New Order endorsed the mosque's construction, the debate diminished [11]. The current state of affairs indicates a loss for the rights of religious and cultural minority groups. Intercultural competency and local wisdom play a crucial role in fostering tolerance [12]. In many parts of the world, managerial conduct is influenced by religious observance. Certain aspects of the negotiation process benefit from the negotiators' shared religious commitment [13]. In today's socio-scientific discourse, concerns over the effects of cultural ignorance and bigotry are common. Misunderstandings and divisions between individuals from diverse ethnic, racial, religious, and cultural origins arise due to inappropriate socio-political, psychological, and cultural circumstances [14]. The intersection of religion and ethnicity reflects distinct cultural underpinnings and engages in communicative persuasive action. Intersection of religion and ethnicity reflects distinct cultural underpinnings and engages in communicative persuasive action [15]. Due to the delicate and complicated nature of religion, it is crucial to fortify the bonds that exist across religious groups. With radicalism becoming a bigger problem in Indonesia, this contribution is extremely important [16]. Younger generations are devoted to ideals that reject radicalism, and when they are faced with difficult decisions, dissonance arises in their dedication to ideals and group identity [17]. People who feel superior to others often get irritated and try to control the conversation [18].

When the demographics of the target audience fit the message's theme and structure, populist communications will have greater impact. Reading communications phrased in a populist manner as opposed to a pluralist one caused people who were more fearful of social concerns to display more populist sentiments, and populist messaging also led to politicians assigning more blame to themselves [19]. Populist discourse as a framework for identity The spread of populist political discourse is crucial to the emergence of populist beliefs [20]. Based on constructive pluralism, which allows students to respect their views while comprehending, tolerating, and dealing with those who hold different opinions, pluralistic Islamic religious education has grown in Indonesia [21]. Islamic education textbooks have the potential to promote and encourage intolerance among pupils who may misidentify them with Islamic doctrines [22]. Although linguistic similarity is not truly isomorphic to overall similarity assessments, narrative character accents are a powerful indicator of similarity judgments [23]. Studies that look at how religious people's preferences relate to how they deontologically evaluate ethical circumstances. When considering ethical arguments for mitigating the effects of climate change, deontological arguments are generally viewed by religious respondents as more persuasive than utilitarian ones [24]. Given the diversity of religions and beliefs practiced by Indonesian society, tolerance for plurality is essential. Respect for diversity can be fostered through religious education, which can be quite effective. In terms of encouraging respect for plurality and cultivating favorable attitudes in students toward plurality, religion education plays a very high-quality role in higher education. By encouraging them to participate in interfaith discussions or visit sites of worship, lecturers help students develop a greater tolerance for adherents of different religions [25].

METHOD

A qualitative research methodology is used in this study. Data collection was carried out through focus group discussions, observations and in-depth interviews with two priests in Rote, five congregations, two non-Muslim Malacca residents, and three preachers. Research employing inductive reasoning is known as qualitative data analysis. Data activities are carried out continually until completion, until the data is saturated, according to the interactive model data analysis technique. The data analysis process consists of the following stages: 1) Reduction of Data. In order to clean up the image and facilitate the collection and retrieval of additional data, researchers must compress their data by summarizing, identifying key points, concentrating on what matters, and searching for themes and patterns. 2) Data Display. Examining the data comes next, following data reduction. Data presentation in qualitative research may take the shape of flowcharts, charts, flow descriptions, and other similar visual aids. It will be simpler to comprehend what occurred and plan future work based on the understanding gained by going over the facts. 3) Determining and validating conclusions.

RESEARCH RESULT

Based on observations and in-depth interviews with three preachers, five congregations, two pastors in Rote, and two non-Muslim residents in Malacca, it can be identified that religious harmony and tolerance in Kupang has been going well and is in the tolerant category. Related to the implementation of worship, if anyMajor Muslim religious events are guarded by police with Christian identities to oversee the implementation of the event. Likewise, vice versa, if there is a Christian event, then Muslim brothers will supervise the implementation of the event. So it can be concluded, each of them maintains each other's comfort in tolerating. For example, during Idhul Adha, Christians and Catholics also share sacrificial ivory, even eating it together in the homes of Muslims and non-Muslims. This was said by informants, both Muslim and non-Muslim, as a means of strengthening relationships and establishing friendship. So it can be said that the relationship between Christians and Muslims is very close. Distribution of sacrificial animals to non-Muslims during Eid al-Adha, as a bond of love, which can show the high level of tolerance among religious communities in Kupang. In fact, non-Muslim widows are often given rice by Muslims, and vice versa.Religious harmony is very conducive and there is no friction. Muslim residents state that religious life respects each other and Muslims often help and work together in social life. It is proven that every Christmas celebration, Muslim citizens help maintain the safety and comfort of non-Muslim citizens in celebrating the holy night. Muslims always share with non-Muslims fairly and equally.

Even though Muslims are a minority population (only 5%), they do not hesitate to help or donate to non-Muslim families if they experience a disaster or are having an event.WNon-Muslims do not feel disturbed by the sound of the call to prayer and the recitation and reading of the holy verses of the Koran using loud speakers. The strains of holy verses and lectures sung by preachers and Muslim congregations are even able to shake the hearts of some non-Muslims who find serenity to be peaceful and comfortable. What's interesting is that it turns out that the sound of the call to prayer, especially the morning call to prayer, according to non-Muslims, actually helps Christians and Catholics to wake up in the morning. So that it can be felt that all Muslims and non-Muslims can live in harmony and respect each other. Through persuasive and assertive communication it can help to build relationships and approach Catholic and Christian religious figures more optimally in order to create empathy and tolerance so that all religious activities can be supported jointly and comprehensively. Even though tolerance has been going well, occasionally there have been conflicts between Muslims and non-Muslims due to lack of communication. For example, when non-Muslims marry Muslims and then convert to Islam, sometimes if it is not communicated well, it will cause family conflict. But such problems can be resolved well when two families sit together to discuss.

CONCLUSION

Religious tolerance in Kupang is going very well. The relationship between Muslims and non-Muslims is harmonious, helping each other, mutual cooperation, and mutual respect for each community's worship processions and major religious events. Large religious events are mutually supervised and shared equally between Muslims and non-Muslims. Even though Muslims only make up 5% in the Kupang area, this does not mean they are a minority among the majority. However, it cannot be denied that conflicts have occurred due to misunderstandings between Muslims and non-Muslims due to a significant lack of communication. However, comprehensively, religious tolerance in Kupang is very conducive and creates an atmosphere of safety, comfort, harmony and tranquility.

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Women and Cultural Heritage: Traces of Guardians and Heirs

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Abstract. The role of women in preserving and inheriting cultural heritage has long been an important aspect of societal development. However, this role is often overlooked or forgotten in historical and cultural narratives. This paper explores the important role of women in preserving and passing on cultural heritage in the context of globalization and contemporary issues. The role of women in traditional societies and cultures covers various aspects, such as the role of women in rituals, oral traditions, arts, and cultural education. Women are involved in the maintenance and transmission of cultural practices through informal education and practical learning. This paper also covers how women are the inheritors of cultural values and knowledge. Women play a role in cultural preservation through the development of traditional skills and creative interpretation. A number of initiatives and programs can support women's role in cultural preservation, such as cultural skills training, cultural entrepreneurship development, and community groups. Based on these, women have a central role in maintaining and passing on cultural heritage. Despite global challenges and changes, women continue to strive to maintain cultural identity and pass on noble values to future generations. Through the support of community initiatives and awareness, the role of women in preserving culture can be further strengthened and appreciated.

INTRODUCTION

The role of women in preserving and inheriting cultural heritage has long been an important aspect of societal development. However, it is often overlooked or forgotten in historical and cultural narratives. History has recorded many instances where women have played a central role in maintaining and inheriting cultural values, but their contributions have not been fully recognized. The dedication of women in preserving cultural heritage should no longer be overlooked. Their contribution in maintaining the cultural identity of a society has a profound and long-term impact [1]. Women's dedication in the roles of leaders, guardians of traditions, and inheritors of knowledge has shaped the cultural foundation of a society and contributed significantly to collective identity.

Women have long been a key pillar in maintaining and passing on cultural traditions [2]. However, history has often obscured this important role. We can see how women have pioneered cultural change and led movements that transformed the social fabric. From civil rights struggles to environmental protection advocacy, women have demonstrated their unique ability to lead and inspire positive change. In addition, women also play a central role in preserving traditional values. They are the custodians of oral traditions, local knowledge and ritual practices inherent to a community's cultural heritage. In addition, women are also responsible for the process of passing on values and knowledge to future generations, thus ensuring the continuity of a rich and diverse culture.

This theme is increasingly relevant in an era of globalization, where communities around the world are faced with the challenge of maintaining their cultural identity in the face of homogenization. Therefore, it is important to explore the role of women in preserving and inheriting cultural heritage to ensure the sustainability of local cultures and global cultural diversity. This paper aims to explore the various roles played by women in the context of cultural heritage. We will look at how women have been custodians of precious traditions and inheritors of invaluable values in various cultures. This topic is particularly relevant in today's global context, where women's roles and contributions are

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030029-1–030029-8; https://doi.org/10.1063/5.0241672

increasingly recognized and valued. Understanding the role of women in preserving cultural heritage can provide a more comprehensive view of social, cultural and identity development.

Women in Cultural History

Women have played a central role in traditional societies and cultures throughout history. They are often the backbone of the family, holding important responsibilities in managing the household and educating children. In addition, women also have a key role in maintaining and preserving cultural traditions that are passed down from generation to generation. Women as guardians of cultural traditions have a profound impact on the collective identity of a society [3]. However, cultural norms also need to be critically examined in order for women's full potential to be realized. Women have played an important role in cultural history from ancient times to modern times. They have shaped culture, art, religion, politics and society with profound influence. Their role in producing art, maintaining ritual practices and passing on local knowledge has given color and depth to a community's cultural heritage. For example, in many Asian cultures, women are often regarded as "keepers of the flame" or guardians of family harmony. They play a role in maintaining family values and keeping family members united. In indigenous tribal societies, women often serve as recorders and transmitters of oral stories that contain the history and cultural identity of the community.

While women have a very important role in preserving culture, the influence of culture on women's roles must also be considered. Sometimes social norms and cultural traditions can limit women's potential, prevent them from accessing education, or hinder active participation in the public sphere. The role of women in preserving cultural heritage is crucial in maintaining the continuity of rich cultural traditions and identities [4]. Therefore, it is important to analyze how cultural norms can shape and influence women's roles and contributions in maintaining and inheriting cultural heritage.

Women as Guardians of Tradition and Cultural Identity

Women play a crucial role in preserving culture in many profound and diverse ways. One of their main roles is as custodians of oral traditions. Through stories, songs and tales, women have preserved the historical narratives, myths and cultural values attached to their communities. These stories provide a window into the past and help pass on cultural roots from generation to generation. The role of women in maintaining oral traditions is crucial as they are the living recorders of the ancestral stories that form the cultural basis of a community [5]. They are historically responsible for maintaining and passing on values, norms, customs, language, dance, music and other aspects of culture from generation to generation. This role is important in maintaining the continuity and identity of a community. In addition, women also play an important role in maintaining and preserving cultural ritual practices. These practices include traditional ceremonies, dances and religious rituals that have existed for many years. Women are often the main actors in these rituals and serve as the guardians of cultural authenticity and distinctiveness. Women as key actors in cultural ritual practices prove that they are the real guardians of ancestral values and the soul of the community. It is important to remember that women's role as custodians of tradition and culture is not only limited to the preservation of traditional aspects, but also includes innovation and adaptation into an evolving context. Women often bring new perspectives and creativity in preserving and enriching cultural heritage.

In conclusion, women have a very important role as custodians of tradition and culture in society, both in maintaining and passing on traditional values and in bringing innovations that enrich cultural heritage. This is reflected in their responsibility to transmit ancestral values, knowledge, rituals and wisdom to the next generation, thus ensuring the continuity and diversity of cultures around the world.

Maintenance of Oral Traditions and Rituals

Women have a very important role in the maintenance of oral traditions and rituals that are an integral part of a society's culture. Oral traditions include stories, songs, poems and tales that are passed down through generations. Women often serve as storytellers and guardians of these stories, ensuring that the values, experiences and history of the community remain alive and relevant. Similarly, women contribute to maintaining and passing on cultural rituals. The rituals performed by women in our culture are a living link between generations, connecting the past with the present and future. These rituals include religious celebrations, traditional ceremonies and traditional dances that shape cultural identity. Women often take on the role of ritual custodians, introducing younger generations to practices that have been carried out for centuries.

The role of women in the maintenance of oral traditions and rituals is important and diverse, reflecting the diversity of cultures around the world. Women often serve as custodians of local wisdom and conveyors of cultural values through stories, songs, prayers and rituals. They become custodians and bearers of traditions, transmitting traditional knowledge, myths and history to the next generation. Women are also often key figures in religious rituals or traditional beliefs, such as ceremonial leaders, worshippers and keepers of secret knowledge. They have a key role in maintaining and passing on ritual practices that include preparation, execution, and interpretation of the meaning of the ritual. The maintenance of oral traditions and rituals by women makes a significant contribution to sustaining cultural heritage and strengthening the identity of local communities.

Women also play a key role in shaping and developing narratives and symbolic interpretations in oral traditions and rituals. They have the expertise to understand and interpret the deep meanings behind traditional rituals, myths and stories. traditional stories. In many cultures, women are often the keepers of secret knowledgerelating to rituals and spirituality. They may have special authority and expertise in leading certain rituals, teaching ethics, and connecting between nature, humans and spirits.

Not only as custodians of tradition, women also play a role in shaping the adaptation and evolution of oral traditions and rituals. They can bring innovations, incorporate new elements, and integrate more modern values without losing the essence of the inherited traditions. By assuming this role, women help keep traditions alive, relevant and pertinent to a changing society. In the contemporary context, women also have an important role in recording, documenting and preserving oral traditions through modern media such as audio, video and written recordings. Thus, women simultaneously contribute to the preservation of oral traditions and rituals and their adaptation into a changing world.

Role in Art and Artistic Heritage

Women also have an important role in preserving the art and artistic heritage of a culture. They are often the custodians of traditional arts such as weaving, embroidery, carving and other handicrafts. These skills not only have aesthetic value, but also contain deep cultural values. In addition, women are also often the main actors in dance, music and other cultural performances. Their performances bring the soul of the culture to the surface and provide continuity to artistic expressions that have existed for centuries.

There is a strong connection between the guardian role of women and cultural heritage. Women play a role in preserving and maintaining aspects of culture that are often pillars of a community's identity. Through the maintenance of oral traditions and rituals, women not only preserve cultural stories and practices, but also provide a bridge between the past and the present. In the context of art and artistry, women are the custodians of fine arts and cultural performances. Women as custodians of culture are the pillars of the sustainability of a community's cultural heritage. They nurture the roots of culture that grow from oral tradition and art. Artworks created by women contain deep stories and meanings, reflecting the values and worldview of their society. Through the performance of art, women give voice to cultural heritage and pass it on to future generations.

WOMEN AS INHERITORS OF CULTURAL VALUES AND KNOWLEDGE

Women play an important role as inheritors of cultural values and knowledge. They are the teachers who transmit knowledge of traditions, morals and ethics to future generations. They not only hold the responsibility of passing on cultural traditions and values, but also play a role in educating future generations about the cultural heritage that has existed for so long.Women often act as a link between the past and the future, bringing values that have been inherited from the ancestors and applying them in a modern context.

Women have a very important roe as inheritors of cultural heritage. They have played a central role in preserving, passing on and promoting cultural heritage through various means. These include the preservation of traditions, ethnobotanical knowledge, arts, and crafts, as well as the preservation of folklore and language. One quote that illustrates the role of women as inheritors of cultural heritage can be found in the book "Women, Gender and Art in Asia, c. 1500-1900" written by Himani Bannerji:

> "Women have often played a central role in the transmission of culture and knowledge, not only in their domestic roles but also as cultural producers, musicians, artists, and storytellers. Their contributions to the preservation of cultural practices and traditions are immeasurable [6]."

The above quote reflects how women have played an important role in preserving cultural heritage and knowledge in various fields of art and culture around the world. They have contributed significantly in maintaining traditions and passing on cultural values from generation to generation.

Transfer of Knowledge Between Generations

The role of women in society is as custodians of cultural traditions. They play a key role in transmitting traditional values, knowledge and wisdom from one generation to the next [7]. Knowledge transfer between generations is the process by which women as cultural heirs transfer cultural knowledge, stories, skills, and values to the next generation. It involves women's active involvement in teaching, speaking, and interacting with children and youth to ensure that cultural knowledge is not lost or forgotten. This process enables new generations to understand their cultural roots and appreciate the heritage that has been passed on. The transfer of knowledge between generations by women is a valuable investment in the future of culture. They carry the important task of ensuring that cultural heritage lives on in the minds and actions of younger generations [8]. Women are often responsible for the transmission of culture from one generation to the next. They are the custodians of the stories, songs, rituals and values that make up the identity of a society.

Knowledge Transfer Between Generations through Education

Education has a significant role in preserving and passing on cultural heritage. Women as inheritors of cultural values utilize education to transfer knowledge in a more structured manner to the younger generation. Through the education system, women can teach about history, tradition, art and cultural values to children and youth. Education is a vital tool in passing on cultural knowledge from women as inheritors to the next generation. Education opens the door for the younger generation to explore and appreciate the rich cultural heritage [9].

By including cultural heritage in the education curriculum, women help the younger generation understand their cultural roots and appreciate the importance of preserving that heritage. Education also provides a platform for women to guide the younger generation in developing appreciation and skills related to culture. In addition, a female writer and activist, Malidoma Patrice Somé, also emphasizes the role of women in maintaining cultural heritage. Women are the keepers of the flame of tradition and culture. They nurture children and lead in the transfer of ancestral knowledge, rituals and wisdom to the younger generation [10]. The role of women as inheritors of cultural values and knowledge can be seen in the table below.

TABLE 1. Women's role as cultural heirs

No.	Aspects	Women's Role As Cultural Heirs
1.	Education	Women as teachers, educators and lecturers bring cultural traditions, values and knowledge to the younger generation through the education process.
2.	Art and the Arts	Women as artists, dancers, musicians and craftsmen carry the legacy of art and culture through their works.
3.	Literature	Women as writers, poets, and storytellers immortalize stories and cultural traditions in the form of writing, poetry, and other literary works.
4.	Customs and Ceremonies	Women play an important role in maintaining and carrying out traditional customs, religious ceremonies, weddings and cultural rituals.
5.	Language and Dialect	Women as speakers and custodians of local languages, dialects and accents ensure the preservation and use of traditional languages in their communities.

Case Study: Young Women as Cultural Heirs

The role of young women as cultural heirs has important implications in maintaining, reviving and developing the cultural heritage of a community. The following case studies illustrate how young women can be key agents in passing on and preserving culture:

Case Study: Young Women in Traditional Dance Maintenance in Bali, Indonesia

On the Indonesian island of Bali, traditional dance is an integral part of the community's culture and identity. Young women in Bali have a crucial role in preserving and passing on the heritage of traditional dance. They are not only the dancers, but also the keepers of the movements, costumes, and cultural meanings associated with each dance.

Young women as inheritors of traditional dance culture bring freshness and innovation, but also maintain the continuity of cultural heritage that has existed for centuries. In a study conducted by Agung Putri Darmayanti, a cultural anthropologist, young women in Balinese villages were involved in the process of learning traditional dance from an early age. They learn from older generations, including their mothers and grandmothers. Knowledge of the movements, songs and meanings in each dance is passed on through hands-on training and through oral tradition. These young women are also active in local cultural performances, including traditional ceremonies, festivals and other community events. They bring new energy and vibrancy to the interpretation of traditional dances, but still respect the values and meanings present in their culture.

MODERN CONTEXT AND GLOBAL CHALLENGES

Globalization has had a significant impact on the cultural heritage of a society. Global integration in the form of trade, technology and communication has brought about changes in the way of life and worldview. However, globalization also brings challenges to preserving and maintaining the integrity of traditional cultural heritage. Globalization brings an influx of outside cultures that threaten the sustainability of local cultural heritage [4]. We need to embrace change while still honoring our cultural roots.

The influence of outside cultures coming in through media, consumer products and lifestyles can undermine aspects of unique local cultures. People can be influenced to abandon old traditions in favor of more modern global trends. This can result in a decline in interest in art, music, dance and other cultural practices that have existed for centuries.

Women's Role in Overcoming the Impact of Globalization

Women have an important role to play in overcoming the negative impact of globalization on cultural heritage. As custodians of cultural values and knowledge, women can play an active role in maintaining traditions and preserving local cultural heritage. They can take the initiative to teach the younger generation about the importance of maintaining cultural values and practices. The role of women in dealing with the impact of globalization is key to ensuring that our culture remains alive and relevant. They are agents of change who are able to combine cultural heritage with global dynamics [11]. In addition, women can also play a role in creating innovations that combine elements of traditional culture with modern trends. They can be the link between cultural heritage and the globalized world, developing approaches that honor cultural values while remaining open to change.

Contemporary Issues Affecting Women's Involvement in Preserving Culture

Women's involvement in preserving culture is confronted with a range of contemporary issues that can affect their efforts in maintaining cultural values and heritage. Some of these issues reflect social, economic and political changes that play an important role in how women can play a role in preserving culture. Initiatives and programs that support women's role in preserving cultural heritage provide a platform for them to take an active role in maintaining cultural identity and developing communities [12]. Here are some relevant contemporary issues.

1) Dual Roles and Modern Demands

Women often experience a dual role, working outside the home while carrying out household and family responsibilities. Modern demands such as these can inhibit women's active involvement in preserving culture. Limited time and energy can make it difficult for women to engage in traditional cultural activities that often require a significant time commitment. Female dual roles refer to situations where women have to take on different responsibilities and roles simultaneously, such as being a worker and a mother, or a worker and an educator in the household. This is a frequent challenge faced by many women around the world and can create extra stress and conflict in their lives. Women do an average of 15 hours a week of housework more than men do. That is almost an extra month of 24-hour days of work each year. The reason is that women are the keepers of the second shift [13]. An imbalance in the division of housework between couples, with women often shouldering the additional burden of what is referred to as the "second shift" or dual role. Women often have to work outside the home and then return home to do household chores, which is an additional burden for them.

2) Urbanization and Land Conversion

Urbanization and land conversion often result in the loss of traditional places where cultural communities operate. Women often have a strong emotional connection to their environment, and the loss of these cultural places can affect their ability to preserve traditional cultural practices.

3) Education and Social Mobility

Education and social mobility can open up new opportunities for women, but can also shift the focus away from preserving culture. Young women may be more interested in formal education or careers, which may reduce the time they spend engaging in traditional cultural practices.

4) Technology and Globalization

Technology and globalization can bring outside cultural influences in quickly. Young women may be influenced by global trends and modern lifestyles that may shift their interest in taking part in preserving local culture.

5) Changes in Gender Values and Roles

Changes in values and gender roles in society can also affect women's involvement in preserving culture. These changes may alter views towards women's roles in traditional culture and affect whether they are allowed to take an active role in cultural preservation efforts. Changes in gender values and roles refer to shifts in how society perceives and organizes the roles and expectations associated with the sexes. Over time, gender values and roles have undergone significant changes, reflecting social, cultural and political developments. These changes include efforts to achieve gender equality and eliminate limiting gender stereotypes. "One is not born, but rather becomes, a woman. No biological, psychological, or economic fate determines the figure that the human female presents in society; it is civilization as a whole that produces this creature, intermediate between male and eunuch, which is described as feminine" [14].

Initiatives and Programs that Support the Role of Women in Cultural Heritage

Recognizing the important role of women in preserving and passing on cultural heritage, various initiatives and programs have been designed to provide support, training and platforms for women to be actively involved in cultural preservation. These initiatives and programs help raise awareness of cultural values and increase women's involvement in efforts to preserve cultural heritage. Here are some examples of initiatives and programs that support the role of women in cultural heritage:

1) Cultural Skills Training

Cultural skills training programs provide women with the opportunity to acquire skills related to traditional cultural practices, such as weaving, handicrafts, or dance. This training enables women to become experts in specific cultural skills and actively engage in the preservation and development of cultural heritage.

2) Development of Cultural Entrepreneurship

The initiative supports women in the development of entrepreneurial ventures related to cultural heritage. This could include the production and sale of traditional cultural products, such as textiles, crafts, or specialty foods. Thus, women can contribute economically and still maintain cultural practices.

3) Community and Cooperation Groups

Setting up community groups or cultural organizations that include women can enable the exchange of knowledge, ideas and experiences in cultural preservation. Women can support each other, collaborate on cultural projects, and participate in traditional ceremonies and celebrations together.

4) Education and Counseling

Education and outreach programs on cultural heritage play an important role in increasing women's awareness and understanding of cultural values. By understanding the importance of cultural heritage, women are more likely to be actively involved in efforts to preserve it.

5) Recognition and Appreciation

Recognizing the role of women in preserving culture through awards, recognition, and appreciation can motivate and provide encouragement for women to continue to engage in cultural heritage preservation. These awards can also raise public awareness about the important contribution of women in preserving culture.

CONCLUSIONS

This paper has reviewed the crucial and complex role played by women in preserving and passing on cultural heritage. In the context of globalization and contemporary challenges, women have proven themselves as leaders, guardians and inheritors of cultural values. They have taken a central role in safeguarding cultural practices, passing on knowledge, and carrying on cultural heritage in changing times. Through involvement in rituals and oral traditions, women have played a vital role in nurturing deep cultural roots. They are the tellers of ancestral stories, oversee important rituals, and teach younger generations about cultural meanings and values. Women have also held responsibilities in the arts and artistry, preserving techniques and artworks that speak to the identity of the community.

As inheritors of cultural values and knowledge, women have carried the role of educators and connectors between generations. By facilitating the transfer of knowledge between the past and the future, they have bridged the gap between cultural heritage and modern realities. Education is key to ensuring that cultural values are not lost to globalization. However, contemporary issues such as multiple roles, urbanization, and changing social values cannot be ignored. These challenges can hinder women's involvement in cultural preservation. However, through initiatives and programs that support women's involvement, cultural skills training, entrepreneurship development, and education, they can still play an important role in cultural heritage preservation. Man is defined as a human being and a woman as a female — whenever she behaves as a human being she is said to imitate the male [15].

In conclusion, women not only act as custodians of cultural heritage, but also as leaders in maintaining it. Women's role in preserving culture involves dedication, knowledge and passion to pass on cultural heritage to future generations. In the ever-evolving era of globalization, recognition of women's contribution to cultural heritage is becoming increasingly important, so that cultural values can remain alive and relevant amidst the changing times.

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Patriarchal System: How does Gaslighting Trigger the Violence?

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Abstract: The term "gaslighting" is unfamiliar to some people as a form of abuse. This research uses Marcia Baron's article "Manipulativeness" to analyze the manipulation tactics that are used by male characters in the novel. The method used is a qualitative method. The results of this study are finding the forms of gaslighting tactics perpetrated by the male characters namely deception, pressuring to comply, and employing emotional vulnerability. Gaslighting makes the two main female characters in the novel hard to decide their choices and tend to doubt their decision to leave their manipulative husbands. Therefore, through this novel, Hoover criticizes that women must have the economic power to get their rights and live independently to break the cycle of abuse.

INTRODUCTION

Intimate partner violence (IPV) is an issue regarded as a violation of human rights and public health in all countries that causes physical, psychological, or sexual harm to those in the relationship ([1]; [2]. In intimate relationships, men are the most frequently found perpetrators of violence against women. By contrast, men often face violent acts from strangers or acquaintances compared to someone close to them. Abuse does not always take the form of physical harm that causes serious physical injury but abuse can also take the form of emotional or psychological abuse. Psychological abuse can involve any nonphysical behavior or attitude that controls or isolates another individual through humiliation or fear, potentially leading to psychological trauma [3], [4]. Gaslighting is an effective form of psychological abuse that causes a victim to doubt their own feelings, instincts, and sanity. As a result, the abusive partner has a lot of power to control the victims' feelings [5]. Gaslighting is a pattern of behavior that occurs over a long duration and not on a one-off basis.

This novel was published in 2016 and became the most popular book in 2021-2022 by introducing relationship abuse and gaslighting as the main issue. The popularity of this book is supported by the increase in domestic violence cases in 2021 due to Covid-19 [6]. Here is the story of it at a glance. The novel tells the story of Lily Bloom who witnessed her mother, Jenny Bloom, being abused by her father all her life and feeling powerless to stop it. Lily's father, Andrew Bloom was an abusive drunk and short-tempered husband who beat his wife. He never intentionally touched Lily but constantly hit and yelled at Lily's mother for no reason. After her father's death and graduation from college, Lily Bloom moved to Boston to start her business career. In Boston, she feels a spark with a handsome neurosurgeon named Ryle Kincaid and they decide to get married. Ryle Kincaid, a romantic and gentleman, begins to reveal his true nature; he is arrogant, possessive, temperamental, and gradually employs violence and gaslighting behavior against Lily Bloom.

A boyfriend, husband, a boss, a family member, a doctor, or any individual in a position of power can engage in gaslighting. According to a survey conducted by the National Domestic Violence Hotline, 74% of adult female victims of domestic violence have been manipulated by their partner or ex-partner. Male abusers frequently use gender stereotypes to deceive their female partners. Gaslighting in heterosexual personal relationships is based on the notion that women are fundamentally irrational and emotional, while men are rational by nature [7]. Gaslighting, like most women's problems, is rooted in a patriarchal society, which creates specific gender roles that create unequal expectations of women. The patriarchy promotes women as being in an inferior position to men, which eventually

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030030-1–030030-8; https://doi.org/10.1063/5.0241605
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

leads to gender oppression. These expectations frequently objectify women, which results in men attempting to control them. The authoritative male voice is rooted in the traditional gender role assignment, which positions women as less capable than men [8]. Male voice which has power to control and power in society is giving disadvantageous to the victims of emotional abuse who try to break the cycle of abuse. This makes it difficult for women to prove that they are being manipulated because women are viewed as being overly emotional.

Gaslighting is seen as an oppressive force that denies victims' ability to name the harm done to them, as the perpetrator denies his or her wrongdoings and is typically a convincing liar who may even appear charming [9], [10] concentrate on the significant "emotional manipulation" experienced by the characters in the novel Girls with Sharp Sticks. This research is inquired as to how schools gaslight young girls. Teachers and school leaders use the school to foster patriarchal values, such as heterosexuality (the belief that straight is the "correct" sexual orientation), gender stereotyping, and the notion that women exist to serve men, resulting in physical and emotional abuse of young girls. Therefore, this paper was conducted to investigate the manipulation tactics and effects of emotional abuse within relationships that have arguably trapped the female characters in the novel which influence women's way of thinking and decision-making.

Gaslighting in The Novel

Manipulation is interfering with or seizing another person's right to free choice and influencing it in ways that benefit the manipulator's intended outcome by attacking the mental and emotional aspects of the victim [11], [12]. Manipulation, as a form of psychological abuse, affects between 35 and 49% of men and women in the USA and Europe, making it the most common type of IPV when compared to physical and sexual violence [13], [14]. Manipulators frequently engage in negative actions that lead to power imbalance. A person may become confused, lonely, or even depressed as a result of the damaging effects [15]. Someone who manipulates another person knows what their weaknesses are and will use them against the victim [16].

Psychologists use the term “gaslighting” to refer to a specific type of manipulation in which the manipulator attempts to get someone else (or a group of people) to question their own reality, memory, or perception. Dr. Robin Stern, associate Director of the Yale Center for Emotional Intelligence and author of The Gaslight Effect said that victims of gaslighting can end up in a cycle in which they cannot negotiate daily life, think clearly, focus, make sound decisions, or have a sense of well-being [17]. Despite its origins in the 1938 play Gas Light, the term gaslighting gained popularity in the 2010s after being reinterpreted as a political metaphor. Particularly since the United States 2016 presidential election, it is now used to depict a range of deceptive behaviors by politicians, most often by Donald Trump [18].

Manipulation Tactic

Deception

There are three basic tactics of manipulation such as deception, pressuring to comply, and employing emotional vulnerability or character weaknesses. The first tactic that will be analyzed is deception. It includes blatantly lying to those manipulated, including making false promises and misleading them without actually telling the truth [19].

> “He pulls me against him and starts kissing the top of my head. “I’m so sorry. I just… I burned my hand. I panicked. You were laughing and… I’m so sorry, it all happened so fast. I didn’t mean to push you, Lily, I’m sorry." [20].

Ryle loses his temper because Lily laughs at his carelessness when he tries to take the casserole in the oven without using a pot holder. Though cocky and manipulative from the start, Ryle applies deception tactics to manipulate Lily by denying facts that he hit Lily. Ryle also applies another way of lying by misdirecting his emotion. Misdirecting is acknowledging an emotion but misidentifying what caused that emotion [21]. Ryle deceives Lily by claiming that the accident happened because he was panicked because of his burned hand, when in fact he hit Lily because she laughed at him.

Another example of manipulation tactic through deception in page 144

> “Oh my God,” Allysa says. “Ryle told me what happened but I didn’t think it was that bad.” I glance at Ryle, wondering what he told her. The truth? He smiles and says, “Olive oil was everywhere. When she slipped, it was so graceful you’d think she was a ballerina.” [20].

This behavior is portrayed by Ryle in the novel when he tells his sister about Lily's accident. The deception tactic is also done by telling false information as if it is true with such exaggeration or humor that the target remains uninformed or misled. Ryle says calmly and jokingly about the accident that Lily only slipped because of the olive oil and says "it was so graceful you'd think she was a ballerina" as if assuring his younger sister that it was just a minor accident. Ryle managed to deceive his younger sister and conceal the facts by using exaggerated sentences and humor in conveying the information.

Pressuring

Another technique to be analyzed is pressure to comply. It can involve browbeating or insulting someone, wearing down the other's position, and forcing someone to agree to something to avoid further discomfort or embarrassment [19]. The illustration of how manipulation is accomplished through demanding reason may be provided by Excerpt 3, page 174

> "He leans forward and presses his lips hard against my forehead, then rests his forehead against mine. "Please tell me you aren't seeing him. Please." He breathes out a shaky breath…"You swear, Lily? You swear on our marriage and our lives and on everything that you are that you haven't spoken to him since that day?" [20].

Ryle already doubts Lily's faithfulness towards him by saying "Please tell me you aren't seeing him. Please." without hearing her explanation first. He begins to pressure Lily by reminding her about their marriage vow which shows that he doubts her. Lily can't stand Ryle's attitude of doubting her faithfulness in their marriage before even letting her explain the real truth, as portrayed in the novel: "I swear, Ryle. You overreacted before giving me the chance to explain," I say to him."[20]. When the truth is offered, Ryle still doubts that. This tactic also includes wearing down another person or putting the guilty on the victim.

There are two manipulation tactics done by Andrew Bloom, Lily's father namely pressuring and exploiting emotional vulnerability. The example of pressuring may be presented on page 114.

Lily's parents get home after going to a community function - a charity dinner. Lily could hear them fighting, and her father accused her mother of flirting with some man. Andrew seems to want his wife to give him an explanation about that matter, but instead of giving her time to tell him her explanation. Andrew blocked her chance to tell him the truth because he was too overcome with anger and could not believe what his wife was about to say by browbeating her with abusive words.

> "I could hear them fighting as soon as they walked through the front door. A lot of the conversation was muffled, but for the most part, it sounded like my father was accusing her of flirting with some man." [20].

Employing Emotional Vulnerability

The third tactic which will be analyzed further is playing upon emotional needs, or weaknesses of character. It includes eliciting an emotion with the aim of making use of it. Typical emotions used to manipulate are fear, sympathy, a sense of gratitude toward the manipulator, and feelings of guilt if the manipulated person does not consent to what the manipulator wants [19]. The example of employing emotional vulnerability may be presented following sentence:

> "When you ran after me last night, I swear I had no intention of hurting you. I was upset and angry. And sometimes when I feel that much emotion, something inside of me just snaps. I don't remember the moment I pushed you. But I know I did… I didn't process that there were stairs around us. I didn't process my strength compared to yours. I fucked up, Lily. I fucked up." [20].

Based on that dialogue, Ryle used his trauma to provoke Lily's sympathy for his mental illness situation to make Lily think that the violence she had committed was an accident that was unintentional due to the effects of his past trauma which caused him to be unable to control his anger. Once again Lily fell for Ryle's manipulation and shows her sympathy towards Ryle's situation by telling herself that "And still, I'm trying to justify what happened. It was an accident. He thought I was cheating on him. He was hurt and angry and I got in his way." [20].

Andrew seems to want his wife to give him an explanation about that matter, but instead of giving her time to tell him her explanation. Andrew blocked her chance to tell him the truth because he was too overcome with anger and could not believe what his wife was about to say by browbeating her with abusive words which are described in the novel on page 115

> "I heard him call her a whore… I'll never forget his words when he said, "You want attention? I'll give you some fucking attention." And that's when she got real still and stopped fighting him. I heard her crying and then she said, "Please be quiet. Lily is here." [20].

Andrew manages to "browbeat and wear down" his wife from the beginning and has him treated with respect. In the end, Jenny is unable to report her husband to the police when Lily said that Andrew was trying to rape her mother. To avoid further unpleasantness and also deceives herself and Lily, as depicted in the novel on page 116:

> "She ducked her head and winced when I said that. She shook her head again and said, "It's not like that, Lily. We're married, and sometimes marriage is just . . . you're too young to understand it." [20].

Most manipulative people are skilled at detecting weaknesses. Once discovered, the manipulators exploit someone's weaknesses and persuade them to give up something of themselves to serve their self-centered interests. Andrew used this manipulation tactic on his wife after abusing her, just like Ryle in the previous section.

> "My father was abusive. Not to me—to my mother… When that happened, he would spend the next week or two making up for it. He would do things like buy her flowers or take us out to a nice dinner." [20].

This tactic is usually known as love bombing, it is a common manipulation tactic whereby the perpetrators overwhelm their partners by offering compliments, affection, and intimacy to win over your trust and affection so that they can meet a goal of theirs. The perpetrators do this by learning, and then exploiting, their partner's needs, insecurities, and innermost desires [22]. The intention is to make their victim helpless, vulnerable and indebted to them. As portrayed in the novel, Andrew involves over-the-top gestures towards Jenny, such as sending her excessive gifts by buying her bouquets for about two weeks or taking her out to a nice dinner.

This act is used by Andrew during the honeymoon phase to weaken the victim's mind to get their apology. This cycle of abuse is repeated to maintain control over the victim who remains in the abusive relationship; both victims and perpetrators accept this routine as normal. However, if the routine is repeated over and over again, the victim will find it easier to forgive the perpetrator. The abuser is no longer afraid to abuse without apology and does not experience much backlash from the victim [23].

The Effects of Gaslighting

Jenny Bloom is portrayed as having difficulty breaking away from her abusive husband. In several scenes, it is described that he always refuses and forbids Lily from reporting her father's actions to the police. Jenny even tends to protect her husband so that his reputation will not be destroyed in the eyes of society. Jenny's husband, the mayor of Plethora, is described in the novel as a prominent figure in the city. She believed that divorce would reflect negatively on her husband and her family. Minimizing her experiences is also common because denial is a safer place than feeling traumatized. The victim may rationalize the beating, believing that the victim must have "deserved" the "punishment" or that the perpetrator was simply "too drunk" to know what the perpetrator was doing (a belief spread by the perpetrator)

> "..."He's drunk, Lily," she said. "...If you call the police, it'll just make it worse, believe me. Just let him sleep it off, it'll be better tomorrow."..." [20]

Gaslighting, control, and intermittent love are used by abusers to push their partners into self-blame and desperation of regaining their affection. Victims of abusive and manipulative partners are usually trapped in a cycle of abuse, which makes it difficult to leave their abusive partner. The cycle of abuse is divided into three phases: tension, violent incidents, and the honeymoon phase (when everything seems lovely). The manipulative partner often apologizes after inflicting violence and promises to change (repetition of the honeymoon phase) [24]. This pattern gradually becomes accepted as a normal routine by victims and perpetrators, making it easier to remain in abusive relationships.

Moreover, women stay with abusive men due to the fact that they are financially dependent on them and they have no one to turn to for help or support. In addition, women are often hit harder financially by divorce. According to a research published by the United States Government Accountability Office, women's household income decreased by 41% on average following a divorce, but men's household income decreased by only 23%, nearly twice the size of the decline experienced by men [25]. Most of the financial burdens of divorce fall on women since they will leave their jobs to raise their children. Child support payments frequently do not cover all of the costs involved with child care. Unfortunately, only 45.6% of custodial parents who are owed child support get the full payments, indicating that caring for children after divorce is a considerable financial burden for many women. According to a U.S. Census Bureau 2013 report, approximately 80% of custodial parents are mothers and 17.5% of custodial parents were fathers [25], [26].

At the same time, gaslighting is a difficult case to report because it is difficult to prove in court. Typically, society advises abused women to seek help at a shelter only if they are physically abused, as they have no concern about emotional, financial, sexual, verbal, or psychological abuse [27]. Gaslighting can be reported when the perpetrator's actions lead to a form of coercive control. This makes it a crime if the offender aims to hurt their spouse or ex-partner in a way that controls, regulates, or monitors their daily activities, or that frightens, humiliates, degrades, or otherwise punishes them. There are no federal laws in the United States that cover coercive control. Even though several states have taken action to make coercive control illegal. Hawaii is the only state in the US that exposes perpetrators of coercive control to prosecution under new criminal charges [28]. Bills, amendments, and laws are being worked on in both Maryland and South Carolina. Coercive control, on the other hand, is a crime in several countries other than the United States, punishable by up to five years in prison in the United Kingdom and 14 years in Scotland. Gaslighting was criminalized in December 2015 under Section 76 of the Serious Crime Act (2015), which provides for the offense of controlling or coercive behavior (CCB) [28], [29].

Meanwhile, Lily Bloom, Jenny's daughter, experiences physical violence and manipulation carried out by her husband, Ryle Kincaid, which makes her remember past wounds about her abusive father. However, in several scenes, Lily continues to try to make excuses for Ryle's actions and instead places guilt on herself. This could happen because she lived in an abusive environment when she witnessed her mother being abused by her father, unknowingly also manipulated Lily by saying that she was fine. According to research, between 50 and 80 percent of adults will experience emotional abuse in their lifetime. Furthermore, the Centers for Disease Control and Prevention classifies emotional abuse as a negative childhood experience that affects 11% of children [30]. Lily’s mother might have the best intentions – to protect her – but it comes across as unreliable. Parental gaslighting which is done by Lily’s mother indirectly influences how she deals with her manipulative husband.

In the end, Lily decides to divorce her husband. However, Lily has many difficulties escaping from the negative stigma about women who divorce their husbands, although most people no longer believe divorce is scandalous or disgraceful. Women in the 1970s gained many rights and freedoms, which may have given them the courage to defy tradition and leave an unhappy marriage. More men began filing for divorce to escape unhappy marriages, and this trend has continued [31]. However, at the end of the story, Lily decides to divorce Ryle and enters into a co-parenting agreement with . Ryle, a violent sex offender, is picking up the baby for "his days with her" in that scene. Lily cannot be given a pass for not understanding the danger of this situation. According to Massachusetts Law, Section 31A, Chapter 208, states that any unsupervised visitation or custody with the abusive parent is deemed "contrary to the best interests of the child" and is generally forbidden where physical or sexual abuse has occurred between parents. Abusers will be granted visitation rights only if the court determines that they do not potentially harm the child. The parenting plan that both parents agree upon is usually approved by the judge, who ultimately decides on custody and visitation. Lily appears to have a physical custody agreement that she is the one who takes care of and lives with her child for all or a majority of the time. As portrayed in page 268 when Lily moves out with her child to a new place:

> “I moved out of the apartment Ryle bought when Emerson was three months old. I got my own place closer to my work so I’m within walking distance, which is great.” [20].

In the novel, Lily is also portrayed as having sole legal custody. Sometimes physical custody and sole legal custody are awarded together, but this is an uncommon case. This type of custody gives one parent the legal right to make all decisions regarding the children: education, religion, place of residence, family rules, and health care. Ryle, the noncustodial parent, has visitation rights to regularly see his or her child, which are established by the court [32], [33].

In the 20th century, there was some progress on attitudes towards domestic violence. In the United States, the first women's shelter in the modern world was Haven House, which opened in 1964 in California. Other women's shelters quickly appeared all throughout the country, including Elsie Huck's Atlanta Union Mission and Kip Tiernan's Rosie's Place in Boston, Massachusetts, which were both founded in 1974 [34]. In 1993, the United Nations enacted the

Declaration on the Elimination of Violence Against Women, officially recognizing domestic abuse as a global human rights issue. Domestic violence and sexual assault were finally recognized as crimes in the United States with the passage of the Violence Against Women Act (VAWA). The VAWA was reauthorized in 2022, which increased funding, resources, and services for victims of domestic abuse. Attitudes towards domestic violence remain troubling, even though governments no longer endorse beating wives to assert authority. Despite that, men still use violence against women and their dependents to demonstrate their dominance, whether it is through physical abuse, emotional manipulation, or other mistreatment.

Hoover through her novel emphasizes that women should have the power to make the best choices for their lives. She emphasizes that women have the power to fight against the patriarchal system that dominates and biases women in society. However, Hoover also wants to show her concern about the patriarchal system that still exists and influences women's lives. In the novel, her mother cannot free herself from her abusive and manipulative husband due to a lack of government support and depends financially on her husband. Hoover's mother's experience influenced her to create this novel to provide the solution which portrays in the novel that women should have economic power. Therefore, Lily, the main character in the novel, is portrayed that she can be free from her husband's dominance and live independently. She also succeeded in getting custody for her child. However, she gives Ryle permission to raise and care for her child because she put aside her problems with her ex-husband to keep the relationship between her son and father intact though she knows how abusive and manipulative Ryle is. Through this novel, Hoover criticizes the patriarchal rules that disadvantages women and rejects gaslighting as a way for men to show their dominance.

CONCLUSION

Abuse does not always involve physical but it can also take the form of emotional or psychological, which is called gaslighting. Gaslighting does not result in bruises or broken bones, but it can cause someone else to doubt their reality, memory, or perception. This type of abuse can be more difficult to prove. There are three types of tactic manipulation carried out by Ryle Kincaid, Lily's husband: deception, pressuring (to comply), and employing character vulnerability. Meanwhile, Andrew Bloom, Lily's father, used two manipulation tactics: pressuring (to comply) and employing character vulnerability. These manipulation techniques include making false promises, controlling feelings, and placing guilt on female characters.

The victims of gaslighting can end up in a cycle in which they cannot negotiate daily life, think, focus, make sound decisions, or have a sense of well-being. Jenny Bloom is portrayed in the novel that she gets repeated emotional abuse from her husband, which causes her to be unable to decide to leave her manipulative husband. Women stay with abusive and manipulative men because they depend financially on them and have no one to help them and nowhere to go. Additionally, women who choose to leave their husbands suffer the divorce's financial burdens. Women choose to leave their job to raise their kids.

Hoover emphasizes that women should be more independent to make the best choices for their lives. She is concerned about repeated abuse, in which women become the victims of gaslighting behavior. Based on her mother's experience as the victim of physical and emotional abuse, she provides a solution that women must have stable economic power to be free from male domination. Therefore, Lily, the main character in the novel, living in the middle of patriarchal rules that are not favorable for women, portrays that she can be free from her husband's dominance and live independently. However, Hoover rejects gaslighting as a way for men to show their dominance. She supports women's desire to free themselves from male domination in a society that is rooted in traditional patriarchal rules

ACKNOWLEDGMENTS

This research was carried out with Universitas Jember through research grant held by the Institute for Research and Community. Thanks also go to the Center of English Literature and Culture (CELC research group) for providing advice and input in preparing this article. Enormous gratitude is also extended to miss Resti who has provided input and suggestions to improve this article.

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Online Expression of Female Sexuality in The Perspective Of Social Information Processing Theory

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Abstract. This research aims to elaborate on women's expressions of sexuality in online media. In Indonesian society, sexuality is something that resides in the private sphere, never discussed openly in the public sphere. Especially in a society that still holds patriarchal values, women will be viewed badly if they dare to express their sexuality. With the development of communication technology, there has been a shift regarding the disclosure of women's sexuality. The mediated public sphere becomes a new arena for expressing women's sexuality. Women dare to express their sexuality openly, especially in WhatsApp groups whose members consist of fellow women. Things that were previously considered taboo become blurred and are revealed openly, especially if there is a physical meeting where the matter is discussed beforehand. This research shows that communication that occurs in online media (CMC) is able to develop intimacy among its members, although CMC has limitations when compared to FtF communication because online-based media can only send text messages which are interpreted as verbal messages. Discussions about sexuality that are often carried out by women are also able to build intimacy among its members. Intimacy is built in members who are involved in conversations about sexuality, although not all group members are interested in being involved in the conversation.

INTRODUCTION

In Indonesian society, sexuality is often considered a taboo subject. People tend to talk about it secretly or only in a small scope because of the assumption that sexuality is a personal issue that should be in the private sphere. With this understanding, people assume that sexuality is something that should be hidden, not talked about openly and if necessary not talked about at all. Sexuality itself in the Kamus Besar Bahasa Indonesia (Indonesian Dictionary) is defined as the characteristics, nature, or role of sex, sex drive, and sex life (Kemdikbud, n.d.). Etymologically, the terms sexual and sexuality are derivatives of the term sex, which means sex, sex organs, sexual activity or *intercourse*. Meanwhile, the term *sexual is* an adjective form of the word sex which means, related to the nature of sex. *Sexuality* means sexual traits or characteristics or sexual *attraction* [1]. Meanwhile, sex is defined as gender (Kemdikbud, n.d.). From this it can be understood that sex is different from sexuality. Sex is only defined as biological sex, which humans get from birth (*given*). Meanwhile, sexuality is much broader because it is not only a physical construction.

There is an important difference between sex and sexuality. Sexuality has a much broader dimension, also greatly influenced by various things. One of them is socio-cultural. Sexuality is a socio-cultural process that directs human desire or lust. Sexuality is influenced by the interaction of biological, psychological, social, economic, political, religious and spiritual factors. Sexuality is a positive thing related to a person's identity and also honesty towards himself. Unfortunately, society generally still sees it as negative and even taboo to be discussed [2]. It can be understood that sexuality is something that is constructed in society and is related to gender, activities and things related to it.

In a society that still firmly embraces patriarchy, sexuality is also often understood as the domain of men. Only men are considered "natural" to talk about and express their sexuality openly, and women as citizens who are labeled feminine must keep matters related to sexuality tightly. Bad judgment will be given to women who dare to

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030031-1–030031-8; https://doi.org/10.1063/5.0243576
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

openly convey sexuality and various matters related to it to the community. For women, sexuality is also interpreted in a negative context. Germaine Greer wrote that women's sexuality is not only negatively defined, but also negatively constructed [3].

When viewed in a social and cultural context, sexuality is fluid, meaning that it is not fixed. There are many things that can influence changes in the understanding and construction of sexuality in a living and changing society. The classification of approaches to sexuality is based on different approaches. This emphasizes the many layers of meaning that can be explored from the issue of sexuality, which not only has a biological dimension that is *given* or *taken for granted* but also has a social dimension.

Society is currently experiencing massive technological developments with the presence of the internet. The changes brought by the internet have reached all lines of life. The presence of internet-based media gave birth to what we call cyberspace, a virtual space that provides a place to interact and exchange information that transcends the boundaries of space and time. Cyberspace is the *internet considered as an imaginary space without a physical location in which communication over computer nets takes place.*(Oxford Learner's Dictionary, n.d.). It can be concluded that *cyberspace* is a space for interaction between community members created by internet-based technology. And one of the active users of this *cyberspace* is women. Women use these cyberspaces for various purposes. This situation is used by women as part of their lives, some even make it a behavioral trend or social standard [4].

One of the characteristics of sexuality is that it is fluid and influenced by social and cultural factors, so women's sexuality also changes along with technological developments that facilitate communication. Especially now that women are the ones who actively utilize internet technology to communicate. In *cyberspace*, there is often a process of communication and expression about various things, including the exchange of information, space for expression and various things related to sexuality carried out by women. There is a kind of shift experienced by women in the expression of their sexuality related to the presence of cyber media.

Meanwhile, expression in the large Indonesian dictionary is defined as the expression or process of expressing (showing or expressing intentions, ideas, feelings, and so on). (Kemdikbud, n.d.)From this definition, it can be seen that expression can be interpreted as the disclosure of something. And the disclosure can be done through various mediums, including disclosure in terms of female sexuality.

The practice of exchanging everything about sexuality carried out by women through cyberspace is a practice that is rampant today. Social Information Processing theory explains how communication that meets through *computer-mediated-communication* (*CMC*) text-based communication develops interpersonal impressions and relationships. This theory explains that the formation of relationships through CMC contains verbal and temporal clues as a central influence on the formation of relationships. [5] The exchange of information related to sexuality is usually carried out by women in cyberspace, which in this study is the WhatsApp group, in addition to expressing what is in their minds is also used to form intimacy relationships.

At first, the formation of intimacy with CMC was considered impossible due to the limitations of CMC which can only send text, which in communication are verbal symbols. With this limitation, CMC is considered to be ineffective in forming relationships because it lacks the interaction factor when compared to face *to face* (FtF) communication. The social information processing theory developed by Walther assumes that in CMC communication, communicators meet communicants through computer text and develop relationships. Social information processing theory uses both sets of cues as parameters where communication and technology can combine to produce impersonal, interpersonal, and hyperpersonal relationships. [1]

This research seeks to elaborate how aspects of communication interact with technological features to encourage the development of intimacy in whatsapp groups in relation to the disclosure of female sexuality among members of the female *online* community.

RESEARCH METHODS

This study aims to look at the disclosure of sexuality to form intimacy between women in *cyberspace*. This research is a descriptive qualitative study that takes as case examples 2 WhatsApp groups whose members are all adult women and use cyberspace as a place to communicate, seek information, and express various things including sexuality. The selection criteria for WhatsApp groups are based on the following criteria: 1) The whatsapp group consists of adult women, 2) Group WhatsApp is an active group, 3) Each member has the freedom to express and express their thoughts and attitudes, 4) Members of the WhatsApp group actively discuss sexuality in the forum. The focus of the research is to look at topics about sexuality to explore women's expressions and thoughts about sexuality in cyberspace to build intimacy among its members.

This research uses a qualitative approach because the qualitative approach emphasizes the socially constructed nature of reality, the close relationship between the researcher and the subject under study, and the pressure of the situation that shapes the investigation of value requirements [6]. With this qualitative approach, it is expected to find an understanding of the use of internet-based communication technology such as WhatsApp groups used by certain groups, in this case women, to discuss sexuality and form intimacy.

The research design is a case study with the aim of answering the research questions precisely. Data was obtained by participatory observation method in 2 WhatsApp groups whose members consist of adult women and the lively conversation in the group is the issue of female sexuality. In addition, data was also obtained by in-depth interviews with several group members, and literature study. Data processing was carried out using Miles and Huberman with three steps, namely data condensation, presenting data, and drawing conclusions and verification [7].

RESULTS AND DISCUSSION

The development of technology has opened new spaces for people to convey various thoughts, opinions and knowledge called cyberspace. Women are one of the active parties in using these cyberspaces and utilizing them as a means of expression that accommodates interests regardless of time and space. One of the changes that occur is that women have the space to talk about their sexuality more openly in the community in cyberspace. The conversations that occur in these cyberspaces occur with a different openness when compared to conversations in public spaces that exist in face-to-face life. New media or *cyber* has created many shifts in human life, sex being one of them. Sexuality in the *cyber* world has hit so many walls of obscurity that in the real world are so strongly guarded and maintained [8].

Translate
A: You're wrong to talk to me
B: if to me the answer is not polite
A: try if to a good woman
B:Ahh… good outside is not necessarily
A:Dah.. just ask your friends so that I can get the data immediately and I can process it.
B: Later, I'm still in training

Translate
A: Schedule it
B: sometimes men like sexy women
A: Waiki
B: depending on each partner

FIGURE 1. Example of a conversation about sexuality in a WhatsApp group

The research results were obtained by processing data generated by data collection techniques in the form of observation, documentation, literature study, and in-depth interviews. Interviews were used to explore primary data, conducted with 6 informants, members of 2 WhatsApp groups who were willing to provide data and information. Observation was carried out in 2 WhatsApp groups directly (participant observation), and literature study to find the necessary study material.

This research was conducted in 2 WhatsApp groups consisting of adult women, and all members were free to express their opinions openly. Group 1 consists of 27 adult women, with various educational backgrounds (high school - master's degree), with various professions (housewife, civil servant, self-employed, private employee), with 2 kinds of marital status (married and not married) with almost the same age (40-44 years old). Informants from group 1 are 2 group members who often talk openly about sexuality issues. Group 2 consists of 9 adult women, with various educational backgrounds (bachelor - master). Same profession (civil servant) with 2 kinds of marital status (married and unmarried) with age (28-40 years old). Informants from group 2 consisted of 4 people. All informants in the group actively access internet-based media with exposure of 3-8 hours per day.

The following is a description of the findings generated from observations and interviews after going through the coding and categorization process. Results were also added by way of documentation to complement the findings and research data. The names of informants and groups are masked to disguise identities, as well as chats that contain pornographic elements.

Conversations about sexuality in WhatsApp group 1 usually happen spontaneously. The conversation can start from other themes but then connect to matters related to sex or sexuality. Most group members will respond to the conversation with various expressions. Expressions are sometimes conveyed not only with text, but also through pictures, *emoticons*, and stickers contained in the WhatsApp feature. Informant E (43th), stated that conversations about sexuality through whatsapp groups or through private whatsapp are the same for him. It's just that if through a group there will be various reactions from other members so that the conversation becomes livelier. Like his statement as follows:

"It's the same. What you want is fine. There's no difference. It's just that sometimes it's livelier because it's more crowded than the others."

As for informant S (42 years old), he stated that he is always open, but he also sees who is talking. Like his statement:

"For me, it depends on who I'm having fun with. I mean who the interlocutor is, with people who seem quiet it can also be done, although it is not as vulgar as with open people, but it can be done through groups or privately."

Meanwhile, in Whatsapp group 2, conversations about sexuality based on observations will usually occur if there is an opening in a physical meeting. Although it does not rule out the possibility that it also occurs spontaneously if there is a topic that is considered interesting. As stated by informant V (35 years old):

"Usually you have to open it first at a meeting, now in the whatsapp group it only connects the unfinished chat. But if you directly beat in the whatsapp group, usually there is no response,"

But sometimes there are some discussions that can be started directly into the wahtsapp group without the need for face-to-face communication, such as some time ago there was a confession from one of the members (informant W) who informed that she was pregnant again. The pregnancy was not something that was planned, considering that Mrs. W's first child was still at *playgroup* age.

"Ouch sister, I conceded, even though I felt safe when I did it outside..maybe someone had stolen the start first and went straight in, eh so deh..until I was shaking when I saw the line II testpack yesterday. My husband also can't sleep with his stress.

This chat was then responded to by another member who asked whether or not to use contraception. This is a very personal conversation, given that it openly discusses the sexual activities of one of the whatsapp group members which would most likely not be too open if done directly through FtF communication.

Talking about sexuality by women through cyber media is also no longer considered a taboo. Women see it as natural, not excessive and a right. Women see that talking about sexuality is talking about human things, so it is natural to do so. Informant S from WhatsApp group 1 stated that talking about sex will become taboo if the conversation is very specific and depends on the person who is talking to respond to the conversation how.

"It goes back to who we talk to. Sometimes some people feel that it's taboo so the conversation becomes crisp. For me, it depends on how the conversation goes. It will become taboo if it's very specific, very specific,"

Informants from WhatsApp group 2 stated that they did not feel taboo because all WAG members are active sex offenders who are married and have children. Informant L stated:

"Lah, what's the use of jaim, we are all already emak-emak..we've learned about that,"

For informants, talking about sex in whatsapp groups is an expression of sexuality that is considered natural. It is not something that should be covered up. Informant E's statement:

"I see it as an outlet, there are those where we can be outspoken and haha hihi to relieve fatigue, but yes, there are those who just listen while smiling and want to comment but think too much because of jaim. For me this is part of expression,"

Informant E from whatsapp group 1 also stated that conversations about matters related to sex in whatsapp groups are not taboo. The conversation is considered a normal thing because it is something that happens in life.

"It's not taboo at all. Yes, this does happen in life. Sometimes people like to see it that way, a small example is buying sanitary napkins, there are those who buy them secretly, even though everyone knows that women normally experience menstruation. Sex is also like that, it's human nature,"

Informants from whatsapp group 2 stated a similar thing, that conversations about sex are a means of expressing sexuality, needs and not taboo, as stated by L:

"In fact, we can't be ignorant, we have to know the science of sex, it's not taboo, there are many strange things out there today. Instead of us being ignorant, then the husband is not satisfied, looking for others to satisfy is complicated. After all, I also have needs (sex), not just men."

Informant S stated that conversations about sex in whatsapp groups are his means of expression and also establishing relationships.

"If I really see it for fun. It usually gets crowded right away, right? In the old days, that wouldn't have been possible. Not anymore. If you look at the groups, I think there are many that are more excited and open. This also serves to build relationships, because usually this kind of talk makes the atmosphere lively. If you talk about this, many people will be provoked and then a story will come out that makes the atmosphere lively."

CMC Contextual Factors in The Expression of Female Sexuality

1. Topics Discussed

In general, WhatsApp groups whose members consist of women can indeed help informants express their sexuality. The computer-mediated chat about sexuality also forms intimacy between the group members involved. There are informants who feel that conversations through CMC have the same quality of intimacy as FtF. As stated by informant E:

"Podo wae ma'am (just the same ma'am), nothing different,"

Informant S also stated that the media used to communicate has no effect on the intimacy that is built. The main influence lies in the communicant he is talking to. Like his statement:

"For me, it goes back to who I'm talking to. If the person is not open, the conversation will be crisp. So I won't be intimate either. It will be normal,"

In addition, informants saw that the whatsapp group application became a new space to express their sexuality. Before the existence of whatsapp groups, conversations about sexuality among women were rare. This is because whatsapp groups are able to eliminate the time and space barriers that were previously an obstacle in group 1 whose members live in different places with different backgrounds so it is very difficult to meet face-to-face (FtF). As stated by informant E:

"Even if for me the conversation is no different whether it is through whatsapp group or directly, but the existence of this whatsapp group does make it easier. Actually, any discussion, sex too. Some might be more exciting if we meet in person, but we can't meet in person."

Informant S stated:

"Talking about sex is familiarizing. If there's no chat about it, it's not crowded."

WhatsApp group 2 experienced something similar. At first the group aims to just chat and stay in touch. The group will become lively when one of the group members starts a conversation, especially about sexuality. The topic of sexuality is one that can generate chatter in the whatsapp group.

2. Group Member Engagement

In Whatsapp group 1, not all group members are actively involved in the conversation about sexuality that is happening. There are 9 group members who tend not to respond to conversations about sexuality that occur in the group even though the conversation is very intense. If observed further, members who do not respond to the conversation are passive members who do not respond to conversations with other themes.

In whatsapp group 1 there are also group members who feel uninterested or even respond to counter chatter about sexuality that is considered vulgar. As in the following screenshot:

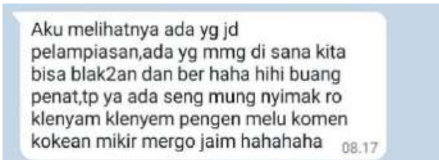
(a) (b)

FIGURE 2. All members feel interested in chatting about sexuality because all group members are sexually active and socially close

Meanwhile, in Whatsapp Group 2, all members feel interested in chatting about sexuality because all group members are sexually active and socially close. Thus, they will be comfortable sharing conversations about sexuality. The formation of social communication and closeness between members in the real world are determining factors for conversations in Whatsapp groups.

3. Purpose of Communicating

Not all informants have the same motives in expressing sexuality or talking about sex in whatsapp groups. Some of the goals revealed in the research are to express thoughts and opinions, add familiarity and intimacy among group members, and just to add fun to communication. As can be seen in the following screenshot of E's statement:



Translate
I see that there are those who become an outlet, some can talk clearly to relieve boredom, but there are also those who only listen but do not dare to comment.

FIGURE 3. Screenshot

Based on the screenshot, it can be seen that the informant felt that he and other group members used the application to communicate openly, relieve fatigue, and vent their various opinions and thoughts. Other informants stated that chatting about sexuality in whatsapp groups is just for fun, such as informant S's statement:

"The main thing is that it's just fun for me,"

4. Length of time spent communicating

Almost all informants have used the WhatsApp Group application for more than 5 years. Most members of whatsapp group 1 have been members since the group was formed in 2016, and have used whatsapp many years before. Group members also stated that there were no difficulties when using the whatsapp application. Like E's statement:

"The group has been formed since the beginning. At first, it was formed for female members of the alumni group next door. Then this was formed. There are no difficulties because we have been using it for a long time. It's just a matter of adjusting if there are new features such as emoticons or stickers."

All informants in group 2 also have the same experience. All have been using the WhatsApp application for more than 5 years with all the development of features in the WhatsApp application, so they do not find significant difficulties. All members are also active users of online-based media. As stated by V:

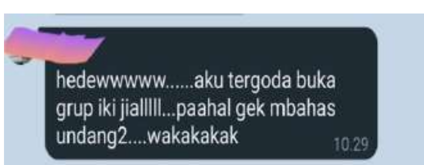
"It's been years ago, definitely more than 5 years. From the beginning there were no emoticons, until now there are stickers and so on. There are no significant difficulties either, if there are difficulties just ask a friend, everything is done. I've been a gryp member for years too, I've forgotten exactly,"

It can be understood that group members are active users of online media, have used whatsapp for more than 5 years, and have been members of the group for several years.

Relational Factors in CMC

1. Time Used

The women who are members of Whatsapp Group 1 and 2 generally use different times. Based on researcher observations, some members of group 1 can use any time to communicate or talk about sexuality in the whatsapp group. Generally, those who can use time freely are women who do not work formally. Meanwhile, women who work formally will try to refrain from participating in conversations about sexuality during working hours even though sometimes they really want to join the chat. As captured in the screenshot:



Translate
Hadeew… I'm tempted to read the message in this grub. even though it is discussing the law .. wkakakakak

FIGURE 4. Screenshot

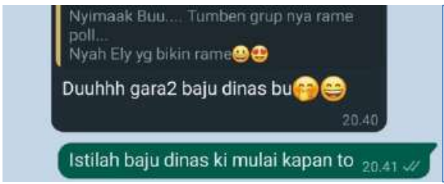
Meanwhile, based on observations in whatsapp group 2, during working hours the chatter usually revolves around work and small talk. Chats about sexuality sometimes occur, but not much frequency. Conversations about sexuality will start to get crowded when it is time to go home from work.

In general, members of groups 1 and 2 have an interest in talking about sexuality. Members who feel they have better intimacy will immediately engage with the conversation if a member they consider close starts talking about sexuality even though it is during working hours. But most of the women who work formally will tend to use time to talk about sexuality in whatsapp groups outside of working hours. While for whatsapp group 2 because they have the same work background, the time used to discuss sexuality is often not limited to working hours, because the chat can flow at any time even in between work talks.

2. Previous Interaction

Both members of whatsapp groups 1 and 2 had interactions both in CMC and Ftf for a long duration before the conversation about sexuality that occurred through *online* media. The background of group 1 members is a group of women who have gone through the same education, while group 2 is a group of women who work in the same place.

Based on observations, there is a tendency that informants who have offline intimacy will also establish more intimacy in communication that occurs through *online* media. Informants with previous intimacy will support each other's opinions and form a flowing conversational convo. As shown in the screenshot:



Translate
A: This is because the official clothes
B: since when is this official dress term

FIGURE 5. Screenshot

3. Anticipated Future Interactions and Expectations & Motivations

Some informants feel that there will be future interactions. This is usually experienced by new members who have just joined the group. In some cases, informants hoped that in addition to warm relationships in the group related to all conversations including talks about sexuality, there was also hope for future relationships in relationships through *online* and *offline* media.

Based on interviews and observations, there are group members who hope to be more intimate and familiar after conversations about sexuality that occur through whatsapp groups. In some cases, informants continue certain conversations outside the whatsapp group, conversations outside the whatsapp group do not only discuss sexuality, but discuss various things up to work and business issues.

Informants generally access whatsapp more than 10 times a day. And there are several things that get the attention of group members if they want to start talking *online* via whatsapp but outside the original group, including if there are interests that are felt to be the same and the need for something, for example one has a certain business and the other needs the item.

DISCUSSION

In several previous studies, the communication process through online media has been discussed with various variations. Among them are by Putri [9], Laksana [10] and Li. These studies prove that computer-mediated communication (CMC) is able to foster intimacy in interpersonal communication between its members. In some cases there are still barriers faced in computer-mediated communication, but these barriers can generally be overcome by group members and group members can benefit.

In a WhatsApp group consisting of women, sexuality is a topic of conversation that can increase intimacy between its members. Talking about sexuality will find momentum in some members to openly express sexuality without hesitation. Some group members stated that there was no significant difference when talking about sexuality through WhatsApp groups or directly through FtF communication. However, there were also those who stated that the main factor in building intimacy was not due to the medium used but who the communicants were talking to about sexuality and how they responded to the conversation. Intimacy will not be built if the communicant is not open and welcoming to the conversation that occurs. Talking about sexuality not only serves to express sexuality but also serves as a medium to unwind, although there are group members who respond contra to talk about sexuality.

Thurlow explains that the duration of time that individuals have used to communicate in online media will also affect online relationships. [11] In communication that occurs in WhatsApp groups whose members are female and discuss female sexuality for a long period of time, there is a tendency that members will find different intimacies. Usually, the factors to foster further relationships after talking about sexuality in the WhatsApp group are the compatibility of the chat and other interests, such as business factors. In some cases group members will develop intimacy outside the whatsapp group if they find compatibility with other members, meaning that there are factors of expectation and motivation that influence sexuality communication in WhatsApp groups because there are members who develop further relationships after communication about sexuality in WhatsApp groups.

CONCLUSION

This research shows that communication that occurs in online media (CMC) is able to develop intimacy among its members, although CMC has limitations when compared to FtF communication because online-based media can only send text messages which are interpreted as verbal messages. Discussions about sexuality that are often carried out by women are also able to build intimacy among its members. Intimacy is built in members who are involved in conversations about sexuality, although not all group members are interested in being involved in the conversation.

In general, group members who express sexuality in the group think that the conversation is a means for them to express and establish relationships with other members. There are group members who feel that conversations through online media do not affect the quality and intimacy built with communication that occurs through FtF, but there are also those who feel that intimacy and relationships built are not influenced by online or offline media, but are influenced by the interlocutor and how the interlocutor responds to the conversation. If the interlocutor does not respond well, even though the discussion occurs via FtF, intimacy and relationships will not be built well. The existence of motivation and expectations and anticipation of future interactions also affects the communication that is built.

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The Role of Women and Entrepreneurial Unit Development Strategies in Agricultural Institutions Using the Business Model Canvas Approach in Jember Regency

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Abstract. This research aims to identify the role of women in strengthening entrepreneurial units and development strategies in entrepreneurial units in Jember Regency. The research location was chosen purposively based on the consideration that the research area used was one of the areas with high community enthusiasm for establishing womenpreneur-based entrepreneurial units . The data analysis method used is descriptive and Business Model Canvas (BMC). The research results show that the role of women in forming entrepreneurial units involves the role of agricultural institutions in their participation through PKK and MSME institutions, BUMDES, Farmer Groups, Village Officials, and Media. The development strategy carried out to support the role of women in entrepreneurial units uses the Business Model Canvas (BMC) approach which consists of 9 main elements, namely customer segment, value proposition, channel, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure.

INTRODUCTION

Resources in an area are one of the potentials that can be developed to increase sectoral income. The types of resources that can be utilized are natural resources (SDA) and human resources (HR). All forms of regional resource management are within the authority of each autonomous party based on the regulations that have been made. Jember Regency, according to data reported [1], recorded a population of 2,584,233 people in 2022 with a male population of 1,290,488 people and a female population of 1,293,745 people. The existing population is dominated by women in the productive working age of 15-64 years. Meanwhile, natural resources in Jember Regency in 2022 according to the type of plant are divided into five main commodities, namely coffee (4,193.53 tons), coconut (9,913.10 tons), cocoa (16.06 tons), tobacco (13,952 tons), and sugar cane (599,048.9 tons). The potential for agricultural products in the village needs to be addressed with activities that involve women in utilizing agricultural products and managing the surrounding environment.

Several countries have played a good role in prioritizing the role of women in household and agricultural activities. Based on research entitled Sustainable Rural Development in Rwanda: The Importance of a Focus on Women in Agriculture [2]. The research results obtained are that Rwanda's impressive achievements in reducing rural areas and increasing food security for its population make it a model for other countries to follow. However, its efforts to ensure that women are equal participants in economic and economic development and are represented at all levels of decision-making structures is what truly sets Rwanda apart, and offers the best indication of the future stability and sustainability of its development initiatives. This is also in line with research entitled Indonesian Rural Women: The Role In Agricultural Development [3], explaining that women have a neglected role in rural development even though they have the same role as men in household decision-making. Women are often only considered as heads of households who have informal and quiet power. The research was conducted using a literature study with descriptive analysis. The research results show that Indonesia is in a good position to integrate rural women into development because social values in cultures such as Javanese have accorded them a relatively egalitarian status.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030032-1–030032-8; https://doi.org/10.1063/5.0241844
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

The abundance of raw materials and available labor is an opportunity for the development of the entrepreneurial sector in Jember Regency . Entrepreneurship can be said to be a business process that imposes all its resources and activities on business actors called entrepreneurs. An entrepreneur, according to Thomas W., is a person who is or has created a new business to achieve profit and growth by identifying various opportunities and combining the necessary resources [1], the average employment data for the community in Jember Regency is as entrepreneurs amounted to 23.56% of the total population (608,759). This figure is in second place after the number of people who have not worked or are unemployed at 25.84% of the total population. The high number of entrepreneurs growing in society also creates new jobs in the form of Micro, Small, and Medium Enterprises (MSMEs). Based on data from the Jember Regency Cooperatives and SMEs Service, the number of MSMEs reached around 647,000 units. The problems faced by entrepreneurial units are related to institutional availability and capacity. The main problems found in Panduman Village, Jember Regency are: 1) The institutional capacity of entrepreneurial units is not yet optimal, 2) Increasing human resource skills in institutions is not yet optimal, and 3) The role of women in managing entrepreneurial units is still limited. Based on existing problems, it is necessary to optimize the role of women in managing agricultural institutions through a womenpreneur-based entrepreneurship unit.

Success in developing a business cannot be separated from the role of HR, especially the role of women as managers. Startup businesses need to build the right management for their development in the next two to three years. A good management design can be contained in a document model in the form of a business model canvas (BMC). This model can explain the characteristics of the business being built, starting from the raw materials needed, the value of the goods or services offered, to the source of income. The formation of entrepreneurial units can be carried out by all groups. With a larger population of women than men, it expands opportunities for women to be able to start entrepreneurial units in Jember Regency. Following the background that has been presented, this research will discuss the potential role of women and strategies for developing entrepreneurial units based on womenpreneurs through the Business Model Canvas (BMC) approach in Jember Regency .

METHOD

The research was conducted in Panduman Village, Jelbuk District , Jember Regency, East Java in August - October 2023. The approach used was qualitative research. The data collection methods used were conducting in-depth interviews with heads and members of entrepreneurial unit groups, direct observation at the research location by observing and extracting meaning from existing phenomena, documentation of various activities carried out, and conducting Focus Group Discussions (FGD) with the role of women in the development of entrepreneurial units. The data analysis method used to determine the perspective of strengthening entrepreneurial units is descriptive analysis including data condensation, data presentation, and conclusions. The data analysis used to determine the entrepreneurial unit development strategy is Business Model Canvas (BMC) analysis.

RESULTS AND DISCUSSION

Potential Role of Women in Starting an Agricultural Entrepreneurship Unit in Jember Regency

Women have an important role in life, always being involved in household activities and agricultural activities to fulfill food needs. The majority of workers in crop production activities are women, but often women are not considered to have a role in decision-making. A lower opinion of women than men still exists so women are deemed not to need to take part in decision-making, both in the household and in agricultural activities. This is in line with research conducted by [4] with the title Gender Issues in Agriculture and Rural Development in Nigeria: The Role of Women. This research aims to determine the role of women in rural development in Nigeria. The research was conducted using descriptive analysis. The research results show that the contribution made by rural women to agricultural production and rural development in Nigeria is greatly underappreciated despite the dominant role played by women in this sector. Women compete more favorably with men in terms of their excessive participation in agricultural activities. The survival and sustainability of agriculture and rural development in Nigeria, as well as in many sub-Saharan African countries, rests on rural women. Therefore, they deserve to be given recognition in terms of decision-making processes in the agricultural sector.

The role of women in developing the management of entrepreneurial units has a dual role, namely as a housewife and breadwinner to help increase the family's economic income. Based on interviews with 20 female respondents in Panduman Village, Jelbuk District, Jember Regency, a distribution of identity data was obtained based on age, education level, and type of work.

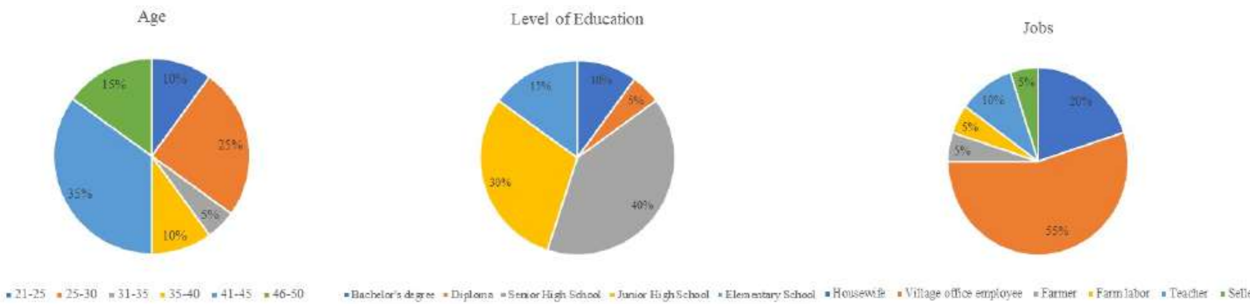

FIGURE 1. Distribution of respondent identities based on age, education level, and employment

Based on the respondents' age data, it can be seen that the majority of women's roles in forming entrepreneurial units are dominated by the age range 41-45 years (35%) and the next position is in the age range 26-30 years (25%). This proves that the role of women in agricultural entrepreneurship is at a productive age. The identity of female respondents is based on education level, the majority of women who have a role in establishing the Entrepreneurial Unit are at high school (40%) and middle school (30%) education levels. This indicates that women have the opportunity to pursue higher education to be able to play a role in managing agricultural entrepreneurship. Meanwhile, the data distribution of jobs held by women who play a role in the formation of entrepreneurial units mostly work as village officials (55%) and housewives (20%). This indicates that women have a dual role apart from being housewives and can also work as workers. Gender is related to the social construction of women. Society often considers women as a weak group of people who are limited to doing domestic or household work [5].

The role of women in the formation and development of entrepreneurial units is based on aspects of behavior and response to the environment. The formation of an entrepreneurial unit as a form of empowerment aims to improve the welfare and economic level of the community. Efforts to increase the role of women can be more easily achieved if they have the ability and can maximize their abilities to achieve a better social and economic life. The potential that is possessed can be maximized if women have the will, both from within themselves and the will resulting from interference from outside humans. The formation of an entrepreneurial unit requires the role of women in management who can support the smooth and sustainable activities of the entrepreneurial unit. Activities carried out by the entrepreneurial unit include providing tools and materials, product processing, product packaging and storage, offline and online product marketing using social media, to weekly and monthly meeting agendas which are carried out according to needs. This is by research by [6], entitled The Role of Women Farmers Group and Agriculture Development in Jeruksawit Village, observed the role of institutions, namely women farmer groups, in overcoming problems in Jeruksawit Village, including limited farmers' knowledge and low technological adaptation. The research was conducted using qualitative methods using descriptive analysis. The results of the research show that groups of women farmers act as initiators to solve various problems by 1) holding meetings to find out problems and sharing, 2) technology training to adapt to using technology, 3) working together to overcome pests and plant diseases, 4) increasing knowledge by conducting comparative studies to increase agricultural knowledge. Women's farmer groups participate and are actively involved in several agricultural activities. Apart from that, they have also contributed to creating strategies to develop agriculture in the village. The following is the participatory role of women in the formation of entrepreneurship units in Jember Regency.

TABLE 1. The participatory role of women in starting entrepreneurial units in Jember Regency through Strengthening Agricultural Institutions

No.	Institution Name	Entrepreneurial Unit Support Efforts
1.	PKK and MSMEs	empowerment programs through program outreach, training in making processed chili products in the form of various chili sauce variants, and product marketing training by utilizing friendship connections, social media, and e-commerce.
2.	BUMDES	Participate in training in setting up an entrepreneurial unit and starting a business, assisting with marketing connections, as well as providing bazaar activities to support the introduction of products produced by the entrepreneurial unit to the general public.
3.	Farmers	Following technical guidance on chili cultivation so that it can produce good quality chili harvests, processing activities of chili derivative products in the form of various chili sauce variants to product packaging, distribution links for marketing the products that have been produced, participation and activeness in membership of the entrepreneurial unit.
4.	Village Apparatus	Providing support in the form of women's empowerment activities in agricultural entrepreneurship units, providing facilities to coordinate with various agencies in supporting program sustainability and the formation of entrepreneurial units, providing facilities in the form of on-farm and off-farm training in chili farming, providing assistance in processing business permits and product legality, supports the use of integrated digital marketing to facilitate marketing activities and gain a wider market share.
5.	Media	Providing support by promoting activities and products owned by entrepreneurial units through online and print media.

Based on interviews, the role of women in the formation and management of entrepreneurial units can be explained as follows:

1. PKK and MSME groups; At the beginning of the development of the entrepreneurial unit, women played an initiating role in utilizing the processing of the abundant chili harvest. Their ideas and motivation ultimately provide a stimulus to the community to explore the village's potential which can be developed for the development of entrepreneurial villages by pioneering the formation of entrepreneurial units.
2. BUMDES; The various potentials that exist in Jember Regency regarding the processing of chilies into processed products require a lot of development and financial and marketing support. Currently, various private parties collaborate in managing existing resources such as financial support and product introduction facilities in the form of bazaar activities for MSME players.
3. Farmers; The community group that has played a role in developing entrepreneurial units in Jember Regency is the farmer group which synergizes with the Family Empowerment and Welfare (PKK) group. Entrepreneurial units are spearheaded by people who recognize the potential and opportunities of their region and are highly motivated to improve their lives and economic well-being.
4. Village Apparatus ; The government plays an important role in developing entrepreneurial units in Jember Regency. The support provided takes the form of various forms of providing facilities, facilitating services, and providing training to members of the entrepreneurial unit.
5. Media; The media plays a very important role in the role of women as an effort to publicize various activities and products produced by entrepreneurial units. Apart from that, currently, social media is also widely used by members of the entrepreneurial unit to obtain the latest information about entrepreneurial tips and as a marketing medium. The promotion of entrepreneurial unit products and activities comes from photos shared by social media accounts of customers or consumers of entrepreneurial unit products.

Women as holders of dominant roles tend to be neglected both in terms of obtaining information and the results obtained. This is supported by research [7] with the title The Role of Women in Promoting Agricultural Productivity and Developing Skills for Improved Quality of Life in Rural Areas. The research aims to determine the role played by rural women in the agricultural environment by paying attention to the condition that women as the dominant labor providers often do not pay attention to their contribution to rural agricultural development. The research was conducted using qualitative analysis methods with descriptive analysis. Research results show that rural women produce as much as 80% of the food we eat. Rural Nigerian women are the main source of agricultural labor but are also the main victims of hunger, malnutrition, poverty, high fertility rates, and maternal mortality. The result is a progressive decline in productivity and crop yields. Another study entitled Women in Agricultural Production and Food Security in Rural Cameroon [8]. The research aims to determine the determining factors of women in agricultural production, the contribution of agriculture to rural food, and the implications of policies that will be implemented. The research was conducted using quantitative methods with descriptive analysis. The research results show that the mother's health level, agricultural land area, education level, place of residence, and marital status have a real and positive influence on agricultural production results. Women in Cameroon dominate the agricultural workforce as the main actors in the production of staple foods. Women are required to be fully involved and have more time on the farm than men. Based on research entitled The Role of Rural Women in Agricultural Development: A Review [9]. The research method used was a literature study with descriptive analysis. Based on the research results, it is known that rural women are generally constrained by lack of capital and access to institutional credit, lack of technical skills and access to extension, workload, lack of access to irrigation, and limited access to land compared to their level of contribution. Therefore, it is recommended to increase access to credit by strengthening local microfinance institutions and increasing the participation of women farmers; providing modern agricultural inputs and modern extension services and extension services to rural women so that they can utilize agriculture for agricultural and rural development, and reducing women's workload through the introduction of better agricultural technology.

Development Strategy

Empowering women farmers is very necessary to support community welfare and awareness regarding the important role of women in agriculture. The existence of institutions that work to empower women has had a very good impact. Like the institutions listed in research entitled The Role of Women Self–Help Groups in Rural Development of Karnataka State, India [10]. The research results stated that the formation of SHGs had a real impact by increasing women's empowerment. This institution has been able to strengthen them financially, as well as help them to save some money and invest it for further development. Another research entitled Rural Woman in Agricultural Extension Training [11]. The problems found were barriers for women farmers to reach agricultural extension services caused by limited time, lack of training, social structure, and poverty. The research was conducted using qualitative methods with descriptive analysis. The research results explain the importance of female farmers obtaining extension services to increase agricultural productivity. Women and men farmers have an equally important role in placing agricultural labor, so leaving them uneducated will have an impact on reducing agricultural productivity.

Agricultural institutions also have the potential for business development. The business model is used as an illustration for business people in determining company development strategies through the Business Model Canvas analysis tool. The Business Model Canvas (BMC) is structured as a business model tool using a canvas which is divided into nine (9) important company elements to make it easier for entrepreneurs to simplify complex business realities into basic elements. Preparing a Business Model Canvas (BMC) in agricultural institutions has the advantage of introducing the business through a simple description and the overall condition of the company based on the company's internal environment and external environment. The Srikandi Entrepreneurial Unit's Business Model Canvas (BMC) is mapped into 9 components which include customer segmentation, value proposition, channels, customer relationships, revenue streams, main resources, main activities, main partnerships, and cost structure. Figure 2. is the result of development strategy mapping using the Business Model Canvas approach.

FIGURE 2. Jember Regency Entrepreneurial Unit Business Model Canvas Mapping

Customer Segmentation

The Srikandi Business Unit is a business unit engaged in the chili processing industry into products in the form of chili sauce and selling chips. Customer segmentation of the Srikandi entrepreneurial unit can be divided into two characteristics, namely psychographics and demographics. Psychographic customer segmentation in the Srikandi Entrepreneurial Unit is based on psychographics, namely consumers who like processed chilies. Consumers who like processed chilies certainly have an interest in buying all kinds of processed chilies because of their interest or habit of consuming processed chilies. Customer segmentation based on demographics in the Srikandi Entrepreneurial Unit means that consumers are divided into several criteria, namely type of work and level of education. Based on the level of education, customer segmentation in the Srikandi Entrepreneurial Unit is students and college students. Based on the type of work, the Srikandi Entrepreneurial Unit customer segmentation is housewives, workers, culinary business pioneers, and PKK mothers.

Value Proposition

The proportion of value or excellence provided by the Srikandi Entrepreneurial Unit consists of human resources who are skilled in processing chilies to make superior products that are suitable for sale on the market. The marketing carried out at the Srikandi Entrepreneurial Unit has been carried out in a modern way, namely by utilizing digital marketing so that the marketing carried out can reach widely and optimally. The activities carried out by the Srikandi Entrepreneurial Unit are very structured and all existing human resources have worked by the directions given so that the work carried out is maximized. Apart from that, the participation and activeness of all members is an advantage in making operational activities more effective and efficient. The existence of the Srikandi Entrepreneurial Unit has had a positive impact on business development in the village so the Srikandi Entrepreneurial Unit has received support from the local government to be developed even better. The smooth running of all operational activities of the Srikandi Entrepreneurial Unit is also supported by the existence of very supportive facilities and infrastructure so that every activity can be carried out well.

Channel

The Srikandi Entrepreneurial Unit provides all sales information on processed chili and chip products that customers need through various media and channels. The marketing channels that the Srikandi Entrepreneurial Unit has in reaching customers are direct and indirect. Direct marketing channels are in the form of BumDes Panduman which has been prepared by the Panduman village government, UKKM Cafeteria at the Faculty of Agriculture, Jember

University, and MSME product bazaars which are usually held by the government and other agencies. Meanwhile, indirect or online marketing channels are carried out through the website provided by the Srikandi Entrepreneurial Unit and also through social media intermediaries such as WhatsApp, Instagram, YouTube, and TikTok. Apart from that, the Srikandi Entrepreneurial Unit also uses sales services through paid promotions, endorsements, and influencers so that the products sold can reach a wide reach.

Customer Relations

relations relate to how the company maintains good relationships with customers through maximum service efforts to achieve customer satisfaction. The method applied by the Srikandi Entrepreneurial Unit company in maintaining relationships with customers is by providing product discounts and bundling packages so that consumers are more interested in buying products made by the Srikandi Entrepreneurial Unit because they have affordable prices and discounts. The Srikandi Entrepreneurial Unit also provides several product testers so that consumers can taste the products made by the Srikandi Entrepreneurial Unit before making a purchase. Apart from that, consumers can also provide reviews of the testimonials that have been provided. The Srikandi Entrepreneurial Unit also provides member services for every buyer to increase customer interest in becoming regular customers of the Srikandi Entrepreneurial Unit. The Srikandi Entrepreneurial Unit also forms a community for chili-loving consumers so that consumers also know about some of the preparations made by the Srikandi Entrepreneurial Unit.

Income Stream

The Srikandi Entrepreneurial Unit generates income from sales of chili products and processed chips. Apart from that, other sources of income come from COD commissions, sponsorships, and paid promotional services. The Srikandi Entrepreneurial Unit through digital processing, promotion, and marketing activities has had an impact on increasing income for womenpreneurs.

Key Resources

The resources owned by the Srikandi Entrepreneurial Unit are in the form of the Panduman Village chili garden which is cultivated directly by all members of the Srikandi Entrepreneurial Unit. The next resource is a production house to carry out all operations for processed products from the Srikandi Entrepreneurial Unit. The equipment resources owned by the Srikandi Entrepreneurial Unit in carrying out all these activities are good and competent. The Srikandi Entrepreneurial Unit's human resources are skilled and always active so that all activities carried out run well.

Main Activities

The main activities are the core of the activities carried out by the Srikandi Entrepreneurial Unit in achieving business success. The activities carried out include several activities that support the development of the Srikandi Entrepreneurial Unit and MSMEs in Panduman Village. The activities carried out are holding meetings and coordinating the running of all activities. The second activity is related to the production of chili sauce and chips, which begins with procuring raw materials to meet all production needs. The next activity is processing the product into chili sauce and chips. The finished product will be packaged to make it more attractive and durable. The packaged products will later be promoted and then sold and distributed to consumers.

Key Partnerships

The Srikandi Entrepreneurial Unit has several cooperative relationships with several parties such as chili farmers, government agencies, cooperative and MSME services, information and informatics services, investment and one-stop services, food crops and horticulture services, Jember media radar, BumDes, machine tool shops, grocery stores, souvenir centers, and delivery services. Farmers assist the Srikandi Entrepreneurial Unit in providing chili supplies and assisting with chili processing. Government agencies assist the Srikandi Entrepreneurial Unit in providing tools and grants. BumDes helps in providing a place to sell products, Radar Jember Media helps in publications to expand all activities and product sales of the Srikandi Entrepreneurial Unit. The hardware store assists the Srikandi Entrepreneurial Unit in providing production equipment. Grocery and souvenir shops help the Srikandi Entrepreneurial Unit in marketing products.

Fee Structure

The cost structure of the Srikandi Entrepreneurial Unit agro-industrial business includes all costs incurred from the beginning to the end of the production process. Costs in an entrepreneurial unit are divided into fixed costs and variable costs. Fixed costs consist of equipment and building rental costs. Meanwhile, variable costs consist of raw material costs, packaging costs, labor costs, promotional costs, electricity costs, administration, internet, domain costs, and hosting costs.

CONCLUSION

Based on the research that has been conducted, it can be concluded that (1) Strengthening entrepreneurial units through the role of women in agricultural institutions including PKK and UMKM groups, BUMDES, Farmer Groups, village officials, and the Media which aims to maximize the support that has been provided. Each woman's role in agricultural institutions has an important role so the support received by entrepreneurial units also comes from various sides. (2) The business development strategy in this research is to use a model carried out by the Srikandi entrepreneurial unit with nine main components, namely customer segments, value propositions, channels, customer relationships, income streams, main resources, main activities, main partnerships, and structure. cost.

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Islamic Experiential Marketing (A Reception Analysis of Among Muslim McDonalds Consumers)

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Abstract. The potential and opportunities of the Muslim market in the world continue to increase, especially in Indonesia, where the majority of the population is Muslim. Capturing this potential and opportunity, business people continue to carry out various strategies to welcome this opportunity, one of the strategies carried out is to use an experiential marketing approach. Experiential Marketing is an approach that focuses on the consumer experience. The approach focuses on the five senses (sense), feelings (feel), ways of thinking (think), habits (act) and relationships (relate). Experience has a big influence on a consumer's buying decision. Emotional and rational aspects are the focus that business actors want to target, this is because the experience factor has an influence on the repurchase process. The experience that Mcdonalds wants to target is the protection of the religiosity of Muslim consumers. Internalization of Islamic values in Experiential Marketing as a marketing communication strategy is expected to capture the attention of Muslim consumers in Indonesia. This research is a kaulitative research with constructivism paradigm. The subject of this research is Experiential Marketing activities at McDonald's with the object of research being McDonalds Muslim consumers. This study uses a reception analysis research method which is a way to understand how the meaning of messages received by audiences (consumers) in determining the content or text of a media message. Through the existence of halal logos, prayer rooms, clean places, clear prices and female hijab waiters, Muslim consumers' experience of Islamic values is built and strengthened in the minds of consumers. The internalization of Islamic values built through Experiental Marketing has succeeded in understanding, interacting with Muslim consumers and empathizing with their needs through Islamic values.

INTRODUCTION

According to the *State of* the *Global Islam in Economy* 2014-2015 issued by Thomson Reuters and Dinar Standard, there are very promising opportunities in the economic sector in the Muslim market, such as the Halal Food and Beverage Sector. The increase in global Muslim consumption of halal food and beverage products in 2013 reached a value of US $ 1.29 billion with an increase of 10.8% compared to the previous year, and it is estimated that the value in 2019 will increase to US $ 2.54 billion, or equivalent to 21.2% of total world consumption. In the Muslim travel sector, the consumption value of these products/services in 2013 reached US$ 140 billion and is estimated in 2019 to be US$ 238 billion, equivalent to 11.6% of total world consumption. In the Fashion sector, the consumption level of the global Muslim community for this product in 2013 reached a value of US$ 266 billion and is estimated in 2019 to be US$ 488 billion (11.9% of total world consumption). In the Pharmaceutical and Cosmetic sector, in 2013, this product had a value of US$ 72 billion and is estimated in 2019 to reach US$ 103 billion or equivalent to 6.6% of total world consumption ([1] The Organization *of* Islamic Cooperation (OIC*)*, which consists of 57 countries with a majority Muslim population, is now starting to discuss the potential and opportunities for halal products in the world market. In several conferences, this organization discussed the value of the halal products sector in recent years and predictions that indicate that it will increase in the coming years [1].

Along with the growth of Muslims in the world has made opportunities for the Muslim market to increase, so approaches through Islamic values are carried out by McDonalds to reach the potential and market opportunities that exist. The development and potential of this market is what makes the rulers of capital rack their brains and organize strategies to be able to control the market and control consumers to gain profits. Strategies in seizing the market and mastering the industrial scene to win consumers become a very fierce battle. This process of struggle is carried out in order to lead the market, control consumers and gain multiple profits. McDonalds carries out various strategies to win

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030033-1–030033-12; https://doi.org/10.1063/5.0244763
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

the hearts and emotions of consumers, execution secretly or overtly becomes a common thing to highlight the existing *'core product'*, as well as the efforts made by McDonlads.

The reason why researchers determine McDonalds as the object of this research study is because McDonalds, which is a western product, is able to become *top of mind* in the minds of Muslim consumers as a fast food restaurant by providing halal products that are friendly to Muslim consumers. besides that McDonalds is also one of the largest franchises in the world released by www.franchisedirect.com and is ranked second. McDonalds is a fast food restaurant famous for its various hamburgers and fried chicken dishes. McDonalds has 36,290 restaurant units in almost all corners of the world. McDonalds, which was founded in 1940 and changed its name to McDonalds Corporation, is also a company originating from the United States. In 2016 McDonald's has 168 restaurant units in 32 cities spread throughout Indonesia.

Experiential Marketing is a relatively new marketing method, which was presented to the marketing world through the book *Experiential Marketing: How to Get Customers to Sense, Feel, Think, Act, and Relate to Your Company and Brands*, by Bernd H. Schmitt. [2] states that the essence of the concept of *Experiential Marketing* is experience-driven marketing and management. *Experiential Marketing* is an activity to anticipate, manage and achieve consumer satisfaction through an exchange process that is a personal event that occurs in response to or some stimulus [3]. *Experiential Marketing* differs from traditional marketing which focuses on features and benefits in four main ways. Focus on the first experience. In contrast to traditional marketing, *Experiential Marketing* focuses on the customer experience. Experiences that occur as a result of meeting, going through, or passing through certain situations. Experiences provide sensory, emotional, cognitive, behavioral and relational values that replace values [4]. *Experiential Marketing* tries to pay attention to both consumers individually or per group, presenting a communicative communication style, dialogue, so as to provide experience and empathy to its consumers [5]

This phenomenon and opportunity for Muslim consumers is what makes McDonalds create various strategies in convincing Indonesian Muslim consumers. Through the internalization of Islamic values into a marketing strategy. This is a way to create closeness with consumers through an *experience* that evokes emotional value. Pine II and Gilmore [6] argue that *experience is an* event that occurs to each individual personally. Kotler (in [7] argues that a pleasant experience with a consumed product will determine consumer satisfaction and create repeat purchases. Experience has a big influence on a person's satisfaction and makes him make repeat purchases. Emotional aspects and rational aspects are the aspects that marketers want to target through this program and often these two aspects have a tremendous effect in marketing [8]. Building the emotional sector with an Islamic values approach. This will create a sense of ownership to the brand, so that consumers are willing to set aside a *share of their wallet* for the product. Religious experience is one part of consumer decisions in determining a product, especially food products for the Muslim community. This religious experience and Islamic values are used to strengthen McDonalds' existence in Indonesia. The internalization of Islamic values using the *experiental marketing* approach has a big share in the process of capturing the market and controlling the hearts of Muslim consumers in Indonesia.

Islamic values are essentially a collection of life principles, teachings on how humans should live their lives in this world, which one principle with another is interrelated to form a whole unit that cannot be separated. Value is also an idea or concept about what a person thinks and considers important in his life [9]. Islamic values are not only a guideline for humans in living life but by some humans, these Islamic values can turn into a strategy in the marketing process. Islamic values are used by some companies to seize emotions, steal attention and convince the growing Muslim market. Islamic values are used as a marketing communication strategy to win Muslim consumers. Researchers see an effort made by McDonalds in order to win the Muslim market in Indonesia by awakening the *experience of* religiosity in consumers. This marketing communication strategy is used as a strategy to capture the increasing potential of the Muslim market.

The audience refers to a group of people formed as a result or result of communication activities carried out which are large in number (perhaps even unlimited), widely dispersed, many of whom do not know each other, and heterogeneous in terms of socio-economic and demographic characteristics. The audience as part of a society with dynamic social construction has a public space to question all the symptoms they get or consume from certain media. The audience as a critical society and part of the development or decline of the environment has the right to contribute to the environment according to personal understanding.

The analysis in this study will be described descriptively to describe a reality, in this case wanting to reveal how McDonalds consumers' receptions of the Internalization of Islamic values through *Experiential Marketing* as a Marketing Communication Strategy of McDonalds Indonesia. Researchers use reception theory from Struat Hall which focuses on audience reception *(decoding). Decoding* is an activity to translate or interpret physical messages into a form that has meaning for the recipient [10]. According to Stuart Hall, audiences decode media messages through three possible positions, namely dominant hegemony, negotiation and opposition. The utilization of the theory of reception analysis as a support in the study of audiences actually wants to place audiences not passive but seen as cultural agents who have their own power in terms of producing meaning from various discourses offered by the media. The theory of meaning in this research will be used by researchers to understand and see audiences interpret messages that are communicated through a cultural approach and refer to Struat Hall's reception theory so that it will determine the possible position of the audience. Researchers will describe matters related to informants' interpretation of the Internalization of Islamic values in *Experiential Marketing* as a marketing communication strategy of McDonalds Indonesia.

RESEARCH METHODS

This type of research is a type of leatherative research that is used to examine objects by telling, interpreting existing data and its implementation through collecting, compiling, analyzing and interpreting the data under study. This research uses the constructivism paradigm which is one of the paradigms in social science which has the aim of inquiry to reconstruct understanding. The subject of this research is Mcdonals consumers in determining the research object, the researcher uses purposive sampling selected on the basis of criteria and the number of informants in this study is not a benchmark. Researchers will select informants based on criteria that researchers consider to be the main basis for selecting informants related to this research. The object of this research is the activity of internalizing Islamic values through *Experiential Marketing* as a marketing communication strategy carried out by McDonalds. This research was conducted at McDonalds restaurant, Jalan otto iskandar, East Jakarta and the research time span was July to September 2021. Data collection was carried out by means of in-depth interviews, documentation and literature study. This research uses the reception analysis research method. Reception analysis is a way to understand how the meaning of messages received by audiences (consumers) in determining the content or text of a media message. According to Eoin Devereux (2003: 138-140) explains that reception analysis is a type of research that focuses on the meaning of messages in the context of the media and then generalized in everyday life.

RESULTS AND DISCUSSION

Experiential Marketing seeks to create a positive experience for consumers in consuming products or services that can be used as a reference for producers to predict future consumer behavior in the form of repurchase actions. *Experiential Marketing* has a direct influence on repurchases on the stronger and clearer the *Experiential Marketing* provided by the company to consumers, the more consumers will make repeat purchases [3]. In this strategy, the emotional side of the product is developed through marketing efforts. Emotional experiences can be created by creating brands that provide unforgettable experiences to their customers, with the support of a good marketing program. This strategy is also carried out by McDonalds in creating consumer experiences and emotions. McDonalds creates the emotional side of consumers by providing Islamic values. This strategy using Islamic values was built in order to win the hearts of consumers in Indonesia, the majority of whom are Muslim.

Experiential Marketing is an approach that provides information about brands and products. It is closely related to the customer experience, this is what distinguishes it from traditional marketing systems that focus on the functions and benefits of a product. *Experiential Marketing* refers to the real experience of customers with brands, products, services to increase sales, sales and brand image or awareness. [11]. This good and memorable experience will create positive feelings and emotions towards the brand. The emergence of a feeling of satisfaction and wanting to repeat the experience gained, this is what is now widely applied by producers to face the tight competition where there are many similar products with only minor differences in specifications from each other. McDonalds is able to create a good experience in the minds of Muslim consumers in Indonesia as an American company that is friendly to Indonesian Muslims. McDonalds has succeeded in creating a good experience in the minds of Muslim consumers in Indonesia about halal food and making McDonalds the *Top Of Mind of* halal food for Muslim consumers in Indonesia.

The marketing concept that can be used to influence consumer emotions is through *Experiential Marketing*, which is a marketing concept that not only provides information and opportunities for customers to experience the benefits obtained but also evokes emotions and feelings that have an impact on marketing, especially sales. The main key to *Experiential Marketing* is the generation of emotions that create a feeling of connection with consumers. McDonalds builds consumer emotions with Islamic values. This is closely related to the values prevailing in the consumer environment. These values bind consumers' emotions with McDonalds more closely so that McDonalds' presence can still be accepted by Indonesian Muslim consumers even with the existing issues. The goal of Experiental Marketing is to increase the value and level of consumption. This means *Experiental Marketing* seeks to do emotional control, education, cross-selling, brand alliances. Experience is a means of making consumers feel physically, mentally, emotionally, socially or spiritually connected in consuming products or services, making meaningful interactions for consumers.

McDonalds forms emotional bonds with Muslim consumers using *Experiential Marketing* with 5 indicators, namely the five *senses* (*sense*)*,* feelings (*feel*)*,* ways of thinking (*think*)*,* habits (*act*) and ties or relationships (*relate*)*. Experiential Marketing* contains Islamic values, this can be seen from the 5 indicators.

First, the five *senses* (*sense*)*,* namely efforts to create experiences related to the five senses through sight, sound, touch, taste and smell. These elements are used to differentiate businesses and their products in the market, arousing consumer desire to buy these products. Rini (2012) argues that sense is the tangible and perceivable aspects of a product that can be captured by the five human senses, including sight, sound, smell, taste and touch. Sense indicators according to [12] are: color design, comfort, cleanliness and service.

TABLE 1. McDonalds Consumer Reception on the *Seen* indicator

No.	Informant	Intepretation	Category	Revenue Position
1	AH	First, the place is clean, second, the service is friendly, third, it's cool and the service is fast. My impression is that I am comfortable with the service.	− Hygiene − Waiter & service	Dominant Hegemony
2	SD	What I saw when I entered the Mcd was that the place was neat, clean, the staff were pretty and the service was fast.	− Hygiene − Waiter & service	Dominant Hegemony
3	HA	M logo, the restaurant is clean, the waiters are friendly, the ladies are beautiful because they all wear hijab, because I like women with hijab.. heheheh	− Logo − Hygiene − Waiter & service	Dominant Hegemony
4	AK	Clean, communicative waiters, fast service, and the price is clearly within the pocket.	− Hygiene − Services − Price List	Dominant Hegemony
5	BM	The place is clean, the service is also fast, there is a halal logo from MUI, there is a place to relax,	− Hygiene − Halal Logo − Facilities	Dominant Hegemony

Source: Research Results, 2021

Based on table 1, consumer acceptance through the *seen* indicator can be categorized into four focuses of consumer attention, namely cleanliness, waiters, *price list*, halal logo and prayer room. The receiver has positioned McDonalds consumers into the dominant hegemony category. Dominant hegemony is where consumers accept the messages conveyed by the media. This is a situation where the media conveys its message using the dominant cultural code in society. The dominant cultural codes in society are Islamic values such as cleanliness, waiter performance, halal, *price list* and prayer rooms.

McDonalds has successfully built that experience by creating a restaurant atmosphere that prioritizes cleanliness. Islam also teaches people to maintain and love cleanliness as contained in the hadith narrated by tirmizi, *"Allah SWT is pure who loves pure things, He is clean who loves cleanliness, He is glorious who loves glory, He is beautiful who loves beauty, therefore clean your places. And do not imitate the Jews." (HR At Tirmidhi: 2732).* From this hadith, it is clear that what McDonalds does in shaping the experience of restaurant cleanliness contains Islamic values that make Muslim consumers comfortable.

Furthermore, through the five *senses* (*sense*)*,* consumers see the existence of a halal logo that is spread across various media in the restaurant. This evokes a comfort for Muslim consumers in consuming McDonalds products. Islam regulates its people in consuming food and drinks, this is explained in the Quran Surah Al Baqarah verse 168, "*O people, eat what is halal and good from what is on earth, and do not follow the steps of the shaitan; for indeed the shaitan is a real enemy for you"* (QS. Al Baqarah 168). This evidence is very clear how food and beverage consumption patterns have been regulated in the Quran. Halal food is a basic food choice for a Muslim. This is what McDonalds has given to Indonesian Muslim consumers. Through its halal logo, McDonalds has succeeded in binding the emotions of Muslim consumers in Indonesia to be more comfortable with the existence of McDonalds products.

Next, what can be captured by the five *senses of* consumers is the appearance of female services in front of the order table or cashier. The majority of McDonalds services use hijab, which is the way Muslim women dress. This is captured by Muslim consumers as an Islamic sight. The existence of an Islamic sauna is built with the presence of female waiters who use the hijab. Hijab becomes an identity of Muslim women, this is also confirmed in the Quran Surah Al Ahzab verse 59, "*O Prophet, Say to your wives, your daughters and the wives of believers: "Let them spread their headscarves over their bodies". so that they are more easily recognized, so they are not disturbed. and Allah is the Most Forgiving, the Most Merciful ".*This surah expressly recommends that women use the hijab. This emphasizes that the hijab is an identity for women who are Muslim. The appearance of this female waiter is captured by Muslim consumers as Islamic values.

Another thing that is captured by the five *senses* (*sense*) *of* Muslim consumers is a *price list*. *Price list* is one of the factors that strengthen consumer confidence to buy. Price list is one of the ways producers display the price of their products. Price list for consumers as one of the indicators determining the purchase based on the ability of consumers to buy. If the price is clear and consumers are able to buy, there will be confidence in consumers to buy and a sale and purchase process will take place. This belief can be referred to as a sale and purchase contract. The sale and purchase agreement occurs between the seller (in the form of a *price list*) and the buyer so that the sale and purchase process occurs. The most important thing in the buying and selling process is mutual consent and sincerity. Price clarity in the buying and selling process is a concern for Islam as the Hadith narrated by Bukhari, *"Companion Urwah al-Bariqy Radhiyallahu anhu said, "Rasulullah Shallallallahu 'alaihi wa sallam gave me one dinar to buy a sacrificial goat, or a goat. Armed with one dinar I bought two goats and then I resold one of them for one dinar. Then I came to see him with a goat and a denarius." Upon seeing this clever action of his friend, the Messenger of Allah (peace and blessings of Allah be upon him) prayed for blessings on the business of his friend Urwah, so that if he had bought dust, he would have gotten profit from it." (Bukhari: 3443).* Some scholars argue that the ethics of consuming food and drink in an Islamic manner is to fulfill consumer obligations first, namely by paying. This is so that there is clarity of price when consuming so as to create a sincerity for consumers when consuming the food. Paying first will create pleasure in consumers and not feel cheated considering that some *price lists do* not include taxes and *services*.

Second*, feel,* which according to [2] feel marketing is a strategy to approach feelings (affection) and implementation of companies and brands through *experience providers,* with the aim of influencing the mood, feelings and emotions generated by *events*, *agents (*people who do events, companies and situations), and *objects* (things that have been seen). According to [12] this feel has indicators, namely: pride, product perception, pleasure and comfort.

TABLE 2. McDonalds Consumer Reception on *Feel* indicators

No.	Informant	Interpretation	Category	Revenue Position
1	AH	So far, I feel comfortable eating at Mcd because the service is fast, the process is hygienic and certainly halal.	- Hygiene - Halal - Waiter	Dominant Hegemony
2	SD	No problem bro, McD already has a halal certificate so it's suitable for Muslims to eat.	- Halal	Dominant Hegemony
3	HA	Until now, I am still comfortable with what McD provides and as a Muslim, I am also not afraid because it already has a halal logo.	- Halal	Dominant Hegemony
4	AK	Yes, if it's a halal issue, it's fine, but why does he have to have a non-Muslim.	- Halal	Dominant Hegemony
5	BM	Because there is already a recommendation from MUI through	- Halal	Dominant Hegemony

No.	Informant	Interpretation	Category	Revenue Position
		the halal logo, the product is halal for consumption as a Muslim.		

Source: Research Results, 2021

Based on table 2, consumer acceptance through the *feel* indicator can be categorized into four focuses of consumer attention, namely cleanliness, service, *price list*, halal logo and prayer room. This category has similarities with the categories in the *seen* indicator, this is because of the feelings that arise in consumers due to a stimulus from the senses *(seen)*. *Experiences providers* carried out by McDonalds through restaurant cleanliness which makes Muslim consumers feel comfortable eating at the restaurant. Through the halal logo to create a sense of security and comfort when consuming McDonalds products. Through the service of women wearing hijab that creates an Islamic atmosphere. Through a price list that creates a sense of sincerity and pleasure when buying and selling. So that in this indicator McDonalds consumers fall into the category of dominant hegemony which is still influenced by the dominant cultural code.

The third way of thinking (*think*), Think according to [2], aims to encourage customers to engage in careful and creative thinking, where the results obtained without reassessment of the company and product. [12], think has indicators, namely: interest, knowledge of a product and previous experience.

TABLE 3. McDonalds Consumer Reception on the *Think* indicator

No.	Informant	Interpretation	Category	Revenue Position
1	AH	A fast food restaurant that sells fried chicken, Humberger, which is a native American company that has been certified halal.	− America's Original Fast Food Restaurant − Halal	Negotiation
2	SD	American restaurant, fast food, hangout place, providing halal food, has the famous M logo.	− Native American Restaurant − *Fast Food* − Halal	Negotiation
3	HA	American restaurant, cozy place, selling halal products, and fast service.	− Native American Restaurant − Halal − Services	Negotiation
4	AK	Chicken, the general mindset is not Muslim. Elitist,	− Products − Native American Restaurant (non-Muslim) − Elitis	Negotiation
5	BM	American products, dining, *Junk Food*	− Native American Company − *Junk Food*	Negotiation

Source: Research Results, 2021

Table 3 shows how McDonalds consumer acceptance mapping on the *think* indicator. The table categorizes the existence of McDonalds in the minds of Muslim consumers as an American company that sells *junk food* and *fast food* products that have halal certificates. In this indicator, the category refers to things that are against the dominant culture, namely Islamic values such as *Junk food*. *Fast Food* and *Junk Food* are foods that have unbalanced nutritional levels. Some studies show that *Fast Food* and *Junk Food* will potentially interfere with the health of those who consume it.

Muslim consumers' perspective on the existence of American products has a negative connotation. This is because the existence of McDonalds from America is always associated with Zionist issues because of America's support for Israel. Idelogical political issues are always juxtaposed with McDonalds, especially with the humanitarian disaster that afflicts Palestine, which is predominantly Muslim. Muslim opinion is led that Zionist funders are native American products such as McDonalds. In this indicator, consumer acceptance is in the Negotiation Position, which is a position where consumers are willing to accept dominant ideologies that are general in nature, but they will make several exceptions in their application which are adjusted to local cultural rules.

Through *Experiental Marketing,* McDonalds has succeeded in building the way Muslim consumers think that McDonalds is in favor of Muslims. The presence of the halal logo and prayer room logo is one of the *Experiential Marketing* strategies in controlling the emotions of Muslim consumers. The presence of the halal logo creates a thought in the minds of Muslim consumers that McDonalds is an American company that provides halal products for Muslim consumers. Making McDonalds the *Top Of Mind of* halal food in the minds of Indonesian Muslim consumers. The presence of halal logos, prayer room logos, hijab-wearing female waiters, clear prices strengthen the perspective in the minds of consumers that McDonalds has created a strong Islamic atmosphere. This makes consumers think again, conducting an evaluation of the ideological issues that are always associated with McDonalds.

The fourth habit *(act)* is a marketing technique to create consumer experiences related to the physical body, behavior patterns, and long-term lifestyles and experiences that occur from interactions with others. According to [8] that habits are related to real behavior and a person's lifestyle. Where lifestyle itself is a pattern of individual behavior in life which is reflected in actions, interests and opinions. *Act experience* in the form of a lifestyle can be applied by using ongoing trends or encouraging the creation of new cultural trends. The purpose of *act experience* is to give an impression of behavior patterns and lifestyles, and enrich social interaction patterns through the strategies carried out. According to [12] act has indicators, namely: appearance, innovative and lifestyle.

TABLE 4. McDonalds Consumer Reception on *Act* indicators with the presence of a halal logo

No.	Informant	Interpretation	Category	Revenue Position
1	AH	Yes, by having a halal certificate from MUI, it is a sign that Mcd has invited people to eat halal food products.	Have a share	Dominant Hegemony
2	SD	Never mind bro, with the halal logo attached to the entrance, it's a sign that mcd has contributed to inviting us to eat halal food.	Have a share	Dominant Hegemony
3	HA	Yes, he has contributed, with the halal logo it proves Mcd's commitment in campaigning for halal products.	Have a share	Dominant Hegemony
4	AK	Can, provide public awareness of halal food with the hahal logo.	Have a share	Dominant Hegemony
5	BM	Because he asked MUI for a halal certificate, it can be said that he has contributed in encouraging the consumption of halal food.	Have a share	Dominant Hegemony

Source: Research Results, 2021

Table 4 shows that consumer acceptance of the halal logo is related to behavior and lifestyle *(Act)* in the consumption of food and drinks that are recommended by religion. The existence of a halal logo, consumers assume that McDonald's has contributed to shaping the lifestyle of halal food consumption which is the values of Islam. These Islamic values influence consumer acceptance so as to position acceptance in the dominant hegemony. This is because the majority of Indonesia's population is Muslim so that the dominant hegemony that applies is Islamic values.

TABLE 5. McDonalds Consumer Reception on the *Act* indicator with the presence of Mushola

No.	Informant	Interpretation	Category	Revenue Position
1	AH	I agree, with mushola facilities, it makes it easier for consumers to pray, so they don't need to go out to find the nearest mosque.	Make it easy for consumers to pray	Dominant Hegemony

No.	Informant	Interpretation	Category	Revenue Position
2	SD	It's okay bro, just make it easy and simple to find a place to pray.	Make it easy for consumers to pray	Dominant Hegemony
3	HA	That's actually a facility that every restaurant or public place has, because McD is in Indonesia, where the majority of the religion is Islam.	Public facilities	Dominant Hegemony
4	AK	They provide public rights, because they are in a Muslim country, they are obliged to provide facilities for worship and that is natural.	Public Facilities	Dominant Hegemony
5	BM	Yes, it's good that he provides a place of worship for Muslims, indirectly he has given attention to Muslims even though we don't know what's behind it.	Make it easy for consumers to pray	Dominant Hegemony

Source: Research Results, 2021

Table 5 also shows consumer acceptance of the existence of prayer rooms which are accepted by consumers as public facilities for Muslim worship. The existence of the prayer room is accepted by consumers as a facility that makes it easier for Muslim consumers to worship, indirectly the existence of the prayer room is one of McDonalds' support for Muslims to worship on time. This is related to behavior and lifestyle *(Act)* in praying on time.

McDonalds does *act experience* through Islamic lifestyle, this is reflected in the halal logo and prayer room logo. The halal logo is a reflection of McDonalds participating in marketing halal food, by marketing halal-halal products McDonalds has contributed to the community to choose halal products for consumption according to Islamic values. The Mushola logo reflects that the *act experience is* to carry out a lifestyle of praying on time. The existence of prayer rooms at McDonalds is a worship facility provided by McDonalds so that consumers do not have to bother looking for mosques outside the restaurant and make prayer patterns on time. Praying on time is a recommendation for a Muslim, this is found in the Quran Surah An Nisaa Verse 103, "*So when you have completed your prayer, remember Allah while standing, while sitting and while lying down. then when you feel safe, then pray (as usual). Indeed, prayer is a fardhu whose time is determined for those who believe."* This evidence is clear that praying on time is a recommendation for Muslims, it is obligatory to pray on time under any circumstances. The existence of prayer room facilities has made it easier for Muslim consumers to pray on time. It is clear that through the halal logo and prayer room logo, McDonalds has indirectly contributed to influencing the *act experience of* Muslim consumers in Indonesia. Based on the explanation above, it is clear that consumer acceptance is included in the dominant hegemony category which is influenced by Islamic values prevailing in Indonesia.

Fifth*, relate,* in general, *relate experience* shows relationships with other people, other groups (eg work, lifestyle) or broader and abstract social communities (eg country, society, culture). According to [8] relations are related to relationships with one's culture and reference groups that can create social identity. The purpose of the *relate experience* is to connect the consumer with the culture and social environment. According to [12] relate has indicators, namely socialization, product community and networking. A marketer must be able to create a social identity (generation, nationality, ethnicity) for his customers with the products or services offered.

In this stage, consumers are brought to a certain culture and social environment, namely culture and social environment that reflect Islamic values. McDonalds, which is an original American company, has cultural values that are thick with western accents, this can be seen from the products sold, the transaction process and so on, while Indonesian Muslim consumers have Islamic values. McDonalds is accepted by Muslim consumers as a Native American company that is always associated with Zionist issues. Information in various media has successfully led Muslim consumers to think about Native American products and Zionist practices. This unconsciously affects consumers in acceptance on the *relate* indicator.

TABLE 6. McDonalds Consumer Reception on the *relate* indicator

No.	Informant	Interpretation	Category	Revenue Position
1	AH	Once from the internet, Mcd is from America so it's natural that it is always associated with Zionists. When I see the phenomenon of world politics between Israel and Palestine, I as a Muslim also feel angry because we are fellow Muslims.	Native American products are Zionist supporters Reactive Muslim Disillusionment	Dominant Hegemony
2	SD	Wow, there are a lot of them on the Internet, although it's not clear whether the news is true or not. But because McD is from America, which is very close to Israel, it is natural that people think that McD is Zionist. If you ask me how I feel, I'm definitely angry. .... We are both Muslims.	Native American products are Zionist supporters Reactive Muslim Disillusionment	Dominant Hegemony
3	HA	Never, not just Mcd anyway mas... all products from America are always associated with Zionists such as Sratbuck and others are also always associated with Zionist stooges.	Native American products are Zionist supporters	Dominant Hegemony
4	AK	As a Muslim, it is actually a neutral economic domain because of fastabiqul khoirot. Non-Muslims cannot buy from non-Muslims. So psychologically we as Muslims have a burden because the original American mcd is often associated with Zionism.	Native American products are Zionist supporters Islam does not limit the process of buying and selling to anyone	Dominant Hegemony
5	BM	There are many of them on the internet. There was a feeling not to shop there even though in Sharia it is not forbidden to do business with Jews. But because we see what the Zionists are doing to our Muslim brothers, maybe boycotting is a form of protest against the humanitarian disaster in Palestine.	Native American products are Zionist supporters Islam does not limit the process of buying and selling to anyone	Dominant Hegemony

Source: Research Results, 2021

In table 6 how McDonalds Muslim consumer recipients when influenced by various Zionist issues which are certain social groups. In this *relate* indicator, it can be seen that consumer recipients accept that McDonald's is an original American product that is always associated with Zionist issues. This recipient is influenced by the dominant hegemony of the local environment, which is predominantly Muslim. It is clear that McDonalds cannot be separated from the shadow of American political policy, especially its support for Israel.

Indonesia, where the majority of the population is Muslim, requires McDonalds to build a *relate experience* that applies in Indonesia, namely through Islamic values, even though historically McDonalds has a different ideology. Historically, McDonalds ideology was born from Jewish descent, therefore it is not wrong if McDonalds is always attached to Zionist issues. The Quran in Surah Al Maidah Verse 88 mentions how hard the enmity of Muslims and Jews *is,* "*Verily you find those whose enmity is most intense against those who believe are the Jews and the polytheists, and verily you find those whose friendship is closest to those who believe are those who say: "We are Christians." That is because among them are priests and monks, and because they do not conceal themselves*" (Al Maidah: 83*)*.

Based on this proposition, it is clear that the enmity between Muslims and Jews will continue to exist and is still being felt as well as the tragedy of the humanitarian disaster in Palestine. The difference in ideology does not make McDonalds clean hard to defend its ideology. Then Islam also teaches Muslims to do mualamah with anyone. Islam does not limit Muslims to do muamalah, Muslims can build cooperation with Narcissists, Sabians, Magi or Jews. This has been exemplified by the Prophet SAW narrated by Bukhori and Muslim hadith From 'Aisha Radhiyallahu anhuma, "*That the* Prophet Sallallahu 'alaihi wa sallam bought food from a Jew *with* payment of tempo and he pawned his armor." (HR. Bukhari and Muslim: muttafaqun 'alaihi). This evidence explains how the Prophet conducted the process of muamalah with a Jew. It is clear that in the process of muamalah Muslims can cooperate with anyone as long as they do not harm each other and are equally satisfied.

To be accepted in the Muslim market, McDonalds still accommodates Islamic values which are the prevailing values in Indonesia. The presence of the halal logo and prayer room logo is part of an identity relationship or values that apply in the consumer environment which is a *relate experience*. McDonalds tries to pay attention both to consumers individually or per group, presenting a communicative communication style, dialogue, so that it can provide experience and empathy to its consumers, one of which is through the halal logo and prayer room logo. The halal logo and prayer room are the focus of research that will be more specifically studied by researchers.

TABLE 7. McDonalds Consumer Reception of the Halal Logo

No.	Informant	Interpretation	Category	Revenue Position
1	AH	It's perfectly legal, because it's part of the legality that McD has passed the halal test. Secondly, it is also part of the protection for Muslim consumers.	Legality of Halal Assurance Consumer Protection	Dominant Hegemony
2	SD	It's obligatory bro, as we are Muslims, everything must be guaranteed halal what we eat to be safe as Muslims.	Legality of Halal Assurance	Dominant Hegemony
3	HA	There is no problem, and it is mandatory for food and beverage companies to guarantee consumers, especially consumers who are predominantly Muslim.	Legality of Halal Assurance	Dominant Hegemony
4	AK	Iyak is okay, it means that Mcd kl in Indonesia must have a Halal MUI logo Mcd must adjust to conditions in Indonesia. The point is Muslims in Indonesia need a guarantee of halal food.	Legality of Halal Assurance	Dominant Hegemony
5	BM	Good, it gives a sense of security to consume it and removes any doubts because as Muslims we are concerned about what we eat and drink.	Consumer Protection	Dominant Hegemony

Source: Research Results, 2021

Table 7 is the result of consumer acceptance of the halal logo how McDonalds consumers accept the halal logo so as to produce acceptance in their daily lives. Halal logos are accepted by consumers as the legality of halal guarantees and are a form of consumer protection.

TABLE 8. McDonalds Consumer Reception of the Mushola Logo

No.	Informant	Interpretation	Category	Revenue Position
1	AH	The mushola symbol under the logo is good, so as a sign that there is a mushola at Mcd.	Mushola presence information	Dominant Hegemony
2	SD	Cool, the design is also in line with the M logo. so consumers on the street know that McD provides a Mushola.	Mushola presence information	Dominant Hegemony
3	HA	That's good, it's a sign that Mcd provides Muslim worship facilities.	Mushola presence information	Dominant Hegemony

No.	Informant	Interpretation	Category	Revenue Position
4	AK	It shows that there is a prayer room in McDonald's, so it is convenient for Muslims to worship.	Mushola presence information	Dominant Hegemony
5	BM	Good, as a notification of the mushola in that place so that those who are not able to pray at the mosque can pray there.	Mushola presence information	Dominant Hegemony

Source: Research Results, 2021

In table 8 is the result of consumer acceptance of the mushola logo accepted by McDonalds consumers. The existence of the prayer room logo is accepted as a sign that gives a message on the existence of Mushola facilities in McDonalds.

Decoding process is an activity to translate or interpret physical messages into a form that has meaning for the recipient [10]. This is also done by McDonalds consumers in interpreting the halal logo and prayer room logo. According to Stuart Hall (in [10]: 550-551), audiences decoding the text go through three possible positions, namely the dominant hegemony position, negotiation position and opposition position. This research only produces one position, namely the dominant hegemony position.

Dominant Hegemony Position, which is a situation where the audience accepts the messages conveyed by the media. This is a situation where the media conveys its messages using the dominant cultural codes in society. In other words, both the media and the audience both use the prevailing dominant culture. The media must ensure that the messages it produces must be in accordance with the dominant culture that exists in society. If, for example, the audience interprets advertising messages in the media in ways that the media wants, then the media, the message, and the audience are all using the dominant ideology.

In this position, McDonalds consumers accept the halal logo and prayer room symbol because of the dominant cultural code that applies in Indonesia. The halal logo and prayer room symbol are a form of internalization of Islamic values and are the dominant cultural codes in Indonesia, which is predominantly Muslim. The halal logo is a legitimization from MUI as an authorized body in determining halal food and drink worthy of consumption by Muslims. The mushola logo is a facility provided by McDonalds as a place of worship. McDonalds provides this facility because it is a public facility that needs to be provided considering the existence of McDonalds in Indonesia, where the majority of the people are Muslim.

McDonalds consumers accept the dominant ideology that has been provided by McDonalds through the halal logo and prayer room. In some cases, McDonalds will be positioned as a company that is considered to support Zionist actions because of McDonalds' history, which was founded by Jewish descendants. The American McDonalds center is also considered a supporter of Israel, which has resulted in a humanitarian disaster in Palestine. Palestine, where the majority of the people are Muslims, makes Indonesian Muslims feel the same way. This feeling sometimes leads to rejection even though McDonalds has internalized the dominant cultural codes of Indonesian society. However, the persuasion messages that consumers receive are often very subtle. Cultural studies theorists do not think that audiences are easily fooled by the media, but often audiences do not know that they have been influenced and become part of the dominant ideology [10]. As is the case with the halal logo and prayer room logo is a subtle message or persuasion. Through the halal logo and prayer room logo, McDonalds is able to attract the hearts of Muslim consumers in Indonesia.

Through *Experiental Marketing*, McDonalds strives to understand, interact with consumers and empathize with their needs through Islamic values. With this strategy, it is expected that consumers will become loyal, willing to enter into long-term relationships, use the company's products and services continuously and recommend them to their friends and closest people. This loyalty will be obtained if consumers feel they get something more valuable than if they switch to another brand [2]. Another advantage that companies get from loyal consumers is that they will recommend brands, company products or producers voluntarily, thus saving the company's expenses for these activities.

CONCLUSIONS

Through the internalization of Islamic values through *Experiental Marketing* as a Mcdonald's communication strategy to win Muslim consumers in Indonesia, Mcdonalds tries to understand, interact with consumers and empathize with consumer needs with an Islamic values approach. This is influenced by the *experience of* Muslim consumers who are very close to the values that apply in their daily lives. The closest values that influence the behavior and acceptance of Indonesian Muslim consumers are Islamic values. *Experiential Marketing* is received by consumers through five indicators, namely the five *senses* (*sense*), *feelings* (*feel*), ways of thinking (*think*), habits (*act)* and relationships or relationships (*relate*) with the presence of halal logos, prayer rooms, clean places, clear prices and hijab-wearing female waiters making the *experience of* Islam even stronger in the minds of consumers consumers. Islamic values in this case are more of an Islamic symbol that is built through *Experiental Marketing*, Mcdonalds tries to understand, interact with consumers and empathize with their needs through Islamic values.

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Visualization of Women Empowerment in MKS' Shoes Advertisement: *What Makes Us Women* (2021)

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Abstract. The MKS' Shoes *What Make Us Women* advertisement expresses thoughts, feelings and stories by celebrating and creating all the unique stories of being a woman. Women's empowerment is a perspective on women's expression and self-freedom that is interesting to study more deeply. Women empowerment, in more detail, explains gender stereotypes from patriarchal pressures constructed by the general public about women's weaknesses to become women's strengths and empowerment. The research focuses on dynamic shots, visualization of expression and function of actors in MKS' Shoes *What Make Us Women* advertisement. Dynamic shot is used as the leading theory and women empowerment as a supporting theory to analyze the visualization of the advertisement. The research subjects used MKS' Shoes: *What Make Us Women* advertisements as a source of research information. The research object uses dynamic shots to support women's empowerment. Dynamic shots create visualizations that can support and emphasize women's empowerment. The expression of the mood, confidence, and courage of the four characters against the emerging female gender stereotypes can be free them to express themselves. Handheld shooting, dolly in, and dolly out are maximally applied to convey women's empowerment and can maximize two obstacles. The statement "*That's what makes us women*" stresses that such is the freedom of expression of a woman.

INTRODUCTION

MKS' Shoes is a local footwear brand for women, its base is in Bandung. Its products are fairly common hence MKS' Shoes provides interesting approaches in promoting products. One of them is by using product advertisements with the tagline *What Make Us Women*, which means expressing thoughts, feelings, and stories by celebrating and creating all the unique stories of being a woman. It tells the story of four women who are tired of responding to other people's comments about them. Each character appearing represents these spirits: Fearless, Consistent, Passionate, and Fresh with their own expressions. The four characters represent freedom of expression and confidence emerging against common comments related to female gender stereotypes. The characters *Fearless, Consistent, Passionate, and Fresh* are shown with the movement of actors jumping, moving fast, assertive and confident. The visualization uses movements that it moves in accordance of the actor's expression. It seems to support the message that the actor wants to convey. Women empowerment is a new concept that has become a global phenomenon and an important issue in national and international academic circles since the twentieth century. Women empowerment means that women can use their talents to live the life they want [1]. Women empowerment also provides mental strength and makes them strong, resilient, and confident. Women empowerment in the MKS' Shoes advert is shown by the movement of actors who move freely to express their thoughts. A form of self-confidence to answer any questions that arise about the freedom how they express.

Advertising is a form of effort by a brand to promote or communicate persuasively with consumers. Advertisements are known in Malay to come from the Arabic I'lan or i'lanun, which means information [2]. Advertising is a persuasive message to potential buyers of a product in the form of goods or services at the lowest possible cost [3]. Advertising can also be used as an attraction, so that it can position the product or brand for the right consumers. Therefore, producers or brand owners must have a creative strategy so that the form of advertising can be packaged differently from competitors and attract public interest.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030034-1–030034-11; https://doi.org/10.1063/5.0241716
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Women often appear in television advertisements and on social media. The appearance of a female figure is needed to strengthen the selling power of a product. They are also treated unequally by men. Women are victims of social, political, religious, and economic subordination and deprivation in society. Women are also often presented as sexual objects, with an emphasis on beautiful figures and clothing, and victims of male violence. Women are subordinated by socially constructed factors that make women's position lower than men [4]. Advertising is an audiovisual product, it also has film form and film style. There are two basic areas and controls in film art, namely film form (narrative) and film style (cinematic) [5]. These two elements are important in making audiovisuals. Film form is the overall pattern of a film—the way its parts work together to create a certain effect. Film style is a stylistic way of managing film form, or you could say it is the technical aspects of film or advertising formation. Film style is divided into four main elements: mise en scène, cinematography, editing, and sound.

Cinematography is defined as the science and technique of filmmaking or the science, technique, and art of taking film images with a cinematograph or camera [6]. Cinematography is the process of taking ideas, words, actions, emotional subtext, tone, and all other forms of nonverbal communication and translating them into visual terms [7]. Cinematic techniques are all the methods and techniques used to add meaning and subtext to the "content" of dialogue and film. Cinematography as an applied science is a field of science that discusses the techniques of capturing images and combining these images into a series of images. It can convey an idea (can carry on story) which is a major factor in the success of filmmaking. Dynamic depiction of stories and conflicts can be used as one of the applications of conveying ideas in film. The technique can be used in visualizing dynamically is dynamic shot. Dynamic is a term for changes in conditions or situations continuously and experiencing significant development. According to KBBI, dynamic means full of enthusiasm and energy, so that it moves quickly and easily adapts to circumstances and etc [8]. Dynamic shot is a fast or slow camera movement that aims to visualize conditions and situations according to the mood conveyed in the film. Camera movement as a support for dramatic elements can also add a sense of energy, excitement, threat, sadness, or other emotional layers [7].

MKS' Shoes *What Make Us Women* advert expresses thoughts, feelings and stories by celebrating and creating all the unique stories of being a woman. Women empowerment is an interesting approach especially for women in terms of freely expressing themselves. The idea is interesting to study more about the role of cinematography in supporting the visualization of women empowerment in MKS' Shoes advertisement, especially in dynamic shots. The research is centered on dynamic shots because the majority of shots in the MKS' Shoes *What Make Us Women* advertisement move dynamically following the narrative of the actors' expressions and the text that appears.

METHOD

This research uses dynamic shot as the main theory and uses women empowerment as a companion theory to analyze the visualization of MKS' Shoes What Make Us Women advertisement. The method used in the research is qualitative described descriptively. The data collected is in the form of words or images, so there is no emphasis on numbers [9]. Qualitative descriptive research aims to describe, depict, explain, and answer in more detail the problems to be studied by studying as closely as possible an individual, a group, or an event.Primary data is the main research data, which is processed directly from the source without going through intermediaries [9]. The subject of this research is MKS' Shoes *What Make Us Women* advertisement as the main source of information and using books, journals, theses, scientific articles and lecture notes about dynamic shot and women empowerment as additional sources of information. Secondary data is data obtained indirectly or through intermediaries but is still based on concepts [9]. The object of research is dynamic shot in supporting the visualization of women empowerment, objects or activities that have certain variations that are determined to be studied and then drawn conclusions.

The data collection techniques used were observation and literature study. Literature study is the activity of studying reference books and research results similar to previous research carried out by other people [10]. The data obtained from the MKS' Shoes What Make Us Women advertisement was analyzed using scientific observation methods. Through observation, researchers learn about behavior and the meaning of that behavior [9]. Observation activities are divided into two forms referring to the function of the observer, namely, participant observer and non-participant observer [11]. The research was carried out using observation techniques that did not play a role, so the presence of this research was not known to the subjects being observed in the observation process. The results of data collection are descriptions of notes and screenshots from the MKS' Shoes What Make Us Women advertisement based on dynamic shots and women empowerment. [12]

Data analysis is the process of systematically searching and compiling data obtained from observations and literature studies by organizing the data into categories, describing it into units, synthesizing it, arranging it into patterns, choosing what is important and what will be studied, and drawing conclusions so that they are easily understood by oneself and others [9]. The data analysis technique consists of reducing and presenting the data by sorting it. Data reduction refers to the process of selecting, focusing, simplifying, separating, and transforming "raw" data that is visible in written-up field notes [11]. Researchers will be guided by the goals to be achieved in reducing data [9]. In qualitative research, data presentation can be done in the form of brief descriptions, charts, relationships between categories, flowcharts, and the like [9]. Data presentation uses image fragments based on dynamic shots and women's empowerment that appear, shot description tables according to image fragments, as well as analysis descriptions that are easy to understand and detailed.

RESULTS AND DISCUSSION

The 60-second MKS' Shoes advertisement was released on 4 October 2021 by the official MKS' Shoes Instagram channel. The MKS' Shoes What Make Us Women advert was produced by a production house that focused on culture and lifestyle from Jakarta which is called Sakaspace. It told the story of four women who were tired of responding to other people's comments about them. Every character appearing in this advert represent of fearless, consistent, passionate, and fresh characters with their respective expressions. The four characters are depictions of women's expressions and confidence that appear against common comments. Fearless, consistent, passionate, and fresh are shown by the movement of the actors who jumping, moving fast, assertive and confident.

TABLE 1. Description of Cast A

Name of Cast	Cast Visualization	Cast Description
Woman A (Passionate)		Skinny White skin Cheerful Active Energetic

Firstly, in scene two, the passionate character is shown by Woman A. Passionate means passionate, excited, and engrossed. Passionate characters can be seen in Woman A who is passionate, energetic, active, and cheerful by singing and dancing jumping up and down on the bed expressing her mood. The choice of color in the wardrobe of Woman A shows a contrasting difference from the character she plays. The beige or cream used by woman A actually shows a calm and serene color, while Woman A plays an active, cheerful, energetic, and passionate woman.

TABLE 2. Description of Cast B

Mention of Cast	Cast Visualisation	Cast Description
Woman B (Fresh)		Fat Curly hair White skin Self-confidence

Secondly, Woman B by playing a fresh character is shown in scene three. The fresh character in Woman B is played as a woman who is comfortable, confident in facing all situations and as she is. The fresh character is also shown by the color of her outfit, which is green. The green shows the fresh and grounded color of nature. Lighter colors are also used in scene 3B with pink and white showing fresh color combination.

TABLE 3. Description of Cast C

Mention of Cast	Cast Visualisation	Cast Description
Woman C (Consistent)		Tawny skin Big body Active in looking for new ideas consistent

Third, it introduces the consistent character of Woman C in scene four. Woman C portrays consistence by actively and continuously changing what she wants. The consistence of Woman C is also shown by her outfit in scene four A and scene 4B which still uses orange. The orange also shows that Woman C is actively looking for new ideas when she works, so that she looks solutive.

TABLE 4. Description of Cast D

Mention of Cast	Cast Visualisation	Cast Description
Woman D (Fearless)		Brown skin Skinny Mysterious Brave Love a challenge

Fourth, scene five introduces the fearless character of Woman D. Fearless in means unafraid. The fearless character played by Woman D is shown by Woman D who looks like a strong, brave woman who likes challenges but remains calm. The fearless character is also seen in the color of the wardrobe worn by Woman D, which is black. The black color tends to show a mysterious and strong nature in scene 5A. Scene 5B shows a blue wardrobe color that shows a strong and calming nature.

Scene one (Opening Scene)

TABLE 5. Shot Description Scene one

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
1	Four women who were tired of responding for questions that were often popped up	00:00:00 - 00:00:05	- Wide shot to full shot	- Hip level	Dolly shot floating

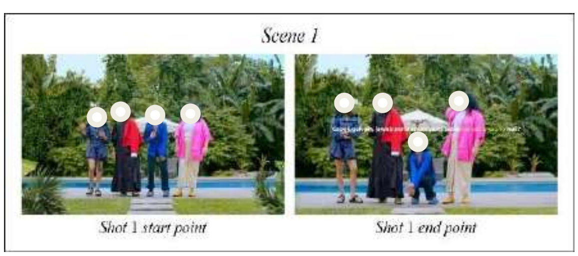

FIGURE 1. Dolly Shot Scene One

The opening scene is shown by introducing four women standing by the pool with tired, weary, and lethargic expressions responding to questions addressed to them as women. The introduction of the characters in the opening scene shows the audience that there is a problem felt by the four characters. The introduction is very important to show curiosity to the audience so that curiosity arises about what problems the four characters feel in the following scenes. The problems of the four women are further clarified by voice over and narration in the text that appears in the picture. The four women will later become representatives of the four characters: passionate, fresh, consistency, and fearless who answer the questions.

Capek gak sih? Jawab pertanyaan berulang-ulang kali. (Voice over timecode 00:00:00)

Dynamic shots are produced by using dolly in or push in camera movements. Dolly in brings the audience closer to the characters in this advert. Dolly shot is also used to emphasize the problems felt by the four women. The use of dolly in at the right time can add dramatic tension and can lead the audience to imagine what the characters are feeling and thinking (13). Wide shots are used to keep the characters visible by showing the location or set so that the characters can appear to fit the location or set (14). The end point shot full shot (Figure 4.1) concentrates on the character's body and what it expresses (15). The dolly in or push in movement in this shot brings the audience closer to the four characters. Therefore, their expression can be seen clearly, so that the audience can pay more attention to their expressions which are tired and lethargic in response to the gender stereotypes that are directed at them.

The dynamic shot is used to produce visualization that can support the delivery of the opening scene in showing a problem of female gender stereotypes conveyed. Dolly shot with dolly in or push in movement brings the audience to get to know more closely the four characters appearing in the opening scene. The changes in shot size in dolly in from the wide shot moves forward into a full shot to emphasize that something is happening or there is something to be conveyed in this advertisement. The message or event that happens next will be explained in the next scenes.

Scene two (Passionate)

TABLE 6. Shot Description of Scene Two

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
2A	Woman A jumped and sang	00:00:05-00:00:08	Medium longshot Medium shot Close up	Low angle High angle Eye level	Handheld floating
2B	Woman A answered the questions and assumed about her expression	00:00:09-00:00:12	- Knee shot to medium shot	- Hip level	Dolly in

FIGURE 2. Handheld Shot Scene Two

Scene two opens with Woman A jumping, dancing and singing freely on the bed. Women empowerment is shown by Woman A freely expressing her mood in a condition where many people comment on her expression. The emerging of comments through a voice over seems to contain stereotypes that women should be calm and not shout, which makes women feel restricted in their expression. Woman A ignores the questions that arise about her freedom of expression and appears to remain confident in her freedom of expression. Woman A's freedom of expression is shown by singing, jumping, and dancing on the bed. Scene two closes with woman A's statement that " Oh, no. That's what makes us (women) PASSIONATE" (Timecode 00:09:00). The following is the voice over narration and copywriting noted by the author

"Can you lower the sound?" (Voice over timecode00:05:00)

"Can you calm down a bit?" (Voice over timecode 00:07:00)

“Oh, no. That's what makes us PASSIONATE” (Woman A timecode 00:09:00)

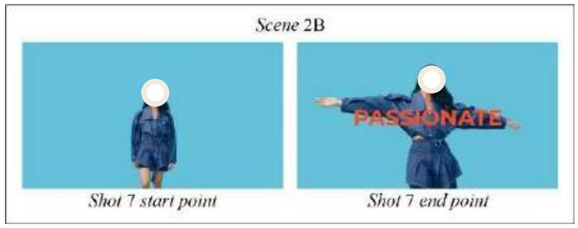

FIGURE 3. Dolly Shot Scene Two

Dynamic shots in scene two with the use of handheld and dolly in shooting concepts produce visualizations that can support the delivery of the freedom of expression of the passionate character played by Woman A. Handheld used in scene two A can show the confidence of the spirit shown in the freedom of expression by singing and dancing. The handheld can easily visualize the movement of attractive woman A jumping and dancing on the bed. Therefore, the audience can see and feel the character's expression that looks happy and free by ignoring the female gender stereotypes through voice over and copywriting. Scene two closes with the use of dolly in to answer the questions and emphasize Woman A's statement of passionate expression and freedom of expression. Dolly in can also add narrative context so that it seems to comment on the importance of the moment (15). Dolly in is used to emphasize to the answer from woman A responding to female gender stereotypes that appear through the voice over. The audience is brought closer with a change in shot size from a medium long shot moving forward to a medium shot that emphasizes woman A's statements and expressions. Consequently, the audience can feel and understand the cast's feelings more personally about the answers from the cast.

Scene three (Fresh)

TABLE 7. Description of Scene Three

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
3A	Woman B stood and sat on the sofa live Instagram in the living room	00:00:12-00:00:16	-Knee shot -Medium shot -Medium close up -Close up	-Low angle -High angle -Subjective POV -Hip level	-Handheld pan left -Handheld tilt up -Handheld shot
2B	Woman A answered the questions and assumpted about her expression	00:00:17-00:00:20	-Knee shot to medium shot	-Hip level	-Dolly in

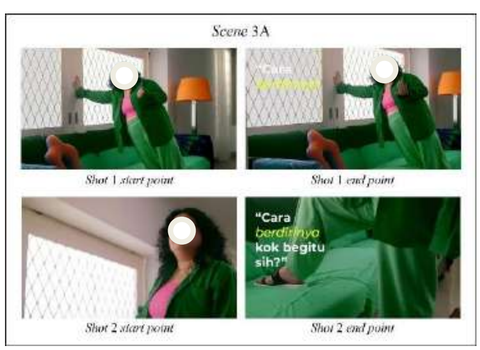

FIGURE 4. Handheld Shot Scene Three

Scene three introduces the character of woman B more closely, a fat woman with curly hair and her way of speaking that seems less feminine. Women empowerment in scene two is shown with woman B showing an indifferent expression but confident with herself even though other people still comment on her. The emerging other people's comments are shown by voice over and copywriting which assume that the woman B who stands and speaks, is not feminine. The comments contain stereotypical words that women are supposed to stand gracefully with their legs uncovered and speak smoothly and elegantly. Woman B's self-confidence is shown with an expression that looks happy with what she has, besides that she answers firmly that her confidence and what she is. That is what makes woman B look fresher. The following of voice over dialogue and copy writing appear in scene 3

" How do you stand up like that?" (Voice over timecode 00:12:00)

" How do you talk like this?" (Voice over timecode 00:15:00)

"Guuurrrllll! That's what makes us FRESH" (Female B timecode 00:17:00)

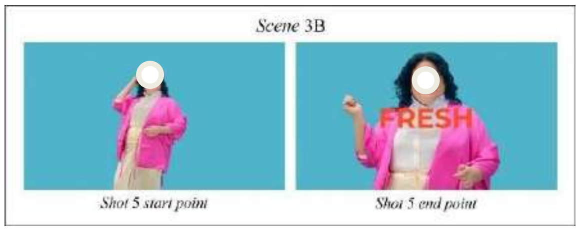

FIGURE 5. Dolly Shot Scene Three

The dynamic shot in scene three with handheld and dolly in shows an important role in visualizing the statement of woman B. The dynamic shot is used to produce visualization that can support the delivery of confidence in the character of fresh who is played by woman A. Handheld combined with pan and tilt in visualizing the way woman B stands. Medium long shots make it possible to show body language, several facial expressions, and the surrounding area simultaneously, which is also ideal for building relationship dynamics between characters (15). It is considered by conveying the narrative that woman B is very confident in the way she stands. Woman B seems to ignore other people commenting on the way she stands. Handheld also supports a point of view shot that shows how woman B speaks while on Instagram. Subjective shots are often held to give a feeling of human movement behind the view, so this approach appears to directly represent what the character is feeling(13). The shot can bring the audience to know the way of speaking and the confidence of woman B when talking to her live audience. The comments are answered by woman B at the end of scene three which is visualized through dolly in. Dolly in is an appropriate way to show a statement according to the author's interpretation. Dolly in can emphasize the answer or the decision regarding the problems experienced by the character so that the audience can also feel the message of women empowerment that the actor wants to convey. Dolly in in scene three shows the statement of woman B answering other people's comments about the way she stands and speaks.

Scene four (Consistent)

TABLE 8. Shot Description of Scene Four

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
4A	Woman C started to do some works. She looked relaxed and chose MKS' Shoes.	00:00:20-00:00:24	Medium shot Medium close up Close up	Low angle High angle Straight on	- Handheld
4B	Woman C answered questions and assumpted about her options	00:00:24-00:00:28	- Knee shot to medium shot	- Hip level	- Dolly in

FIGURE 6. Handheld Shot Scene Four

Scene 4 shows another character from the opening scene, that is Woman C. Scene 4 shows the background of woman C who is a career woman and always happy doing her job. Woman C looks full of enthusiasm and seems unable to stay still in her job, it is seen from woman C that moving here and there, her feet up on the table and choosing footwear in between her job. Women empowerment is shown by the background of Woman C who is a career woman, this shows that women can also compete in the public environment, one of which is the economic field. Women empowerment is also shown by Woman C who is able to face difficult situations and solve problems about her work but remains happy and not depressed. Other people's comments arose in response to women C who could not be silent and chose a lot. These questions appeared to be answered with confidence. Woman C thinks that being energetic and changing a lot makes her a consistent woman. The following of voice over dialogue and copy writing appear in scene four.

"How come you can't shut up?” (Voice over timecode 00:21:00)

"Why do you keep changing?” (Voice over timecode 00:23:00)

“Well baby... Thats what makes us CONSISTENT (Timecode 00:25:00)

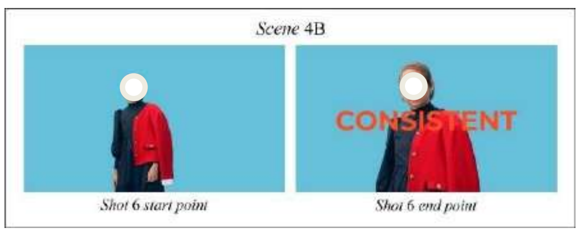

FIGURE 7. Dolly Shot Scene Four

Dynamic shots in scene four are shown using handheld and dolly in. The dynamic shot used produces visualizations that can support the delivery of Woman C's consistency by actively moving around looking for new ideas and showing the role of women in work. The handheld supports the visualization of Woman C who is actively moving and picking and choosing a lot in the collection of footwear that she has. Handhelds have a sense of immediacy and energy that cannot be duplicated in any other way, thereby subtly implying that “you were there” and “it really happened”. Handheld is very supportive because this technique is very flexible in visualizing the narrative that wants to be conveyed in the form of confidence from the cast so that the message of women empowerment can be conveyed. The audience can also more easily feel what the Woman C feels by using handheld. The ending of scene three that uses dolly in is quite appropriate to show the statement of Woman C that it is what makes her consistent to move and confident by the cast. Dolly in can also add narrative context so that it seems to comment on the importance of the moment(15). Dolly in visualizes Woman C's statement firmly and confidently with a change in shot size from medium long shot to medium shot. The change in shot size using dolly in can emphasize the message of women empowerment to the audience.

Scene five (Fearless)

TABLE 9. Shot Scene Description

No.	**Scene Description**	**Timecode**	**Shot Size**	**Camera Angle**	**Camera Movement**
5A	Woman A sang and danced, woman B was live on her Instagram, Woman C was actively working, and Woman D did yoga.	00:00:29- 00:00:35	Knee shot Medium shot Medium close up Close up	Low angle High angle Eye level Hip level	Handheld Handheld tilt down

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
5B	Woman D answered the questions and assumpted which is directed to them (women)	00:00:37-00:00:40	- Knee shot to medium shot	- Hip level	- Dolly in

FIGURE 8. Handheld Shot Scene Five

Scene 5 tells the story of the questions that people keep asking the four characters in this advert. Women empowerment in scene five is shown by the expressions of the four women who remain to be confident with the comments that terrorize these four women. The comments seem that women should be this, should be that, asked what, where and when. These comments are responded to ignorantly and remain confident in what they are, but they are annoyed with the question "when", as shown by the narration "Ugh ... kapan?" (Timecode 00:33:00). The final assertion of the question appears in scene 4 asking when the four women will stop to act freely as they want. Then the questions are answered firmly and bravely by woman D. Woman D stated that their courage and freedom would not stop. The following voice over dialogue and copy writing appear in scene five:

"Why 'this'?" (Voice over timecode 00:28:00)
"Why 'that'?" (Voice over timecode 00:30:00)
"Ask 'what', 'where', 'when'?" (Voice over timecode 00:31:00)
"Ugh. 'when' " (Voice over timecode 00:33:00)
"Like 'when are you going to stop?'" (Voice over timecode 00:35:00)
"Oh boy, the FEARLESS don't stop" (Voice over timecode 00:37:00)

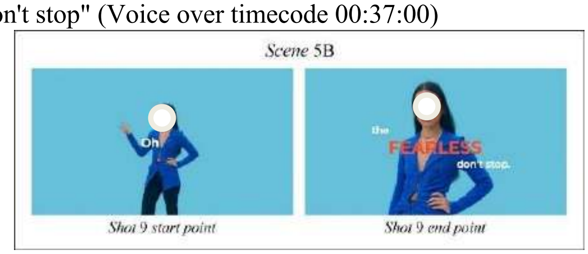

FIGURE 9. Dolly Shot Scene Five

Dynamic shots that use handheld and dolly in camera movements produce visualizations that can support the delivery of the message "fearless" by showing the four characters who remain expressive, confident, active, and indifferent to gender stereotypes. The use of handheld again attempts to bring the audience into the reality of the scene. Handheld allows the audience to feel the confidence and freedom to express their thoughts. Handhelds have a sense of immediacy and energy that cannot be duplicated in any other way, thereby subtly implying that "you were there" and "it really happened". Handheld can also visualize expression that has been shown as the technique can more easily visualize the feelings felt by the characters through its movement. However, it can also match the movement of the actors. Dolly in makes a statement that the courage of the four women in expressing their thoughts will never stop at the end of scene five. Dolly in can also add narrative context so that it seems to comment on the importance of the moment(15). The statement spoken by woman D firmly visualized using dolly in makes an emphasis on women empowerment. Hence the audience can be more focused and pay attention.

Scene six (Closing)

TABLE 10. Shot Description of Scene Six

No.	Scene Description	Timecode	Shot Size	Camera Angle	Camera Movement
6	four women who expressed various characters	00:00:41-00:00:60	Wide shot Full shot Medium long shot Medium shot Medium close up	Low angle High angle Eye level Hip level Shoulder level	Handheld Handheld tilt up Dolly in Dolly out

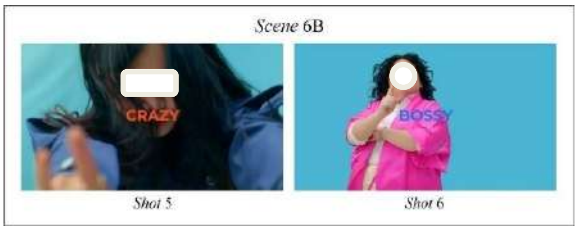

FIGURE 10. Handheld Shot Scene Six

Women empowerment in scene 6 is shown by showing the expressions of the four women representing several female characters in the MKS' Shoes What Make Us Women advertisement. The four women express freely their happiness, courage, ambition, and confidence. The freedom is expressed by the four women which is a form of expression of self-confidence that is not limited by female gender stereotypes through voice over and copywriting in the previous scenes. The end of scene 6 and the end of this advertisement shows the four women answering female gender stereotypes that are often asked, that is the things that make they are women. The following dialogue is voice over and copy writing that appear in scene 6

"Which makes us..." (Voice over timecode 00:42:00)
"CRAZY" (Voice over timecode 00:43:00)
"BOSSY" (Voice over timecode 00:44:00)
"COMPASSIONATE" (Voice over timecode 00:45:00
"GODLY" (Voice over timecode 00:46:00)
"DIFFICULT" (Voice over timecode 00:47:00)
"CLEVER" (Voice over timecode 00:48:00)
"ALIVE" (Voice over timecode 00:49:00)
"MISUNDERSTOOD" (Voice over timecode 00:50:00)
"AMBITIOUS" (Voice over timecode 00:52:00)
"FEARLESS" (Voice over timecode 00:53:00)
"INEVITABLE" (Voice over timecode 00:54:00)
"That's what makes us woman. " (Voice over timecode 00:55:00)
"That's what MKS' us." (Voice over timecode 00:57:00)

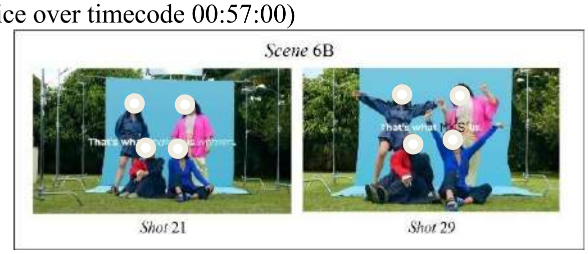

FIGURE 11. Dolly Shot Scene Six

The dynamic shots are used to produce visualizations. It can support the delivery and emphasis of the four characters' women empowerment statement that the form of expression of their mood, confidence, and courage to fight against female gender stereotypes that can make them are women. Using handhelds, dolly in, and dolly out can maximize the delivery of women empowerment. The statement expressed through voice over and copywriting "crazy, bossy, compassionate, godly, difficult, cleaver, alive, misunderstood, ambitious, fearless, inevitable" at timecode 00:43:00 to 00:54:00 are freedom to express thoughts without the need to think about female gender stereotypes addressed to them. Handheld shots are used as a technique to visualize expressions and scenes in accordance with the narrative to be conveyed such as crazy, bossy, ambitious, and fearless by capturing images of the character's expressions shown. Continuous camera movement tends to add extra dramatic weight to the moment. The use of dolly in and dolly out with the right narration can reveal and emphasize the meaning of the narrative therefore it can be more easily conveyed to the audience. The narration in the form of a statement "That's what makes us women. That's what MKS' us (Make us)" at timecode 00:54:00 to 00:59:00 emphasizes what makes them a woman. Dolly in can also add narrative context so that it seems to comment on the importance of the moment.

CONCLUSION

MKS' Shoes is a local brand (from Bandung, Indonesia) founded in 2012 under the name Moksa and changed to be MKS' Shoes. MKS' Shoes released an advertisement on 4 October 2021 with 60 seconds of duration on the official MKS' Shoes Instagram channel. The MKS' Shoes What Make Us Women advertisement was produced by a Production House (PH) from Jakarta that is Sakaspace. It focuses on culture and lifestyle. The product advertised with the tagline What Make Us Women means expressing thoughts, feelings, and stories by celebrating and embracing all the unique stories of being a woman. Based on the results of research on dynamic shots in supporting the visualization of women empowerment, the following conclusions can be drawn: Dynamic shots take a cinematic role in visualizing women empowerment. Dynamic shots using handheld camera movements used in the majority of shots can bring the audience to experience the condition of actors who are suppressed by gender stereotypes about women in general. Handheld can clearly convey the visualization of actors' movements in expressing their feelings. The use of the majority of shot sizes using knee shots to close ups clearly captures the movements and expressions of the actors in each character, thus the visuals feel more personal and the audience can feel the character's problems. Camera angles from high angle to low angle can visualize the character's depressed condition and against gender stereotypes. Dynamic shots in the form of dolly in at the beginning of the opening of the advert are used to convey the depiction and introduction of the problem. The movement of dolly in or push in is deliberately used to bring the audience into the problems of the four characters. Dolly in can show the assertiveness of female characters against gender stereotypes. Dolly shot in the form of dolly in is also used as a closing conclusion as well as an answer from the four characters, "this is what makes us women" clearly visualized MKS' Shoes What Make Us Women.

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Appearance's Changes of Rara's Character toward Gender Injustice and Toxic Femininity in *Imperfect: Karir, Cinta & Timbangan*

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Abstract. Women face problems both from themselves and surroundings in different ways and effects. Many people do not understand how to treat a woman who has been blessed with a different character and even a "beautiful" condition with her own portion. The depiction of women with their problems can be seen from *Imperfect,* romance drama film genre directed by Ernest Prakasa. Problems of verbal violence can be identified from a series of aspects of *mise en scene* , in the form of unfair treatment, cornering behavior, sad life processes, the emotions of the characters to changes in the appearance of characters who are part of a resistance. The main character named Rara changes her overall appearance just because she experiences unpleasant actions in her environment. Looking at the film in detail, it is clear that there has been a change in the appearance of Rara's character as a form of resistance to the condition of being cornered and feeling wrong in the surrounding environment which is the object of writing study. Analyzing changes in the appearance of the main character of the film due to experiencing *toxic femininity* is the focus of this research. The main character is a subordinate figure who changes appearance to prove that the character is experiencing violence in the form of verbal or what is known as Toxic Femininity, which often occurs in the victim's environment, done consciously or unknowingly by the perpetrator. The method used in this article is a qualitative descriptive research method with a *mise en scene approach* along with the theory of gender inequality and social transformation. The results of the research contained in this paper show that the main character is a helpless character who experiences verbal violence/ *body shaming* and the impact that occurs from the main character Rara.

INTRODUCTION

Films are arranged nicely from ideas, plot lines and so on. Films can be enjoyed like a dream. For audiences, films will be accepted according to their imagination, with the affirmation that filmmakers will comply with the script, while viewers enjoy films freely, interpreting them according to their own perceptions. Structurally, the film is formed from two mutually sustainable elements, these are cinematic elements and narrative elements. Narrative elements can be connoted as materials, while cinematic elements are ways to process these materials [1]. This article tries to take a closer look at the film through one of the film's elements, namely cinematic, especially from the perspective of *mise en scene.* [2] argue that *mise en scene* means "placement on the stage", so that it can be concluded in the film world that *mise en scene* is everything that appears in the camera frame.

Bordwell and Thompson explained that *mise en scene* consists of four elements: *setting* or background; costumes and make-up; lighting; and the players & their moves. *Misse en scene* in the film *Imperfect* as material to be able to see the movement of the main character and changes in appearance. In *the misse en scene* film there is an interesting part, which is conveyed about gender injustice and *toxic femininity* perpetrated by people around the main character. Therefore, two supporting theories are used, these are the theory of three dimensions of character and the theory of gender inequality.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030035-1–030035-16; https://doi.org/10.1063/5.0241635
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Imperfect: Career, Love, & Timbangan is an Indonesian romance drama genre film directed by Ernest Prakasa and released in 2019. *Imperfect* is an ecranization of a novel entitled *Imperfect: The Journey to Self-Acceptance* by Meira Anastasia published in 2018. The main character in this story is a portrait of the novelist. The description of self which is then written in fictional form tells the story of a woman who has experienced a downturn due to unpleasant actions (gender injustice, bullying, and body shaming). The effects of gender injustice will differ depending on human psychic strength. Good effects can occur, but many negative effects also often occur, starting from depression, anxiety, and so on, so that sometimes it can result in self-harm. A little message from the story that strengthens the victims to rise up is to find themselves by loving themselves and becoming what they want.

Back to the brief plot that tells about Rara. He was born inheriting his father's genes (fat, untidy curly hair, and dark skin). While other figures around Rara's house are father, mother and Rara's sister named Lulu. Rara's mother, Debby, is a former model who has good posture, fair skin, with straight, straight hair, and the ideal of "beautiful". Rara's mother in the story also went through periods of body shaming even though she had kept her body ideal. She did not directly tell her children about the body shaming incident she had experienced, but her mother advised Rara over and over again to refrain from eating, as if Debby had done the same to Rara. The ideal physical form was inherited by Rara's younger sister, Lulu, completed with smooth and shining skin. Since childhood, Rara has experienced the pressure of bullying, physical bias and criticism for being physically different from Lulu and also her mother. The unpleasant incident continued until Rara grew up and worked. Rara, who is known to be intelligent and has talent according to her field. According to Kelvin, it was right to get a promotion but with the condition that she had to change her appearance to be "pretty" ideal and feminine.

The character Rara in the film *Imperfet* is starred by Jessica Mila. According to an interview, in order to become and live up to Jessica's role, she gained up to 10 kg weigher than her previous weight [3]. The character Lulu played by Yasmin Napper in the story has an ideal body following her mother's genes. Debby or Rara's mother, played by Karina Suwandi, was a former model in the 1990s, physically has a slim body shape, fair skin, and an ideal body. Debby's ideal body and beauty are still maintained like a model even though she already has 2 grown-up children. Debby's body image, as ideal as it is, still gets *body shaming* from her closest friends.

Rara works as an employee in a company engaged in the beauty sector. After that, Rara's career grew until she gets a promotion to the position of research manager. Even though Rara received unpleasant treatment from the surroundings, Rara loves her job. The depiction of Rara's character has an optimistic attitude in dealing with things, confident, likes to share, and is also a character who is described as very cheerful. Rara's life journey as an adult is accompanied by a male character named Dika played by Reza Rahadian, a guy who loves Rara for who she is. The next male character who plays a role in changing Rara's appearance is the boss in the film named Kelvin, played by Dion Wiyoko.

Imperfect is very interesting in terms of gender inequality and its effects. Changes in appearance are the effect of a long process of gender injustice. Through *misee en scene,* this article explains about incidents of gender injustice, body shaming and toxic femininity. Furthermore, the effect of the incident was conveyed regarding changes in the appearance of the main character, namely Rara, both in terms of style and color of the costumes. The use of color costumes on characters Rara along with emotion is the main attraction for writers to research and convey about the strengthening of emotions built in a film. Supporting theories to examine this problem are the theory of gender inequality and David Krech's theory of emotional classification.

THEORY

Mise-en-scene or in other terms mean putting in the scene is everything that is arranged in such a way in front of the camera. Acting, blocking, setting & property, and make-up and wardrobe are the elements of *Mise-en-scene*. These elements are arranged, so that the intent of the language concept is visually conveyed. Added by David Brodwell, *mise- en-scene* can create tension, curiosity and also give a certain impression. Actors in a sense are actors who play a role and convince the audience. Blocking is how to arrange the layout, determine the movements and movements of the players so that everything runs like a dream flowing the storyline. It can be divided from when Rara was little. She was given only descriptions around his house, when Rara grew up he was still told about problems around the house. Furthermore, when Rara became an adult, more blocking was done, which means that Rara's life developed was carried out at home, at the teaching place, around Rara's boyfriend's house, and at work. Setting & property is a selected location that gives space and time information to a film. The settings and properties in *Imperfect* consist of indoor settings (Rara's house, Rara's boyfriend's house, office, & cafe) and outdoor (cafes, streets, teaching places, offices, exhibition locations). Makeup and Wardrobe used show about space-time, social status, and Rara's self-image. The highlight of the makeup depends on the background of the story, its relation to the film Imperfect, and the main character whose life concept has changed. Two makeup concepts were chosen, natural and formal, complete with the style of dress. The light arrangement is specifically presented to clarify the appearance of the object.

The supporting theory uses three character dimensions, to see about the shape of the character using three character dimensions. Human characters are chosen as the main story actors, and these main characters will always be seen in a scene. Characters can also be called figures, as a driving force for the course of the story because they have character and have characteristic traits [4]. According to [4], character can be divided into three, namely the physiological dimension, the sociological dimension, and the psychological dimension. The main character will be played by a professional actor who is highly trained and able to play in the types of roles given, in the film one of which is a woman named Rara. Rara's character is only a talented female character, but once she was overweight and experienced body shaming, she was insecure about herself, she was hurt, and she was depressed.

Another supporting theory is gender theory which provides meaning, conception, insurance, ideology, and practice of new relations between women and men and their implications for other broader aspects of life. Therefore, in a gender perspective, social transformation is actually a process of deconstructing gender roles in all aspects of life where gender differences are reflected which have given rise to gender injustice [5]. Systems and structures that place men or women as victims in the public or private spheres are a form of gender injustice. Gender injustice in this film is experienced by a character who is a woman named Rara, even though Rara is the main character of the film, Rara's position remains subordinate. Being unable to fully become herself from childhood to adulthood, Rara is always controlled by men (father figures, Dika and Kelvin). Another form of gender injustice can be seen in the form of stereotypes, that Rara as a a woman should maintain an ideal body shape, smooth and white skin, straight hair and appear feminine. The labeling of a female figure as having to be “beautiful” like a model was not found in Rara's body, and what was even worse was that there was violence in the form of verbal behavior or body shaming.

METHOD

The types of research used to analyze is qualitative methods and descriptive in nature. The data generated from this research is descriptive data which is generally in the form of words, pictures, and recordings.

The subject in the research that the writer will examine is the film *Imperfect* directed by Ernest Prakasa and produced in 2019. The object of this research is the change in the appearance of the characters. The primary data from this study are the main characters in *Imperfect.* Secondary data in this study is the change in the appearance of Rara's character in dealing with gender injustice and toxic femininity. The entire data will be viewed from a cinematic aspect to focus more on the *misse en scene* part.

Data collection techniques used in this study were interviews, observation, documentation, and literature study. Interviews were conducted with the wadrobe team to obtain information about the meaning of the costume selection for Rara's character before and after changing. Observations were made by repeatedly watching the film and observing each scene which contains elements of emotion and color, especially in the part where there is gender injustice, toxic femininity and changes in Rara's appearance. Documentation is done by taking screen captures of scenes that contain elements of changes in the appearance of Rara's character in dealing with gender injustice and toxic femininity conducted obtained from observation, documentation and literature study. Observations were made by observing the research subject that is the film repeatedly and everything that appears in the film was taken with a capture scene. Literature study was conducted to learn about the three theories used (*misse en scene*, three dimensions of character, gender inequality) from popular books that have been published, journals (related to theory, subject and object of research), and various literature related to research topics. for reference in research. The data collected are processed starting from reduction to the data presentation stage and then conclusions are drawn to get the results in this study.

RESULT AND DISCUSSION

Rara’s character as the subordinated main character

The character is the character played by an actor according to the story by bringing certain characteristics. It is known that physically the character can appear in the dialogue process, what is done and from the various actions. According to [4], character can be seen from three dimensions, that is the Physiological Dimension which is something related to physical characteristics, such as gender, body condition, facial characteristics and age. The second dimension is sociological which is of course related to sociology, for example regarding social structures, social processes including social changes, and social issues such as character backgrounds. Examples of the sociological dimension are work, education, beliefs, religion, ideology, way of life, hobbies, ethnicity, descent and organization. c) Psychological dimension which is the psychological background, for example symptoms and thoughts, feelings and will. For example, mentality that can distinguish between good and bad, temperament, namely personal desires and feelings, attitudes and behavior, level of intelligence, and special expertise in certain fields [6].

This three-dimensional theory is very helpful and plays a role in understanding the character of the character. and can be used to describe the characters clearly and in detail in a story or film. The main character of the film is female, the child who inherited her father's genes. Her height is less than 160 cm, she is fat with a body weight more than 78 Kg, brown-skinned, curly-haired girl. Sociologically, Rara's character is easy to get along with, likes to share, easy to adjust and has a good job and future job. On the psychological dimension, Rara's character is a cheerful, simple, loving woman, friendly, loyal, smart, and obedient.

Rara's character in *Imperfect* is the main character, however Rara remains a subordinate figure with the presence of three men, they are Rara's father, Dika (Reza Rahadian) her boyfriend and Rara's boss, Kelvin (Dion Wiyoko). It is clear that the presence of three male characters reinforces the existence of a patriarchal cultural background in the film. Rara does not have absolute authority over him. Three male figures give a sign that the highest power is still held by their people. In every phase of Rara's life, men control Rara's character. In the selected scenes, it can be seen that the three of them greatly influenced Rara's life journey. The father figure protects and controls Rara when she was little. The character Dika protects, is always there, and accepts Rara and her changes when she was a teenager, while the character Kelvin intervenes and gives affirmation about the future and life changes.

In *Imperfect*, it is clearly illustrated that women are in the private sphere as well as in the public sphere, unable to achieve ideal gender equality. Gender equality in question is in a situation where men and women become the best versions of themselves through mutual agreements without being burdened by gender expectations that are taken for granted. Issues related to gender can cause psychological pressure on both men and (often on) women [6]. The concept of gender that has been attached to both men and women is the result of social and cultural construction. In understanding the concept of gender, one must be able to distinguish the word gender from the word sex (gender). Gender is a characteristic or division of two human sexes that are biologically determined which are inherent in certain sex [5]. However, gender differences can actually produce various gender injustices, both for men and for women [5].

In social reality, the relationship between men and women is formed from various social processes into an arrangement of power that places women in a subordinated sexual life. Firestone [7] states that the description of the relationship between men and women has become a social reality that was formed historically by various social processes, which then becomes a power structure where women are in a subordinated position in sexual life. Women here seem to have to meet all kinds of standards set by men or by structures that benefit men. Patriarchal culture in certain societies holds that it is men who have the highest position. Women are the sidelined and lose a lot. [8] argues that patriarchy is a system of social structures, practices that place men in a dominant position, oppress and exploit women. [10] states that patriarchy is a system of male authority that oppresses women through social, political and economic institutions.

Gender injustice in the film is manifested in the main character Rara who has no power over herself or what is called subordination. Subordination is an assessment that one gender is lower than the other. Subordination is more common in women and makes them in an inferior or lower position. According to the Big Indonesian Dictionary (KBBI) online: The meaning of the word subordination is sub.or.di.na.si [n] (1) a subordinate position (especially in the military); (2) Ling combining two grammatical elements in such a way that one is bound to the other; relationship between bound clauses and independent clauses in a sentence (source: KBBI Online). The following describes the 3 figures who played roles in Rara's attitude change.

FIGURE 1. Father & little Rara

In screenshot 1, it can be seen that Father played an important role in helping Rara solve problems, being patient, advising and protecting her. Even though in fact it actually adds to the burden of hidden wounds and it seems as if there is neglect about the mistakes made by the people around them. Figure 1 clearly shows that Rara's physical form is identical to her father's, with a large body, dark skin and untidy curly hair. Her father taught me about simplicity, being happy to accept yourself as you are and letting people talk about your body and appearance as it is.

FIGURE 2. Adult Reza & Rara Figures

The character Dika is a man who protects Rara when she is an adult. Dika is someone who loves Rara for who she is, never demanding about a perfect or ideal physique such as a slim body, shining white skin etc. Dika enjoys being close to Rara, behind his large body Rara is a kind, friendly and helpful person. Dika's support for Rara's activities is always shown by wanting to pick Rara up and down by riding a motorcycle and capturing the moment Rara teaches suburban children. Dika's family welcomed Rara very warmly, indirectly Dika gave Rara comfort, protection and acceptance. Dika's attitude is seen as a balancing act for other adult male characters as well as controlling Rara's attitude, because whatever Rara wants to do is discussed with Dika first. The attitude of protecting, giving a sense of security, acceptance of what it is from men causes women to believe, comfortable whatever they are going to do will be discussed first. Therefore, this process becomes evidence of subordination.

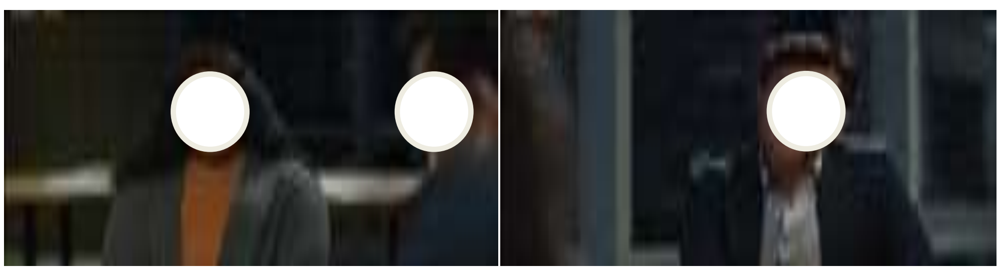

FIGURE 3. Adult Kelvin & Rara Figures

The third male influential figure is Kelvin, the boss or head of the company at Rara's workplace. A cosmetic company is a company engaged in a very feminine field, but in the film, this company is led by a man. Kelvin so much influenced in changing Rara's appearance. Kelvin as the superior offers a promotion to Rara, but with the condition that Rara must change her appearance to become a feminine figure. The presence of a third male character shows gender inequality. As high as Rara's position offer was, it was still under Kelvin's leadership, meaning that women still had a position not equal to men in the employment sector, women were still the second person, still being ruled by men.

Treatment of verbal violence on Rara Figures

Humans are born and endowed with different shapes and characters. Each human being has a unique body shape. There is no identical similarity or uniformity between humans with one another even though they were born to the same parents even though twins were born. However, in society there are ideal standards regarding body shape, certain characters (beautiful/handsome). The ideal standards that looks physically are: white shining skin, tall, proportional body (slim/ *six pack*), sharp nose, straight hair, smooth face/does not have acne blemishes on one's face, which then refracts, disguises and sometimes even eliminates something that 'unique' in each human being.

According to the official website of the Association of Anorexia Nervosa and Associated Disorders or ANAD, body shaming is anything or a form of action and practice in which a person insults the shape or size of another person's body [9]. Sometimes the treatment of body shaming is conveyed subtly, in a joking, satirical way, even to the point where it is openly conveyed, sometimes it can even be done repeatedly in the form of verbal, symbol, action/.

Imperfect presents a story about the main character, a woman who has been under pressure since she was a child. Her father's inherited body shape became the subject of bullying. In everyday life Rara experiences verbal violence, the form of violence can be in any form. Even though it is not physically visible, verbal violence in any form feels sadistic for the victim and sometimes it's worse that the perpetrator does not feel that he is committing verbal violence. Verbal violence can occur anywhere in disguised forms such as: greetings, jokes, satire, small glances, wry smiles, or laughing broadly with ridicule, or even directly in the form of reprimands, repeated advice and so on. Even more it can be serious if the form of verbal violence is already at the level of cursing and insulting with harsh words. In *Imperfect,* the incident is in the form of ridicule of body shape and skin color or body shaming. Advice to keep up appearances, refrain from eating and maintain eating patterns/diet that is repeated, insults, satirizes can be said to be a form of toxic femininity.

Rara was born with a plump body, curly hair and slightly darker skin than her younger sibling. Rara's body shape does not have any physical defects, including Rara who is gifted with a smart mind and a kind heart. God always bestows different body shapes on every human being. It seems undeniable that humans have ideal standards in looking at the best body that is owned by other humans. Once again, if we want to examine the matters discussed in the previous sentence, that may be grateful and must be remembered that 'perfect' belongs only to God Almighty.

Verbal violence is "violence against feelings". Issue harsh words without physically touching, slanderous words, words that threaten, frighten, insult or exaggerate other people's mistakes are forms of verbal violence [11]. Verbal violence usually occurs when the mother is busy and her child is asking for attention but the mother instead tells her child to "shut up" or "don't cry" and can even say the words "you are stupid", "you are talkative", "you are impudent", "you are annoying" and so on. Those words can be remembered by the child, if done directly by the mother (Rachmat, 2007). Not only a mother can do verbal violence, a father can also do verbal violence when he feels upset. "Bastard, use your ears to listen to old people's advice, I'm sick of seeing your behavior..." is an example of verbal violence when a father feels annoyed because his son does not listen to his advise [11].

Violence at home in the private spere

Violence against women occurs in all aspects of human relations, these are in family relations and other close people (personal relations), in work relations, as well as in carrying out social relations in general. Various forms of violence against women occur in society even though in normal situations in this writing there is violence against the character Rara which will be represented by the scene capture. Discussion of violence against Rara's character in the family environment, those closest to him and in the work environment.

FIGURE 4. Baby Lulu

Picture 4 is Lulu's baby who physically looks different from Rara which is being talked about by Debby's friends or Rara's mother. Since childhood, Rara's character often hears physical comparisons made by people around her and these actions are unpleasant. Even worse, it happened in the private sphere, in his own house and repeatedly, these actions had the effect of hurting Rara's feelings. Body shaming is an action experienced by Rara in the film, starting from the physical comparison between Rara and Lulu, reprimands and ridicule, even a minor glance directed at the victim, in this case Rara's character.

(a) (b)

FIGURE 5. (a) Debby's friend compares her daughter, (b) Rara's father calms Rara

At the beginning of the scene, Lulu's baby character is seen being praised more by her mother's friends than Rara's character. Rara's mother's friends said Lulu resembles her mother because of Lulu's beauty, but her father calmed Rara by saying "it's okay, it's normal.". Rara's father's statement at a glance seemed to give the impression of being safe and comfortable, for the unpleasant incident that had befallen Rara. Seeing the attention to the delivery of Rara's father's words, it seems that he agrees with his mother's friends that Lulu is beautiful and Rara is ugly. Rara's father conveyed this message, as if he did not realize that it was adding Rara's wound and left the wound without treating it. As a father, he should protect his daughter, not condone bad treatment for his child. In some cases, it is not good that has happened, but has had a negative impact on thriving because of acts of neglect. Bad behavior cannot be justified, parents must understand the limits of behavior that can have a bad impact on their child's psychology. In the film, it is conveyed that in the end, the character little Rara also considers it "normal" for the verbal abuse that happened to her.

FIGURE 6. Rara is angry at mealtime

In this picture, Rara's character's emotions and annoyance due to harboring and holding back wounds inside her can be seen. Rara's character gets unpleasant treatment even in her own home, she does not feel comfortable when she wants to eat with her mother and sister. Rara did not find anything about eating large portions, eating nutritious food so she could grow big and fast. On the other hand she had to withhold food so she would not grow bigger than Rara's body, which was blessed with fast growth.

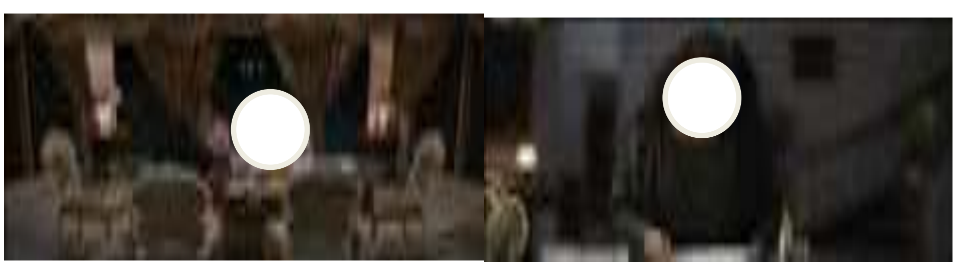

FIGURE 7. The sad atmosphere at the dining table

Shown in picture 7 scene minutes 03.23 Lulu, Debby and Rara are having dinner together. However, Debby told Rara to reduce the portion of rice, Rara felt annoyed and resisted by putting the rice back where it was and not continuing to eat. The little treatment that the mother did was violence against Rara, as if she did not want Rara to get bigger after eating too much. Debby's intention is to advise her daughter. Debby thinks about the general concept of "beautiful" in her environment: ideal body; slim, clean-skinned; and straight hair.

FIGURE 8. Debby's friend greets Rara and Lulu comparing the looks of the two

At 04.44 minutes the scene shows Rara greeting her mother's friends. However, Debby's friends actually conveyed about Rara's "appearance" (large body shape, untidy curly hair, dark skin and not sexy look outfit) that Rara had not changed. Furthermore, when Lulu came down the stairs and greeted her friends, it turned out that Debby's friends praised Lulu's appearance and compared it to Rara's. Debby's friends insinuated that there were striking differences between the two, Rara encountered painful treatment again at her house. This treatment is included in the category of body shaming. It endangers the victim if she has a fragile soul and probably results in depression and even psychiatric disorders.

FIGURE 9. Toxic Feminity full talk

At 1.14.40 minutes Debby gathered with her friends again to talk about the visible aging on her face. Debby is also influenced by the superior views of her friends, which then makes her feel uneasy with her own appearance and feel *insecure*. Unpleasant treatment, verbal violence, and acts of toxic femininity in the private sphere are clearly depicted in the film.

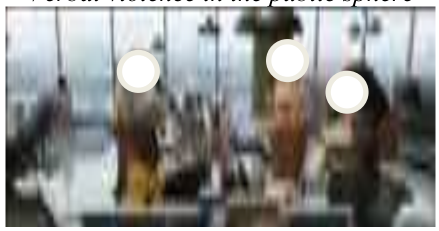

FIGURE 10. Atmosphere in Rara's Office

At 15.27 minutes, Rara, who had just arrived at the office carrying office supplies and food supplies, was greeted by office mates by greeting, teasing and talking about it. Rara's friend's greeting at the office turned out to be part of the violence, instead of being friendly and accepting Rara as she is. Words like "remember your fat" and "nutrition for pregnant women" are part of the verbal abuse. Rara's office friend's greeting should not be done, reminding that body fat is not a business between office friends. The statement regarding nutrition for pregnant women was also not Rara's condition at that time, Rara was not pregnant and was not married. Painful greetings are appropriate if they are resisted and given punishment or a deterrent effect. However, because Rara was given an example by her parents since childhood to allow this unpleasant incident, Rara chose to remain silent and did not respond.

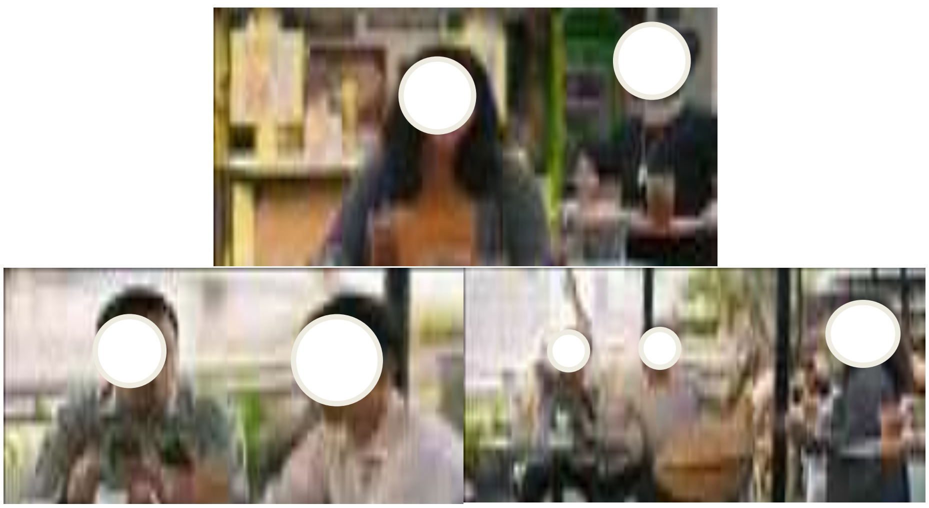

FIGURE 11. The atmosphere and events in the office canteen

Again, the incident of injustice is presented in Figure 11 with a series of scene capture in the canteen near the office during recess. Rara was seen having trouble carrying a tray of lunch to find a seat. The picture shows the daytime situation in the canteen where employees rest and have lunch. The cafeteria looked crowded and many visitors were eating. Rara asked 2 men about seats that were not occupied by visitors. It turned out that the two men were not willing to share a table with Rara. The two of them spontaneously did not come together to give Rara an alternative to find another seat, seen by pointing to the opposite location. Both of them said that if the empty seat was immediately occupied by their friends. The two men deliberately lied so that Rara and Rara's friends would not sit at the same table. Frame the capture scene the midlle shoot makes it clear that the male character who is sitting with his friend does not want to share his place with a woman who is not "good looking".

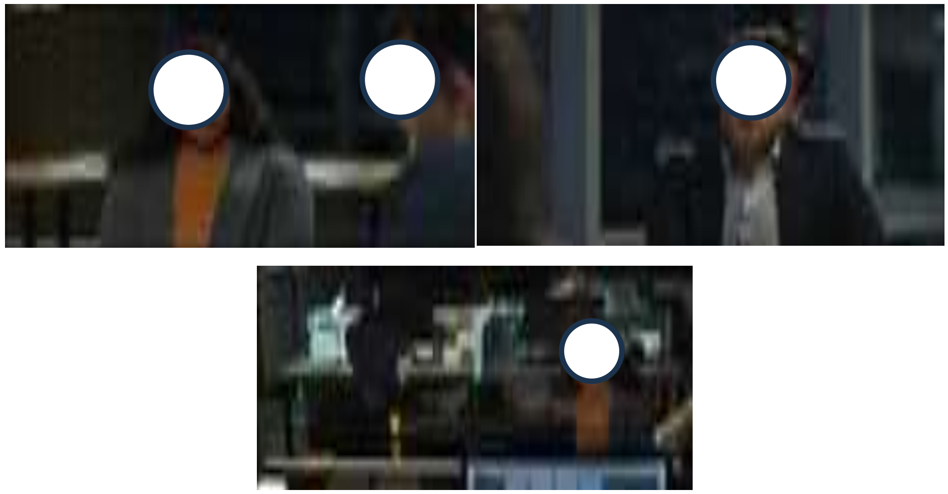

FIGURE 12. Kelvin conveys the department's promotion conditions to Rara

At minute 27.40, there is a series of capture scenes of Rara being seriously spoken to Kelvin the Boss about a promotion. Rara's work which was considered good and the achievements that were also shown by Rara especially related to work received appreciation from Kelvin. Rara listened very happily, but one thing about the promotion offer that Rara should have deserved with the work she had done was not easy for her to get. A serious discussion with the Boss added to the pressure for Rara about what conditions Rara could fill the vacant position. Rara's job is not good enough to fill the vacant position, but changing her appearance is the next condition. Rara's appearance is considered inappropriate enough to occupy the vacant position, Rara's appearance is considered not good, not in accordance with the position. Injustice is seen again in the public sphere, a person's appearance becomes part of the assessment of his work performance. A heavy blow for a Rara who has tried her best, but was broken only because of the conservative standard "beautiful woman" stereotype. Turns out to be good, just achieving is not enough to be a provision for a decent life to occupy a position at a higher job. The stigma about the beautiful standards that Rara experienced in the public sphere really colonized her, made her sad, insecure and took away the peace within Rara.

Luckily, in the story, Rara is described as a character with a strong and smart character. Rara was able to immediately reconcile and rise from her slumped state, making years of pain felt as a turning point to start changing her appearance. Rara experiences a degradation of her identity and takes a path that can actually hurt herself by dieting, suppressing her appetite, and exercising.

Changes in Rara's Character Appearance

Appearance is identical to the image or image, which means it is a combination of visual elements such as: dots; line; field; color and so on. The appearance was deliberately created to give the impression of imitation of an object, in this case the human physique of the film's main character, Rara. The change in the appearance of the main character of the film *Imperfect* from a child to an adult is visualized as a figure with a dense body, until there is a drastic change in appearance due to encouragement from outside. Conservative beauty standards that are very attached to Rara's environment trigger a drastic change in appearance. The compulsion to follow beauty standards and the strong urge to be in the best position in a career makes the character struggle to lose weight. Rara's independence, especially when it comes to appearances in public spaces, is seized by the terms of promotion. The urge to change the appearance is not from himself, but from the environment around him. Several scenes conveyed that the hardest part in changing Rara's appearance was losing weight.

FIGURE 13. Rara's struggle to lose weight

Display of Rara Children

FIGURE 14. Little Rara

Rara's appearance as a child looked innocent. The body shape was dense and filled, which is shown to be the same type as Rara's father's body shape. Visualizing both of them having curly, thick hair and skin that looks dark brown, Rara followed her father's genes. Like any other child, little Rara did not seem to use makeup, although if you look at it in more detail, little Rara's face can be seen wearing makeup with powder and a little lip balm without color.

The clothing worn by Rara when she was little was very simple with bright colors. The determination of bright colors in the costume aims to give the impression of increasing body volume while at the same time aiming to convey confirmation of a body that has been densely packed since childhood. Through clothing and make-up, we can show the appearance and character of the little Rara, who is simple and candid.

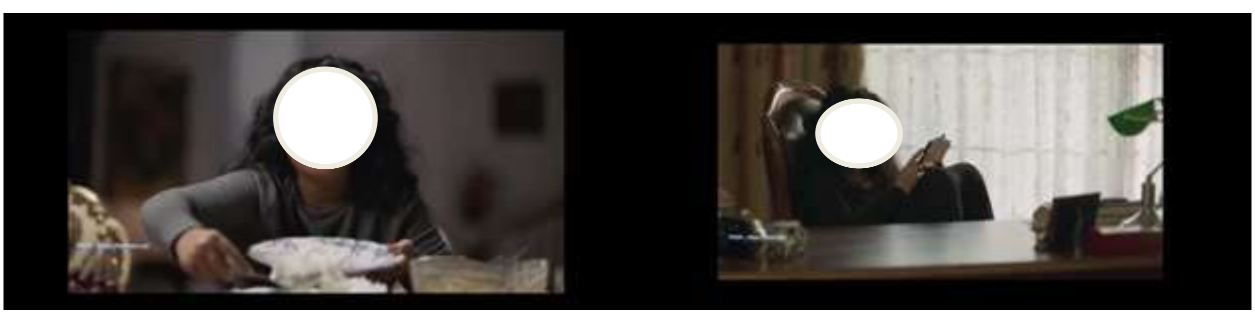

FIGURE 15. Rara in her teens

The bitterest period in the film's story is depicted at this time, when Rara grows up and her father dies. Growing up, Rara also appeared in a similar style. Rara's makeup when she entered her teens was classified as natural makeup, with no protruding makeup on her face. Character make-up is used as part of the sadness emphasis on Rara's character. Rara's facial makeup was made to look sad, foundation was added to the lips to create the impression of dry lips, and it was easy to form wrinkles and protrude sad lines at the corners of Rara's lips. Rara's hairstyle when she was a teenager was the same as when she was a child, her hair was left long and curly. The hairstyle was chosen so that Rara's character is portrayed as a character who doesn't care about her appearance, appears simple, straight-forward as well as adds volume to her body. Complementary other display is the fashion. As a teenager, Rara wore long-sleeved shirts and trousers up to the ankles, with clothes that tended to be dark. The color of the chosen dress also complements Rara's sad mood after the death of her father.

Adult Rara’s appearance

FIGURE 16. Types of shooting in scene 3

Rara's appearance towards adulthood was chosen to match or be described as consistent with a dense, filled body, natural, innocent makeup, loose and fluffy hair. Rara's appearance is even clearer, supported by medium shot and medium close up shooting techniques or types. According to Mattinson, taking medium shots has a motivational message, these are highlighting aspects of facial expressions, gestures, and details of dress or appearance. The eye level shooting angle is deliberately used to convey expression and body shape and gives the impression of self-doubt. With an angle at the level of the human eye or what is considered a normal point of view, this is chosen to convey the activities and atmosphere built on a film about everyday life.

FIGURE 17. Rara's body shape

In the scene of Figure 16 Timecode 00:37:47, Rara's appearance while working is shown in red with a low intensity. The color red has associations with human emotions, strength and courage. However, with the low intensity of the red color in the scene, it creates the opposite meaning, daring becomes brave and strong becomes weak. The scene shows Rara hesitating to change his appearance according to the request of the company boss. The use of red with low intensity or better known as dusty pink, was able to strengthen Rara's insecurities.

Rara's dialogue that says "it's not that easy, within a month I have to change my appearance, take care of my body" supports the emotion of doubt in that scene. The shooting used in the scene also supports emotional reinforcement. Medium shot is the dominant shooting technique in that scene.

FIGURE 18. Rara conveys difficulties to her mother and sister

In figure 18 the timecode 00:35:15 is shown by Rara using bone white with low intensity. Physically white bones give the impression of being bright, cheerful and clean. with the low intensity of the yellow light in the scene causing a faded effect on the meaning of the color itself. Cheerfulness or pleasure actually turns into sadness, so the use of low-intensity bone-white color or better known as cream -white bone color is able to support the sad emotion depicted in the scene. The emotion of sadness according to [12] is a basic emotion.

Medium shot and medium close up shooting types supports the focus on using Rara's costume. Type lighting is deliberately arranged this way, it looks dim or dim, it does not focus on the characters, but only adds a little light intensity to the background. The lighting arrangement that appears in the entire scene in Figure 19 conveys an atmosphere of sadness, doubt, seriousness, and weakness.

FIGURE 19. Contemplation of changes in Rara's appearance

Figure 19 as a whole conveys how Rara contemplates and begins to consider changing her appearance. Rara experienced doubts, but mother and Lulu actually provided support and encouragement to make the decision to change their appearance. Rara has to change her appearance on a large scale, on her body, hair and skin color especially, besides that it will follow the style of clothing and make-up. On Rara's large body, she had to go on a strict diet to lose weight and stay toned. On the hair, she had to trim her hair and change her hair type to make her look fresher. Moreover, the look that needs to be changed next is on dark skin types, treated with vitamins to make it look brighter. It takes time and enthusiasm to consistently carry out the process to change the appearance of a woman in the film *Imperfect* .

Rara's Appearance Changes

A person's image will be seen based on an appearance. The appearance of someone who is guarded will give the image that the person looks good and polite. A good appearance is an appearance that can adjust to the time, place and conditions in which a person is. And it can be the other way around for someone who does not take care of their appearance and cannot adjust, so that person is considered not good. The appearance referred to is physically visible to our senses, starting from clothing or fashion, make-up, jewelry/accessories, and hairstyles or headscarves. A person's physical appearance can sometimes change social status and even identity. Sometimes one can see who the person is like and what kind of group they are from the way they dress and their overall appearance, this is what is called internal stereotypes. The truth is that other people cannot be seen just by appearances, that would be unfair. In *Imperfect*, the conditions regarding appearance are described and told that the main character changes in appearance.

The change in Rara's appearance visually looks significant from the previous appearance. Lack of body volume, costume wear, costume color, hairdo, skin color, and make-up are very supportive of change. Rara's appearance changed along with the promotion as a manager in the office. Rara made changes and improved the quality of her appearance from head to toe. Rara's appearance gave a better mood, radiated on Rara's face. Changes in appearance affect the psyche, affect mood and increase enthusiasm to become energetic. All the changes can be associated with a positive image. With an attractive appearance, Rara is able to interact socially better. Even so, changing Rara's appearance is one way to improve her self-image and quality, but in truth that does not mean that Rara's problem can only be solved by simply changing her appearance.

FIGURE 20. *Timecode* 00:56:15

The scene of Figure 20 shows Rara who has occupied the manager's position and managed to change her appearance. This scene also shows Rara for the first time using a different clothing concept. Rara in that scene looks more glamorous and feminist. His body weight is reduced, it can be seen from the shoulders, arms and confidently showing the curves of the body down to the calves. The prominence of clothing color selection looks more free and bold in using colors outside Rara's comfort zone when she was overweight. High-intensity strong colors are part of the focus of interest or part of attracting attention.

FIGURE 21. Rara's costume in scene 5

Rara's appearance in the scene was seen for the first time wearing a shocking pink dress with a short skirt underneath, carrying a tote bag, and high-heeled shoes. The use of bright color in Rara's costume enhances the emotions of happiness, pride and confidence. Rara seems to be attracting attention with her new look. The support of a radiant face is a picture of joy, pride and confidence because they have succeeded in changing their appearance and getting and successfully occupying the position of manager of the company. The implied message of focusing on changes in Rara's appearance is conveyed by using cinematographic techniques in the form of camera movements or follow techniques.

FIGURE 22. *Timecode* 01:27:28

Rara, who always radiates happiness, after changing her appearance does not guarantee that the problems will stop. The scene in picture 21 is a scene showing Rara crying because of a misunderstanding between Rara, Dika and Lulu.

Rara's expression in picture 21 is seen crying as part of the depiction of the emotion of sadness that is being felt. The blue support on Rara's costume is able to convey sad emotions and is interpreted as being in a negative space, namely depression. Rara's expressions and facial expressions of depression and sadness are strengthened by the cinematic aspect of the medium shot.

FIGURE 23. Rara's sad expression and makeup

The strengthening of emotions in the scene is also supported by Rara's dialogue "You never understand what it's like to be me, always being compared, always feeling lacking. Then I'm like this now, I still don't think I'm wrong", this dialogue is considered to be Rara's outburst of feelings that she is feeling.

FIGURE 24. *Timecode* 01:30:55

Figure 24 shows the scene of Rara crying. Rara's crying expression is considered to be an emotion of sadness, or even the sorrow that Rara feels because of the fight between Rara, Rara's boyfriend, and Rara's sister.

The use of black in this scene is able to support Rara's emotions. The black color in Table 1 shows a negative emotional association that is grief. This is supported by the use of medium shot shooting techniques, Rara's facial expressions, and Rara's body gestures.

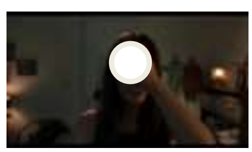

FIGURE 25. *Medium shot* in Figure 9

Rara's body gesture when removing her make up was seen as an overflow of feelings of depression that Rara was feeling. The use of the Medium shot clarifies the movement and Rara's crying expression.

FIGURE 26. *Timecode* 01:43:35

The scene above is a scene of Rara giving a speech. The contents of Rara's speech showed that Rara was experiencing feelings of happiness, pride and confidence. A slight smile at every break in Rara's speech strengthened the emotion of happiness that Rara was feeling.

FIGURE 27. *Medium shot* in the scene Figure 11

The medium shot shooting type helps in showing Rara's expressions more clearly. Based on David Krech's classification of emotions [12], the emotion that Rara displays in that scene is an emotion of pleasure. Rara's smile looked like an overflow of emotions for the feelings she was feeling. The red color in the scene strengthens Rara's emotions. The red color in Table 1 has an association with being brave, attractive, and strong, so that the use of red in the scene can strengthen Rara's confident emotions.

CONCLUSION

Rara is the female main character in *Imperfect*. In Rara's story, she lives in modern times through the struggle for life against the negative actions committed by her family, her surroundings and her work environment. Rara often fights by giving in, being silent, and letting repeated painful reprimands pass her by. In the final story of the film, Rara's character takes a risky decision towards herself, by changing her appearance, meaning that she also chooses a strict diet. In the scenes of the film, Rara's character is described as having experienced acts of verbal violence in the form of: body shaming, toxic femininity, and several discriminatory treatments cornering Rara's appearance without make-up. Rara's weight is one of the wrong parts in the view of people who believe in stereotypes of tall, smooth and slim beautiful women. The injustice of treatment is also well described in *Imperfect.* Furthermore, it also conveys its impact on victims, in this case the main character named Rara. As a woman who has experienced acts of gender injustice, she finally takes unfair actions against herself to make a total change in appearance from the ends of her hair to the toes.

Bullying by people surrounding is in the form of reprimands, jokes and cynical glances. Bullying occurs repeatedly by a person or group. Unknowingly, reprimands, repeated innuendo can hurt the victim and can damage someone's psyche. In accordance with the research objectives to observe the actions resulting from the treatment of gender injustice, the process and its impact. Changes in Rara's appearance have become the focus of research in dealing with and fighting gender injustice. Another thing that can be conveyed to the audience is a message about how gender injustice can occur anywhere and anytime.

Suggestions that can be conveyed by the author for further researchers are that this research can be used as a reference for analyzing further research on costumes and colors, narratives, and shooting techniques.

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Representation of Muhammadiyah as the Islamic Movement Progressed in the New Public Region (Representation of Muhammadiyah as a Progressive Islamic Movement in the New Public Sphere)

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Abstract. After the 46th Congress in 2010, Muhammadiyah identified itself as a Progressive Islamic movement represented in various forms of activities and programs. The doctrine of Islamic Progress Muhammadiyah has experienced contestation and dialectics with various problems of the ummah, nationality, and global humanity. The 48th Muhammadiyah Congress in 2022 proves the propriety of Muhammadiyah as a Progressive Islamic movement. The purpose of this study is to show the representation of Muhammadiyah as a progressive Islamic movement in online media during the 48th Muhammadiyah Congress in Solo. The theory used is the representation theory of Stuart Hall, while the research method used is the Halliday-Hasan model of Critical Discourse Analysis, which focuses its analysis on three elements, namely (1) tenor of discourse, (2) field of discourse, and (3) mode of discourse. Data collection through documentation and literature study, while data analysis is carried out qualitatively by (1) text analysis and (2) socio-cultural context analysis. The results showed that the representation of Muhammadiyah as a progressive Islamic Progress in online media during the 48th Muhammadiyah Congress in Solo was in accordance with the identity of Muhammadiyah as a Progressive Islamic movement. The results of this study strengthen the position of Muhammadiyah as a Progressive Islamic Progress represented by online media through the process of representation, namely encoding, representation, and ideologization.

INTRODUCTION

After the 46th Muhammadiyah Congress in Yogyakarta in 2010, Muhammadiyah confirmed itself as a Progressive Islamic movement. The doctrine of Progressive Islam is stated in the Statement of Thoughts of Muhammadiyah for the Second Century as a result of the 46th Congress in Yogyakarta in 2010. One of the important ideas of the statement of thoughts is stated that Progressive Islam is "Islam that promotes the mission of anti-war, anti-terrorism, anti-violence, anti-oppression, anti-injustice and anti against all forms of destruction on earth such as corruption, abuse of power, crimes against humanity, exploitation of nature, as well as various evils that destroy life. Islam which positively gives birth to virtues that encompass the diversity of ethnic groups, races, groups and cultures of mankind on the face of the earth."

As a Progressive Islamic movement, Muhammadiyah emphasizes itself as a movement with a reformist-modernist character. Progress means renewal and progress in line with the spirit of Islamic teachings. Progressive Islam substantively contains important elements of Islamic reformism and modernism. In particular, it is relatively the same as the Progressive Islamic movement. As a Progressive Islamic movement, Muhammadiyah's ideology has a reformist-modernist character which contains a spirit of renewal and progress in line with the spirit of Islamic teachings [1].

During its development, the doctrine of Progressive Islam as the ideological basis of Muhammadiyah experienced contestation and confirmation with various issues of global humanity, nationality and humanity. Contestation and testing of Muhammadiyah's Progressive Islam doctrine can be carried out in the conventional public sphere as well as in the new public sphere (new media) by various groups such as the government, media, non-governmental organizations, professional groups, and even contested with the Islamic Archipelago doctrine initiated by Nahdlatul Ulama (NU), an influential Islamic organization which is ideologically often positioned at odds with Muhammadiyah.

In certain cases or issues, Muhammadiyah can indeed claim its organization as a progressive Islamic movement.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030036-1–030036-15; https://doi.org/10.1063/5.0243361
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

At least in certain cases and issues such as regarding the Foundations of the State, Muhammadiyah has positioned Pancasila as darul ahdi wa syahadah, viewing jihad as jihad lil-muhadapah, issues of radicalism and terrorism, peace and the environment. However, for other cases or issues such as gender equality (female leaders), the Russia-Ukraine war, and cases related to inter-religious relations (blasphemy), Muhammadiyah's position as a Progressive Islamic movement can be questioned.

Regarding the validity of Muhammadiyah's claim as a Progressive Islamic movement, the 48th Muhammadiyah Congress in Solo 18-20 November 2022 can be used as proof again of the validity of Muhammadiyah's Progressive Islam doctrine. One way is to analyze the representation of Muhammadiyah as a Progressive Islamic movement through online mass media reports regarding the issues discussed and included in public discourse during the Congress. Online mass media is one of the important elements in discourse in the new public sphere, which is an extension of the previous conventional public sphere such as discussion forums, salons, coffee shops, and conventional media which are all domains. or areas of social life in which public opinion can be formed [2].

The new public sphere itself is formed by mass self-communication, namely a communication network that connects many to many in sending and receiving messages in the form of multimodal communication. Public opinion through global media and internet networks is the most effective form of encouraging political participation on a global scale, with a synergistic connection between government based on international institutions and global civil society. This multimodal communication realm is what forms the new global public sphere [3].

Of course, many studies on Muhammadiyah have been carried out by various scientists with various points of view, especially Muhammadiyah's relationship to the fields of education and politics, the first of which is regarding the role and position of Muhammadiyah as an Islamic organization in elections. This research examines the role of Muhammadiyah in political democratization in Indonesia where Muhammadiyah prioritizes institutional logic, religious and social interests rather than momentary political interests. The results of this research also show that Muhammadiyah continues to remain non-partisan and neutral with all political parties, even though as an organization Muhammadiyah has the potential to be involved in politics [4].

Second, a study of Muhammadiyah and pluralism in the field of education. This study focuses on the role of Muhammadiyah in the field of education, how Muhammadiyah.

THEORETICAL FRAMEWORK

This research theoretically uses Stuart Hall's representation theory as its theoretical basis. The term representation refers to the action, statement, or reality of representing or being represented: that which represents/symbolizes: image: picture: dramatic appearance: mental image: a presentation of views on facts or arguments [9].

In Cultural Studies, representation is one of the main concepts in cultural studies apart from ideology initiated by Stuart Hall. In practice, these two concepts are interrelated. The identity and actions of those represented are an ideological reflection of those who represent. Ideology is realized and articulated through representation [10]. For example, the words "black" or "negro" represent a certain ethnic or racial group, when articulated in discourse or language it is very likely to be influenced by certain ideologies [11]. So representation is everything that is practiced through the use of language to express or communicate thoughts, concepts, ideas or feelings [12].

Basically, representation refers to how a person, a group, certain ideas or opinions are presented in the media. Representation is very important in relation to whether a person, a particular group or idea is presented as it should be, and how the representation of a person, a particular group or idea is displayed [13].

According to John Fiske, in the process of presenting an idea or object in the media, there are three stages or processes of forming the idea or object. First, objects, ideas, or events are encoded as reality. Second, how the reality of the object or idea is described; how the photo looks, the sentences used and so on. This is a process of representation. Third, it is called the ideological process, namely how the reality that has been represented is organized into ideologically accepted conventions. Here representation codes are connected with social coherence such as class, belief, certain forces in society (patriarchy, materialism, capitalism, and so on) [14].

Representational practices are always linked to how language is used. Language is the main instrument in the practice of representation, meaning that how a person, a group and an idea are presented is by using language. Therefore, what needs to be considered to see a representation is the languages used by the media. Apart from being the main instrument of representation, language is also the main tool of the media to describe a reality by writing facts in certain ways so as to give rise to certain meanings as desired by the media [13].

Representational practices that do not correspond to actual reality can give rise to misrepresentation. Misrepresentation is a misrepresentation of a person, group, or idea. They are not portrayed as they should be but are portrayed badly or negatively. Some forms of misrepresentation practices are first, excommunication. Excommunication relates to how a person or group is excluded from public discussion. Because he is considered other, not part of us. The second practice of misrepresentation is exclusion. Exclusion relates to how a person or group is excluded from conversation. They are talked about and talked to but they are looked at differently because they are considered not part of us. The third is marginalization, namely a bad portrayal of other parties or groups as a result of the practice of excommunication and exclusion [13].

Hall's studies, especially regarding representation as a cultural study, are currently being challenged by cultural changes caused by technological developments in communication with the emergence of new media, for example cultural studies are used to read people's culture in the era of digital media (new media). Followers of Cultural Studies believe that Hall's thoughts such as encoding-decoding, representation, ethnicity, and others are still relevant and contribute theoretically to the development of media in the current digital era [15].

Hall's study of culture, ideology, representation, and hegemony can be demonstrated and is relevant to the phenomenon of the Hollywood culture industry, which is a measure of United States values and norms. Isabel Molina-Guzmán's study of the diversity of film and television production in Hollywood shows the absence of diversity in Hollywood films and television shows. This study maps three discursive frames on film and television production in Hollywood, namely: Hollywood exceptionalism, economic imperatives, and institutionalized racism and sexism [16].

RESEARCH METHOD

This research uses a qualitative approach, because it emphasizes the depth of the study and research findings are the result of interactions between researchers and research subjects. The method used is Halliday and Hasan's Discourse Analysis model. Discourse includes meaning-making in social processes, language associated with certain social fields or practices, and ways of constructing aspects of the world that are associated with certain perspectives [17]. This discourse analysis is relevant to the focus of this research, namely representation, which also emphasizes language as a means of representation. Halliday and Hassan's model of discourse analysis uses three elements of discourse, namely: discourse participants (tenor of discourse), field of discourse (field of discourse), and means of discourse (mode of discourse). Discourse participants identify the parties involved in the conversation, as well as the positions and relationships between them. The field of discourse refers to the social action that is occurring or being discussed in which the subject is involved. Discourse means refer to the choice of language used, including the use of certain language styles [18].

The online media examined in this research are (1) detik.com, (2) Kompas.com, and (3) cnnindonesia.com. The determination of online media was carried out purposively based on the criteria for online media most accessed/consumed by Indonesian citizens, based on the 2022 Reuters Institute survey. The unit of analysis for this research is online media news detik.com, Kompas.com, and cnnindonesia.com during the 48th Muhammadiyah Congress in Solo, 18-20 November 2022. The unit of observation is the title, content, source, and photo of the news online media detik.com, Kompas.com, and cnnindonesia.com.

Data collection uses documentation and literature review methods. Documentation is internal data such as personal documents, administrative documents, periodic documents, mass media clippings/news [19]. The documentation in this research is in the form of online media news that has been determined regarding the 48th Muhammadiyah Congress in Solo. A literature review aims to help readers understand the background context of the research being conducted [20]. Literature study in this research was carried out to obtain data or information regarding the context of Muhammadiyah representation through previous research in the form of journal articles, proceedings and relevant books.

Data analysis includes text analysis and context analysis (socio-cultural). Text analysis was carried out using the Halliday-Hasan model of discourse analysis which includes three elements, namely (a) discourse tenor/actor, (b) discourse field/field, and (c) discourse mode regarding online media news regarding the representation of Muhammadiyah. Context analysis is carried out by examining the social and cultural situation when the text was produced through literature review of journal articles, proceedings and relevant books.

RESULTS AND DISCUSSION

Representation of Muhammadiyah as a Progressive Islamic Movement in Online Media

Representation is everything that is practiced through the use of language to express or communicate thoughts, concepts, ideas or feelings. In this section, we will present the representation of Muhammadiyah as a Progressive Islamic movement in the reporting of three online media, namely detik.com, Kompas.com, and cnnindonesia.com during the 48th Muhammadiyah Congress in Solo, 18-20 November 2022. This representation of Muhammadiyah is associated with three The issues that are the subject of discussion at the congress are community issues, national issues and global humanitarian issues.

a. Community Issues

1) Detik.com

During the 48th Muhammadiyah Congress in Solo in 2022, Detik.com represents Muhammadiyah as a Progressive Islamic movement on public issues by presenting discourse participants from state officials and political figures. The state officials involved in the discourse are Ma'ruf Amin (Vice President) and Yandri Susanto (Deputy Chair of the MPR), while the political figure is Zulkifli Hasan (General Chair of PAN and Minister of Trade). Internally, Muhammadiyah's discourse actor is Haedar Nashir (General Chair of PP Muhammadiyah).

In the field of discourse, Detik.com represents Muhammadiyah as a Progressive Islamic movement with various depictions of identity such as Muhammadiyah as moderate Islam, Muhammadiyah as a movement for peace and tajdid, progressive Islam in line with the vision of Golden Indonesia 2045, Progressive Islam is Islam that brings peace, unites , build optimism, bring progress, and have a work ethic that is enthusiastic, serious and sincere.

Muhammadiyah as moderate Islam was conveyed by Ma'ruf Amin (Vice President) who said, "We continue to implement moderate Islam with a commitment that never fades. "Because Ibadiyah Islam is the identity of Indonesian Islam, and we are known as the most moderate Islam" (Datik.com, 11/20/2022). Meanwhile, Muhammadiyah as a movement for amar ma'ruf and tajdid was emphasized by Yandri Susanto (Deputy Chair of the MPR) who said, "the vision of amar ma'ruf and tajdid is a guide for Muhammadiyah members to continue to play a role in advancing the people and nation. "By adhering to that vision, through its network and potential, Muhammadiyah can provide benefit and advance the people of the nation and the country" (Datik.com, 11/20/2022).

Apart from that, Muhammadiyah as a Progressive Islamic movement is also represented as an Islam that brings peace, unites, builds optimism, brings progress. As emphasized by Haedar Nashir (General Chair of PP. Muhammadiyah), "Muhammadiyah has the task of disseminating progressive Islamic views. "Islam that brings peace, Islam that unites, Islam that builds optimism, but also Islam that brings forward progress in the lives of all communities, countries and humanity" (Datik.com, 11/20/2023). Muhammadiyah as a Progressive Islamic movement is also represented as having an ethos of working enthusiastically, seriously and sincerely, as stated by Zulkifli Hasan, as General Chair of PAN and Minister of Trade (Datik.com, 11/20/2022).

Regarding the means of discourse or language used by discourse participants to convey areas of discourse, Detik.com displays them mostly descriptively and narratively. This is because the news displayed by Detik.com is mostly taken from remarks and statements via press releases from state officials and political figures. Narrative language can be seen in the Detik.com news which includes Ma'ruf Amin's discourse. Detik.com quoted many statements from Ma'ruf Amin when delivering the closing speech of the 48th Muhammadiyah Congress in Solo. Meanwhile, descriptive language can be seen in discourse participants Yandri Susanto, Zulkifli Hasan, and Haedar Nashir, to describe the various identities of Muhammadiyah as a Progressive Islamic Movement.

2) Kompas.com

Kompas.com, in representing Muhammadiyah as a Progressive Islamic movement on public issues during the 48th Muhammadiyah Congress in Solo, featured the tenor of discourse, namely KH. Ma'ruf Amin (Vice President) and Haedar Nashir (General Chair of PP. Muhammadiyah).

In the field of discourse, Kompas.com represents Muhammadiyah as a progressive Islamic movement with an Islamic identity that drives the empowerment of the people, Muhammadiyah as a bright light for community problems, and an Islam that is peaceful and unites Indonesia. The representation of Progressive Islam that moves the people was delivered by KH. Ma'ruf Amin (Vice President) said, "The Vice President invited the Muhammadiyah and Aisyiyah Central Management (PP) to fight together with the government in mobilizing the empowerment of the people. "According to the Vice President, Muhammadiyah and Aisyiyah have large economic and social tools in Indonesia so that they are able to mobilize the people in building the nation" (Kompas.com, 21/11/2022).

Muhammadiyah's Progressive Islam is represented as peaceful Islam to advance Indonesia as stated by Haedar Nashir (General Chair of PP Muhammadiyah). Haedar said, "the view of progressive Islam is a view of Islam that is advanced and brings grace to all of nature. "Islam that brings peace, Islam that unites, Islam that builds optimism, and Islam that brings progress in the lives of all people, nations and global humanity" (Kompas.com, 11/20/2022).

Kompas.com's mode of discourse in representing Muhammadiyah as a Progressive Islamic movement uses narrative and descriptive language. Narrative language is used to describe Muhammadiyah as an Islamic movement that drives the empowerment of the people. Meanwhile, descriptive language is used by Kompas.com to describe Muhammadiyah as a peaceful Islamic movement to advance Indonesia. Kompas.com uses narrative and descriptive language because the news sources used are more than speeches or statements from figures.

3) Cnnindonesia.com

Cnnindonesia.com represents Muhammadiyah as a Progressive Islamic movement featuring discourse participants who are not much different from Detik.com and Kompas.com, namely from state officials. Participants in the discourse presented by cnnindonesia.com were Ma'ruf Amin (Vice President), Haedar Nashir (General Chair of PP. Muhammadiyah), and Erick Thohir (Minister of BUMN).

The field of discourse presented by cnnindonesia.com in representing Muhammadiyah as a progressive Islamic movement is progressive Islam in line with the vision of a Golden Indonesia 2045, superior Islam, progress in all aspects of life, and Muhammadiyah as an important pillar for the economic revival of the people. The representation of progressive Islam which is relevant to the vision of a Golden Indonesia 2045 was expressed by Ma'ruf Amin (Vice President) who said, "the vision of Progressive Islam promoted by Muhammadiyah is in line with Indonesia's vision to realize a Golden Indonesia 2045. Ma'ruf Amin said the vision of a Golden Indonesia emphasizes Superior human resources master technology, prosperity and strong governance. "In Islamic teachings, he said, this spirit is called a generation capable of making the earth prosperous" (cnnindonesia.com, 11/20/2022).

Meanwhile, the representation of Muhammadiyah as an important pillar for the economic revival of the people was stated by Erick Thohir (Minister of BUMN). Erick Thohir said, "Muhammadiyah is an important pillar in encouraging the economic revival of the people. Collaboration with Muhammadiyah can foster the growth of business actors among the Ummah. This is especially related to the empowerment of micro, small and medium enterprises" (cnnindonesia.com, 18/11/2022). Haedar Nashir (General Chair of PP. Muhammadiyah) said that the representation of Islam is superior and progressive in all aspects of life.

The means of discourse used by cnnindonesia.com in representing Muhammadiyah as a Progressive Islamic movement are also relatively the same as Detik.com and Kompas.com, namely narrative and descriptive. The use of narrative language can be seen in Ma'ruf Amin's delivery regarding the representation of Progressive Islam which is in line with the vision of Advanced Indonesia 2024. Meanwhile, descriptive language can be seen in Erick Thohir's statement regarding Muhammadiyah as an important pillar for the economic revival of the people, and Haedar Nashir's statement regarding progressive Islam which is superior in all aspects. life.

Online media have relatively similar tendencies in the use of discourse actors, discourse fields, and discourse means in representing Muhammadiyah as a Progressive Islamic Movement on Public Issues during the 48th Muhammadiyah Congress in Solo. Overall, the representation of Muhammadiyah as a progressive Islamic movement on public issues in online media can be seen in Table 1.

TABLE 1. Representation of Muhammadiyah as a Progressive Islamic Movement on Public Issues in Online Media

Discourse Elements		**Media Online**	
	Detik.com	**Kompas.com**	**Cnnindonesia.com**
Discourse Participant	State officials, political figures and Muhammadiyah figures.	State Official, Muhammadiyah figure.	State Official, Muhammadiyah figure.
Field of Discourse	Muhammadiyah as moderate Islam and as a movement of amar makruf and tajdid.	Islam drives the empowerment of the people.	Advanced Islam that excels in all aspects of life.
	Muhammadiyah has a work ethic that is enthusiastic, serious and sincere.	Muhammadiyah as a shining light on public, national and humanitarian issues.	Muhammadiyah is an important pillar of the economic revival of the people.

Discourse Elements	Media Online		
	Detik.com	Kompas.com	Cnnindonesia.com
	Islam is progressing in line with the vision of Golden Indonesia 2045. Islam that brings peace and progress to the people.	Peaceful and unifying Islam for the progress of Indonesia	Islam is progressing in line with the vision of Golden Indonesia 2045.
Means of Discourse	Descriptive Narrative	Descriptive Narrative	Descriptive Narrative

b. National Issues

1) Detik.com

Detik.com, in representing Muhammadiyah as a Progressive Islamic movement, displays the tenor of discourse which is dominated by state officials and Muhammadiyah figures. The state officials featured by Detik.com are Joko Widodo (President of the Republic of Indonesia), Puan Maharani (Chairman of the DPR RI), and Ganjar Pranowo (Governor of Central Java). Meanwhile, Muhammadiyah figures are Haedar Nashir (General Chair of PP. Muhammadiyah) and Anwar Abbas (Member of PP. Muhammadiyah). Detik.com's discourse involvement, which is dominated by state officials and Muhammadiyah figures on national issues, shows that this online media relies more on official sources in representing Muhammadiyah as a Progressive Islamic movement.

The field of discourse presented by Detik.com on national issues, Muhammadiyah is represented as an Islamic movement that establishes national political relations and maintains closeness with all political parties. In national issues, Muhammadiyah is also represented as an Islamic organization that has a national commitment through contributing to development and peace, tolerantly maintaining unity and brotherhood. Apart from that, Muhammadiyah played a role in educating, treating and providing vaccinations during Covid 19. In preaching, Muhammadiyah took concrete action by building hospitals and schools.

The representation of Muhammadiyah as an Islamic organization that establishes national political relations and maintains closeness to all political parties was initiated by Anwar Abbas (Member of PP. Muhammadiyah). He said, "approaching the 2024 political election year, Muhammadiyah must maintain closeness with all political parties (political parties). Maintain closeness with all political parties. In the past, you kept your distance, but now you don't, you maintain closeness to all existing political parties. "This means we must be able to build friendship between us" (Datik.com, 11/20/2022). Ganjar Pranowo conveyed Muhammadiyah's national commitment to development and peace.

Muhammadiyah as a Progressive Islamic movement is also represented in its role in educating, treating and providing vaccinations during Covid 19. This was conveyed by President Joko Widodo who said, "thank you for the support of the Muhammadiyah extended family and the 'Aisyiyah extended family in helping deal with the COVID-19 pandemic in the last three years. "Thank you for mobilizing more than 120 Muhammadiyah hospitals and 235 Muhammadiyah health clinics which are active in educating the public as well as in treatment and vaccination during the pandemic" (Datik.com, 11/19/2022). The representation of Muhammadiyah as an Islamic organization that preaches with real action by building hospitals and schools, was put forward by Puan Maharani (Chairman of the Indonesian House of Representatives).

Detik.com's mode of discourse in representing Muhammadiyah as a Progressive Islamic movement relating to national issues predominantly uses narrative and descriptive language. This is because the field of discourse displayed by Detik.com is from official remarks or statements from state officials and organizational figures. Narrative language can be seen in Jokowi's statement as president regarding the role of Muhammadiyah for the nation. Meanwhile, descriptive language appears in the statements of Ganjar Pranowo, Puan Maharani, and Anwar Abbas to describe Muhammadiyah on national issues, such as education, health, and politics.

2) Kompas.com

Kompas.com in representing Muhammadiyah as a Progressive Islamic movement relating to national issues predominantly uses discourse (tenor of discourse) from state officials and political figures. State officials involved in the Kompas.com discourse relating to national issues are Joko Widodo (President of the Republic of Indonesia), Ganjar Pranowo (Governor of Central Java), and Zulkifli Hasan (General Chair of PAN). Apart from that, there is Haedar Nashir who is involved in the discourse of Muhammadiyah figures. The participants in the Kompas.com discourse, which is dominated by state officials and political figures, show that what the discourse participants convey represents the government's position, as well as the government's recognition of Muhammadiyah as being progressive.

Kompas.com's field of discourse regarding Muhammadiyah as a progressive Islamic movement on national issues presents Muhammadiyah as an Islamic organization that is full of tolerant values and brings goodness to the nation and state. Muhammadiyah is also represented by an Islamic organization that maintains unity, maintains peace and brotherhood, and is committed to religion, statehood and humanity. In relation to political power, Muhammadiyah is presented as an organization whose role is to control political power and oppose the phenomenon of sharing political power.

Representation of Muhammadiyah as an Islamic organization that is full of tolerant values and brings goodness to the community.

TABLE 2. Process of Representing Muhammadiyah as a Progressive Islamic Movement in Online Media.

Discourse Elements	**Media Online**		
	Detik.com	**Kompas.com**	**Cnnindonesia.com**
Discourse Participant	State officials and Muhammadiyah figures.	State officials, political figures and Muhammadiyah figures.	State officials, Muhammadiyah and NU figures.
Field of Discourse	Islam establishes national political relations, and Muhammadiyah maintains close ties with all political parties.	Islam establishes national political relations, and Muhammadiyah maintains close ties with all political parties.	Muhammadiyah is committed to advancing the nation and state and has good relations with various groups.
	Muhammadiyah has a national commitment through contributions to development and peace.	Muhammadiyah opposes the phenomenon of sharing political power.	Islam that maintains unity, peace, and brotherhood.
	Muhammadiyah preaches with concrete actions by building hospitals and schools.	Muhammadiyah has a commitment to religion, statehood and humanity.	Muhammadiyah preaches with concrete actions by building hospitals and schools.
	Islam is full of tolerance, maintains unity and brotherhood, and peace.	Muhammadiyah plays a role in controlling political power.	Muhammadiyah pays attention to the criteria for Indonesian leaders.
	Muhammadiyah plays a role in strengthening education for sustainable development.	Islam that maintains unity, peace, and brotherhood.	
Means of Discourse	Descriptive Narrative	Descriptive Narrative	Descriptive Narrative

c. Global Humanitarian issues

1) Detik.com

On global humanitarian issues during the 48th Muhammadiyah Congress in Solo, Detik.com only displayed one news item, with the tenor of discourse being Jusuf Kalla (10th and 12th Vice President). As a participant in the discourse, Jusuf Kalla is presented as a former state official, namely the 10th and 12th Vice President. This is because Jusuf Kalla is seen as a peace figure whose statements are considered competent.

In the field of discourse, Detik.com represents Muhammadiyah as a Progressive Islamic movement in global humanitarian issues is an Islamic organization that carries the message of world peace. This representation was put forward by Jusuf Kalla, who was quoted by Detik.com as follows, "Indonesia has two large Islamic organizations, namely Muhammadiyah and Nadhatul Ulama (NU). He hopes that the two organizations can carry the message of world peace. JK hopes that Muhammadiyah will become an even better organization. JK also hopes that Muhamamdiyah will become an organization that enlightens Muslims" (Datik.com, 11/19/2022).

The mode of discourse used by Detik.com in describing the representation of Muhammadiyah as a Progressive Islamic movement is narrative language, or telling. JK, as a participant in the discourse, said that Muhammadiyah is an Islamic organization that brings world peace.

2)Kompas.com

In representing Muhammadiyah as a progressive Islamic movement on global humanitarian issues, Kompas.com uses tenor of discourse from state officials, namely Jusuf Kalla (10th and 12th Vice President), and Joko Widodo (President of the Republic of Indonesia) . Participants in the Kompas.com discourse from among competent state officials show the state's recognition of the representation of Muhammadiyah as a Progressive Islamic movement. Progressive Islam is what establishes peace and supports environmentally friendly development and preserving nature.

The field of discourse presented by Kompas.com regarding Muhammadiyah in global humanitarian issues is Muhammadiyah as a peacemaking organization and an organization that supports environmentally friendly development and preserves nature. Muhammadiyah as a peacemaking organization was presented by Kompas.com by quoting Jusuf Kalla's statement as follows, "Muhammadiyah is said to be one of the community organizations that promote peace. "According to Jusuf Kalla, to achieve peace, Muhammadiyah must do it through education and economics" (Kompas.com, 11/19/2022).

Meanwhile, Kompas.com presented the representation of Muhammadiyah as an Islamic organization that supports environmentally friendly development and preserving nature, quoting President Jokowi's statement, "through the Muhammadiyah and Aisyiyah educational institutions, I also entrust the strengthening of education for sustainable development, for environmentally friendly development. Jokowi also invited all participants of the Muhammadiyah and Aisyiyah Congress, apart from strengthening their relationship with God, their relationship with nature should also be strengthened with humans" (Kompas.com, 11/19/2022).

The mode of discourse or language used by Kompas.com in representing Muhammadiyah on global humanitarian issues is narrative language. Kompas.com tells about the representation of Muhammadiyah as a progressive Islamic movement that plays a role in peace and sustainable development through nature conservation.

3) Cnnindonesia.com

The tenor of discourse involved in cnnindonesia.com in representing Muhammadiyah on global humanitarian issues during the 48th Muhammadiyah Congress featured a state official, namely Joko Widodo (President of the Republic of Indonesia). The involvement of Jokowi's discourse is related to Muhammadiyah's role in strengthening environmentally friendly development. This shows the credibility of the source as Muhammadiyah's recognition that it plays a role in strengthening environmentally friendly development.

Cnnindonesia.com represents Muhammadiyah in global humanitarian issues by discussing the role of strengthening environmentally friendly development as a form of field of discourse. In representing Muhammadiyah on this global humanitarian issue, cnnindonesia.com refers to President Jokowi's statement which said, "Muhammadiyah, through its large broadcasting space, plays a role in strengthening environmentally friendly development. Because, currently human dependence on the environment is very high. "In addition to Hablum Minallah (relationship with Allah) and Hablum Minannas (relationship with humans), please also strengthen Hablum Minal Alam (relationship with the environment) which emphasizes the importance of preserving nature," (cnnindonesia.com, 11/19/ 2022).

The mode of discourse used by cnnindonesia.com in representing Muhammadiyah in global humanitarian issues is narrative language. Cnnindonesia.com tells about Muhammadiyah as a progressive Islamic movement which is demonstrated by its role in environmentally friendly development.

On global humanitarian issues, online media also have relatively similar tendencies in engaging in discourse, fields of discourse, and means of discourse in representing Muhammadiyah as a Progressive Islamic Movement during the 48th Muhammadiyah Congress in Solo. Overall, the representation of Muhammadiyah as a progressive Islamic movement on global humanitarian issues in online media can be seen in Table 3.

TABLE 3. Representation of Muhammadiyah as a Progressive Islamic Movement on Global Humanitarian Issues in Online Media

Discourse Elements	**Online Media**		
	Detik.com	**Kompas.com**	**Cnnindonesia.com**
Discourse Participant	Political figure	State officials and political figures	Political figure
Field of Discourse	Islam brings a message of world peace.	Muhammadiyah supports environmentally friendly development and preserving nature. Peacemaking community organizations.	Muhammadiyah plays a role in strengthening environmentally friendly development.
Means of Discourse	Narrative	Narrative	Narrative

DISSCUSSION

New Muhammadiyah Representation Process in the Public Sphere

Muhammadiyah's identity as a progressive Islamic movement is then represented in online media as a new public sphere. The new public sphere is an expansion of the concept of the conventional public sphere in the form of discussion forums, salons, coffee shops, and conventional media where public opinion is formed [2]. The new public sphere is formed by mass self-communication, namely a communication network that connects many to many in sending and receiving messages in the form of multimodal communication. Public opinion through global media and internet networks is the most effective form of encouraging political participation on a global scale, with a synergistic connection between government based on international institutions and global civil society. This multimodal communication realm is what forms the new global public sphere [3].

Online media as a new public domain based on internet networks has a strategic role in sending multimodal communication messages, including messages related to the representation of the identity of a community, organization and public democratic ideas. This is because online media has characteristics that conventional media do not have, such as massive amounts of news that can be repeated, wide and fast dissemination, flexibility, interactiveness, hyperlinks, and convergence that combines news with audiovisuals in one report (multimedia). [21]. With these characteristics, online media can also be called new media because the characteristics of new media are also found in online media. New media is internet-based media that provides convergence, digital networks, global reach, interactivity, many-to-many communication, and forms of media where someone can be both a producer and a consumer [22]. New media is identified with digital, interactive, hypertextual, virtual, network, and simulation [23].

Conceptually, the representation process includes three stages, first, the encoding process, namely objects, ideas or events that are encoded as reality. Second, the representation process, namely how the reality of the object or idea is depicted; how the photo looks, the sentences used and so on. The third is the ideological process, namely how the reality that has been represented is organized into ideologically accepted conventions. Here representational codes are linked to social coherence such as class, belief, and certain forces in society (patriarchy, materialism, capitalism, and so on) [14].

Referring to the representation process above, the process of representing Muhammadiyah as a Progressive Islamic movement in the new public sphere is as follows. First, Muhammadiyah as a Progressive Islamic movement during the 48th Congress in 2022 was encoded by online media through representation codes. In the communication process, encoding or encoding is the process of encoding a message, the process of compiling it before the message is conveyed by the communicator to the communicant. So encoding is essentially a message that has not been delivered. In the representation process, encoding is related to objects, ideas, or events that are encoded as reality. In this case, encoding is related to the production of messages by media institutions (broadcasting and printing) with production practices and networks, as well as infrastructure technology for producing programs or news. Production here is the process of constructing messages [24].

In encoding practice, Muhammadiyah as an Islamic movement progresses as an idea encoded as a reality by online media. In the encoding process, the role of the editor as a gatekeeper is very decisive, namely his role is to determine the selection of sources or discourse participants (tenor of discourse) which are considered to represent the issues being highlighted, deciding on the field of discourse (field of discourse) that will appear, including the use of language (mode of discourse). in representing Muhammadiyah during the Congress on online media. In the encoding process, the production of messages about Muhammadiyah is designed by the editor following the infrastructure and production network. Apart from that, it is also adjusted to the interests and objectives of each online media before being distributed to a wide audience..

The second representation process is the representation itself, namely how the reality of Muhammadiyah as a Progressive Islamic movement is depicted through the use of language in online media reporting during the 48th Congress in Solo. The use of language in representation aims to describe a reality by writing a fact in certain ways so that it gives rise to certain meanings as desired by the media [13]. In the writing of online media about Muhammadiyah as a Progressive Islamic movement during the 48th Muhammadiyah Congress in 2022, the use of language (mode of discourse) of online media uses more descriptive and narrative language. These two styles of language are widely used by online media to describe and tell all kinds of things related to Muhammadiyah as a Progressive Islamic movement. In this case, online media use descriptive and narrative language because they quote more statements or speeches from state officials, mass organization figures and politicians who are official.

The use of language as a representation process can also be seen in the field of discourse of online media in discussing Muhammadiyah as a Progressive Islamic movement. To show that Muhammadiyah is indeed a progressive Islamic movement, online media in reporting about Muhammadiyah use phrases or sentences such as "Muhammadiyah as moderate Islam and as a movement for makruf and tajdid", "Muhammadiyah as a shining light on public, national and humanitarian issues", and "Muhammadiyah as an important pillar of the economic revival of the people". Other sentences or phrases that emphasize Muhammadiyah as a progressive Islamic movement "Muhammadiyah supports environmentally friendly development and preserving nature", "Muhammadiyah is committed to advancing the nation and state and has good relations with various groups", "Muhammadiyah has a national commitment through contributions to development and peace", and "Muhammadiyah is concerned with the criteria for an Indonesian leader".

The third representation process is the ideological process, namely how the reality regarding Muhammadiyah as a Progressive Islamic organization which has been represented in online media is organized into conventions that are accepted ideologically by various groups. That ideologically Muhammadiyah is a Progressive Islamic movement that practices the values of moderation, namely Tawassut (taking the middle path), Tasamuh (Tolerance), and Shura (deliberation) [7], recognized by the State, the media and other mass organizations. This can be seen in the recognition in the remarks of the President and Vice President, Ministers, political figures and mass organizations, that Muhammadiyah is a progressive Islamic movement that contributes to development and peace.

In this ideological process, the representation codes displayed by online media in the form of phrases or sentences related to Progressive Islam as an ideology accepted by many groups are linked to certain beliefs and powers in society. In this case it is the belief and strength of Moderate Islam in Indonesia, especially as a force to fight radicalism in Indonesia. Muhammadiyah and Nahdlatul Ulama (NU) are two mainstream moderate Islamic organizations in Indonesia [25], both of which have characteristics as moderate Islamic movements in Indonesia [26], [27].

The process of ideologicalization of Islam and the progress of Muhammadiyah can also be linked to the ideology of online media in reporting an event, including the 48th Muhammadiyah Congress in 2022. Detik.com is considered to have a nationalist ideology which in every report prioritizes national interests [28]. Meanwhile Kompas.com has the jargon of precision journalism [29]. Kompas.com is also known for its transcendental humanism ideology which emphasizes the human side in every report [30]. The jargon of cnnindonesia.com is constructive journalism, namely the practice of journalism that displays constructive information and solutions [31]. The process of representing Muhammadiyah as a Progressive Islamic movement in online media can be briefly seen in Figure 1..

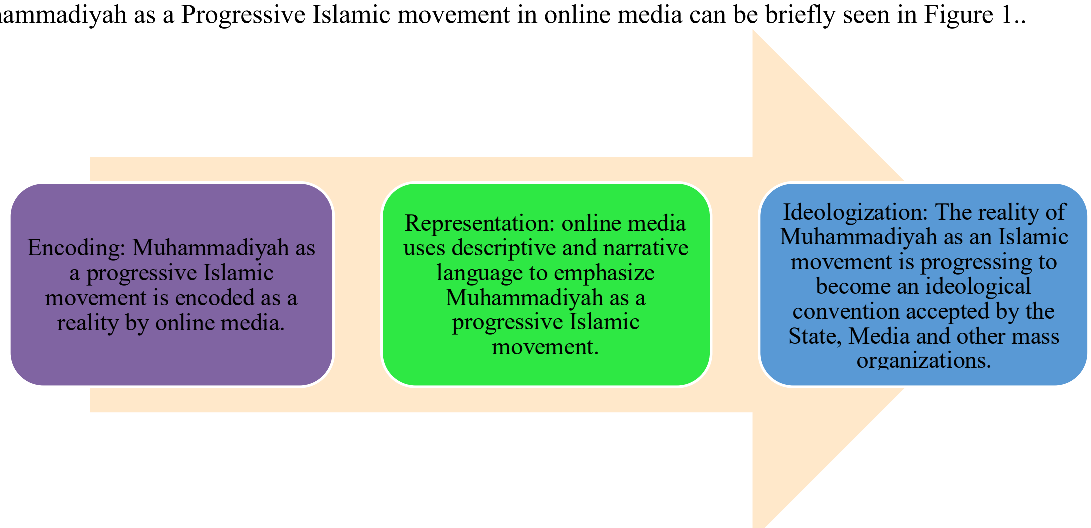

FIGURE 1. Process of Representing Muhammadiyah as a Progressive Islamic Movement in Online Media

Muhammadiyah in the Midst of Global Issues of Community, Nationality and Humanity

The research results show that what the online media represents about Muhammadiyah as a Progressive Islamic movement, on the one hand, strengthens Muhammadiyah's identity as a Progressive Islamic movement so far. But on the other hand, there were also many other Muhammadiyah identities that were not represented by online media during the 48th Muhammadiyah Congress. For example, the representation of Muhammadiyah as a Progressive Islamic movement which is anti-corruption, anti-radicalism and anti-terrorism, as well as anti-violence and anti-war. However, what the online media represents about Muhammadiyah as a Progressive Islamic movement is in accordance with Muhammadiyah's identity so far. In other words, online media does not misrepresent or misrepresent Muhammadiyah. Online media depicts Muhammadiyah as it should be, and does not portray it negatively.

Referring to the decision of the 46th Muhammadiyah Congress in Yogyakarta in 2010 regarding Muhammadiyah and Strategic Issues of Community, Nationality and Universal Humanity, that Community issues include: (1) poverty of leadership and example, (2) commodification of religion for business interests and politics, and (3) religious conservativism. Meanwhile, national issues include: (1) revitalization of national character; (2) eradicating corruption; (3) reform of legal institutions; (4) worker protection and welfare; (5) national leadership succession system; (6) bureaucratic reform; and (7) agrarian reform and land policy. The humanitarian issues are: (1) modern humanitarian crisis; (2) food and energy crisis; (3) global economic crisis; (4) environmental crisis and climate change; (5) Islamophobia; (6) global migration; and (7) dialogue between religions and civilizations [32].

Muhammadiyah's representation on public issues shows Muhammadiyah as a modernist Islamic movement in Indonesia. Muhammadiyah's modernism is demonstrated by emphasizing the concepts of da'wah and tajdid as ways to achieve good human progress. Islam must be seen as a progressive religion suitable for the future of civilization whose presence must benefit the universe as a whole. In community issues, Muhammadiyah's modernism is proven by establishing three institutions whose role is to empower the community, namely the Amil Zakat Infaq and Shadaqah Muhammadiyah Institution (LAZISMU); Community Empowerment Council (MPM); and Muhammadiyah Disaster Management Center (MDMC). These three institutions have contributed a lot to the internationalization of the Muhammadiyah movement [33].

In addition, on public issues, Muhammadiyah is also presented as a moderate Islamic organization that fights radicalism and religious conservatism through moderation [34]. Muhammadiyah positions itself as an Islamic preaching organization amar ma'ruf nahi munkar, which accepts Pancasila as darul ahdi wa shahadah (State of Unity and Testimony). To fight religious radicalism and conservatism through the idea of Moderate Islam, Muhammadiyah developed various activities known as charitable efforts in the fields of education, hospitals, orphanages and empowering mustadhafin [35].

In the context of politics and power, Muhammadiyah is also represented as an Islamic organization that avoids the commodification of religion for political and power interests. Muhammadiyah's role in political democratization in Indonesia prioritizes institutional logic and religious and social interests rather than partisan politics. Muhammadiyah continues to remain non-partisan and neutral with all political parties. Even though some elites and members of Muhammadiyah are involved in politics, and organizationally Muhammadiyah has the potential to be involved in politics, Muhammadiyah prefers to have integrity with its community [4]. Apart from that, in an effort to avoid the commodification of religion for political interests and to avoid being trapped in partisan politics, Muhammadiyah takes a position of moderation by taking a moderate position in politics and supporting patriotism for the sake of broader national interests. This was demonstrated by Muhammadiyah in the 2019 Election which officially did not support any candidate based on the "middle way" concept [36].

On national issues, Muhammadiyah can be viewed from various issues such as good governance, Muhammadiyah's role in legal reform, and Muhammadiyah's political role, especially in national leadership succession. On national issues, Muhammadiyah is one of Indonesia's Islamic civil forces which plays a role and is involved in establishing and strengthening good governance in Indonesia. One of these roles is through cultural da'wah which plays the role of internalizing new values and culture that are more robust and weighty as contained in the principles of good governance. Quality mental attitude, quality work ethic, independence, discipline, solidarity and other civil values are part of what is promoted and internalized through cultural da'wah. The anti-corruption moral movement carried out by Muhammadiyah can also be seen as part of cultural da'wah and at the same time relevant to the principles of good governance [37].

Another national role of Muhammadiyah is constitutional jihad as Muhammadiyah's effort to create civil society. Constitutional jihad is the implementation of Muhammadiyah's transformative preaching in monitoring and correcting legislative processes and products so that they are in accordance with the morals and ideals of Pancasila and the 1945 Constitution. One example of Muhammadiyah's constitutional jihad is Muhammadiyah together with other organizations and a combination of individuals submitting a judicial review of the Law (Law) Number 7 of 2004 concerning Water Resources (UU SDA) because it is not in line with the 1945 Constitution and Pancasila and is far from the principles of justice. The Constitutional Court also granted the request for review of Law Number 22 of 2001 concerning Oil and Gas (UU Migas) by dissolving the Oil and Gas Implementing Agency (BP Migas) [38].

In connection with the political role of Muhammadiyah, it is as a civil society that acts as a balancing force for the state. As an Islamic civil society movement, Muhammadiyah fights for Islamic values and the benefit of the people to create a truly Islamic society in Indonesia. In particular, Muhammadiyah's political role is more about maintaining a distance and not getting involved, whereas in national politics being active is in accordance with Muhammadiyah's personality. Muhammadiyah's national politics is realized by first, increasing empowerment, guidance, development and political education. Second, increasing national involvement and participation in actual problems and contemporary national issues. Third, strengthen networks, communication and relationships between organizations and government institutions. Fourth, increasing the advocacy function in the form of action and service to the interests of the community [39].

Muhammadiyah's political attitude which is more distant from political parties is also shown in the succession of national leadership. In the 2019 presidential election, Muhammadiyah took a more neutral stance, not supporting the competing presidential candidates, namely Joko Widodo-Ma'ruf Amin and Prabowo Subianto-Sandiaga Uno. Muhammadiyah prefers to be steadfast in maintaining neutrality in the presidential election and giving freedom to all Muhammadiyah members to give their voting rights to the presidential and vice presidential candidate pairs according to their respective choices [40].

In global humanitarian issues, Muhammadiyah shows itself as a modernist Islamic organization and a progressive Islamic movement. In the global arena, Muhammadiyah is actively involved in humanitarian missions, peace and reconciliation projects. Muhammadiyah's international projects under the banner of Muhammadiyah-Aid as Muhammadiyah's new flag in international projects. In the peace and reconciliation project as Muhammadiyah's new ijtihad, there are at least three cases in Muhammadiyah's internationalization process. First, Muhammadiyah's involvement in peace talks in Mindanao (Bangsamoro). Second, a reconciliation project in Southern Thailand, and third is an international humanitarian mission in Nepal and Bangladesh [33], [41]. Muhammadiyah's international role is also realized by the opening of the Muhammadiyah Special Branch Leadership (PCIM) as an extension of the Muhammadiyah network abroad such as in Australia, New Zealand, Germany, France and other Asian countries [42].

Muhammadiyah's role in global humanitarian issues can also be proven through Muhammadiyah's role in dealing with the Covid 19 pandemic which has hit almost the entire world. Muhammadiyah's efforts to overcome the Covid 19 Pandemic are a humanitarian ijtihad as a social implementation of Islamic values which is realized through the Muhammadiyah Covid-19 Command Center (MCCC) under the control of the Muhammadiyah Disaster Management Center (MDMC). Muhammadiyah's humanitarian ijtihad against the Covid 19 Pandemic was carried out with steps, namely: revitalizing theological rituals, canceling the strategic agenda of the organization and technical engineering of learning in Muhammadiyah educational institutions. Apart from that, Muhammadiyah also continues to convince the community to follow the health protocols set by the Government, and of course care for and treat Covid 19 patients in Muhammadiyah hospitals [43], [44].

In connection with Muhammadiyah's role in global humanitarian issues, especially the issue of Islamophobia and dialogue between religions and civilizations, it can be seen in the contribution of two Muhammadiyah figures, namely Ahmad Syafii Maarif and Sirodjuddin (Din) Syamsuddin, who each led Muhammadiyah from 1998- 2005 and 2005-2015. In 2003, Syafii Maarif founded the Syafii Maarif Foundation, which sponsored the establishment of the Maarif Institute (MI), in 2003. The Maarif Institute is concerned with issues such as democracy, good governance, religious pluralism, poverty eradication, and human rights [33]. Through the Maarif Institute, Syafii Maarif's thinking as a moderate preacher is conceptualized into three main ideas, namely Islam, humanity and Indonesianness through persuasive and rational Islamic preaching, not intimidating preaching [45].

Meanwhile, Din Syamsuddin founded the Center for Dialogue and Cooperation among Civilizations (CDCC) in 2007. CDCC's mission is "to provide advice and assistance to governments, organizations and individual decision makers regarding the urgency of dialogue and cooperation between civilizations as a model for building resolution of political problems, social, economic, cultural, security and environmental”. CDCC has played a major role in organizing and conducting interfaith forums by inviting religious leaders and facilitating interreligious dialogue, both nationally and internationally [33]. CDCC also facilitates a free and independent public space for citizens with different religious or cultural backgrounds to speak, discuss and dialogue to discuss religious issues and state issues in an effort to form good governance. CDCC also holds meetings between followers of different religions to create a pluralist and tolerant society [46].

CONCLUSION

The representation of Muhammadiyah as a Progressive Islamic movement in online media is in accordance with Muhammadiyah's identity as a Progressive Islamic movement. However, there are issues that do not appear in online media, such as the representation of Muhammadiyah as a Progressive Islamic movement that is anti-corruption, anti-radicalism and terrorism, as well as anti-violence and anti-war, and several other issues. On the issue of ummah Muhammadiyah, it is represented as an Islamic movement that brings peace and progress to the people, an Islamic movement that drives the empowerment of the people. Muhammadiyah is also shown as an important pillar of the economic revival of the people, and Muhammadiyah has a work ethic that is enthusiastic, serious and sincere.

On national issues, the Muhammadiyah Progressive Islam movement is represented by online media with various identities, including Islam which is full of the values of tolerance and brings goodness to the nation and state, Islam which maintains unity, maintains peace and brotherhood, Islam which establishes political relations. nationality, and Muhammadiyah maintains close ties with all political parties. Muhammadiyah is also represented as an organization that has a national commitment through contributions to development and peace, and Muhammadiyah plays a role in educating, treating and providing vaccinations for Covid 19. As for global humanitarian issues, online media represents Muhammadiyah with its identity as an Islamic organization that carries messages and is the originator. world peace, and Muhammadiyah supports environmentally friendly development and preserving nature.

The process of representing Muhammadiyah as a progressive Islamic movement in online media includes three stages, namely (1) encoding, namely Muhammadiyah as a progressive Islamic movement is encoded as a reality by online media, (2) representation, namely online media using descriptive and narrative language to emphasize Muhammadiyah as a progressive Islamic movement, and (3) ideology, namely the reality of Muhammadiyah as a progressive Islamic movement organized into an ideological convention accepted by the State, Media and other Islamic Mass Organizations.

Suggestions or recommendations for further research are that it is necessary and important to research the representation or discourse about Muhammadiyah in online media more comprehensively, linked to various issues and over a relatively longer time span, at least one year. This kind of research will produce a more complete and complete picture of Muhammadiyah in online media, not partial as during the Congress. Furthermore, the research results show that there are issues presented by online media that are not included in the scope of public, national and global humanitarian issues that have been determined by PP Muhammadiyah at the 46th Muhammadiyah Congress in Yogyakarta. Therefore, it is practically recommended that the scope of global public, national and humanitarian issues be reviewed or expanded further. Apart from that, when holding national activities such as conferences, there needs to be some kind of issue management from PP Muhammadiyah so that the issues that appear in the mass media are in accordance with the interests and broadcasts of Muhammadiyah as a Progressive Islamic movement.

Finally, the researcher would like to thank the Muhammadiyah Central Executive Board of Higher Education, Research and Development for providing funds for this research, so that this research can be carried out well.

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Gender Reconstruction in ABC Ketchup Advertisements A Study of Critical Discourse Analysis

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Abstract. The gender construction that has developed in society has become firmly embedded in society, both regarding the description of gender characteristics, duties and roles. This also happens in the media world, one of which is the world of advertising. In advertising, what is often highlighted in the world of advertising is the existence of gender bias in advertising. This is because there are gender stereotypes attached to the male and female genders. The existence of gender stereotypes is also greatly influenced by the division of domestic and public roles which are greatly influenced by gender stereotypes. This is also clearly depicted in the advertisement. However, along with the development of public knowledge, stereotypes in advertising have begun to shift. This can be seen in one of the advertisements that constructs the division of roles based on gender, namely the ABC Ketchup advertisement. Mass media advertising discourse, which often positions women as objects with a waist image, is starting to be reconstructed through these advertisements. The highly gender-biased division of roles is starting to unravel.

INTRODUCTION

As social creatures, humans have the instinct to live together and interact with other humans using the medium of language. Apart from language, an important aspect of social relations in society is the division of roles based on gender. According to [1] cultural influences result in the division of roles based on gender as a result of different social treatment of male and female behavior, known as gender. Social treatment that differentiates men and women results in differences in language as a social symbol. This is also reinforced by Trudgill [2]. As a result of social conventions, of course language will reflect social relations. If within a social group there are gender differences, these differences will be reflected in their language. This can happen because language contains terms and concepts that mark appropriate behavior for men and appropriate behavior for women. [2] puts forward claims related to gender and language variation, namely (1) biologically men and women are different and these differences have serious consequences for gender; (2) social organization is assumed to be a power relationship so that language behavior shows male dominance; (3) men and women are social creatures who must learn to act in a certain way, namely language behavior is learned from behavior.

The social behavior of a society will be reflected in its language, which appears in structure and vocabulary [2]. Therefore, what must be considered when looking at gender markers in a language is how the people who speak that language treat the gender system.

Advertising is a form of reflection on language use. Advertising is a medium for promotion. According to [3] advertising is an effort to convey a message to persuade a certain target audience. Based on this definition, it can be concluded that advertising has the function of "encouraging" and "persuading" us to remember, like, choose and then buy what the advertisement offers. Based on this definition, it can be seen that advertising is one of the most effective ways to introduce products to the public.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030037-1–030037-5; https://doi.org/10.1063/5.0241724
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

In Burton notes, goods advertised on television will acquire cultural value [4]. Advertising, which is basically just a promotional activity for a product, becomes a marketing activity for a set of values and beliefs. Television advertising has become a part of popular culture that produces and represents values, beliefs and even ideologies. Interestingly, television advertising then did not escape its role as an arena for commodification, where advertising messages were no longer just offering goods and services, but also became a kind of tool for imparting symbolic meaning. Therefore, the advertisement will be packaged in such a way that it can attract the audience, starting from the language style to the appearance of the characters who play a role in a very patriarchal social culture which of course latently influences the wider audience.

Advertisements also need to choose attractive language to display product imagery. In advertising a product, advertising will build the product's image. According to [5], one of the product images is built using mythologization techniques. Mythologisation is a strategy of mystical meaning, logos, product designs, advertising and advertising. Through this mythologisation, advertising will try to build an image of the product being offered. This is very important because with this imagery it is hoped that advertising can influence consumer perception.

Tomagola categorizes the image of women in advertisements in the mass media as follows: 1) Frame image: women as perfect figures with ideal body shapes; 2) Pillar image: women as support for the integrity and administrator of the household; 3) The image of the competition: women as sexual objects; 4) The image of the plate: women as figures who are synonymous with the world of the kitchen; 5) Social image: women as figures who lack self-confidence in relationships [6]. The image of women in these advertisements is built on mythologies that are strongly influenced by culture. Language is a tool for building the image of women in advertising. Imagery as a representation of gender can be seen from advertisements for condom contraceptives in the media. The large number of advertisements for condom contraceptives which are represented by women as advertising stars is very interesting when examined from ethnosemantic studies.

One that takes advantage of the existence of cultural values in advertising is ABC Ketchup. ABC Ketchup ads in 2018 are starting to make changes. ABC soy sauce advertisements, which before 2018 displayed the image of women's waistbands, began to make changes in 2018. Starting in 2018, ABC Ketchup advertisements began to shift the image of women's waistbands to men. ABC Ketchup is making a change that means men can also do domestic things that have previously been limited to women. Gender reconstruction began to be carried out by ABC Heinz through ABC advertising. This becomes very interesting to study using discourse analysis.

Critical discourse analysis, text is not something that is value-free and describes social reality. There are personal tendencies of the text creator and the social structure that surrounds the text creator which influences the content of the text. Language is never neutral because language carries certain ideological messages which are influenced by the creator of the text. AWK understands discourse not solely as a study of language, but critical discourse analysis also connects it with context. The context in question is the context of power practices which aim to marginalize certain individuals or groups through the use of power in producing texts (discourse). There are several techniques in popular critical discourse analysis. One of them is Norman Fairclough's discourse analysis.

Norman Fairclough's analysis is based on how to connect micro texts with the macro context of society. Fairclough built a model of discourse analysis that has a contribution to social analysis, so that he combines the tradition of textual analysis - which always looks at language in a closed space - with the broader context of society. Fairclough's great point of interest is to see language as a social practice. Fairclough's analysis is focused on how language is formed and shaped by social relations and certain social contexts. Fairclough calls his understanding of language the term discourse [7]. According to [7], the concept of discourse is a form of "social practice" which has three implications. First, discourse is part of society because it is separate from society. Second, understanding discourse as a social practice implies that discourse is a social process. As society processes and develops, makawacana (language) also processes and develops. Third, the discourse proceeds appropriately.

Norman Fairclough divides discourse analysis into three dimensions [8]. First, carry out a language analysis of the text, by looking at vocabulary, semantics and grammar. Second, Discourse Practice, dimensions related to the process of text production and consumption. The third is Discourse Practice, a context-sensitive dimension, which is related to many things, such as the context of the situation, and the practices of the media system itself or certain societal and political cultures.

Fairclough developed an analytical framework [7] of the concept of intertextuality, namely the relationship between 'before' and 'after' texts, and interdiscursivity, namely the combination of genre and discourse in a text. In the concept of intertextuality, each text is part of a chain of texts, which influences, creates and changes other texts. Interdiscourse is a way of making texts different from one another through how these texts are created, unified, continuous (including here 'genre' and 'style'), connected in discourse practices, and connecting discourse sequences.

The research in this paper is qualitative. According to [9] a qualitative approach is used to understand a social phenomenon holistically (whole). This qualitative method allows us to understand people and view them as they express their views of themselves.

Thus, in this research the problem can be formulated as follows, (a) what is the intertextuality and interdiscursivity contained in the ABC Ketchup advertising text; (b) what is the perspective of Indonesian society towards women who read the ABC Ketchup advertisement?

DISCUSSION

Language has an important role in advertising, especially culinary advertising. Culinary advertising tries to display the image of the product. The image of this product is built on mythologizing that women are creatures identified with domestic roles. With this domestic role, women in advertisements are always identified with the image of a plate. The image of the plate appears as a mythology that women have a role as providers of the family's economic needs. When women can satisfy the stomach needs of family members, especially husbands, it is assumed that family harmony can be maintained. This can be seen from the ABC Ketchup advertisements before 2018. From several ABC Ketchup advertisements before 2018, it can be seen how the language used in these advertisements always assumes that the role of women is as satisfying the needs of family members' stomachs.

However, since 2018 the ABC Ketchup advertisement has reconstructed the image of women's waists. The ABC Ketchup advertisement carried out gender reconstruction regarding the division of roles between men and women which had been considered established. This can be seen in the sentences in the following advertising discourse.

Data 1

Discourse "Real Husbands Want to Cook, Thank You ABC Soy Sauce"

One evening, a father had just come home from work. He saw his daughter drawing while face down on the floor. Meanwhile on the other side, his wife was preparing ingredients for cooking.

(1) Si Ayah duduk sambil berkata “Wah Capeknya.”
(2) Lalu Si Ayah bertanya, “***Itu Adik, ya***?”
(3) Anak pun menjawab “Ini Superbunda.”
(4) Si Ayah kembali bertanya, ”***Kekuatan Superbunda apa***?”
(5) Anak menjawab, “Banyak: bangun pagi, kerja, masak.
(6) “***Kalau ayah***?” lanjut Ayah.
(7) Jawab Adik, “***Ayah cuma ngantor, Bunda sudah ngantor masih kuat masak.***”
(8) Dengan raut wajah bersalah dan menyesal si Ayah mendekat ke isterinya yang sedang memasak dan berkata: ”***Maaf ya, enggak pernah bantu***. ***Harusnya kalau kamu bisa kerja, aku juga bisa masak***.”
(9) Dengan gembira, sang Istri menanggapi dengan menyodorkan sebotol kecap dan berkata,” Mau bantu? Ini bisa bantu.”
(10) Dan berakhir dengan narasi ***Kecap ABC, bantu suami sejati masak lebih baik***.

In the ABC advertisement data 1 shows three characters, namely: father, mother and child, in the scene in the advertisement there is a conversation between the three, in a family setting. The advertisement illustrates that these biological differences between men and women have serious consequences for gender. The ABC soy sauce advertisement contains a reconstruction of gender that has long been considered established. The ABC Ketchup advertisement really depicts the dominant feminist representation, how women are portrayed. In the ABC Ketchup advertisement, you can see how a child draws a picture of a mother, who in fact is a female figure as a hero in her imagination. The child is describing and narrating how the female figure takes the position as subject. This visual is reinforced by sentences (3), (5), and (7). These three sentences illustrate the existence of gender reconstruction which has long been considered established, namely that superheroes are always synonymous with men. This is shown in sentences (4) and (6) which illustrate that the father figure cannot accept the child's argument that makes the mother a superhero by using question sentences about the father's role. In sentences (3), (5), and (7) the concept of superhero is reconstructed from male to female. Superheroes, which are always synonymous with masculinity, are reconstructed that superheroes do not have to be masculine, so superheroes do not have to be men. This knowledge was later called discourse by Foucault. In connection with this discourse, feminists represent or construct images or restate reality in visual and verbal form.

Data 2
Discourse "ABC Ketchup Supports Equality in the Kitchen on Women's Equality Day"

Di sebuah dapur ada seorang perempuan menyampaikan narasi,
(1) “Tahukah Anda? Hanya satu dari tiga suami Indonesia yang mau membantu di dapur. Hal ini dapat menimbulkan pertengkaran di rumah.

Selanjutnya terdapat adegan pertengkaran antara suami dan isteri,
(2) “Kamu kenapa sih, susah banget sih bagi tugas,” kata si isteri.
(3) Si Suami menendang kursi sambil berkata, “Buat apa aku punya istri kalau aku harus masak sendiri?”
(4) Aku sudah melakukan tanggung jawab aku, sedangkan kamu? Jawab si istri.
(5) Tanggung jawab aku kerja. Kamu di dapur! Udah gitu kodratnya! Sahut si suami.
(6) Slide berikutnya muncul sosok laki-laki berkata, “Konflik seperti ini harus dihentikan. Kita sebagai suami harus bisa masak, karena suami istri seharusnya punya tanggung jawab yang sama di dapur kan?”
(7) Kemudian si lelaki mendekati istrinya yang sedang memasak dan berkata, “Aku saja yang masak ya?”
(8) “Serius?” Tanya si istri.
(9) “Iya,” jawab si suami
(10) “Emang kamu bisa masak?”Tanya istrinya tidak percaya.
(11) Dan berakhir dengan narasi **“**di hari kesetaraan perempuan ini kecap ABC melanjutkan komitmen untuk mendukung kesetaraan di dapur dan memastikan bahwa ke depannya suami dan istri punya tanggung jawab yang sama untuk memasak. Jadilah suami sejati yang pasak, saat ini dan di masa mendatang”.

In the ABC advertisement data 2 shows two characters, namely: husband and wife. The advertisement illustrates that the biological differences between men and women have consequences for the division of roles. This can be seen in sentences (1) (2) (3) (4) and (5). These five sentences show that there is a division of roles based on gender that already exists in society and is considered to be established. In the next sentence, the gender reconstruction which has been considered established can be seen in sentences (6) (7) and (11). Sentences (6) and (11), which are sentences calling for change, emphasize the dominant feminist representation in the ABC Ketchup advertisement. The emergence of sentences (1) and (6) is based on a study conducted by Nation Research 2018 which indicates that a lack of appreciation for partners in marriage has a significant impact in the form of arguments and even more extreme divorce [10]. The sentence in the ABC Ketchup advertisement tries to explain that a man who is in conflict and ends in divorce should be able to do many things in his marriage, including helping in the kitchen. This can be seen from sentence (6) which emphasizes that conflicts like this must be stopped by appreciating the wife by learning to cook. Husband and wife should have equal responsibilities in the kitchen.

CONCLUSION

Language has an important role in building a product image, one of which is the mythologization that women are creatures identified with domestic roles. With this domestic role, women in advertisements are always identified with the image of a plate. The image of the plate appears as a mythology that women have a role as providers of the family economy. When women can satisfy the stomach needs of family members, especially husbands, it is assumed that family harmony can be maintained. This can be seen from the ABC Ketchup advertisement. From several ABC Ketchup advertisements, it can be seen how the language used in the advertisements always assumes the satisfaction of serving the stomach's needs. However, since 2018 the ABC Ketchup Advertisement has reconstructed the image of women's hips. The ABC Ketchup advertisement carries out gender reconstruction regarding the division of roles between men and women. At the beginning of the text of the two ABC advertisements, it is explained that the biological differences between men and women have consequences for the gender roles of men and women. Then at the end of the discourse on the ABC soy sauce advertisement, it contains a reconstruction of gender which has been considered established so far. The ABC Ketchup advertisement depicts a fairly dominant feminist representation with the narrative of inviting the husband to cook.

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Critical Discourse Analysis of Dakwah Media Texts on Mubadalah.Id

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Abstract: As a forum for Islamic feminist ideology, Mubadalah.id presents da'wah on the Website and Instagram (IG) media. The discourse analysis of the text raised in this study uses the discourse structure of Teun A. Van Dijk, which consists of macrostructure, superstructure, and microstructure. Each structure has themes, titles, subtopics, lead, body, end, semantics, setting, detail, intent, presupposition, syntax, coherence, pronoun, stylistic, lexicon, diction, rhetoric, and metaphor. The problem in this research is what the macrostructure contained in the Mubadalah.id media text. This research aims to analyze the macrostructure contained in the Mubadalah.id media text. The method used in this research is a descriptive qualitative method. The data in this research includes the text and context contained in feminism-based preaching uploads on the Mubadalah.id account. The data source in this study is the Instagram account Mubadalah.id taken from 2020-2022. The researcher focuses on posts related to feminism. There were approximately 250 contents uploaded from 2020-2022, so the researchers chose ten content that contained the ideology of Islamic feminism. The analysis results of the discourse structure data show that the macrostructure includes words and sentences in each Mubadalah. id upload. This upload on the Mubada.id Instagram account does not only take sides with women's rights but reconstructs the thinking of fellow human beings in fighting for their rights as human beings while at the same time providing a broad view to glorify fellow human beings.

INTRODUCTION

Media is very effective in hegemonizing the public because it can send messages directly. Recent media developments have become an effective tool for conveying messages and influencing the public. Unfortunately, quite a few media influence the public with a patriarchal paradigm. Not few media often exaggerate reports with gender-biased titles regarding victims of violence against women. The media often creates negative connotations in cases of violence against women, namely that women are the cause of violence, so they must be responsible to society. It is detrimental to women and silences their rights as independent human beings who have reason and can make decisions. The role of the media, in this case, is very much needed as a forum for educating the public. The role of women is not to be second class, and women must be treated equally and equally in terms of thought, reason, and space with men without any restrictions in any area of everyday life. Media is needed to break down a lousy stigma against women in the surrounding environment. It is expected to balance the function of the media, namely, as a mediator to convey information to the entire community.

Based on Law Number 40 of 1999 concerning the Press, the media functions to inform, educate, entertain, social control, and monitor public behavior, as well as the authorities. The success of mass media in acting as an agent of change can be seen from the influence of mass media on individuals and society. [1] Media can not only influence what a person already knows but also influence how a person learns about their world and interacts with one another. The influence of mass media includes three aspects:

1. The cognitive aspect, namely from ignorance to knowing.
2. The affective aspect which means from dislike to like. This aspect can also increase or decrease moral support.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030038-1–030038-5; https://doi.org/10.1063/5.0242248
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

3. The conative aspect, namely, is changing attitudes and behavior.
4. The media plays a significant role in the development and change in society's behavior.

Based on these three media influences, it can be seen the importance of the media's position so that in this era of increasingly sophisticated technology, there is much news that has to be filtered. This is because the validity of not all the information can be confirmed. For example, the media reports about the viewpoint of feminism, which is considered unsuitable to be applied in Indonesia because feminism comes from Western culture, so it is considered not Indonesian culture. It is an issue to outwit the resistance movement carried out by women. In this case, it needs to be revisited because feminism is an exchange of ideas to achieve justice and the essence of humanity.

In subsequent developments, the emergence of Islamic feminism also opened women's voices regarding feminism and theology. So far, religion has only been a perpetrator of patriarchy. Here, the role of media in processing language becomes essential. Language is not just a structure but a social practice. [2] [3] As a social practice, language cannot be reduced to a purely linguistic level but needs to be viewed from the context and social interactions that surround the language. As the language used by the Mubadalah.id preaching content media is easy to understand because the language used is light. Apart from that, Mubadalah.id da'wah content media carries a da'wah mission that is pro-women. It is considered appropriate in the current conditions of society. Mubadalah.id feminist content media can be found on the Website and Instagram. The connection between understanding feminism and the Mubindah.id account lies in the explanation and perspective that can be accepted by society by bringing a vision of Islamic feminism.

METHOD

This research was analyzed using Critical Discourse Analysis (CDA). CDA is a branch of discourse analysis that examines not only how social structures are formed but also how discourse itself contributes to the (re)production of those structures.[4] [5] [6]. Discourse analysis suggests two main approaches. The first, following Michel Foucault, is that he uses one discourse as the primary unit of analysis, such as the emergence of new discourses that define *madness* as a disease that justifies the institutionalization of psychiatry. The second approach, established in the 1980s, focuses on the linguistic aspects of discourse and investigates how different formulations can reflect and produce different sociopolitical orders. For example, critical discourse analysis examines how using linguistic devices such as the passive voice creates power relations and biases. [7]

For CDA analysts such as Fairclough, Van Dijk, and Wodak, language is about understanding how language functions in the social construction of reality and in shaping social events and training. Language plays a vital role in the above. Interdisciplinary analysis is essential for performance. [8] Parker offers three subsidiary criteria that suggest that discourse is embedded in the structure of institutions such as religion, law, politics, and science. Discourses reproduce power relations. Discourses, in turn, have political implications through their ability to maintain these power relations. Parker offers his three subsidiary criteria that suggest that discourses are implicated in the structure of institutions such as religion, law, politics, and science. Discourses reproduce power relations. Discourses, in turn, have political implications through their ability to maintain these power relations. [9]

Language mediates the production of culturally normative selves, and the 'critical' imperative of this type of discourse analysis is to seek to understand the mechanisms underlying this transmission. In this way, this study presents how narratives and discourses of resistance are produced and reproduced, challenging dominant narratives and frames of excluded discourses. [10]

Critical discourse analysis is used to describe, interpret, and explain how values-based language is constructed and how social inequalities are maintained and justified. [11] CDA views discourse not only as a phenomenon of language texts, but also as social practices and social events contained within it. Critical discourse analysis focuses on the forms of inequality expressed and reproduced through texts. [12] Brown and Yule reveal that the realization of discourse is text in the form of written and oral texts. In written texts, it takes more than just producing words in the correct order; and it involves copying punctuation conventions and line divisions that indicate speaker changes. Adequate realization of the text places the u-speech. [13]

RESULT

Researchers conducted a discourse analysis of the IG Mubadalah.id text for 2020-2022 with a total of ±250 news publications. The objects of this research study were ten news stories. The selection of news is based on mapping news themes/topics related to feminist issues. The ten news stories will be analyzed using the theory of Teun A. Van Dijk, which has text discourse structures including macro structure, superstructure, and microstructure as follows.

Context: Text is taken from IG Mubadalah.id content in the news title "Impact of Child Marriage." The news text was published on December 30, 2020. The data can be seen as follows.

Research data :

(1) Do not rush! These are five consequences of early marriage.
(2) Vulnerable to Divorce
(3) Too young for couples makes them unprepared for household matters and existing realities.
(4) "It turns out that there are many problems besides adultery."
(5) Vulnerable to Causing Maternal and Infant Deaths
(6) A gestational age that is too young is vulnerable to causing maternal and infant death.
(7) Not to mention the low access to education, especially knowledge about reproductive health.
(8) "The doctor said my reproductive system is not ready to have children."
(9) Babies are susceptible to growth delays
(10) Even though babies born from child marriages can survive, they are likely to experience developmental delays, learning difficulties, and behavioral disorders and tend to repeat the same cycle as their parents: child marriages later in life.
(11) The risk of being born is higher if the child is also a girl.
(12) "Why is my child's growth so slow?"
(13) Vulnerable to Experiencing Domestic Violence
(14) Women who are married off as children (at least 14 years of age) are most vulnerable to becoming victims of domestic violence.
(15) Because their low level of education (due to dropping out of school) makes them unaware of their rights as wives, mothers, and human beings.
(16) If their husbands eventually abandon them (or their husbands die), they will have difficulty finding a decent source of livelihood.
(17) "My husband beat me because I played with my friends."
(18) Susceptible to Depression
(19) Women who marry as children are also vulnerable to experiencing depression, especially if they are forcibly married off.
(20) His right to determine his path in life has been taken away, so his emotional condition has become unstable.
(21) Not only are they vulnerable to becoming victims of domestic violence, but women can also become perpetrators, for example, child abusers.
(22) "You unlucky child!"

The news text discourse entitled "The Impact of Child Marriage" above is a macro discourse structure built by the media by raising issues related to early marriage. In this context, the issues depicted by the media have several negative impacts. Apart from being detrimental to women's psychological preparation, another factor is their vulnerability to slow reproduction. Other factors include vulnerability to domestic violence, death of mothers and children, and vulnerability to divorce. The subtopics/subthemes that make up the news text include (1) the Impact of Child Marriage, (3) Vulnerability to Divorce, (6) Vulnerability to Cause Death of Mothers and Babies, (10) Babies Vulnerable to Experiencing Growth Delays. (14) Vulnerable to Experiencing Domestic Violence. (19) Susceptible to Depression.

The superstructure is the framework of the text, namely how the structure and discourse elements are arranged in the text. However, in general, the importance of schematics is a journalist's strategy to support specific topics they want to convey by arranging parts in a specific order. Schematic structure or superstructure describes the general form of the text. This form of general discourse comprises several general categories or divisions, such as introduction, content, conclusion, problem-solving, and conclusion. Important information conveyed at the beginning or end depends on the utterance's meaning.

In the title section, an identification strategy is used, which explains the subject in question, namely victims of child marriage. The sentence "Impact of Child Marriage" illustrates that in Indonesia, there are still many children who marry early. It harms children, such as incomplete childhood dreams that are only wishful thinking and can rob children of their right to grow and develop well. In terms of less mature reproduction, early marriage results in higher maternal and infant mortality rates. Insufficient psychological provision also results in domestic violence and even divorce. Sentence (1) is the lead or opening part of the news text. In this lead section, it is explained that there are five impacts summarized from Mubindah. id's content regarding child marriage, namely being vulnerable to divorce, being vulnerable to causing maternal and infant death, babies being vulnerable to experiencing delays in growth, being vulnerable to experiencing domestic violence, and being vulnerable to experiencing depression. Sentences (2), (5), (9), (13), and (18) are subheadings, subtopics, or subthemes that explain more precisely the impacts that occur because of child marriage. Sentences (3), (4), (6), (7), (8), (10), (11), (12), (14), (15), (16), (17), (19), and (20) are news content that explains in detail the negative impacts of child marriage. Marriages between minors are very vulnerable to many things. However, if viewed from a religious aspect, the act of marrying young can prevent adultery. Most children who marry early drop out of school, so they do not receive educational provisions regarding reproductive health. Even though babies born from early marriages can live, they are susceptible to delays in their growth and development. It is related to the psychological side and nutritional intake in the body of the mother and baby. From an economic perspective, child marriage causes many cases of domestic violence. It is due to the low level of education of women due to dropping out of school, so they are not aware of and understand their rights as wives, mothers, and human beings. Quite a few have experienced divorce. Other impacts of child marriage can rob children of their right to make their own life choices, make them emotionally unstable, and be vulnerable to depression.

Sentences numbered (21) and (22) are the end or closing part of the news. In this section, it is thoroughly explained that the impact of child marriage is very detrimental to women. Women are not only victims but can also become perpetrators of violence against children, for example, torturing their children. This is due to the lack of reasonable parenting provisions in childcare patterns.

Microstructure is the meaning of discourse that can be observed by analyzing concrete word choices, sentences, propositions, clauses, and styles used by individuals and specific communities. The microstructure in the Mubadalah.id content entitled "The Impact of Child Marriage" is as follows.

1. The background of the news text with the title "The Impact of Child Marriage" is in the body or body of the news number (3). The couple's too-young age makes them unprepared for household matters and existing realities. In this paragraph, there is a social background, namely, the fact that being relatively young hurts child marriage. There are quite a few victims of child marriage who are not ready for household matters and the realities that exist after marriage.
2. Sentences (15) and sentences (16) emphasize the impacts that occur if child marriage is still a habit in society. The impact of child marriage is very clearly emphasized on the low level of education because many children drop out of school. Especially for women, so that after marriage, they become unaware of their rights as wives, mothers, and human beings. It impacts her life after becoming a wife, and she is more dependent on her husband for her life. If one day their wife is abandoned by her husband (divorces or dies), she will experience feelings of confusion and depression because she will have difficulty finding a decent living. Therefore, these two factors are a lesson that a marriage must be carried out based on sufficient age and the mental, intellectual, spiritual, and financial readiness of both parties.
3. The sentence embedded at the end or closing of news number (22), "You unlucky child!" implicitly means that parenting developed by children who marry too early can make them emotionally unstable. Sometimes, the words spoken are not considered beforehand, whether they will impact the child's psychology. The description of these words can also be traumatic for a child.
4. In the news quote number (4), the presumption that arises is that child marriage causes many problems that arise apart from adultery. Apart from being deprived of their rights as children, early marriage makes it vulnerable to divorce and high mortality rates for mothers and children. Apart from that, the impact also causes vulnerability to depression and domestic violence.
5. The coherence in Sentence number (2) shows the cause and effect of the impact of child marriage. This sentence is related to the previous sentence, which discusses child marriage. Sentences (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19), (20), and (21) are explanatory sentences from the previous sentence. There are five impacts of child marriage, namely, vulnerability to divorce, vulnerability to maternal and infant deaths, babies prone to growth retardation, vulnerability to domestic violence, and vulnerability to depression. Based on existing facts, the practice of child marriage is very detrimental to women. Starting from the interruption of education for women in particular, because if a woman is married and then pregnant, she cannot go back to school. It is different for the man, who can continue his studies if the school does not know, which means the marriage is carried out religiously. Another impact is depriving children of their rights to happiness under the pretext of protecting children from adulterous behavior and immature child hormones, resulting in mental accidents in mothers and children. Sentence (22) has causal coherence from the statement regarding women being victims of domestic violence in child marriage. Apart from that, women also become perpetrators of child abuse because they lack provisions when they get married.

6. In the data, there are different word choices, such as a mention of the editorial "The Impact of Child Marriage and the Consequences of Child Marriage." The news headline "The Impact of Child Marriage" looks the same as the headline "The Impact of Child Marriage." The word 'marriage' refers to an intimate relationship between a man and a woman, which is based on laws and regulations that are valid for the state and religion. The word 'wedding' comes from Arabic, which means gathering. In these two terms, the meaning of 'marriage' places a position in a wedding procession.

CONCLUSION

Based on this discussion, it can be concluded that the Mubadalah.id Instagram account contains the ideology of Islamic feminism, which was built not to side with women. This upload on the Mubadalah.id Instagram account not only takes sides with women's rights but reconstructs the idea of placing women in their position and fighting for their rights as human beings while providing a broad perspective to glorify fellow human beings. The macrostructure of the Mubadalah.id Instagram account raises a problem or issue that occurs in everyday life. The superstructure on the Mubadalah.id Instagram account begins with a short explanation about the title or the background to the title of each upload. Then, the essence of the title is explained, balanced with explanations of the Koran and Hadith. Then, it ends with a closing containing solutions drawn from the conclusions. The microstructure of the Mubjadi.id Instagram account emphasizes the meaning of each article regarding the concept of mubjadi (reciprocity between both parties).

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Feminization of Public Policy: A Critical Perspective on Stunting Handling Policy Practices in Indonesia

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Abstract: Abstract: This study aims to examine stunting management policies critically. A postmodern feminist perspective used to dismantle stunting management policies will help detail and critique how the concept of feminization is used in policy practice. This approach also aims to reveal how policies may produce unintended effects or even perpetuate inequality. The feminization process of public policy in Indonesia has been a concern for quite some time. It is narrated to encourage the role of women and provide benefits from policy results to women. The study results on the case of policies for handling stunting in Indonesia show a feminization of policies. Feminization occurs in the rules regarding program requirements, program implementers, and program participants. Feminization is strengthened while strengthening social norms that give women roles as mothers, family, and child caregivers and caregivers. Social norms and government policies mean that women's bodies no longer have the power to interpret themselves autonomously. Behind the feminization policy, in practice, it strengthens stereotypical thinking about women's role as leaders in household matters and caring for children. This may hinder broader social change regarding gender roles. This can create internal inequalities in society. Therefore, it must be critically anticipated so that the handling of editing must use an inclusive approach involving all components of the family and community. Because children are a problem for the next generation, this is related to a humanitarian issue, not just a woman's problem.

INTRODUCTION

One of the public problems faced and to be handled by the Indonesian government is the problem of the condition of children who fail to grow and develop physically, stunting. Based on the 2022 National Nutrition Status Survey, the number of stunting cases in Indonesia has decreased in the last nine years, from 37.8% in 2013 to 21.6% in 2022.[1] However, this figure is still higher than the maximum tolerance for stunting set by the World Health Organization (WHO), which is less than 20 percent. Indonesia's status is still in fourth place in the world and second in Southeast Asia regarding cases of stunting under five in 2021.[2]

The amount of government spending to support the acceleration of handling stunting is very large. However, there was a decrease in 2003 compared to 2022, namely IDR 34.15 trillion in 2022 and IDR 30.4 trillion in 2023.[3] This budget is spread across 19 ministries and institutions. Including this, the Ministry of Villages for Development of Disadvantaged Regions and Transmigration in the form of village fund allocations, especially for stunting, has reached IDR 11.3 trillion in 2019-2021.[4] Ministry of Social Affairs through the Hope program in 2023, amounting to IDR 74 trillion.[5]

Several studies related to stunting have looked at the factors that influence stunting. Firstly, factors that are directly related to the child's body, namely the type and behavior of the child's eating which is not good and does not meet nutritional needs, such as the habit of eating snacks or snacks,[6], the practice of eating foods that contain minimal vitamin A and calcium or micronutrient intake [7][8] giving complementary foods to breast milk for babies aged 0-6 months who are not yet due,[9][10] the physical condition and health of the mother before and before giving birth, such as the mother's height,[11] the mother's nutritional intake.[12][13] The two indirect environmental factors are sanitation and access to health services.[14][15][16] These causal factors are then used as a basis for carrying out

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030039-1–030039-7; https://doi.org/10.1063/5.0241834
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interventions in the form of stunting management programs in various countries, including Indonesia, as mentioned by the Team for accelerating the handling of stunted children above.

From side policy, the Indonesian government has created two intervention programs to reduce stunting rates: Specific and Sensitive Intervention services [17]. The scope of the specific intervention service program consists of reducing the percentage of pregnant women with chronic energy deficiency (CED) through additional nutritional intake and providing extra blood tablets for consumption during pregnancy by pregnant women, pregnancy checks, providing MPASI according to recommendations for children, management of malnourished toddlers, providing immunizations and vitamin A capsule supplements for toddlers, providing blood supplement tablets (TTD) for consumption by young women, providing additional nutritional intake for thin toddlers, implementing Posyandu to monitor the health of pregnant women and the growth of toddlers. [17] Meanwhile, sensitive intervention service programs include providing access to adequate drinking water for priority targets, providing access to adequate sanitation (domestic wastewater) for priority targets, Providing access to health insurance for poor families, priority targets, providing access to postnatal family planning (KB) services, Providing access to conditional cash assistance for poor families, facilitating gender mainstreaming and child protection in accelerating stunting reduction, increasing PAUD participation rates, increasing the percentage of communication targets who have an adequate understanding of stunting, increasing fish consumption to fulfill the nutrition of priority target families for reducing stunting, increasing the percentage of children aged 6- 23 months of consuming sufficient and varied food, an increase in the percentage of poor priority target families receiving nutritional guarantees in social food assistance, the number of couples receiving pre-marital guidance with stunting prevention material, nutritional supplementation and immunization packages. [17]

By attention to several of these treatment programs, they are closely related to the position and role of women. So, the socialization that continues to be carried out is to encourage the role of women. This outreach is not only carried out by the government but also by academic groups who are also concerned with women's issues. An example is the activities carried out by the Women's Study Center at Gajdah Mada University.[18] In terms of the simultaneous implementation of government programs, the government's efforts are also directed at the positions and roles of women. For example, the Program Keluarga Harapan-PKH (family hope program) and Bantuan Lansung Tunai-BLT (direct cash assistance) also emphasize the position and role of women. Women here are considered individuals who care about their families, including children. Individuals positioned for domestic affairs. Meanwhile, they are considered to be in a weak condition, and they need encouragement to play a role. When viewed from a liberal feminist perspective, these policies and programs are solutions that can encourage women to gain access, control, and empowerment. [19] But is it true that programs such as stunting management practices position women in a fair position and make them more empowered? Therefore, I am interested in looking more critically using a postmodern feminist perspective.

METHOD

One of the goals of postmodern feminism is to dismantle power relations and structures over social practices, including policy practices related to women. One of the approaches used by a postmodern feminist perspective is the deconstruction approach. [20][21] A deconstruction approach to stunting intervention policies will help detail and criticize how the concept of feminization is used in policy practice. This approach also aims to reveal how policies may produce unintended effects or even perpetuate inequality. [22] The ultimate goal is to produce a deeper understanding of how policies to address child stunting can be more effective in paying attention to gender issues and improving welfare. Children and women. The following are some of the steps taken in this study. 1) identify how feminization is used in the context of stunting intervention policy. 2) identify how social, cultural, and health norms influence the practice of feminizing stunting intervention policies. 3) Identify how stunting intervention policy practices can reflect existing inequalities of power and social structures. 4) Analyze the concrete impact of stunting intervention policies on women and children by studying how women and children respond to and experience these policies.

RESULT

Feminization Occurs in Program Terms, Program Implementers, and Program Participants.

The feminization of stunting programs aims to ensure that efforts to prevent and overcome stunting include a deep understanding of gender issues and recognize women's important role in supporting children's growth and development. This feminization in the stunting management program occurs in determining the terms of other programs that explain who can and cannot get it, such as the Non-Cash PKH Social Assistance program, which is social assistance in the form of money to a person, family, group or community that is poor, underprivileged, and socially vulnerable who have been designated as PKH/KPM participants, who are they? People with low incomes are those who are pregnant or breastfeeding mothers and early childhood children (aged 0-6 years).[23] Feminization also occurs from program implementers at the village level, namely posyandu cadres. Even though the provisions of Posyandu cadres do not specifically mention women, more than 90 percent of Posyandu cadres in villages are women.[24] Apart from that, the feminization of the stunting program occurs in practice, and most of those who check and accompany early childhood are women, sometimes mothers—biological or female siblings or grandmothers.

Social Norms Place Women as Mothers, Childcare, and Caregivers.

Social norms that influence the feminization of stunting management policies can be identified, namely norms that position women as mothers, child caregivers, and caregivers. Women as mothers are often considered the central figures in raising children, and women are often expected to have greater attention and involvement in children's development. [25] If they do not pay much attention to their children, they will be stigmatized as "bad mothers." So women must be "good mothers" who provide attention and affection to children. [26] Women become children's guides when studying at home taking them to school. This includes carrying out daily tasks such as caring for, feeding, and accompanying children in their activities. In addition, this norm involves women in providing care to family members who are sick, elderly, or require special care. [27] Often, when a child's condition is not looked after, he has not eaten, or is sick, the first person to be blamed, at least the one who is reprimanded, is the woman. Many still choose because of this norm that women must leave their jobs outside. [28] The stunting management program is greatly assisted by this norm; this is proven when examining children and their presence at Posyandu, which is involved in accompanying them. So, efforts to increase the success of stunting management programs at the lower level are always directed at encouraging awareness and knowledge in providing nutrition, child care, and house cleanliness. [29][30][31][32].

Social norms and government policies shape women's meaning and behavior.

The power relation experienced by women in the practice of stunting management policies, apart from social norms, places women's roles as mothers, child caretakers, and caregivers. Also, by the government through its policies. If we use Derida's binary opposition, women have been conceptualized as "bad" and "good" as wives or mothers. Social norms link health practices to arenas of gender meaning and identity formation. [33] [34] The government also demands women's participation, even as a prerequisite for continuing to be an individual beneficiary of a PKH program; women are defined as compliant and disobedient by being present or absent in inspection activities related to pregnancy and children. Women who are good and have the right to continue receiving PKH security economic assistance are always present and take their toddler children to the Posyandu. When a family is not examined in early childhood, it is not the husband or the man who is reprimanded. The state uses women's and their children's bodies to comply with the program. In Fucault's language [35], women's bodies have been "disciplined" by society and the government through the values of mothers and child nurses and the mechanisms and requirements of a policy program. For Foucault, there is power that controls individuals or groups in society. This power operates through institutions such as schools, hospitals, prisons, and other institutions, including Posyandu institutions, Dasawisma, and women's Islamic studies in villages, which play an essential role in regulating individual behavior and social norms. Supervision, monitoring, and physical and mental discipline are often used to achieve compliance with rules and standards. Supervision or control efforts are not always repressive (punishing) but also productive (shaping behavior and norms). [36] Power is used by the state, institutions, and individuals to regulate individual behavior and society. [37] Bureaucracy, such as village officials, posyandu officers, and PKH program assistant officers, are used by the government to regulate society. This includes using regulations, public policies, and other instruments to achieve government goals. Then, individuals internalize these norms and organize themselves according to social expectations. The methods used by the government to regulate society involve administrative instruments such as SOPs (standard operating procedures), surveys, and reports on the activity of program target groups.

The impact of feminization: liberation, solidarity and the double burden of women.

The feminization of government policies, including stunting management programs, has been seen by various parties as having increased empowerment and participation and reduced the mortality rate of women, mothers, and children. [38] [39] [31] This feminization can increase women's empowerment by giving them more roles. Active in planning and implementing stunting programs. This can help women feel more ownership and a role in improving children's nutrition. Through education and involving women in programs, awareness of the importance of good nutrition can increase in society. This can encourage better behavioral changes in feeding children. Feminization of stunting programs can help identify and overcome obstacles women may experience in ensuring adequate family nutrition. This includes efforts to reduce women's workload, which can hinder the care of children. [40] [41] At the micro level - individual women, policy practices at the grassroots for women can also provide space for liberation and solidarity between women. However, the contradictory impact must be taken into account, namely 1) The feminization of the stunting program can strengthen stereotypical thinking about women's role as leaders in household matters and caring for children. This may hinder broader social change regarding gender roles. 2) There is a risk that women with limited access to education and resources may not have the same opportunities to participate in these programs. This can create internal inequalities in society. 3) Focusing too much on the role of women in stunting programs can mean ignoring the role of men and other social factors that influence children's nutrition.

CONCLUSION

The feminization of stunting policy aims to recognize and address the vital role of women in overcoming stunting and addressing gender inequality that can exacerbate nutritional problems in children. This approach seeks to ensure that policies and programs launched to tackle stunting truly take gender factors into account and give women a more active and influential role in these efforts. Feminization occurs within program requirements, program implementers, and program participants. Feminization is strengthened while strengthening social norms that give women roles as mothers, family, child care, and caregivers. Social norms and government policies mean that women's bodies no longer have the power to interpret themselves autonomously. The meaning of a woman's body is divided into "good mother" and "bad mother," participatory and non-participatory. The power of social norms and policies works through social institutional instruments, such as social gatherings and women's recitations, as well as through village officials, Posyandu cadres, and administrative tools for stunting programs and other village programs. Power over women is not always oppressive but also productive so that women can utilize the activity spaces in the program as spaces for liberation from the hustle and bustle of domestic activities while building solidarity among women.

Apart from producing women's empowerment, the feminization of stunting handling policies also creates norms that strengthen gender stereotypes of women's roles while marginalizing women whose access is limited and who are still trapped in strong models that position men as dominating the family. Focusing more on the part of women in stunting programs could mean ignoring the role of men and other social factors that influence children's nutrition. Therefore, it is necessary to encourage the practice of stunting management policies to be more inclusive, which is not biased, including involving men and fathers in its implementation. Because women's health, healthy wombs, and healthy children are issues of the sustainability of life and humanity, it is not appropriate to rely only on women's involvement.

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Is It Empowering Women or Affirming Patriarchy?

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Abstract: Women's empowerment has become mainstream for raising women from oppression. This study aims to review the concept of empowerment in existing studies. The perspectives of radical and postmodern feminists help to describe this phenomenon by providing clues on how to give a prescription for the oppression experienced by women. In this case, a feminist perception of society is needed, explaining how the social world influences women, analyzing the role of power and knowledge relations in shaping women's perceptions of the social world, and how to devise ways to change the social world. Several articles found various contradictions regarding women's empowerment implemented in multiple countries. In many ways, it turns out that women's empowerment departs from a patriarchal way of thinking, impacts the objectification of women, and places women as parties who will continue to be oppressed throughout their lives. This oppression comes from the state, society, NGOs, and parties who claim to be "empowerers." So, it becomes essential to get out of the patriarchal circle by not objectifying women and allowing women to have and develop their agency to live. If women become a crucial subject in life, the social world will change, no longer placing women in a specific position by continually referring to the patriarchal structure. This change in the social world should be an essential empowerment point, liberating women.

INTRODUCTION

In everyday life, women are considered to experience various forms of oppression. Empowerment is often claimed to liberate this oppression. Empowerment creates transformative social change in women's lives. Empowerment contextualizes women's experiences with different problems under patriarchal power relations in both the private and public spheres. There is a need to raise awareness among women to understand the political dimensions of the individual and how the implementation of male power in the family relates to gender power relations in the wider society. Therefore, empowerment is a dynamic and ongoing process linking women's strengths, competencies, and proactive behavior with their actual social conditions, including the impact of laws and social policies and their possibilities or obstacles. [1] Empowerment measures are often associated with better lives, increased literacy and employment for women, reduced physical and sexual violence against women, more excellent decision-making abilities, increased family planning, and improved education and health of women and children. Women's empowerment is also expected to have implications for the country's development in the long term and must be an intended part of the development agenda. [2]

Women's empowerment has become a mainstream concept by various international institutions, countries, and NGOs. Human rights are one of the references for achieving women's freedom from oppression. However, what is also a new problem is that it turns out that humanity is seen from a very masculine and patriarchal perspective. Women are considered free from gain when they achieve specific achievements that men have obtained and possessed. It happens in all areas of life. Therefore, it is necessary to rethink the concept of women's empowerment so that it brings goodness to women's lives, the size of which does not have to be in a masculine and patriarchal way of thinking.

Jeff Hearn believes that patriarchy consists of men dominating women and "can be seen as a system that also places men below other men in society, using women as a commodity to do so." [3] Patriarchy works by degrading women and femininity. Patriarchy places women in the domestic realm because their biological and bodily functions have considered them. Furthermore, the patriarchy places domestic work as low value and only suitable for women. Work done by women is of lower value because it is considered not to require specific skills and is instinctive

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030040-1–030040-7; https://doi.org/10.1063/5.0241554
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

according to women's characteristics. However, with the same type of work, if it is carried out by men and in public spaces, it becomes work of high value. For example, cooking at home is considered normal if done by women and will be considered taboo if done by men. The job is also not a category of productive work because it does not make money. The cooking job will be highly valued materially and non-materially if men in public spaces do it. So, patriarchy works by oppressing women and femininity. Therefore, empowerment often seeks women to enter the public space and fulfill masculine categories, such as intelligent, assertive, independent, and ready to compete to be free from oppression.

METHOD

This study will show that women's empowerment, considered a solution to women's oppression, perpetuates women's position as a group different from men. Thus, women will always be objects, uncomfortable, have no choice, and even be oppressed by the forced empowerment model. By combining the radical feminist way of thinking that believes that patriarchy is the source of the problem of women's oppression and the postmodern feminist perspective that recognizes that there is no single truth for the interpretation of oppression and its solutions, this study seeks to place women as whole subjects who have desires, obsessions, and achievements.

Walby mentions six main structures that build a patriarchal system, forming a different one. The patriarchal structure has contaminated the way women think. The patriarchal production relations within the family force women to do household chores whose benefit values are taken up by their husbands and other family members. Conversely, women get maintenance from men. At the economic level, patriarchy places women in certain types of work that are worse and lower paid because they are considered less skilled. State institutions are also patriarchal, capitalist, and racist, which can be seen in their policies, among others, in their lack of seriousness in preventing and dealing with violence experienced by women. Patriarchal relations require heterosexuality in sexuality and make women their objects. Here, patriarchal cultural institutions create representations of women from patriarchal views in various fields, such as education, religion, and media. Patriarchy in private and public spaces binds women in an institutional structure. [4] It also influences the idea of empowerment, which revolves around patriarchal thinking.

Unlike previous feminist theories, postmodern feminism strives for justice for women by considering their differences. Postmodern feminists work in this way: (a) identifying feminist perceptions of society, (b) examining how the social world influences women, (c) analyzing the role of power and knowledge relations in shaping women's perceptions of the social world, and (d) designing ways to change the social world. [5]

RESULT

Women's Empowerment Starts from A Patriarchal Way of Thinking

Women's empowerment is often based on the assumption that women are a vulnerable, weak group with less education, low life skills, and low communication skills. Likewise, women are considered to have low problem-solving abilities. Therefore, women end up experiencing subordination, double burdens, marginalization, discrimination, and injustice. This assumption then leads "empowerers," in this case, the state/government, NGO activists, academics, and other parties, to feel the need to help and provide solutions to the problems faced by these women. These "empowerers" feel women must be given new insights and perspectives to see their problems. The following solution offered by empowerers is to encourage women to enter the public space to be empowered economically and politically and have freedom of expression. Women must also have masculine qualities to be accepted and considered successful in the public sphere, which still uses men's achievements/qualifications to measure it.

Women's empowerment is a solution to all the oppression experienced by women.

Even though a region has developed economically, this does not necessarily mean gender equality will be realized. Research in one of India's most economically developed states, Maharashtra, shows that this supports the argument that women's empowerment programs must be prioritized. Empowering women by promoting gender equality is part of economic recovery efforts. Gender equality is carried out by promoting systemic reform of unfair structures and processes in decision-making. Women must be given access to capital and credit by accommodating alternative collateral sources to compensate for discriminatory customary laws that hinder women's control over marital assets and land inheritance. There must be non-discriminatory treatment in determining credit access by not linking gender and marital status. Women must be taught to create credit records using new technologies and non-traditional information-based credit assessments. [6] The government and related parties must facilitate women's access to markets, resources, and business capital. More awareness programs to help women utilize financial services, especially microfinance, should be carried out. [7] Women's business associations and networks that support collective action are needed to address inequality between men and women while positioning women to participate in economic recovery actively and reforming unfair systems and practices. [8] Furthermore, women who organize will also reduce domestic violence and increase social ties between women. [9] Bengesai and Derera, in their research in Zimbabwe, strengthen this argument. Women's empowerment in Zimbabwe is characterized by strengthening economic empowerment, women's bargaining power in the household, and freedom of movement. Women who are economically empowered and women who have freedom of movement are less likely to experience degrading or threatening behavior [10]. In Uganda, women's empowerment, which can increase women's work participation, has reduced the number of sexual violence and the risk of HIV in the household. [11] Considering the importance of empowerment, the government must give attention and priority here. Significant gaps between development policy and implementation that give little attention to women and children in essential sectors are often found in regions categorized as economically advanced. [12] Likewise, Bhattacharjee stated that constitutional protection regarding education, work involvement, economic security, and women's political participation must be ensured. The traditional social and cultural stigma that has long been imposed on women must be removed from society. In this connection, lessons about the importance of women in every aspect must be introduced in the educational curriculum for the awareness of men. In subsequent writings, he emphasized that a family is built with a man and a woman. Moreover, women are the bearers of our future generations, and if she is prevented from empowerment, then the future progress of human society will have to face major setbacks. [13]

Women's empowerment is assumed to be synonymous with regulations to modernize people's lives towards guaranteeing women's rights. Apart from that, women must be encouraged to stand up and fight for social justice and their rights. [14] Governments must play a more active role in ensuring that policymaking adequately meets the specific needs, perspectives, and experiences of both men and women. Government intervention at various levels needs to create more gender-equitable attitudes across society. The government must change society's gender attitudes and behavior, reduce gender-discriminatory cultures and practices in the workplace, and support employee accessibility to family-friendly policies. At the national level, national legislation, regulations, and campaigns need to be strengthened to increase women's participation in decision-making. [15]

Technically, many problems and obstacles have been identified with the mainstream empowerment concept. Various efforts to increase women's competence to improve women's economic situation still need to overcome the various stereotypes, discrimination, and obstacles women face. The need for an equal proportion of female and male participants (or, even better, a more significant number of women than men) in training activities leads to objectifying the target population as just a number. This equal participation assumes that women and men have equal access to the labor market and compete on equal terms for employment opportunities, thereby ignoring occupational segregation and unequal opportunities. Key issues that prevent women from undertaking training courses or employment, including housework and caring responsibilities, should be considered and addressed. Empowerment projects are often designed not according to the desires and needs of women, which reduces women to objects rather than considering them as empowered subjects who can make their own decisions. [16]

On the other hand, women need to be empowered because they have the advantages and potential to contribute to development and improve the community's quality of life. The strengths of women who run economic enterprises are the desire to succeed, commitment, flexibility, and the ability to manage the potential in their environment. They are also open to engaging in research and development and can identify and control threats. These positive characteristics of women are essential for post-Covid 19 economic recovery. This study, conducted in India, identified that most of India's rural population work in unorganized sectors, for example, farming, handicrafts, handlooms, and daily breadwinners. So, the empowerment model offered by the government is to provide financial packages and increase the capacity of entrepreneurs in MSMEs. [17] The positive side of women in maintaining food security is essential for improving social conditions. Women have made a real contribution in the form of public kitchens in overcoming the economic shocks and difficulties caused by the pandemic in India. There were 219,295 meals served by Women's public kitchens in 23 Panchayats, while in India, there are 253,268 Panchayats. [18] What these women did was beneficial to society. This phenomenon is interesting for "empowerers" to make specific schemes that are considered appropriate and replicate what these women have done by involving more women.

Women's empowerment covers various fields of life, opening new opportunities to exploit women when they enter these sectors. There are contradictory things written by gender studies regarding the existence of digital media and its relation to women. Yunyi writes that the success of online literature in China depends largely on the rise of Chinese women as writers in this substantial industrial chain. However, he stated the opposite, that online literary works can dynamically empower women as writers at the individual and collective levels in both material and non-material forms. She said that literary works have the potential to dynamically empower women from various perspectives in the digital era, that gender structures can be reshaped through women's media culture practices in patriarchal and authoritarian societies that have experienced extraordinary changes brought about by marketization, digitalization, and globalization; that digital culture and its infrastructure play an essential role in increasing the creativity and productivity of women. [19] It is once again confirmed that women are still objects in every situation. Women are considered less skilled and need help to keep up with the times, so they must adapt and change according to social construction.

A study conducted by Nguyen et al. found that women's empowerment in an agrarian context is necessary to ensure gender equality and social equality, so it is necessary to consider the position of women as mothers, wives, daughters, caregivers, ethnic and sexual minorities, and disadvantaged classes in general. Economic and social. Projects and programs must be oriented toward raising women's and men's awareness of the power relationships that lead to political, economic, and cultural inequalities. Women must be facilitated to organize or participate in collective action, given freedom of speech, and fight against economic, political, and cultural inequality. Gender-responsive policies also need to be appropriately implemented. [20] Likewise, according to Wong et al., women must become leaders and be involved in natural resource governance issues that cross the normative framework of climate finance and peacebuilding. There have been many mechanisms for women's empowerment, but none have addressed women's conflicts or vulnerabilities. [21] These two studies clearly show that women are objects, even in issues that, for ecofeminism, have always been essential to women. Proximity to nature makes women better understand the environment around them, even related to agrarian management. It is not women who must be taught to negotiate and build power. However, the state and society, including NGOs, must learn from women how to perceive natural resources and use them without overdoing them and destroying them.

Women experience most of the gender-based violence. Stories of violence experienced by other women and direct experiences of violence make women feel unsafe wherever they are. The solutions to overcome this violence include arming women because culture also places women as parties who must be able to look after themselves. Kelley's study analyzes the relationship between feminist identity, gun ownership, and women's empowerment. She found that women who owned a gun were likelier to carry their guns with them all the time. Women's experiences of being violence victims have made them more aware and concerned about their safety. Weapons are considered a tool that supports women's empowerment in self-defense. [22] Shata found another way to prevent violence is to build awareness among women to have the courage to speak out and fight against violence. The 'Taa Marbuta' campaign in Egypt uses Facebook to empower women and give voice to women who are usually silenced. This 'Taa Marbuta' is done by setting and communicating clear goals, using various strategies such as celebrity endorsements, testimonials, visuals, competitions, infographics, and rap songs. This movement's expected impact is creating a supportive community involving men. Men who have dominated society so far are expected to be able to make changes. Men are important in this campaign because there is an assumption that men will listen more and consider men more credible than women. However, women need men as the main actors in fighting for their interests. Even here, Shata quotes advocates who state that 'most empowered women have a supportive male figure (father, brother, husband) who supports them.' [23] From this narrative, we are also increasingly convinced that there is still patriarchal confirmation by consistently placing women in a subordinate position in this matter.

Criticism of Women's "Empowerment".

Criticism related to this empowerment has been done a lot. One of them was by Chubin in a study conducted in Iraq. She investigates feminist activism in the context of women's empowerment programs. Poor women and ethnic minorities are often seen as objects of feminist initiative rather than subjects capable of articulating or advancing feminist debate. There is a dynamic contestation of the feminist debate through centralizing controversial organizational interactions and juxtaposing cosmopolitan views and middle-class NGO workers with subaltern clients. She invites gender scholars in Iran to engage more critically with intersectionality and to take an approach to investigate feminist activism by studying hegemonic discourse vis-à-vis the aspirations and subjectivity of hierarchically positioned actors. [24] The position of "empowerer" is never equal to that of the empowered. Formulating problems and solutions from an empowering point of view becomes hegemonic and does not provide a prescription for the problems experienced by women.

Next, the article written by Hamilton stated that Empowering Women by being involved in combat sports and even being an athlete cannot solve the problem fundamentally. One example is a story about a woman who became a Mixed Martial Arts (MMA) athlete. MMA athletes are also underpaid compared to athletes in other sports because MMA athletes have thus far failed to organize collectively and, therefore, lack collective bargaining power. Female MMA athletes are not only underpaid compared to other prominent sports athletes but also underpaid compared to their male MMA counterparts. Suppose combat sports are to fulfill their potential as a space for women's empowerment. In that case, they need to pay attention to the structures of capitalism, hetero-patriarchy, and white supremacy that limit women's lives. It will require applying their feminist principles and pedagogy rather than simply providing space for women to learn how to punch and kick. What is needed is the liberation of women from the logic of capitalist, hetero-patriarchal, and white supremacy, and recognition that the oppression of women has become a fundamental social project. [25]

Understanding empowerment slightly differently, Baidoo stated that interventions that target empowerment do not necessarily empower but strengthen women's subordinate positions. The success of an intervention is then not measured by the number of people accessing the program but rather by the changes that occur based on assessing the condition of the beneficiaries before interacting with the project. Empowerment aims to build capabilities, have access to resources, and be able to make crucial decisions. Development workers must be able to build on these qualities during their encounters with women. Even if the intervention is centered on the economy, inclusive participation and awareness-raising of both women and men will go a long way to ensure the uptake and sustainability of the intervention. Interventions may be gender specific, as they target women. However, women do not live in isolation, so it is crucial to awaken men, who are favored by the patriarchal system, to understand the need for empowerment. [26] So empowerment means creating conditions that will broaden the choices for life that each woman wants, rather than having to live a life imposed by laws, customs, and societal norms that are not understood. If empowerment is not a purely individual phenomenon, then change must occur on a broader scale, not just changes in lives. From female individuals.[27]

Obiagu acknowledged that women's education and economic empowerment are vital steps to promote gender equality and reduce gender-based violence (GBV) against women, one of the indicators of gender equality. However, her research findings show that women's education and economic empowerment are insufficient to protect women from GBV, especially domestic violence. Nigerian women who are unemployed, have little or no education, and are low-income suffer the fewest victims of domestic violence based on gender. In contrast, women with higher education than their husbands experience higher rates of domestic violence. It is influenced by patriarchy, culture, religion, media, and the "hidden curriculum" in schools. [28]

Women have a broader space to be empowered in how they choose. One of the open spaces is the virtual world. Hurley finds that women's empowerment is an individual or material process and an agency intertwined in visual social media's commercial and conceptual dynamics. Women who can become influencers use their popularity and reach to promote social justice issues, albeit through fads of feminine appeal. Insights about the agency of Arab women as influencers are emerging, and this is the intersection of transnational, local/global, offline/online, and action/intentional agency movements. [29] Strengthening this argument, Mangurkar stated that in India, Twitter is useful for strengthening narratives that support women's empowerment, by forming discourse through online media. [30]

The various scientific works above do not show that empowerment is a process that involves the perception of women who should be an essential subject in life. Women's views, biological experiences, and oppression are not considered valid and valuable as a reference for improving people's quality of life. The social world influences women and makes them fight and survive situations that develop around them differently. If indeed empowerment is an option, it is necessary to explore how relations of power and knowledge have shaped women's perceptions of the social world. Women place themselves as subjects that discipline their bodies and will act and behave according to what is understood. Patriarchal knowledge, which is always reproduced, has shaped and dominated women. However, if women's knowledge is considered valid and becomes a reference for mainstream thinking, then this knowledge will lead to women's self-authority. He will act and behave independently according to his wishes and needs. If women become an essential subject in life, the social world will change, no longer placing women in a specific position by continually referring to the patriarchal structure. This change in the social world should be an essential empowerment point, liberating women.

CONCLUSION

Women's empowerment, carried out so far, even in all areas and fields of life, perpetuates patriarchy because it considers women as parties who are always helpless, vulnerable, and do not have the competence of human beings. Women are objects that need to be changed to meet specific standards, namely masculine standards that are considered universal truths. Next, women's empowerment is carried out in a way that makes it even more subordinated and eliminates itself as a subject with agency. Furthermore, the goals of empowerment are often not following women's wishes, and even this empowerment often results in changes in life orientation that are not necessarily more meaningful for women. Empowerment is done by objectifying women and dragging them into a world that constantly subordinates and exploits them.

Women's empowerment in the economic, educational, cultural, and political fields makes women trapped in an unfavourable system because patriarchy has expanded into the public sphere and is even reflected in the state structure. The state reproduces patriarchal discourse through various institutions and apparatus by disseminating knowledge to societal hegemony. Women can access higher education, which is one way to empower women. However, throughout the process of carrying out education, he is still at a disadvantage because different physiologists do not get adequate facilities and infrastructure, and the education he gets does not even match what he wants/needs. Many rules in educational institutions are still discriminatory and enforced more strictly to control women's morality and behaviours, such as how to dress. A patriarchal education system still contains a curriculum that does not liberate but perpetuates the norms of a patriarchal society. So, no matter how high the level of education a woman receives, it does not automatically free her from oppression.

So, it is essential to get out of the circle of patriarchy by not objectifying women. Women have the agency to live their lives. What women need is to allow women to develop their thoughts and desires and continue living in the way they choose. Men, society and its elements, and the state only need to ensure that no one exploits, marginalizes, and commits violence against women without having to change women into masculine and patriarchal ones.

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Narrative of Radicalism as a Threat to Women's Right to Manifest Religion and Beliefs

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Abstract: The issue of radicalism has been getting stronger in Indonesia lately. This study uses a feminist perspective, Foucauldian genealogical approach, and the concept of freedom of religion and belief to identify radicalism narratives constructed by the government, analyze the impact of radicalism construction on women's freedom to practice their religion and belief and identify the state's position in guaranteeing the right to freedom of religion. The research was conducted in Jember with a focus on the Muslim Women's Community, namely Nahdlatul Ulama (NU) women and women considered radical by the NU community. The research data is in the form of primary and secondary data, which is traced by interviews, Focus Group Discussions, and document searches as needed. Data analysis was done by interpreting experience, understanding individual intentions and motivations, obtaining intersubjective understanding, and socio-historical aspects. This study finds that the narrative of radicalism has shaped the subject of NU women and women who are considered a radical group. These two related subjects threaten the realization of freedom of religion and belief in one of the groups, namely women's groups, which are considered radical.

INTRODUCTION

Legal, political, and social factors influence the implementation of religious freedom in specific contexts. These factors: First, religion becomes an important factor in political debates and processes, which may broadly impact the definition and implementation of freedom of religion. Second, the type of relationship between religious freedom and traditional state-religious relations generally reflects historical developments in a country or region. Third, increasing government control over religion and religious practices in daily life contributes to overall religious restrictions. Fourth, contemporary socio-economic dynamics, especially demographic decline, migration, and globalization, raise questions about how new and exceptional religious views are recognized and protected. [1]

Manifestations of religion and belief have yet to be much discussed and are considered less critical, mainly when associated with women. Discourse on the manifestation of religion and belief in external forums in Indonesia often appears restricted for various reasons. Beyond that, external manifestations of religion and beliefs for women are more insecure, bearing in mind that women must face stereotypes originating from religion and gender injustice from habits, even legal norms in society.

The link between gender equality and freedom of religion and belief can be seen in the following ways. For example, freedom of religion and gender equality are contradictory and negate each other. Gender equality, in this case, is considered as an 'outside' value that does not follow the teachings of religions. Second, freedom of religion and gender equality go hand in hand. In this case, religion can be a liberator for women and a foundation for building gender equality in society. [2] The practice of gender inequality in religious culture deviates from the essence of religion. [3] Ben-Nun Bloom finds that, especially in non-democratic countries, controlling a majority religion will increase women's rights, but restrictions on religious minorities will weaken these rights. Third, the view that women experience two sides of oppression simultaneously. Women are subject to restrictions stemming from religion and beliefs, as well as experiencing restrictions due to gender stereotypes and injustice from other norms in society. Curbing religious freedom is patriarchal, as well as showing contempt for freedom. [4]

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030041-1–030041-8; https://doi.org/10.1063/5.0241555

In many ways, women are more easily bound by the general societal norms that are considered as truth. The narratives that develop around her, whether deliberately constructed by the state or society, produce truths that eventually shape women as subjects. Women place themselves as subjects by thinking, behaving, and behaving according to the wishes of their environment.

METHOD

Feminism, Genealogy, and the Right to Manifest Religion and Beliefs

Feminism has the basic assumption that women experience oppression because of their gender, and feminism is an ideology of liberation for women. [5] Even though feminism is not single and has various perspectives related to oppression and its impact on women, they all use an analysis of power relations between the sexes. [6] Feminism's relationship with religion has, historically, been a complicated one. Feminists view all religions as inherently patriarchal and, therefore, something that needs to be fought. The "War on Terror" is a contemporary example of the dominant relationship between gender and religion. This war was driven by religious fanatics who did not respect women and were misogynistic. Images of injustice and gender inequality caused or justified by religion in domestic and international contexts often dominate the study of gender and religion. [7]

This study shows restrictions on the freedom to manifest religion and beliefs experienced by women by using Foucauldian genealogy. Genealogy discusses the production of knowledge and the production of power that has the potential to hinder the spread of specific knowledge by giving rise to beliefs that may be wrong or systematic misunderstandings that are intentionally repeated. [8] Foucault believes that the individual as a particular subject is not present in an arena as an independent figure, which then enters a situation of harmony or conflict/competition. On the other hand, the subject appears from within the arena of battle in a power relationship, "meticulous rituals of power" that control the subject. Foucauldian genealogy helps identify and analyze this ritual of power, how individuals, groups, communities, and even society become quickly subdued in power over certain discourses. [9] In relationships with other humans and communities, the individual tries to become a specific subject and will try to identify himself as that subject. [10] Humans become active subjects in producing themselves, undoubtedly subject to certain powers. [11] This power manifests because of the created knowledge, forms a power network, and makes individuals recognize themselves as subjects who must submit and discipline themselves.

The research was conducted in Jember with a focus on the Muslim Women's Community, namely Nahdlatul Ulama (NU) women and women considered radical by the NU community. The research data is in the form of primary and secondary data, which is traced by interviews, FGDs, and document searches as needed. Data analysis was done by interpreting experience, understanding individual intentions and motivations, obtaining intersubjective understanding, and socio-historical aspects. The Foucauldian genealogy approach is used to identify contested narratives built by the government and created in the Jember NU Women's communities related to radicalism.

The external dimension of The Freedom of Religion and Beliefs in Article 18 (1) of the International Covenant includes the freedom of every person, personally or with others, in public or private, to manifest his religion or belief through worship, arrangement, practice, and teaching. Manifest means to express faith or belief in words and actions. The United Nations has provided examples of protected activities, including:

1. coming together to worship, celebrate festivals, observe holidays,
2. wearing religious clothing and following a special diet,
3. having a place of worship, a funeral, and displaying religious symbols,
4. playing a role in society, for example, by forming charitable organizations,
5. speaking about religion, teaching religion or beliefs, and training or appointing leaders,
6. writing, publishing, and disseminating literature about beliefs,
7. communicate about matters of faith at the national and international levels,
8. collect voluntary donations. [12]

RESULT

Construction of Radicalism Narratives

Many narratives of radicalism have been developed in many countries, including Azerbaijan. The narrative in the country is constructed by 1. linking increased religiosity with the rise of Islamic "extremism" and thereby framing it as a threat to state security and domestic stability. 2. Comparing Islamic fundamentalism in Iran, accompanied by increasing tendencies of insecurity, destruction, and war in the Middle East, with the secular nature of the Azerbaijani state and domestic stability and security; 3. Linking the trend of increasing religiosity to poverty, illiteracy, and underdevelopment, 4. Linking expressions of religiously inspired public activism to the influence of foreign agents accused of using Islam to radicalize domestic politics in Azerbaijan; 5. Promoting secular nationalism to mobilize the community. [13]

Meanwhile, in the UK, there is a tendency to stigmatize Islam and Muslims and perpetuate Islamophobia by the government. Muslims are often portrayed as troublemakers who need special attention. Muslims are often treated monolithically, the opposite of the British attitude. Muslims are seen as a threat to British values and British security and sexist. Negative representations of Muslims and Islam can cause Muslims to experience unacceptable prejudice and discrimination daily. [14] In the Netherlands, the state seeks to combat radical beliefs as much as possible by spreading counter-narratives in the media, information programs, and education. However, the state's ability to influence civilians is limited. This is due to guaranteeing the fundamental right to freedom of religion and belief, the principle of separation between church and state, and society. Therefore, the state is trying to combat radicalism in prisons, where the state has more opportunities for this. In the Dutch prison system, many professionals monitor and train prisoners. Certain civil servants have been trained in countering radicalization in prisons. [15]

Radicalism has become an essential issue in Indonesia, along with the emergence of various acts of violence and terror in the name of religion. Throughout 2019, various forms of terror were recorded by radical groups. Among them was the Sibolga bombing, namely the suicide bombing that was carried out by Solimah (Husein's wife, JAD congregation) and their child because the police asked them to surrender after their husband was arrested. Next was the suicide bombing at the Kartasura police post, Sukoharjo, the stabbing of Wiranto, the Coordinating Minister for Political, Legal, and Security Affairs, and the suicide bombing at the Medan Police Station. [16] Meanwhile, throughout 2020, in handling and preventing terrorism, Detachment 88 has arrested 228 terrorism suspects, all linked to networks of Muslim radical groups. [17]

Along with the government's decisive action through its apparatus, by arresting and punishing perpetrators, as well as those suspected of having the potential to commit terror, the government also invites the public to participate in efforts to fight radicalism by building a narrative that radical groups are a dangerous threat to the existence of the Unitary State of the Republic of Indonesia and the diversity that exists in it. Indonesia. President Jokowi narrated radicalism as a phenomenon inherent in religion and Islam. The President's statement in a cabinet meeting: "We want to deal with radicalism, which is related to intolerance, really can be carried out by the Ministry of Religion." It was also reinforced by the President's statement in media interviews stating that General (retiree) Fachrul Razi was chosen as the minister of religion because the former deputy commander of the Indonesian Armed Forces from 1999-2000 could overcome the problem of radicalism, which is currently causing public concern. [18] Furthermore, the statement from the Minister of Religion Fachrul Razi, after the inauguration of the Indonesia Onward Cabinet, also acknowledged that the President chose him because he was considered to have a breakthrough in dealing with radicalism. [19] These statements confirm that radicalism leads to acts of violence and terror and will always be related, even synonymous, with religion, so the Ministry of Religion carries out the starting point for handling it.

The government builds a narrative of radicalism in regulations that become a reference for government officials in carrying out efforts to deal with radicalism. Various statements by government officials also confirm this government-built narrative. One of them was stated by the Coordinating Minister for Political, Legal and Human Rights Mahfud MD, who said that radicalism, referring to Law Number 5 of 2018, concerning the crime of terrorism, "Is an action to change the agreed system using violence and against the law". [20] He explained that radicalism means a movement or understanding that wants to offer another alternative to ideology using violence. For this reason, deradicalization efforts are needed. [21]

President Jokowi also made Government Regulation (PP) Number 77 of 2019 concerning the Prevention of Criminal Acts of Terrorism and the Protection of Investigators, Public Prosecutors, Judges, and Correctional Officers. The PP states the criteria for individuals and communities vulnerable to exposure to radical ideas. The notion of radicalism will affect people/communities who:

1. Have access to information containing radical terrorism;
2. Has a relationship with a person/group of people who are indicated to have radical terrorism ideology;
3. Having a narrow national understanding that leads to radical terrorism;
4. They are vulnerable to economic, psychological, and cultural aspects, so they are easily influenced by radical terrorism. [22]

The criteria in this Government Regulation need to clarify the definition and concrete forms of radicalism, which ultimately condition the public to make their interpretations of radicalism. This narrative impacts the religious communities in society to see differently the existence of religious groups around them, especially groups that have just emerged. In Jember, NU, the largest Muslim mass organization, feels that it is a group that has supported the government and is well established with ritual customs in society. When new habits emerge in their environment, different from the existing community, prejudice, and suspicion always lead to radicalism.

In line with the narrative of the closeness of the issue of radicalism to religion, in subsequent developments, the President launched a discourse to change the term radicalism to become a manipulator of religion. "There must be serious efforts to prevent its spread, with what is currently being called radicalism... or maybe we do not know, is there another term that we can use other than radicalism, for example, religious manipulator," said Jokowi at a limited meeting at the Office President, on October 31, 2019. [23]

Regarding the President's statement, Mahfud MD, in his position as Coordinating Minister for Politics, Law, and Security, said that the handling of radicalism would be carried out across ministries, namely the Coordinating Ministry for Human Development and Culture, the Ministry of Religion and Coordinating Minister for Politics, Law and Security. The government's narrative continues to lead to efforts to build a perception in society that radicalism is a dangerous thing that the state and society must fight. It was also confirmed by Deputy Minister of Religion Zainut Tauhid Sa'adi with the statement: "Whatever the term is, whether it is religious manipulators or religious rioters, rioters who create situations that can tear the Indonesian people apart, we must reject this together," Zainut said on the sidelines The Harmony Walk commemorating the 55th Anniversary of Parisadha Buddha Dharma Niciren Syosyu Indonesia (NSI) at the Office of the Ministry of Religion. Still linking it to religion, Zainut stated: "I think that what must be understood is the spirit of the President to understand religion in the right context because it is true that religion exists to provide peace, religion is present to give compassion, religion is present to unite us." [24]

The narrative that places "specific" Islamic groups as radical groups is strengthened by President Jokowi's actions approaching Islamic boarding schools and Islamic groups that are considered moderate. At the same time, this is an effort to strengthen the legitimacy of the community's existence as a control against the development of radicalism, as was done by President Jokowi at the An Najah Islamic Boarding School, Sragen, Central Java, who again emphasized the need to maintain unity amidst the threat of radicalism and trade wars in the global era in the presence of thousands of students and residents. The President emphasized that the community should maintain ethnic-cultural unity and diversity as the nation's wealth. He said: "We must unite to face big challenges and threats, which will be more difficult if we are not united. We face trade wars, radicalism, industrial revolution."

The same thing was stated by Jokowi when attending the inauguration of KH Asep Syaifuddin Chalim, who is also KH Asep, the caretaker of the Amanatul Ummah Surabaya Islamic Boarding School, as a professor of sociology at the Sunan Ampel State Islamic University (UINSA) Surabaya: "Right now we can easily see the growth of radicalism movement that sparked wars and conflicts in several countries," Jokowi emphasized that modern education needs to be developed in Indonesia to prevent the growth of radicalism movements, which have often sparked conflicts in the country. [25]

The radicalism narrative built by the government needs to make the public understand who exactly is considered an honest radical group. It has resulted in the community and its communities distrusting each other between religious adherents and what is often suspected to be the Muslim group. Several government statements illustrating the closeness of radicalism to religion have finally been interpreted as if religion or at least certain religious doctrines are a source of growing radicalism in society.

The impact of radicalism narrative construction on the manifestation of women's religion and beliefs

The threat to the freedom of expression of religion and belief experienced by women occurs for two reasons. First, women experience threats or restrictions because they are women; second, women experience restrictions because they are considered a radical group or at least affiliated with radical groups. The first can be explained by looking at the division of traditional societal roles, which still places women as second-class citizens when they are in the public sphere. Women may leave the house and be active in public spaces with the permission of those considered responsible for their lives, such as their parents, husbands, or brothers, even though the form of their activities is related to their religion and beliefs. It emphasizes that women have a different place of worship than men. Women are more advised to perform prayers or other worship activities at home rather than in places of worship.

In Saudi Arabia, since 2018, women have acquired the legal right to choose their public attire. They explore new ways of living as Muslim women while searching for authentic religious subjects. Clothing becomes new ways of "religion." They feel joy, freedom, control, agency, and empowerment. [26] The phenomenon in Indonesia shows that Muslim women who are not veiled are considered women whose religion is imperfect because, for most of the society, wearing the headscarf is mandatory for women. Likewise, when women wear veils, women are still scrutinized and considered inappropriate because, for specific communities, the veil does not follow the customs of the surrounding community. The next obstacle for women is that women are considered inappropriate or need to be more competent when speaking about religious teachings and beliefs directly in front of all people, men, and women. Women are only allowed to speak in limited forums that are only for women, even though these women have 'more' communication skills and understanding of religion than men.

Barriers to women manifesting their religion and beliefs are also influenced by the power relations surrounding them. Norms in society that are more stringent highlight women and tend to make women objects. Moral control of women does not only come from men but also from women themselves. Even fellow women can suppress each other, even though these two parties are both in the hegemony of the patriarchal system. Women, individually or in groups, who recognize themselves as individuals/groups who obey and adhere to religious and social norms feel superior. Furthermore, they will suppress other women considered disobedient, deviant, or even sinful and feel entitled to provide certain witnesses, or at least by closing space and access for these women.

In the Jember NU women's community, radicalism is interpreted as a threat to the existence of the NU congregation. It impacts attitudes developed by NU women's communities, who tend to be suspicious of groups or individuals considered different. The results of interviews with Fatayat NU and Muslimat NU officials in Jember found that almost all informants said it was essential to be wary of radical groups, which, according to them, are currently very close to being threatened. Most NU women identify women who are considered radical as having these characteristics: they wear large robes and veils, their thoughts are intolerant, and are identified with rigid religious values and always think subjectively, as well as the habit of more exclusive activities. It shows an effort by the NU women's community to negate themselves with radical groups.

The NU women interviewed stated that they would refuse for various reasons if women from groups considered radical came with the community/congregation/family to worship, celebrate religious commemorations, or organize group activities in their environment. They will ask the group to get out of their environment and filter the understanding of the dangers of radicalism to the population through religious leaders.

75% of informants stated that if radical groups wanted to have a place of worship for a funeral, according to their beliefs, they would be refused because their habits were different. Some of them emphasized that they would emphasize that the place of worship already had a manager and had carried out worship according to Islamic teachings. The NU congregation has regular worship services such as sholawatan, diba'an, reading yasin and tahlil, and other community activities. Apart from that, the NU congregation has unique customs at funerals; special prayers are performed at the graves, recitation of Tahlil and Surah Yasin for the next few days. They used these habits to measure the worship of other groups. Those who did not carry out these activities were considered deviant and, even more extreme, were considered as one of the components to identify other groups as radical groups.

Suppose women from radical groups form a charitable organization in their environment. In that case, they will be rejected and even state they will invite the people around them to refuse. It also applies if women who are considered radical socialize/teach/do training about their beliefs in the environment; all of them refuse and will act to give understanding to society to be careful. Jember NU women, who feel that as a moderate group that must maintain moderation in society, consider it necessary to take specific actions when there are radical groups in their environment. They emphasized that if women from radical groups wrote, published, and disseminated literature on beliefs, NU women would not accept the books, buy them, and distribute them. To counter this, NU women will cultivate consuming NU literacy products, which are considered appropriate and in line with the diverse Islam of the Archipelago.

Regarding communication related to religion and beliefs, NU women will ward off radicalism by not networking with groups that are considered radical but will be ready to discuss and debate to straighten out understanding so that these radical groups become moderate and change direction following the NU tradition. They will also try to fortify their families and surrounding communities from the influence of radical groups.

The next aspect in the manifestation of religion and belief that is threatened by the narrative of radicalism is when women who are considered part of radical groups collect voluntary donations in their environment. With a definite answer, the NU women stated that they would not participate in giving charity because they considered donations as a source of movement for radical groups so that they could survive until now. They will also invite people in their immediate environment not to contribute.

What NU women stated about women who were considered radical or at least affiliated with radical groups and how they treated these women was confirmed. The women wearing the veil who were interviewed in this study confirmed that they experienced various forms of discrimination and intimidation so that they did not have the freedom to manifest their religion and beliefs. Just because they wear the veil, they have been branded as part of a radical group by most people around them. "When I wanted to take the bus, the bus driver did not let me in and said that the bus was full even though there were still empty seats," said the informant, whose status is still a student at a state university in Jember. Some informants felt intimidated when they were in public places. "At that time, I was walking, and someone glanced at me and then walked towards me even though the road was wide. Not only once, but I was also stopped at a red light by one of the mass organizations."

Women labeled as radicals do not have the freedom to practice their religion as do other community groups. While praying at the mosque, one of the respondents stated that he had experienced discrimination. There was even a traumatic experience for women branded as radicals, "The community that I used to attend Islamic studies was forcibly disbanded by one of the mass organizations. Ultimately, we disbanded and never held events at that location again."

The freedom of women to manifest their religion and beliefs also faces opposition, including from the family, society, and even government institutions. "The obstacles I experienced started from my family; my parents, especially my father and mother, did not agree when I decided to wear the veil," Meanwhile, some had to give up not wearing the veil at certain moments to avoid discrimination and intimidation from society. "When I was doing KKN, I had to adapt to the culture of the people there who were very new to women wearing the veil, so I decided to take off the veil while I was carrying out KKN," said a final semester student at an Islamic university in Jember. Even his friend once received even stricter opposition from the campus, "I was kicked out of the rectorate when I was applying for a scholarship because I was wearing a veil. In the end, I was forced only to wear the veil in the community, so when I went out, I had to bring a change of clothes." This ban from the campus occurred in several state universities in Jember, carried out by official campus institutions and the student community. "To enter the WhatsApp majors group made by classmates, you have to show a profile photo that shows your face, and you cannot wear a veil," said one of the early semester students who was also forced to remove the veil when on campus and interact with friends.

The above phenomenon shows that the narrative that has been built by the government about radicalism has a real impact on women's freedom to manifest their religion and beliefs every day. These various obstacles arise from individuals, communities, and even government officials who are supposed to guarantee the rights and freedom of women and the whole society in general to manifest their religion and beliefs.

State, Women, and Power Relations

Cole Durham stated that the idea of equality to protect individuals and communities would become problematic when dealing with customs related to sexuality and other sensitive practices that apply in society. Adjusting the meaning of human rights to the norms that apply affects the structure, which ultimately marginalizes/denies the dimension of freedom of religion or belief. It is even worse if the new norms are used to justify discrimination against religion. [27] Combining this with Foucauldian genealogy, the idea of equality and protecting the freedom of the manifestation of women's religion and beliefs is not only against the traditional norms and customs prevailing in society but also must deal with subjects who act based on the meaning of radicalism that is built up in individuals and communities. NU women position themselves as a particular subject, as a moderate Islamic group, who must fight against threatening radical groups. It disciplined her to take specific actions, such as rejection, discrimination, threats, and subordination of women outside NU who were considered radical.

NU women are controlled not by the structure but because of the knowledge produced by the government, because of the pleasure that arises when positioning themselves as a specific subject, and finally, disciplining themselves in something with a specific subject. NU women recognize power and accept this power over themselves because the technology of power built by the government is in the form of regulatory instruments, law enforcement officers, and other instruments. In this case, to establish ourselves as a moderate group, a peace support group, a tolerance support group, and as guardians of the Unitary State of the Republic of Indonesia, we must fight against radicalism.

NU women recognize the government as the holder of authority because of a web of power operated by the government for growing knowledge. Meanwhile, knowledge about radicalism helps build a web of power that can be mobilized to form NU women's obedience. The narrative of radicalism in this study is sequenced based on the power relations between NU women and women considered radical. These women built a narrative of radicalism after interacting with other individuals within their respective communities and with the government. NU women are on a path of meaning that aligns with the government, namely fighting radicalism in various ways that are also permissible for NU women as part of society. Whereas for women considered radical, radicalism is part of the government's efforts to suppress certain groups not in line with the government and most of society. There is something political in every creation of knowledge about radicalism. There is partiality towards specific groups or an interest in maintaining power. Power produces knowledge, so that knowledge will have an impact on power. Therefore, oppression from the government, society, and NU women will likely generate resistance from radical women. The situation and review above clearly illustrate the position of the Indonesian government, which failed to guarantee women's freedom to manifest their religion and beliefs. Quoting Asfinawati's writing on state obligations from the perspective of human rights law, which refers to the Cole Durham Curve, whatever form of state-religious relations, both have the potential to threaten freedom of religion and belief. [28]

CONCLUSION

This study finds that the narrative of radicalism from the government works to shape the subjects of NU women and radical women. The existence of the two related subjects unequally threatens the manifestation of freedom of religion and belief in one of the groups, namely the women's group, which is considered radical. Furthermore, what is essential is how Indonesia's existence should guarantee women's freedom in manifesting their religion and beliefs. The state must have the power to discipline society, build obedience so that everyone looks after each other, and guarantee each other's freedom to manifest freedom of religion and belief.

Disciplining society is possible with the production of knowledge about the importance of freedom of expression of religion and belief. In this context, society's narrative of radicalism is counterproductive for guaranteeing rights. So, the government must build knowledge about radicalism that is more understandable to the public without raising the potential for prejudice that creates discrimination, injustice, and even threats, especially for women considered radical.

The government should build community communal compliance by creating instruments that can become material for forming power networks for the government, such as laws and regulations, supporting apparatus, and knowledge systems that are conducive to the development of tolerance. The narrative of radicalism needs to be reconstructed so that it no longer creates counterproductive interpretations of guaranteeing the external rights of religious communities, especially for women. The narrative of radicalism must be clarified, not referring to a particular religion and not part of a particular religious teaching. If the government considers radicalism a threat, then it is necessary to explain its definition and who is acting to overcome this threat. It is to avoid the emergence of prejudice between various religious groups, which ultimately limits each other, intimidates each other, and even leads to open conflict when they want to exercise external aspects of freedom of religion and belief.

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The Role of Pesantren in Developing Indonesian Women-led Small Businesses' Halal Industry

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Abstract: Amidst the economic crisis caused by the Covid-19 pandemic, there is a projected growth and advancement anticipated in the global halal business. The economic growth potential of the halal industry has prompted numerous countries to engage in competitive efforts to develop and expand this sector. According to the 2022 Global Islamic Economic Indicator (GIE) report, Malaysia has attained the top position in the global halal business, but Indonesia, being home to the biggest Muslim population, has secured the fourth spot. Indonesian Vice President Ma'ruf Amin has set a goal for Indonesia to become as the leading global producer of halal products by the year 2024. In order to attain this objective, it is necessary for Indonesia to enhance its halal initiatives targeting female micro, small, and medium enterprises (MSMEs), particularly those operating within Islamic boarding schools. The objective of this study is to investigate the significance of kyai (Islamic religious leaders) and Islamic boarding schools in the development of the halal business specifically for female micro, small, and medium enterprises (MSMEs) in Indonesia. The selection of Paciran-Lamongan as a research site was based on the fact that its population resides in urban regions in close proximity to industrial zones. In contrast, Kangean Island was deemed less suitable due to its low infrastructure and restricted accessibility. The present study was carried out at two different locations: the Sunan Drajat Islamic Boarding School, situated in Banjarwati Village, Paciran Regency, and the Al-Hidayah Islamic Boarding School, located in Arjasa District, Kangean Island. The gathering of data in this study was conducted through a combination of several methods, including observation, focus group discussions (FGDs), and in-depth interviews. The findings of this study indicate that there are differences in the functions performed by kyai (Islamic religious leaders) and Islamic boarding schools in the regions of Paciran Regency and Kangean Island. Islamic boarding schools and kyai in Paciran play a crucial role in providing strong assistance for the halal certification process of women's micro, small, and medium enterprises (MSMEs). In contrast, the level of emphasis placed on halal certification attempts by kyai and Islamic boarding schools on Kangean Island tends to be limited. The level of coordination between women's micro, small, and medium enterprises (MSMEs) and the Government is currently inadequate, leading to a limited number of MSME products being certified as halal.

INTRODUCTION

The Halal industry involves a range of industrial activities, including the acquisition of raw materials, the processing of these resources, and the production of halal goods, all of which are conducted in accordance with the principles and regulations of Islamic law. Amidst the global economic crisis triggered by the Covid-19 outbreak, there is a projected growth and ongoing development anticipated within the globe halal business. According to the 2019 State of the Global Islamic Report, it was explained that the Muslim populace allocated a total of USD 2.2 trillion towards the acquisition of halal lifestyle commodities. The projected value of this statistic is expected to rise to USD 2.4 trillion by the year 2024. The present opportunity is accompanied by the swift expansion of the global Muslim populace, currently estimated at 1.8 billion individuals, with projections indicating further growth. Consequently, the halal industry has emerged as an essential issue for many countries, as it offers substantial contributions to economic advancement. Considering the above-mentioned opportunities, it is undeniable that numerous countries are vigorously striving to develop the global halal industry. Countries such as Japan, Korea, England, Brazil, and Australia have a

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030042-1–030042-8; https://doi.org/10.1063/5.0241840
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

significant commitment to the development of the halal business. This observation implicitly indicates the penetration and dissemination of the halal lifestyle in countries where the majority population is non-Muslim. The adoption of a halal lifestyle presents significant prospects in the realm of business. The active production of halal items in numerous non-Muslim nations can be attributed to the significant opportunity presented by this phenomenon.

One may ascertain the representation of nations with the most favorable standing in the global halal business by consulting the Global Islamic Economy Indicator (GIE) published by Dinar Standard in Dubai. According to the 2022 GIE report, Malaysia has consistently achieved the top ranking for a period of nine consecutive years. Malaysia's attainment of the top position can be attributed to its notable progress in the sharia financial industry, along with its commitment to innovation and a regulatory framework aligned with Islamic principles. In contrast, Indonesia, which boasts the largest Muslim population globally, is positioned fourth in the GIE index, with Saudi Arabia securing the second position and the United Arab Emirates (UAE) claiming the third position [1]. Nevertheless, Indonesia has witnessed significant developments in the halal food industry. This particular accomplishment can be viewed as indicative of Indonesia's commendable performance in the implementation of the halal food program.

The Vice President of Indonesia, Ma'ruf Amin, has set a goal for Indonesia to become the leading global manufacturer of halal products by 2024. This objective is based on the significant human resource potential in Indonesia, where 87 percent of the population identifies as Muslim. In order to get access to the global halal market, it is imperative to ensure the halal integrity of products through the implementation of halal certification. Hence, the Vice President has decreed that in order to effectively reach the extensive population of small and medium-sized enterprises (SMEs) in Indonesia, the implementation of a digitization initiative is imperative. This program aims to streamline the halal certification procedure, facilitating its efficient processing. The total count of micro, small, and medium enterprises (MSMEs) amounted to 64.2 million, with 99% falling into the micro category. According to Eriyanti et al. (2023), a majority of these micro MSMEs, approximately 57%, are managed by women. Presently, the government is endeavoring to facilitate two significant objectives by the year 2024. These objectives include the mandatory certification of halal for all food and beverage items, as well as the realization of Indonesia's vision as the global hub for the halal product business.

In order to realize the objective of attaining halal producer status by the year 2024, it is important for Indonesia to promptly enhance its halal initiatives targeted towards micro, small, and medium enterprises (MSMEs) under the management of women. This can be accomplished through the implementation of comprehensive coaching and mentoring programs, thereby enabling these enterprises to effectively compete within the global market. Presently, Indonesia has primarily functioned as a certifier for halal items originating from foreign nations. There is an optimistic outlook for the future, as it is anticipated that female micro, small, and medium-sized enterprises (MSMEs) within the halal industry would enhance the productivity of their high-quality goods. This will enable them to effectively compete in both the export and import substitution markets. Considering the significant role played by Micro, Small, and Medium Enterprises (MSMEs) in the Indonesian economy, it is remarkable that these entities contribute approximately 60.5% to the country's Gross Domestic Product (GDP) and employ about 96.5% of the total national workforce. According to Kemenko Perekonomian [3].

Consequently, the Indonesian Government has implemented diverse initiatives aimed at promoting the growth and advancement of the halal business. These endeavors encompass various initiatives such as conducting outreach activities and easing the process for corporate entities to acquire halal certification. Undoubtedly, the success of this initiative hinges upon the collective cooperation of all societal constituents, with particular emphasis on the involvement of Islamic boarding schools and esteemed religious scholars (kiai/ulama). The establishment of a thriving halal sector in Indonesia is heavily contingent upon the active involvement and endorsement of Islamic boarding schools and esteemed religious scholars, commonly referred to as kiai/ulama.

The objective of this study is to investigate the involvement of kyai (Islamic scholars) and Islamic boarding schools in developing of the halal industry for micro, small, and medium enterprises (MSMEs) led by women in Indonesia. The rationale behind selecting women-managed Micro, Small, and Medium Enterprises (MSMEs) within the Indonesian setting stems from the observed challenges faced by such enterprises in sustaining their operations. Government intervention is required for around 90% of micro, small, and medium enterprises (MSMEs) that are managed by women. According to a study conducted by Eriyanti [2], a significant proportion of micro, small, and medium enterprises (MSMEs) led by women, specifically 87%, encountered substantial financial losses. Furthermore, a quarter of these enterprises, around 25%, suffered a reduction in revenue amounting to half of their total earnings. This study selected two specific places for investigation, specifically Paciran and Kangean Island. Paciran was selected as the study site due to its urban setting in proximity to industrial zones. The Paciran community possesses sufficient access to internet connectivity and technological resources. The selection of the second location was based on its underdeveloped nature, encompassing factors such as distance, accessibility, and the availability of infrastructure. Due to the aforementioned factors, the present study was conducted on Kangean Island, characterized by its restricted infrastructure and poor accessibility.

LITERATURE REVIEW

There is some literature that compares the uniqueness of this study to earlier findings. Jufri [4] claimed that the teachings of tradition, culture, and religion—all of which present teachers as role models in navigating life in the world—are the root cause of the strategic elements that shape the role of kiai and Islamic boarding schools in the social life of Madurese society. The utilization of a strategic kiai figure is employed to foster a halal lifestyle throughout society, with a focus on maximizing the influence of kiai (Islamic clerics) and Islamic boarding schools. According to Mutafarida and Sariati [5] Islamic boarding schools and general education have a significant role in preparing individuals for the challenges of the workforce. Additionally, Fawaid [6] discovered that Islamic boarding schools have the capacity to contribute to the halal value chain ecosystem through the enhancement of their potential, such as the incorporation of sharia banking in their financial operations. According to Ramadini et al [7], Islamic boarding schools have the potential to significantly contribute to economic activities. This contribution can range from fulfilling local community demands as producers to expanding their reach to broader markets. Additionally, Islamic boarding schools can enhance the quality of human resources by fostering improved cognitive abilities and business skills.

Islamic boarding schools also contribute to education and the development of human resources. Islamic boarding schools have the potential to drive an economy based on previous rulings. According to Tarigan and Yuliana [8], the MSME empowerment program at Islamic boarding schools can help with financial and local development. MSMEs are the backbone of not only the local community but also the Islamic boarding school economy. In this situation, Islamic boarding schools can serve as a catalyst, motivating and strengthening the community to expand the economy through MSMEs. The role of Islamic boarding schools has grown in line with the advancement of science and technology in the globalized period. As a result, it is intended that the MSME mentorship and development program would help to create a diverse economic ecosystem at the local and national levels.

The halal business is one type of Islamic-based economic growth practiced by Islamic boarding schools. The halal business is currently gaining popular in society. According to Santoso et al. [9] the demand for halal products is substantial due to the growing Muslim population. Aside from that, halal is more than just a religious issue; in the lives of global society, halal has become a broad symbol that represents a guarantee of high quality. Halal items also represent the formation of a moral society. As a result, not just in Muslim-dominated nations, but also in non-Muslim majority countries, has the halal lifestyle become popular. As a Muslim-majority country, Indonesia is believed to be able to boost the MSME economy through the implementation of the halal sector through Islamic boarding schools. According to Tarigan and Yuliana [8], there are currently 36,517 Islamic boarding schools in Indonesia. According to Santoso et al [9], Indonesia has strong capital in terms of sharia economics and finance, which is already developing relatively rapidly. The large number of Islamic boarding schools in Indonesia has the potential to boost the local economy through the halal industry within MSMEs. Meanwhile, Efendi [10] noted that the Indonesian government has aided the growth of the halal industry by providing free halal certification to MSMEs.

However, the halal industry's implementation in Indonesia is still in its early stages. Subakti & Adamsah (2022) claim that, despite this potential, good results at a worldwide level have not been realized. Internally, Indonesian society has poor competitive awareness. Meanwhile, from an external standpoint, Indonesia faces the difficulty of having many competing countries, resulting in a lot of international items entering Indonesia and a shortage of local products. Furthermore, there is still no internationally recognized halal certification. Furthermore, according to Santoso et al [9], the obstacles in implementing the halal industry are due to industry players' lack of knowledge about maintaining the halal process's guarantee, as well as problematic actions within the government, which means that the implementation of halal certification has not been spread evenly in Indonesia.

Based on the literature study, it is clear that many previous study has focused on the role of Islamic boarding schools in achieving the Halal Lifestyle. The originality of this essay will focus on the role of kiai and Islamic boarding schools in promoting MSMEs through coaching and mentoring in order to fulfill the Indonesian government's objective of being a worldwide halal producer by 2024. The research locations chosen to encourage the halal industry for MSMEs are Paciran and Kangean in Indonesia. Paciran was chosen since it is an urban settlement near industrial areas. The Paciran village has sufficient internet and technology connectivity. Meanwhile, the second location was chosen since it is an underdeveloped area, both in terms of distance access and infrastructure availability. Because of these factors, the research was conducted on Kangean Island, which has limited infrastructure and access.

METHOD

The qualitative method was used in this study. Field data, such as observation, focus groups, and in-depth interviews, were employed as the primary source in this study. In Kangean, data was gathered through interviews with 13 respondents. Following that, interviews were held with 10 Paciran respondents, bringing the total number of respondents to 23. Furthermore, this study makes use of secondary data sources such as journals, papers, and other pertinent references. Researchers used this method to learn more about the adoption of halal certification for MSMEs, the community's perceptions of halal, and the role of kyai and Islamic boarding schools in pushing halal certification.

This study was carried out in two locations: Kangean Island and Paciran. The original location was in close proximity of the Sunan Drajat Islamic Boarding School in Banjarwati Village, Paciran Regency. Paciran Regency was chosen by researchers because it has a homogeneous community (the majority of the population is Muslim). This area has an excellent internet network and infrastructure. This condition differs from the second location, particularly around Al-Hidayah Islamic Boarding School, Arjasa District, Kangean Island. The second location was chosen due to its diverse community characteristics. Kangean Island, on the other hand, has a poor internet network and infrastructure. These two sites were chosen to investigate the connection between Islamic boarding schools and community understanding of halal and halal certification.

RESULTS AND DISCUSSION

As part of Islamic educational institutions, Islamic boarding schools and kyai play an important role in the development of the halal business in Indonesia. Studies on halal products can be effectively promoted by utilizing the capacity of Islamic boarding schools. Islamic boarding schools can help the halal business by providing Sharia banking, enhancing halal products, and community development. This goal is quite consistent with Law Number 18 of 2019, which declares that Islamic boarding schools serve three main purposes: education, da'wah, and community empowerment. As a result, Islamic boarding schools can be regarded as playing a critical part in the development of the halal business.

Islamic boarding schools can engage with banks by using Sharia financial management procedures in the first role. Islamic boarding schools, according to the National Committee for Sharia Economics and Finance, can play an active part in the development of sharia finance. This potential can be realized through programs and initiatives at Islamic boarding schools aimed at increasing sharia financial inclusion. Sharia finance can be implemented in such a way in the development of BMT (Baitul Maal wa Tamwil). Because it can provide sharia financial services to the entire community, BMT is appropriate for development in Islamic boarding schools. The second role of Islamic boarding schools is to strengthen halal products through the halal certification procedure. Halal certification is vital for a product since it serves as a reference for consumers to guarantee and ensure the halalness of the product [11]. The government also supports this Islamic boarding school initiative through the Halal Product Guarantee Organizing Agency (BPJPH). The Minister of Religion appoints BPJPH, which has the authority (according to Article 5 paragraph (5) of Law No. 33 of 2014) to design and set policies for JPH (including defining norms, standards, procedures, and criteria). However, according to the research findings, the contributions of the two Islamic boarding schools varied. The third role in empowering MSMEs is that of Islamic boarding schools. Currently, Islamic boarding schools are focused not only on Islamic religious education but also on empowering MSMEs, such as building MSMEs for Islamic boarding school partners and opening access to the larger community. The Islamic boarding school community considers Kyai in high regard as moral role models. Islamic boarding schools are thought to be both centers of Islamic teaching and community builders [12].

According to the findings of a study conducted on Kangean Island, the Al Hidayah Islamic boarding school plays limited role in the development of Sharia finance. The Al Hidayah Islamic boarding school solely provides formal education to its students. On Kangean Island, BMT is carried out via a door-to-door or snowball technique, in which BMT personnel go one by one to Kangean residents who wish to borrow money or save money without having to compete with loan sharks and cooperatives with excessive interest rates. Meanwhile, Nahdlatul Ulama (the biggest Islamic Organization in Indonesia) Kangean recently created BMT NU, with the goal of making it easier for NU member to establish sharia-based enterprises and avoiding cooperatives or lending institutions with high rates of interest. Aside from that, the Al Hidayah Islamic Boarding School in Kangean does little to contribute to the development of women's MSME operations or the halal certification of Kangean food products. Thus far, Islamic boarding schools in the area have primarily concentrated on educating students about halal and haram food. The topic of developing halal certification as a significant indicator of a halal food product has never been addressed. However, it was women's community groups such as Fatayat and Muslimat who took action. In fact, these two organizations play a far larger role in bringing together women's MSME activity. Despite this, just two Fatayat members were moved to apply for halal certification, despite the fact that there were significant access impediments in the procedure.

Meanwhile, the Fatayat Group encourages its members to carry out halal product certification by sending two Fatayat members or administrators to participate in halal product support training. However, the two participants in this training were unable to provide assistance since they did not fully comprehend the content presented, and if they desired a consultation session, they had to travel to Surabaya, which was both time consuming and costly. The Kangean community faces challenges in entering data about female MSME performers into the halal application since they are frequently disconnected owing to failed connectivity and must enter it all over again due to uneven internet connections. In addition to halal product certification, many business actors disregard business permissions. According to data from the Central Statistics Agency (BPS) in Arjasa District and Kangayan District, the number of registered business players as of 2021 did not approach 50. According to Arjasa District data, the following industries have the most households engaged in the industrial sector by village/subdistrict (2020): food, beverage, and tobacco (14), wood, rattan, and bamboo (66), paper and printed products (14), cement industry, and non-metallic minerals (55). The chairman of the Muslimat group said that encouraging members to register their businesses was tough. Several attempts to collect MSME data to be presented as a condition for obtaining a business license have frequently failed. One factor is that many business owners are hesitant to comply with business licensing procedures and instead feel humiliated in order to receive help funds.

On the other hand, entrepreneurs acknowledge that there has been no socialization or encouragement from local governments regarding what a business permit is and the value of registering a business. The majority of women did not feel it significant because there had been no encouragement to apply for licenses for many years. Aside from that, several reported to being hesitant to satisfy administrative requirements if the process was completed online. This occurs virtually equally among female MSME performers who have been in the industry for a long time and those who have just been in the industry for a few years. Women MSME actors on Kangean Island are not yet well-versed in processing halal programs. The public's reaction to the halal program has thus far been limited to formality on product packaging. In this scenario, public opinion of the halal program is considered as a significant indicator that MSME items can be ingested because they do not contain banned ingredients. When people define halal, they think of food that is permissible in the Islamic religion. Even though Kangean Island women's MSME goods lack a halal logo, they think the food is safe to eat and can be consumed.

Aside from that, women MSMEs do not intend to apply for halal certification for a variety of reasons. The first factor is that female MSME actors are unfamiliar with the application process. This predicament is exacerbated by a lack of public education on the usage of digital technology. Due to a paucity of human resources, it is difficult for female MSME actors to leave the island in order to complete the halal certification process. Several examples from the field reveal that female MSME actors are still unaware that the halal certification process can be submitted through online media. Another belief raised by female MSME players is that the halal certification process is done out outside the island, specifically in the city of Sumenep, and that it takes a significant amount of time and money.

Several women in MSMEs are aware of the significance of registering halal certification and product logos for the success of their firm. However, businesses frequently struggle with separating roles between business premises and halal certification providers. They are under pressure to balance their domestic commitments with the requirement to focus on business. Women face pressure not only from their families, but also from the surrounding community, which believes that women must take full responsibility for household duties before engaging in business or other activities (Eriyanti et al., 2023). The second problem is that the administration of Kangean Island does not enforce restrictions regarding the sale of items with the halal emblem on the package. This circumstance is also one of the reasons why women in MSMEs do not seek halal certification for their products. The most crucial thing for MSME players in this situation is to generate income from their firm.

However, in terms of establishing MSMEs, the role of Islamic boarding schools as a reference in commencing their development has not been widely employed. MSMEs, on average, start their businesses to harness their creativity and passions, as well as to meet their daily living necessities. The majority of female MSME actors in Indonesia can be found in the micro and subsistence categories. They engage in business because they have no other option [2].

Despite the fact that Islamic boarding school culture and Islamic principles are quite prominent in Kangean, kiai figures as community leaders are not the primary source of input or establishing women's MSMEs. Existing kinds of business, even within the field of Islamic boarding schools, tend to move from individuals who then market their commodities only within the Islamic boarding school sphere. According to the findings of the interviews, the role of Islamic boarding schools in Kangean had no major impact on the development of women's MSMEs. Aside from the unmentioned issue of Islamic boarding school policy, there is no program unit that includes business activities. As a result, the Fatayat Group assumed the task of boosting MSMEs led by women by marketing MSME items throughout the recitation. At the end of the recitation session, each MSME participant will be invited to display and promote their product. The goal is for the study members' MSME products to be known by a large number of people and to draw the attention of consumers. Indirectly, the Fatayat Group's efforts to aggressively promote the results of MSMEs from recitation groups are exclusively to assist in the development and dissemination of MSME product distribution scope.

Mrs. Suniah, the person in charge of the men's Islamic boarding school canteen, and one of the guards were interviewed on September 26 at 14.34 WIB. He explained that Islamic boarding school canteens do not employ a sales system at all, but instead buy things from middlemen or business players, therefore accountability for the food and goods in the canteen has shifted to the Islamic boarding school canteen. On that particular day, we were accompanied by Mrs. Fath (Siti Fatonah), a teacher at an Islamic boarding school and the leader of the Fatayat organization in Kangean, which also operates a processed fish food company. Mrs. Fath also stated during the conversation that her business was solely advertised in her own home and in her private shop. This also demonstrates that the scope of Islamic boarding schools has not yet evolved into a venue for creating MSMEs led by women.

In Paciran, unlike in Kangean, Islamic boarding schools play a significant role. For example, the Sunan Drajat Islamic Boarding School maintains product halal by doing on-site supervision. Every three months, supervisors from the cottage examine the production location to ensure that the raw ingredients are halal and that it is clean. Sellers who do not meet the Sunan Drajat Islamic Boarding School's criteria may face punishment. In addition, by cooperating with community organizations, the Sunan Drajat Islamic Boarding School enables the registration of halal items. The socialization and free registration of halal items has been stepped up, and MSEs appear eager to register. Sunan Drajat Islamic Boarding School is vital in educating the people about halal and haram items. Because the majority of Pacirans trust and obey the kyai, education from Islamic boarding schools is more beneficial.

The role of BMT in Paciran is likewise similar to the findings of study in Kangean. BMT Sunan Drajat has a door-to-door technique in which personnel contact residents who want to save or borrow money. The distinction between BMT Sunan Drajat and BMT Kangean is that BMT Sunan Drajat was founded by the Sunan Drajat Islamic Boarding School in 1992. However, BMT Sunan Drajat has never provided sharia finance training. Only at recitation or istighosah events are BMT promotions carried out. BMT in Paciran not only serves as a financial institution, but it also provides sharia management education to the community, such as infaq. The influence of Kyai Ponpes Sunan Drajat on BMT Sunan Drajat marketing is limited to the area surrounding Ponpes Sunan Drajat. What is more influential in other areas is BMT Sunan Drajat's own marketing.

In Paciran, as in Kangean, there is a scarcity of information about halal initiatives for female MSMEs. Some have filed for halal certification for MSME products after learning about it from close friends who work at MUI. Information on the socialization of halal products in Paciran will not be available until 2022, and even then it will be based on the initiative of the Islamic boarding school, with the target audience being women in MSMEs surrounding the Islamic boarding school. Another barrier is that no institution controls the halal program procedure. Aside from that, the Islamic boarding school works with community organizations to benefit BPJPH. Similarly, support with halal food certification for women MSMEs would not be available until October 2022. Many women MSMEs are still unaware of the government's halal product requirements, therefore they believe they do not need to register. Furthermore, the size of their business, with the majority of their target market being small. Products that register to receive a halal mark, in their opinion, are those that have been produced on a significant scale. They are still unaware that MSMEs are now required to register halal items.

While the Paciran public recognizes halal, it is not formally interpreted. People believe in halal not only in the framework of sharia or norms, but also in the sense of blessings. Aidrat Water, like AIDRAT (Sunan Drajat Original Water), is mineral water made by the Sunan Drajat Islamic Boarding School. Many people outside Paciran think that this mineral water comes from Drajat Village and has special characteristics or blessings since it contains Sunan Drajat petilasan. Despite the fact that AIDRAT is not produced from the Sunan Drajat well. The Pacirans, too, believe that AIDRAT has blessings, thus they consume it. When people believe that this product is a blessing, they are confident that it is halal. Because they have faith in the party that creates AIDRAT, namely the Sunan Drajat Islamic Boarding School, which will, of course, consider the halal component. One of Sunan Drajat Islamic Boarding School's business units is salt manufacture. All Sunan Drajat Islamic Boarding School business units follow the same SOP, which includes reciting the Koran in the morning and evening, reading Surah Al-Insyirah, Sholawat Nariyah, and so on. Employees at the SSD Salt Factory are required to attend the Koran and pray Dhuhur in congregation at each shift change. The existence of this SOP also influences the confidence of those who are aware of the SOP to purchase SSD salt goods, as they are thought to be more blessed. The public frequently misinterprets the abbreviation SSD as (Suwuke Sunan Drajat). In a recitation, the words Suwuke Sunan Drajat were first introduced by a Kyai from the head of the Sunan Drajat Islamic Boarding School. This Kyai is indeed famous for his suwuk, thus many Pacirans who consider it as a 'blessed' buy this salt product because they believe it is a blessing and has the benefits of this product.

The field conditions indicate that the Sunan Drajat Islamic boarding school is more important than Kangean in empowering women's MSMEs. One of the things that the Sunan Drajat Islamic Boarding School does is receive food deposits from the local community to sell at the cottage. Sunan Drajat Islamic Boarding School, on the other hand, has conducted product control every three months by visiting the manufacturing sites of women's MSMEs that supply the boarding school. To avoid fraud, this product control is done out using the 'inspection' approach or by appearing unexpectedly at the production site.

To regulate this, the Islamic boarding school will examine the materials used, hygiene, processing, and other factors. This routine control strives to keep the quality of products entering the Sunan Drajat Islamic Boarding School, including the halal element, at a high level. A warning will be sent if something does not match the standards. The Sunan Drajat Islamic Boarding School provides halal product support, including production control. So, even if food and beverage goods enter Islamic boarding schools without receiving halal certification from BPJPH, there are already procedures in place from Islamic boarding schools to carry out checks. In October 2022, socialization regarding BPJPH halal certification began to be carried out to MSME merchants who supply Islamic boarding schools and surrounding the Sunan Drajat Islamic Boarding School. Women-owned MSMEs that supply the Sunan Drajat Islamic Boarding School have begun to register halal items in compliance with government standards.

As a result, it is clear that the execution of halal socialization programs is still unevenly dispersed throughout Indonesia. Where the Islamic boarding school area is well informed and has carried out its roles and duties to carry out outreach and support to the community. However, in remote locations, this knowledge is still not evenly and broadly disseminated. As a result, the government must spread information about the halal product program throughout Indonesia, even distant locations.

CONCLUSION

Indonesia, the world's largest Muslim nation, might become the world's largest halal producer by 2024 as the Halal Industry grows. The government is maximizing halal product assurances by implementing halal certification for women-led MSMEs. The Indonesian government still need halal food and beverage certification to achieve its goal of being the worldwide center of the halal product business. However, many female MSME actors are unaware of the halal market, making this approach challenging. Some people are apathetic about halal products. Kangean Island residents still consider halal products unimportant. If the meal or drink is produced without haram ingredients, it can be consumed according to Islamic teachings.

Women-led MSMEs in Kangean and Paciran are influenced differently by Islamic boarding schools. Lack of knowledge prevents Kangean female MSMEs from registering halal products. Insufficient collaboration between the regional administration and Sumenep government exacerbated this situation. In Paciran, women-led MSMEs, especially those linked with the Sunan Drajat Islamic Boarding School, are registering halal products to comply with government regulations. Staff from Islamic boarding schools visit MSME production companies every three months for product monitoring.

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Communication Strategy of Study rograms in Increasing Brand Awareness Through Instagram Study of Communication Science Study rogram, Faculty of Social and olitical Sciences UHAMKA)

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Abstract. Entering the Merdeka Campus era, the world of higher education is increasingly competitive. Higher education competition is not only in the scope of improving campus reputation, but also in brand awareness. Through instagram, Communication Studies Program, increasing brand awareness. Brand awareness of the college is a brand awareness that is attached to the community. Therefore, universities must be able to create effective and efficient strategies to increase brand awareness. The purpose of the study was to determine the communication strategy of the Communication Studies study program, FISIP UHAMKA in increasing brand awareness through Instagram. By using descriptive qualitative research methods. The results obtained that the Communication Science Study Program strategy in increasing brand awareness cannot be separated from the UHAMKA strategy and communication strategies through Instagram are part of increasing brand awareness to the public.

INTRODUCTION

In today's digital era, social media has become a part of everyday life. There are many social media platforms, one of which is popular in Indonesia is the Instagram application. According to Datareportal [1], Instagram users in Indonesia are in third place with 99.15 million, with the order of Facebook totaling 129 million and Youtube there are 139 million in early 2022. This can be seen in data reportal which shows that globally, this number is equivalent to 35.7% of Instagram's advertising reach, while locally Indonesian Instagram users reach 48.4%, with 52.3% female and 47.7% male audiences.

The use of Instagram is not only personal, but can be for organizational or business purposes. Instagram provides a switch feature to a business instagram account (*instagram for business*) that can be used by users to develop their business, either to promote products or communicate with potential clients. Based on business.instagram.com, there are 200 million instagram account users for business, one of which is the communication uhamka account, as the official account of the Communication Science Study Program (Prodi), FISIP UHAMKA.

The Communication Science Study Program of Fisip Uhamka is an educational institution that specializes in Communication Science at the University of Muhammadiyah Prof. Dr. Hamka. Higher education is an educational institution that is basically almost the same as other organizations engaged in various sectors, such as industry and services. Higher education produces reliable human resource output, so that it requires the excellence of the organization's name in the eyes of the public or awareness of the company name called *brand awareness*.

According to Hermawan [2], *brand awareness* is the ability of a potential buyer to recognize or recall a brand that is part of a product category. Entering the era of independent campuses, the world of higher education is increasingly competitive. College competition is not only in the scope of improving campus reputation, but also in *brand awareness*. Thus, the department must have an image in the minds of consumers of a university, which in this case

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030043-1–030043-6; https://doi.org/10.1063/5.0244932

are students, prospective students and student guardians. Self-image or *image branding of* study programs is important to foster public trust in educational institutions, which at its peak will help the development of the science studied.

The ability of customers to recognize or remember a product brand depends on the communication strategy carried out by the company. Therefore, the study program must be able to create effective and efficient strategies to increase *brand awareness*. This research focuses on the communication strategies carried out by the UHAMKA Communication Science Study Program to increase *brand awareness* through Instagram.

There are many studies related to the Communication Study Program, such as his research [3] with the research title, Brand Image Strategy of the Stain Majene Islamic Communication and Broadcasting Study Program, which examines the factors that form the band image of the STAIN Majene Islamic Communication and Broadcasting Study Program and the impact of forming the brand image of the STAIN Majene Islamic Communication and Broadcasting Study Program. This type of research is descriptive, qualitative research. Data was obtained through interviews, observations, interviews and literature studies and using interactive model data analysis techniques. The result of the research is that the brand image of the Islamic Communication and Broadcasting Study Program of STAIN Majene is formed by several factors, namely: The leadership, scholarship offers, increased cooperation with several stakeholders, the curriculum offered, social media management, and excellent programs. These factors have an impact on the increasing recognition of the Islamic communication and broadcasting study program, and the increasing interest in the image of the STAIN Majene Islamic Communication and Broadcasting Study Program in the third year reached an increase of around 300%.

Likewise with [4], her research entitled, Study Program Strategy to Increase Brand Awareness (Study on Communication Science Study Program, Faculty of Social Sciences and Humanities UIN Sunan Kalijaga), examines brand awareness or brand awareness of higher education as part of improving services to the community. Study programs can form brand awareness that can be strongly attached to the minds of the community. The formation of brand awareness of each study program is determined by the target students, who the competitors are, how to make the study program concerned have higher credibility when compared to similar study programs on other campuses. Qualitative research method with SWOT analysis.

[5] examines Marketing Communication in Building Brand Awareness (Partipost Case Study), whose research explains that changing business models is a challenge for business people so that they must innovate so as not to be left behind by increasingly digitized consumers. One of the efforts to build and improve the company's image in the digital era is brand awareness which requires a continuous effort to build. The purpose of this research is to find out the marketing used by Partipost in building brand awareness of a brand. The research method used is a descriptive qualitative approach. The research used in-depth interviews with three resource persons, namely two Partipost members and influencers at Partipost. The research data obtained comes from interviews, online data, observation and documentation. This research shows that the marketing communication used by Partipost in building brand awareness of a brand, using several elements or marketing communication mixes that are interrelated, will create a distinctive form of marketing by Partipost. The form of marketing used is a marketing campaign, which aims to build brand awareness. To find out the success of building brand awareness is determined by the interaction or engagement in the marketing carried out.

This research conceptualizes business communication, communication strategy, marketing communication strategy, brand awareness and Instagram. The Communication Science Study Program of FISIP UHAMKA is a unity of learning plans that are used as guidelines for the course of academic education whose implementation is based on a curriculum in the field of Communication Science. The Communication Science study program of FISIP UHAMKA is one of the scientific specializations in the field of communication in FISIP UHAMKA so that this uniqueness can be attached to the UHAMKA academic community and the hearts of the community, it requires brand awareness. This research will examine and examine the Communication Studies Program in carrying out brand awarenss and communication strategies carried out to increase brand awareness.

Communication Science Study Program of FISIP UHAMKA is in the scope of organization in the context of business communication. Business communication is basically a process of exchanging information and business messages in forming organizational systems and structures that are conducive to maximizing the efficiency and effectiveness of work products. According to [6], business communication includes various forms of communication, both verbal and nonverbal communication that has certain goals to achieve.

According to Sendjaja's opinion in [7] there are four functions of business communication in the organization, informative, controlling (Regulatory), persuasive, and integrative. For the purpose of business communication, Cutis, James J. Floyd and Jerry L. Wilsor [8] stated; 1) Solving problems and making decisions; 2) One's position in the business; 3) Expertise in solving problems and making decisions for business progress; 4) Evaluating behavior; 5) Meeting the needs of goods and services.

In communication, Laswell states that communication is basically a process that explains who, says what, with what channel, to whom and with what kind of effect or result is produced. This explanation has represented the elements of communication, namely source, message, channel, media, receiver, and effect. According to Anwar Arifin [9], the communication strategy is to recognize the audience, compile messages, determine goals, determine methods and choose media.

In business, it cannot be separated from marketing, so the marketing communication strategy according to [10], there are three stages of marketing communication strategy that needs to be carried out by the company, namely determining marketing objectives, determining segmentation and targeting, and determining differentiation and positioning. According to Kotler and Armstrong [11], marketing mix by integrating marketing communications consists of 4 (four) elements, namely a). Product, which is a combination of goods and services that the company offers to the target market. b). Price, which is the amount of money that consumers have to pay to get the product. c). Place, which is a variety of company activities to make the products produced or sold more affordable and available to target consumers. d). Promotion, namely company activities to consume and introduce products to targets.

According to Aaker in [12] brand awareness is the ability of someone who is a potential buyer to recognize or recall a brand as part of a product category. This brand awareness also has its levels. We can separate these levels into four categories, namely: 1) *unaware of brand*, someone does not know the brand. 2) brand recognition, brand recognition, but still at a very minimal level and understanding. 3) *brand recall*, a person is asked to mention the names of products in a certain product category without assistance. 4) *top of mind*, the name of a brand or brand that is mentioned first by someone, is in a special position.

Instagram is a social media platform that is widely used by Indonesian netizens. The application is used easily, fun and creatively to take, edit, share photos, videos and messages with friends and family. Instagram was created by Kevin Systrom in 2010. The creation of Instagram coincided with Burn INC which was later integrated and evolved into Instagram. Activities on Instagram began to share photos and videos, then evolved into business. Instagram provides a switch feature to a *business* Instagram account (*Instagram for Business*) that can be used by users to develop their business, either to promote products or communicate with potential clients.

RESEARCH METHODOLOGY

This research was conducted at the Uhamka Communication Science Study Program. The data collection process was carried out for 6 months. The approach used is descriptive qualitative, with data collection methods using literature searches, observations and interviews. In this study, the data analysis technique used, according to [13] consists of four stages. Starting from the first stage, namely the data collection stage, the data reduction stage, the data display stage until the fourth stage is the conclusion or data verification stage. The author then uses source triangulation, which aims to explore the truth of certain information through various sources to obtain data to find out the reasons for the differences. Data processing is done by classifying data and grouping data. From these results, the data is then analyzed and displayed in the form of descriptions.

RESULTS AND DISCUSSION

In the business process, a university cannot be separated from business communication. Communication activities, strengthening, maintaining a brand in order to provide perspective to others who see it are called branding. Uhamka Communication Science Study Program is an educational institution that was established in 1998. As one of the departments in Muhammadiyah universities, Al-Islam and Kemuhammadiyahan are important values instilled by the university so that graduates have competence in accordance with the *learning outcomes* outlined. In this case, a brand must be able to find its own best platform for success in the form of a brand identity with a unique and meaningful vision, it becomes one of the main components that are mandatory in improving brand strategy [14].

Communication Strategy of UHAMKA Communication Science Study rogram

The communication strategy of Uhamka Communication Science Study Program is integrated with the communication strategy of Prof. Dr. Hamka Muhammadiyah University. Thus said Farida Hariyati as Kaprodi Ilmu Komunikasi Fisip Uhamka (2022). According to Alo [15] communication strategy is a plan to complete an activity as part of an effort to achieve certain goals. In organizing, Mulyadi [16] states that organization is an activity or activity and all kinds of aspects related to efforts to achieve business goals to be achieved.

As an integrated part of Uhamka, the communication activities of Uhamka Communication Science Study Program are sourced from the Qur'an and Assunah which are reflected in the Muqaddimah of the Muhammadiyah Articles of Association, Matan Beliefs and Ideals of Muhammadiyah Life, Muhammadiyah Personality, as well as Khittah and other Muhammadiyah Steps which become Muhammadiyah's ideological doctrine.

Uhamka sets three basic values that must be owned by the Uhamka academic community, namely honesty (*integrit*), *trust*, and *compassion*. The three basic values are applied to the principles of implementing Uhamka's work program, namely 1). Sincerity and obedience; 2). Systemicity and contribution; 3). Solution and vision; 4). UHAMKA Strategic Plan 2020-2024; 5). Credibility and professionalism; 6). Effectiveness and efficiency; 7). Transparency and accountability; 8). Productivity and usefulness; 9). Sensitivity and openness; 10). Harmonization and communication; 11). Cadre and continuity.

The basic values and working principles of Uhamka above are an integrated activity between the academic framework and planning of various *resources*. Kotler [17] states that branding is a combination of names, terms, signs, symbols or designs to identify goods, services or groups of sellers and to distinguish them from competitors' goods or services. [18] identifies brand levels, namely attributes, attribute benefits, values, culture, personality, and users.

Entering its 24th year, the Communication Science Study Program of FISIP UHAMKA has five specialization fields, namely Public Relations, Journalism, Broadcasting, Advertising and Communication Management. Along with the development of information and communication technology, UHAMKA Communication Science Study Program also synergizes and becomes part of digital activities.

Communication strategy of Uhamka Communication Science Study Program shows as an organizational activity in achieving goals. Arni mentioned that everything related to plans and tactics or ways that will be used to launch communication by displaying the sender, message, and recipient in the communication process to achieve the desired goal is called a communication strategy.

Instagram Communication KomunikasiUhamka in Increasing Brand Awareness

Along with technological developments, the publication media for Uhamka Communication Study Program is through social media, one of which is Instagram. Based on datareportal, Instagram is in third position as the largest user in Indonesia. Instagram occupies the highest position among other social media, so Instagram can be an option used to increase *brand awareness*. Aaker [19] states that brand awareness is the ability of someone who is a potential buyer to recognize or recall a brand as part of a product category.

Measurement of brand awareness on @KomunikasiUhamka can be seen from the amount of engagement or interaction with account content. This interaction can be seen from likes, comments, mentions and content followers, because the result of good communication is if the audience gives attention or response.

The use of Instagram by Uhamka Communication Study Program is applied to the Instagram account @komunikasiuhamka. Account name that reflects the identity of the organization. The account profile photo uses the Uhamka Communication logo. The account bio explains the number of specializations in the Uhamka Communication Study Program, namely Journalism, Public Relations, Broadcasting, Advertising and Communication Management.

Based on the Instagram account profile of the Uhamka Communication Science Study Program, it shows that the Instagram account is indeed a brand identity for the Communication Science Study Program. Brand identity describes the vision, certain uniqueness, and distinctiveness of the brand. Branding aims to shape public perception, build public trust in the brand and build public love for the brand.

Instagram is an app that continues to innovate. It started with just sharing photos and videos, then evolved with streaming and TV. Instagram accounts can switch from personal to business. Almost all of the features are the same, what distinguishes personal and business Instagram accounts are the following:

1. Contact Menu. The contact menu of personal and business accounts has significant differences. If a personal account will only receive messages from users who send *direct messages*, while a business account can communicate with potential clients using telephone or email to the address in the contact menu. Because of the difference in the contact menu, the appearance of personal and business accounts is also different. Because, usually the phone, email, and address menus on business accounts will be visible on the business Instagram profile. The Uhamka Communication Instagram account shows that it has been switched to Instagram for business even though it has not yet joined a paid business.

2. Insight feature. The most prominent difference between personal and business accounts is the Insight feature. This feature can only be found on business accounts to make business promotion more effective and relevant. The insight feature will provide Content, Activity, and Audience options.
3. Content, serves to find out how many accounts have seen content that has been created or posted, the number of users who see stories, the number who leave stories, the number of replies received, and other information. Uhamka Communication Instagram activity is known that there are many comments on student achievement information and video content.
4. Activity, serves to find out how many interactions occur in a business IG account, shows the number of business profiles visited by others, the number of followers clicking the website, email, and call buttons in the contact menu. Based on the results of research on January 6 to June 22, there were 44 posts with the theme of Prodi's information message there were 27, congratulations on achievement there were 7, warning information there were 8, and video there were 2.
5. Audience, serves to show demographics or data about the gender, age, geography of followers on business accounts. This menu will also provide information about the effective hours of followers online on IG. For the audience manually from views and likes, the most views are on student activity posts and videos. For the number of views, the most views are on video content as many as 278 views of student work and photos congratulating student graduations as many as 251 views, and the least on information on student activity announcements as many as 20 views.

Instagram is a digital platform that focuses on visuals, so it is not surprising that @KomunikasiUhamka Instagram feed video posts have more views. In content, of the 44 posts, all contain elements of providing positive and informative information to the public. Instagram activities @KomunikasiUhamka can help in increasing *brand awareness of* Uhamka Communication Science Study Program.

CONCLUSION

The Communication Science Study Program of FISIP UHAMKA is an educational vocational specializing in Communication Science with specializations in Public Relations, Journalism, Broadcasting, Advertising and Communication Management. In achieving student achievement in the five specialization fields, the Communication Study Program's communication strategy is integrated with the university strategy. To increase brand awareness, Uhamka Communication Study Program uses social media such as Instagram. Instagram can help get more targets, so that the profile displayed can display the profile of the Uhamka Communication Science Study Program.

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Effectiveness of Tomato Processing Training in Empowering Women Farmer Groups in Bondoyudo Village, Lumajang

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Abstract. Bondoyudo Village, Sukodono Sub-district, Lumajang District is one of the tomato-producing villages, Bondoyudo Village has the potential to make tomatoes a small business run by the women of the Women Farmers Group, which when tomatoes experience a simultaneous harvest that makes the price of tomatoes drop. So with the potential possessed by the village, there are many advantages in empowering the community, especially women. Based on these issues, women's empowerment is an important part of the process of improving the quality of Human Resources (HR) through training activities. The method that will be used in this Community Empowerment is by transferring technology, namely transferring knowledge while providing training on how to make jam and dates made from semi-mass tomatoes to the mothers of the Bondoyudo Village Farmers Group, Sukodono District, Lumajang Regency. The results stated that almost all participants stated that it was very useful. In addition, participants acknowledged that with this training activity, it can add insight and skills that can be used in everyday life. This activity can also be used as an alternative to fill time and utilize local, easy and economical raw materials.

INTRODUCTION

Indonesia has an agricultural region, a lot of land is used for gardening or rice fields. Most Indonesians have a livelihood as a farmer. One of the products produced by these farmers is tomato. Tomato plants or which have Latin Lycopersicon esculentum Mill are one part of strategic horticultural crops and are very easy to grow. Because Indonesia's climate is suitable for tomato cultivation, tomatoes are easily accessible to all levels of society, in Indonesia tomato plantings that are often bred include cherry tomatoes, apple tomatoes, potato tomatoes, and curly tomatoes. Tomatoes have an important role in fulfilling community nutrition. The composition of nutrients contained in it is quite complete. Vitamins A and C are nutrients that are quite prominent in tomatoes. Vitamin A found in tomatoes is lycopene which is found in the highest amount. In fresh tomatoes the amount of lycopene is 3.1-7.7 mg/100g. Vitamin C can be formed as L-ascorbic acid and L-dehydroascorbic acid, both of which have activity as vitamin C.

Tomato fruit will be immediately damaged if without treatment during storage. The amount of damage to tomato fruit after harvest ranges from 20% to 50%. Tomatoes harvested after 10% to 20% color will only last a maximum of 7 days at room temperature." With the advancement of food processing technology, industries that process tomatoes such as the sauce, paste, juice, jam and dried sweets industries or into powdered products began to develop.

Consuming tomatoes should be cooked first. As revealed by research from the world food agency FAO-WHO. The results of this institution's research show that the lycopene content is not damaged and the amount does not change much during heating.

Even the lycopene content will increase 10 times when tomatoes are processed into sauce or tomato paste. Unlike other vegetables that are more beneficial if eaten raw, it turns out that tomatoes are better mixed with dishes or crushed before eating.

The Nawang Sari Farmer Group was established on April 4, 2008 where it began with the composition of the management and members are women. This farmer group is one of 12 farmer groups under Gapoktan Sumberejo

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030044-1–030044-6; https://doi.org/10.1063/5.0241684
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Bangkit. With the potential possessed by Bondoyudo Village, many benefits are obtained by the community, including by the community, including agricultural products that are abundant and can be immediately distributed to consumers, have a high selling price when harvesting tomatoes not simultaneously with other villages simultaneously with other villages. However, if there is a price drop (However, if there is a price drop due to the simultaneous harvesting of tomatoes and there is damage to tomatoes around 20-50%, they can be processed into various kinds of processed tomato products, including tomato dates or tomato jam.

Based on these issues, women's empowerment is an important part of the process of improving the quality of Human Resources (HR) through training. The condition of women's powerlessness not only affects the women themselves but has an impact on the family as a whole, children and household economic arrangements. It is recognized that education is the key to empowerment for women, as it can improve income, health and productivity. Women's empowerment is an important part of a country's development process, because women are also citizens who have the same rights and obligations as men. Empowering women can simultaneously improve their capability and quality of life, family and community. The increase in women's productivity can be seen from the indicators, which include a change in attitude that is more positive and advanced, improving life skills, and the results of work in the form of goods or services for the needs of themselves and their communities.

Women's Skills in the Community

To achieve independent and working women, women need to be trained in skills on how to create employment opportunities and businesses and process materials, such as the current target that tomato farmers can process their tomatoes into jam so that after harvesting they do not have to sell their tomatoes at low prices or even rot. tomatoes at low prices and even rot. To foster a passion for creating employment, it is necessary to have basic business skills and a healthy business climate or opportunity. and a healthy and adequate business climate or opportunity. The problems that occur to female tomato farmers are:

1. Tomato farmers still neglect tomato processing during the harvest season, causing the price of tomatoes to fall. harvest season, causing the price of tomatoes to drop (plummet).
2. Farmers of the Nawang Sari Farmer Group do not yet have the skills regarding processing of tomato products that are less good for making tomato jam as an alternative product.
3. Tomato is one of the fruits that has sufficient nutritional content needed by the body so that it can be processed and packaged with various alternatives.

Training activities were carried out at the Nawang Sari Farmer Group Leader's House. This is because the implementation of activities prioritizes the closest distance to the settlements of other farmer group members who are the target objects. The method that will be used in organizing training activities through practical skills education learning with 1 resource person who will explain the processing of tomatoes into jam and dates with a total of 20 participants. Furthermore, participants will be divided into 2 groups and accompanied by 1 group of 1 companion so that participants can be more intensive in understanding the material to be delivered by the resource person. The methods used in each lesson are as follows:

1. Demonstration method: To train participants in practice, this method is used so that many participants understand because the knowledge learned is theoretical and practical.
2. Varied lecture method: This method is used to provide information and explanations in providing the purpose and objectives of the training. And the most important thing is to motivate them to be willing and happy to participate in this training program with discussions and questions and answers.
3. Resitation or assignment: The tutor/facilitator directly assigns tasks to the participants.

METHODS

Research is the process of applying scientific methods to methodically deal with existing problems. Meanwhile, according [1], research methods are scientific ways to collect data for specific purposes and purposes. In research, researchers use a quantitative approach as a research approach. The quantitative approach is a research study in which a certain population or sample is studied and data collection is carried out randomly using instruments, data analysis, and is statistical in nature. In this study, the location was determined using the purposive area method. Purposive area method is an area chosen based on certain objectives and aspects so that it is possible to assess in advance the possibility of obstacles in the research process. Respondents of this study were 30 women in the Farmer Group.

Data processing techniques in this study used computational calculations of the SPSS (Statistical Product and Service Solution) program because this program has high statistical analysis capabilities and a data management system in a graphical environment using descriptive menus and simple dialog boxes, making it easy to understand how to operate. Data processing according includes activities:

1. Editing
   Editing is checking or correcting the data that has been collected, the aim is to eliminate errors contained in field recording and is corrective in nature.
2. Coding
   Coding is giving codes to each data that belongs to the same category. Codes are signals made in the form of numbers or letters that provide clues or identity to the information or data to be analyzed.
3. Giving scores or values
   In scoring, a Likert scale is used which is one way to determine the score. These assessment criteria are classified into four levels with the following assessment:
   a. Answer a, given a score of 4
   b. Answer b, scored 3
   c. Answer c, scored 2
   d. Answer d, scored 1
4. Tabulation
   Tabulation is the creation of tables containing data that has been coded in accordance with the required analysis. In tabulating, accuracy is needed so that errors do not occur. Tabulation result tables can take the form:
   a. Transfer table, which is a table for transferring codes from questionnaires or recording observations. This table serves as an archive.
   b. Ordinary table, which is a table that is organized based on the nature of certain respondents and specific purposes.
   c. Analysis table, a table that contains a type of information that has been analyzed [1].

TRAINING IN EMPOWERING WOMEN FARMER GROUPS

Empowerment as a Process of Giving Power to Women

Many women work outside the home to help ease the burden on their families, but often women get jobs that tend to be rough and more physical. In rural communities, the most common jobs obtained by women are not far from being housemaids, factory workers, traders and farm laborers, only a small proportion of rural women work as civil servants or employees. This is certainly inseparable from women's education which is often neglected. Women's involvement in the economy must inevitably be recognized, despite the fact that there are differences between men and women in work activities. Women who work can help their husbands in supporting the family economy. To help the family economy, the role of working women is needed, especially in terms of helping to increase family income. They are willing to contribute their energy to generate salaries or wages. There are several motives for women to work, including financial needs, social-relational needs and self-actualization needs. Poor women in villages and cities are the largest group who continuously seek employment opportunities to fulfill their basic needs. They work as farm laborers, domestic servants, scavengers or factory workers [2].

Empowerment is used as an alternative development approach model by giving autonomy to the community. Through this autonomy, people will develop the habit of deciding on their own various interests related to themselves. Empowerment will equip the community with knowledge and skills to improve the standard of living. Modernization of agriculture at this time is a demand and need for increased production and quality. Modern agriculture has the meaning of efficient, effective, productive and insightful agriculture industry in [3]. The Women Farmers Group (KWT) is a forum that provides opportunities for women to take part in advancing the agricultural sector [4].

According to Ife, states that "Empowerment means providing resources, opportunities, knowledge and skills to improve their abilities, to determine their own future and to participate in and influence the lives of their communities". In line with empowerment, women's empowerment is needed to push families out of poverty. The drive to move out of poverty requires the active role and responsibility of the entire community, especially family members. In a family, a woman becomes a mother who educates and sets an example for her children. However, there are still many women who are less empowered due to several factors, including low economic levels, low levels of knowledge and skills and no access to develop their knowledge and skills. This fact shows that women have a significant role in bringing their families out of the economic crush, because in addition to working in the domestic sector (in the household) they are even required to be able to play a role in the public sector (outside the home), for example the agricultural sector [5].

Most women are positioned in domestic roles, so the skills they have also lead to maternal roles. In its development, along with the unending economic crisis situation, it is impossible for women to stand idly by and finally have to be able to do something to increase family income. In the absence of knowledge and skills, women are only able to obtain suboptimal results. This condition will continue if there is no effort to improve it, because basically the unequal relationship between men and women has been rooted throughout human life. Pragmatically, women's empowerment can be achieved by improving skills (which are more expertise in economic activities) that are directly related to daily activities. In relation to the dynamic life of the community, empowerment is more of an effort to provide the ability as well as the opportunity for the community to take an active role in the development process. The government's commitment to realizing gender equality and justice is also very high through women's empowerment programs. The concept of women's empowerment emerged after the IV World Women's Conference in Beijing. "The Millennium Development Goals (MDGs) promote gender equality and women's empowerment as effective ways to combat poverty, hunger, and disease and stimulate genuine and sustainable development [6].

The farm women group (KWT) is an organization or community group that aims to improve the skills of learning citizens to get training or coaching from the agriculture office and the food security office which is expected to be able to drive activities that can support the economy. An international journal explained about women farmers "According to [7] asserted that woman farming is not only contributing to farming, but has become the backbone of the family in fulfilling the economic needs of the family'. It can be interpreted as follows: According to [7] asserted that women farming is not only contributing to agriculture, but has become the backbone of the family in fulfilling the economic needs of the family. The empowerment of farm women's groups will form the independence of farmers. According to [8] explains the independence of farmers (farmer autonomy) is the formation of a complete farmer who is able to choose and direct his farming business activities according to his own will which he believes has the highest level of benefit but does not mean a self-closing attitude but with a humble attitude of accepting the situation of society and the rules contained therein, as well as behavioral motives derived from all the realities faced in his life [9].

Socio-economic factors that can affect the income of farm women groups include the age of farmers, the income they get from cassava cultivation and other income, the number of family dependents, ownership of land area and production. This certainly has an impact on the level of household income of the farm women group [10]. Family income is the total real income of all household members used to meet joint and individual needs in the household. Household income is a reward for work or services obtained because of contributions made in production activities. Income can be in the form of money or goods, for example, in the form of compensation in the form of basic necessities, such as rice, oil, vegetables and so on [11].

An overview of the results of the Tomato Processing Training in Empowering Farmer Women's Groups

The results of the research related to the evaluation to determine the responses given by the trainees are presented in several aspects of the evaluation presented in the following table:

TABLE 1. Material Suitability

Score	Appropriateness to needs		Conformity with Village policy	
	Amount	%	Amount	%
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	19	63	17	57
5	11	37	13	43
Total	30	100	30	10

Table 1 shows that the training materials were perceived by 63% to be in line with the needs of the participants and 37% were perceived to be very in line with the needs, while 57% and 43% were perceived to be very in line with the policies of the Village Head.

TABLE 2. Systematic Training Flow and Ability to Internet with Participants

Score	Systematization of material flow		Ability to interact	
	Amount	%	Jumlah	%
1	0	0	0	0
2	0	0	0	0
3	2	7	0	0
4	4	13	6	20
5	24	80	24	80
Total	30	100	30	100

Table 2 shows that in terms of the systematic flow of practical material, 7% of participants stated that it was sufficient, 13% stated that it was good and 80% of participants stated that it was very good in terms of the systematic flow of practical material. Likewise, with the ability of resource persons to interact with participants, 20% of participants stated that they were good and 80% of participants stated that resource persons were very capable of interacting with participants.

When viewed from the participants' readiness to apply the training results in their daily lives and readiness to develop as a business, the evaluation results illustrate the facts presented in Table 3 as follows:

TABLE 3. Readiness to Implement and Develop as a Business

Score	Readiness to Implement		Readiness to Develop	
	Amount	%	Amount	%
1	0	0	0	0
2	0	0	0	0
3	1	13	1	9
4	7	19	5	22
5	23	68	24	69
Total	30	100	30	100

This figure shows that the training has not maximally encouraged participants to use the training results as business capital for women in Bondoyudo Village. However, participants were enthusiastic if similar skills training was held as illustrated in table 4 below:

TABLE 4. Desire for Similar Activities

Score	Desire for similar activities	
	Amount	%
1	0	0
2	0	0
3	0	0
4	3	10
5	27	90
Total	30	100

After this training activity, participants' expectations for similar activities were identified, with 90% expecting further activities. The tomato fruit processing training as the main focus of the training activities received a positive response from the Bondoyudo Village Head and the Nawangsari Farmer Group Leader. For the Bondoyudo village community, especially the training participants (members of the Nawangsari farmer group) this provided the first experience of getting training in processing food products. Tomato fruit processing is a new thing because so far it has never been thought that one of the preparations that can be used as jam or dates for daily snacks is produced from tomatoes.

CONCLUSION

The training activities can be concluded to have been carried out well, this is evident from the evaluation obtained that almost all participants stated that it was very useful. In addition, participants recognized that with this training activity, they could add insights and skills that could be used in everyday life. This activity can also be used as an alternative to fill time and utilize local, easy and economical raw materials. There are things that need attention so that the sustainability of the activity can be maintained, namely producing on a household scale and establishing cooperation between the Bondoyudo village community and the Head of the Nawangsari Farmer Group of Bondoyudo Village and the Lumajang Regency (UMKM) Office for marketing the products made by the Bondoyudo village community.

ACKNOWLEDGMENTS

The author expresses his gratitude to the University of Jember and the Community Education Study Program who have always supported all of the author's research activities, as well as to women farmer groups in Bondoyudo village, lumajang who have been involved in this research activity.

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Poverty Culture Among Women Who Receive Family Hope Social Assistance Program Aids in Mronjo Village

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Abstract. The research examines the culture of poverty among women from beneficiary families of the Family Hope Social Assistance Program (PKH) in Mronjo, Indonesia. The research question in this study is: "How is the culture of poverty manifested among women beneficiary families recipients of the Social Assistance Program Keluarga Harapan (PKH) in Mronjo Village?" The purpose of this study was to find out, analyze, describe, and examine the manifestations of a culture of poverty for women beneficiary families recipients of the Program Keluarga Harapan (PKH) Social Assistance in Mronjo Village. The theory used in this study is the Cultural Theory of Poverty according to Oscar Lewis. This study uses a qualitative method with a phenomenological approach. Determination of informants in this study used a purposive sampling technique. There are two sources of data, namely secondary data, which is data obtained from the internet and books, and primary data obtained through data collection methods by conducting observations, semi-structured interviews, and documentation. The validity of the data is inferred from data triangulation techniques, while the method of data analysis follows Miles and Huberman by using data reduction, data display, and drawing conclusions. The results of this study are an explanation of the implementation of the PKH in Mronjo Village, a description of the lives of the three women beneficiary families, and an analysis of the cultural manifestations of poverty in woman beneficiary families. The reality of the characteristics of the culture of poverty that develops in the life of beneficiary families is in the form of a culture of dependence on PKH social assistance, debt, child assistance, wife as the main supporter of the family economy, and a mindset of accepting poverty as destiny.

INTRODUCTION

Based on the 2022 Developing Village Index (IDM), Mronjo Village has 1,602 families that are categorized as poor out of 2,177 families in Mronjo Village as a whole. More than half of the member of Mronjo Village hold card who consider them as poor family. In this case, the Mronjo Village government is running a social assistance program from the Ministry of Social Affairs, named the Family Hope Program (PKH), which is hoped to be able to improve the welfare of poor families to reduce poverty [1].

This research examines women who live in a culture of poverty. Poverty in these women's families is reflected in their family's income of less than US $2.15 or Rp. 32,745 per day, equivalent to 982,350 per month (Exchange rate Rp. 15,230 per US $1), based on the poverty line calculation according to the World Bank [2]. This lack of income is caused by poor families not always receiving a steady income every day. With these conditions poor families are often forced to go into debt to meet their family's living needs. The reality of debt has become a habit carried out by poor families as a way to survive. This condition of poverty means that women (mothers or wives) from poor families have to step in to help improve the family's economic conditions. Women from poor families are the main supporters of the economy in poor families, as they are required to work harder to improve the family economy. Apart from being a housewife, the woman also has to bear the burden of the family and is expected to be able to make her family live

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030045-1–030045-8; https://doi.org/10.1063/5.0241602

more prosperous. However, women in rural areas, especially Mronjo Village, have limited access to work. This is due to low education, forcing them to work in the informal sector in jobs such as farmers or farm laborers, seamstresses, casual laborers, looking after livestock, or are even unemployed.

On the other hand, poverty conditions that they experience make women from poor families eligible for poverty alleviation programs run by the government, namely the Family Hope Program (PKH). In the PKH context, women, mothers, or wives are chosen as representatives of their families to receive PKH social assistance. The choice of women as representatives of poor families to receive PKH social assistance is due to the fact that the government recognizes that the woman manages the family's finances while also taking care of all the needs of family members. Apart from that, the government wants to give women the power to manage PKH social assistance funds to meet family needs in order to create prosperity for their families.

The Family Hope Program (PKH) is one of the government's programs that is expected to help alleviate the problem of poverty. However, in several previous studies this program was shown that many beneficiaries increase dependence on social assistance. For example, it is happened in Sidorejo Village, where recipients had high hopes for social assistance funds so that they can fulfill their daily needs [3]. The PKH social assistance program creates dependence on social assistance. With the label of a "poor family," it is profitable for women because they receive social assistance from the government. If they have received PKH social assistance in the past, then indirectly the poor family is already on the list of recipients of other types of social assistance and will receive social assistance continuously, considering that the Indonesian government has several types of social assistance programs. This is what causes poor families to depend on social assistance from the government, especially PKH social assistance.

The reality in Mronjo Village is that poor families who receive PKH assistance are happy to receive social assistance from the Indonesian government, and they do not feel embarrassed if they are considered poor. This is an interesting fact about poor families. By receiving PKH assistance it is shown that the family is unable to take care of its own needs. Ideally a family should be able to meet the needs of all its family members. In this case, there are poor families receiving PKH social assistance in Mronjo Village who have received PKH social assistance for more than six years. If families receive assistance for more than six years, there will be a transformation of PKH membership, but this does not usually happen because the family is still deemed eligible to receive PKH assistance, causing social jealousy among the community. In general, if the family has received assistance for several years, they should be more prosperous and economically independent, but this prosperity does not happen.

This reality is interesting because the family is unable to escape the trap of poverty, even though they have received social assistance from the government for years. In this research, the reality of poverty experienced by women in poor families will be linked to the lifestyle and culture that exist in poor families receiving PKH social assistance in Mronjo Village. The relationship between poverty and culture assumes that there are certain attitudes or behaviors carried out by poor people where these are the main cause of the conditions of poverty experienced by their families; this is often known as the culture of poverty [4].

This research will use the Cultural Theory of Poverty by Oscar Lewis. The Cultural Theory of Poverty is a way of survival passed down in a family from generation to generation [5]. According to Oscar Lewis, there are certain patterns of behavior and attitudes shown by poor people as a way for them to continue to live their lives in poverty [6]. Cultural representations of poverty can be grouped into four categories: behavior, main values, and character of the individual; conditions of poor communities; family conditions; and the relationship between local culture and wider society [7]. Individual factors such as laziness, feelings of hopelessness, acceptance of fate, and low work ethic within oneself are the main causes of a culture of poverty in a poor society. Through this research, we show how the culture of poverty manifests itself among women who receive social assistance from the Family Hope Program (PKH) in Mronjo Village. In this case, the problem of poverty is not a reality that only occurs in villages, especially Mronjo, but can occur anywhere, in rural and urban areas. The problem of poverty that occurs among women in poor families who receive PKH in Mronjo Village reflects the poverty that occurs in other areas.

METHODS

This research uses a qualitative method with a phenomenological approach by focusing on understanding, analyzing, and interpreting individual experiences related to the research phenomenon [8]. This research focuses on the manifestation of a culture of poverty among female families who receive social assistance benefits from the Family Hope Program (PKH) in Mronjo Village. The research location is Mronjo Village, chosen as the research location because in the Mronjo Village community there is a phenomenon of poverty. Researchers needed approximately two months to collect data. Determining informants in this study used a purposive sampling technique [9] with the characteristics of a main informant being a female family who is a PKH beneficiary in Mronjo Village who has received PKH assistance for more than 6 years, as well as PKH assistants and village officials as additional informants. There are two sources of data, namely secondary data which is data obtained from the internet and books and primary data obtained through data collection methods by conducting observations, semi-structured interviews and documentation. The validity of the data is supported through data triangulation techniques by comparing data that has been obtained from informants [10], while the data analysis method refers to data analysis according to Miles and Huberman using data reduction, data display, and drawing conclusions [9].

RESULTS AND DISCUSSION

Family Hope Program in Mronjo Village

In implementing PKH, initially data on poor families in Mronjo Village which had been agreed upon with village officials in village meetings would be included in the Integrated Social Welfare Data (DTKS). This data would then be validated so that poor families can receive PKH social assistance. The data on poor families in the DTKS is dynamic, meaning that village operators, assisted by PKH assistants, can deny or qualify poor families to receive social assistance. In this case, when a poor family no longer receives PKH social assistance or receives it late, the village operator and PKH assistants know the reason. There are many factors that cause poor families to no longer receive PKH social assistance or receive it late.

Based on interviews with village officials who are responsible for PKH social assistance and who are the operators of Mronjo Village, namely Arif, the reality of PKH recipients in Mronjo Village shows that PKH recipients always ask when PKH assistance is not disbursed or is disbursed late. Below is Mr. Arif's statement during the interview:

"... there are those who are like “guarding” when the assistance will come.. there are even those who protest if the assistance just one month late..." (Interview with Arif, Village Apparatus, 2023)

Arif said that PKH recipients protested to him because of the late disbursement of PKH aid. Agus, the PKH assistant in Mronjo Village, also experienced similar protests. The protest behavior carried out by women as representatives of their families to receive PKH assistance is considered unethical because social assistance should not be expected. Women from poor families who receive PKH want this assistance to be disbursed on time because they are trying to meet the living needs of their family members. If the disbursement is late then they will protest and get angry and blame the village operator and PKH assistants, and they will find out the reason for the PKH assistance late disbursement. This was confirmed by PKH recipients as stated by Mujiati, Badriyah, and Ana in interviews:

"I used to protest why it wasn't disbursed..." (Interview with Mujiati, PKH recipient, 2023)

On the other hand, protest behavior like this happens because they depend on PKH social assistance for their livelihoods. The following is Agus' statement in the interview:

“... aid became an addiction. Once you receive social assistance, you will continue to receive other assistance..." (Interview with Agus, PKH Facilitator, 2023)

Agus said that PKH social assistance can become an addiction for the recipient, because once they receive PKH social assistance, the recipient of the assistance will continue to periodically receive other types of social assistance from the government, so this causes the recipient to become dependent on this PKH social assistance. It is not surprising that if PKH assistance is disbursed late or even not disbursed, women as family representatives in receiving PKH social assistance will protest to PKH assistants or village officials. This protest action is a follow-up to the low income of poor families who receive PKH.

The reality of the emergence of behavior to maintain PKH assistance funds and the dependence of PKH recipients on this assistance as explained in the previous paragraph is inevitable; this behavior and dependence are constructed because of the existence of social assistance that facilitates or lightens the burden on the recipients. The existence of direct cash assistance such as PKH is used practically by program recipients in terms of meeting life's needs, so that this assistance can be a way for poor families to experience a more prosperous life. Apart from that, with PKH assistance funds, PKH recipients will gain economic benefits without having to work.

On the other hand, apart from causing dependency, the economic benefits of PKH social assistance funds received without having to work cause the recipients to become lazy. According to Arif, recipients are just waiting for work and do not want to look for or create work. For village residents, PKH social assistance can fulfill their basic needs whether funds are sufficient or lacking. They have no ambition to build better economic conditions - for them, being able to eat and earn a little money is enough and they are grateful. Apart from that, PKH recipients consider that social assistance is a salary once every three months, which is an interesting way to think about social assistance.

PKH recipients' dependence on this assistance, which is shown through certain behavior such as protesting, getting angry, blaming the village operator and PKH assistants, as well as finding out the reasons why the PKH assistance was disbursed late, proves the existence of a culture of poverty among women who receive PKH in Mronjo Village. This dependency reflects the pattern of life of poor families in solving problems or finding solutions to the poverty they experience. The behavior of maintaining the PKH social assistance they receive by protesting, getting angry, blaming the village operator and PKH assistants, and finding out the reasons why the PKH assistance was late in being disbursed is a way for them to continue to survive.

Dependent behavior makes them reluctant to work because they rely on PKH assistance funds, and is one of the causes of the poverty conditions they are experiencing. This occurs without them realizing it; instead, they perpetuate the behaviors of dependence on PKH assistance funds as an instant way to gain economic benefits. Gradually, this happens over a long period of time and becomes a culture among women who receive PKH - a culture of poverty.

The dependence of PKH social assistance recipients was confirmed in previous research above, even though at other research locations. In general, this also occurs in other areas, but in this research, there is new data that the dependence of PKH social assistance recipients in Mronjo Village is experienced by women who are family representatives. This is similar for women from poor families receiving PKH who work and act as the main supporter of the family economy.

Poverty in the Family Life of PKH Woman Recipients

Mujiati's Family

Mujiati is one of the recipients of PKH social assistance and has received PKH assistance from 2014 until now. Mujiati is a farmer and farm worker, her skin is sunburnt brown, and every day she goes to the rice fields to work on the rice fields given to her by her parents which are not very large. She also works on other people's fields so that she can get wages to survive. Mujiati was born in 1970, and currently she is around 53 years old. She married Pi'i, who became her husband and father of her nine children and has faithfully accompanied her to this day. Pi'i is also a farmer and farm laborer.

Mujiati said that the harvest results for her rice fields were not very good, because many planthopper pests attacked them. Erratic harvest results, plus the long harvest time, have caused Mujiati's family difficult in meeting their daily needs. Often while waiting for the harvest, Pi'i and Mujiati work as farm laborers working on other people's agricultural land, but this is not done every day so it is not uncommon for Pi'i to be unemployed because there are no farmers who need his services. Mujiati complained that it is not uncommon for farmers who use the services of their farm laborers to be late in paying their wages, so Mujiati and her husband can only wait and hope that the farmer who hired them will quickly pay the wages of their farm laborers.

Mujiati has to be smart in managing the family's finances because the amount of money they have is not much, yet the family's needs must be met with that money are many and varied. Mujiati has to be creative in dividing the money in order to meet all the family's needs, and she also has to be economical in all things. Moreover, Mujiati and her husband pay for the education of so many of their children, therefore she also has to set aside money for these education costs. During the disbursement of phase one of PKH funds last March, Mujiati received 1.7 million. Mujiati and her husband were able to send their children to school because previously their first three children did not continue their education due to financial reasons.

Mujiati's family lives in a simple house, and the house is not very neat because Mujiati is busy working in the rice fields. That house is a shelter for 10 family members. Their children always help with housekeeping such as sweeping, washing clothes, washing dishes, and so on. The following is Mujiati's statement in the interview:

"... helped by the children, I asked them to help wash clothes, sweep, I came home from the rice fields and was tired, so I helped the children" (Interview with Mujiati, PKH recipient, 2023)

Based on the interview statement above, Mujiati's children are required to help with housework and they miss out on socializing with their surroundings. In the future, Mujiati hopes that her family can continue to receive social assistance like this, the following is an interview statement from Mujiati:

"Hopefully we can still get [social assistance] ..." (Interview with Mujiati, PKH recipient, 2023)

Mujiati's statement above that she hopes that her family will continue to receive PKH social assistance and other social assistance. Mujiati seemed embarrassed to admit that she hoped for this social assistance because Mujiati also said that she didn't expect it; if she got social assistance then it meant her family's good fortune, even though if one day she stopped getting social assistance it wouldn't be a problem for Mujiati because her husband would continue to work to support his life and that of his family.

Sarah's Family

Sarah is one of the recipients of PKH social assistance, and she has received PKH assistance from 2012 until now. However, because Sarah was unable to take care of receiving PKH assistance, she was assisted by Badriyah, her daughter, who also received PKH assistance for approximately one year. Both Badriyah and Sarah, very happy and also sad receiving social assistance from the government. Sarah is a single parent, and she is a widow whose husband died a long time ago. Sarah has three children, and currently the first and second child have gone abroad and rarely come home. Her third child is Badriyah who currently lives with her. Sarah is 82 years old while Badriyah is 62 years old. Both of them are widow.

Even though the assistance is only disbursed once every three months and the amount of money is not that large, Sarah and Badriyah appreciate PKH assistance to help meet their daily living needs. From PKH assistance, Sarah and Badriyah receive 600.000 Rupiah in installments every three months. Usually, this money is used to buy food, medicine, and other household needs. Apart from getting money for daily living expenses, through PKH assistance, Sarah and Badriyah received other social assistance facilities in the form of Non-Cash Food Assistance (BPNT) and the Healthy Indonesia Card (KIS). Badriyah said that she was disappointed because, at the first stage in March, her and Sarah's BPNT aid had not been disbursed, which disappointed her and she asked the PKH assistant why the aid had not come out. For her, BPNT's basic food assistance is very useful because her family doesn't have a rice field, so for basic needs such as rice, Badriyah has to buy it. Often local people give rice alms to Sarah and her daughter, Badriyah. When they harvest rice, they will give rice to Sarah because they feel sorry for her, so this is quite helpful for Sarah to save money on buying rice.

With the social assistance received by Sarah and Badriyah, they felt assisted and happy. Sarah and Badriyah admitted that they were also looking forward to this social assistance. As Badriyah said during an interview:

> "... you know, I've tried using my card [at the ATM]..but nothing come out. I use it many time, still the same, nothing happen. So, I just surrender to Allah SWT. (Interview with Badriyah, PKH recipient, 2023)

From Sarah's account in the interview, it can be concluded that she felt sad and disappointed when the social assistance was not disbursed.

Badriyah admitted that she didn't want to ask her children for money, because she understood that her son didn't have much money either. Sarah feels sad because she can't help much, and is also embarrassed when she has to ask her child for money, so Sarah and Badriyah have to be frugal in using social assistance so that they have enough to meet their living needs. Sarah shared about her living conditions regarding receiving PKH assistance, following her statement during the interview:

> "... don't have any money at all, it's not nice to ask your children to be embarrassed. So what else do you have to do? Sometimes, look for help first, look for debt help first from close family or friends, like that... later when you get PKH, then pay off the loan." (Interview with Sarah, PKH recipient, 2023)

From Sarah's account in the interview, it can be concluded that Sarah only relies on PKH social assistance to meet her daily needs. When Sarah didn't have money, Sarah was confused about what to do. The only way out is for Sarah to borrow money from her family or friends, then when the PKH aid money has been disbursed, Sarah will pay the debt with the money from the PKH aid. Sarah and Badriyah hope that in the future, their PKH assistance will run smoothly without any problems, always be disbursed on time, and hopefully this assistance will not stop, as stated in their interview:

> "Hopefully the future will go smoothly, smoothly. We do hope that assistance does not stop..." (Interview with Sarah and Badriyah, PKH recipients, 2023)

From this statement it can be concluded that Sarah and Badriyah hope that they will always receive this social assistance.

Ana's Family

Ana (name disguised) is one of the recipients of PKH social disability assistance from Mronjo Village for her child named Niko (name disguised) and has received PKH assistance from 2014 until now. Ana is currently 59 years old, and now Ana's lives alone with Niko. Ana's husband died last year due to an illness he was suffering from. Ana's child, Niko, is a special needs child. Niko is a child with developmental delays mentally, emotionally, intellectually and physically due to Down syndrome. Niko was born in 2000, and he is currently 23 years old. Currently, Niko is in the

3rd year of high school and attends a special school (SLB) not far from his house. According to Ana, Niko is a good child even though he suffers from Down syndrome. Niko rarely throws tantrums, and as long as he doesn't get rude he is gentle. Apart from that, Niko is also independent and often helps with housework such as washing clothes and dishes, sweeping, and drying clothes, as Ana said in an interview:

"... I can leave him here while I look for grass [for the cows]….he can wash the dishes and wash the clothes too" (Interview with Ana, PKH recipient, 2023)

From the interview statement above, even though he has limitations, Niko can help with housework to lighten his mother's burden. Ana also didn't hesitate to give tasks to Niko, because Niko had to be independent and Ana felt overwhelmed taking care of everything herself. Usually, Niko looks after the house alone when Ana has to go to the rice fields to look for grass.

Ana's daily life is busy taking care of Niko, sewing clothes, and looking after the two cows left by her husband. In the morning, Ana had to take Niko to school. After that, she cleaned the house and did the sewing orders. In the afternoon, she picks up Niko and takes care of his needs. After that, Ana has to rush to the rice fields, looking for grass for her two cows. According to Ana, the cow did not belong to her because the cow had been used as collateral when Ana borrowed money from the bank. Ana burden increases because she has to pay bank installments every month. At night, Ana had to work on her sewing orders until late at night.

Ana received 600.000 rupiah, and this money was used for education, transportation and food costs or other living necessities for Niko, considering that his income from sewing was not enough to meet his living needs. Even though the assistance is only disbursed once every three months and the amount of money is not that large, Ana feels very supported by the PKH assistance.

From Ana's narrative, it can be concluded that Ana is a devout person who worships, leaving everything to Allah SWT. Ana is willing to go through all this, hoping that God will always help her. The interview statement also shows that Ana depends on PKH assistance, and this is because her income from sewing is not enough to meet her daily needs.

In the future, Ana hopes that her family can continue to receive social assistance like this. The following is a statement from Ana:

"... then hopefully it will still come out, then next year I want to register too so I can..." (Interview with Ana, PKH recipient, 2023)

Next year, Ana will be getting older. She hopes that next year, she will also get PKH assistance for the elderly.

From the presentation of the findings above, the conditions of poverty experienced by PKH recipients can be seen. There are differences and similarities in the three families receiving PKH social assistance. The striking difference is that Sarah is an elderly person who is no longer able to work, while Mujiati and Ana are people of productive age so they both have to work to provide for their family. Mujiati works to help her husband to support their children, while Ana is the head of the family. In this case, there are similarities between Mujiati and Ana, as women, apart from being housewives, as they are also required to earn a living to meet the needs of their families, and they are faced with a situation of poverty which requires them to work.

The similarities between the three families lie in their context as PKH recipients. The three families have something in common in that they show symptoms of dependency on PKH assistance which provides direct assistance in the form of money to the recipients. In this case, the dependence of PKH recipients on this assistance shows the existence of a culture of poverty which is characterized by the emergence of certain behaviors such as protesting, getting angry, blaming village operators and PKH assistants, as well as finding out the reasons for their PKH assistance's late disbursement to ensure that they continue to receive this assistance. Besides that, the dependence of PKH recipients on this assistance is reinforced by direct statements during interviews that state that they hope to continue receiving PKH social assistance. Mujiati and Ana even tried to find other types of social assistance, while Sarah and Badriyah looked very disappointed when they did not get complementary social assistance from PKH.

Another similarity is that poor families rely on debt to meet their needs. This is shown by Ana and Sarah who stated that they are used to being indebted to neighbors, friends, and banks. This debt has the same motives as dependence on PKH assistance, namely that it is a behavioral effort made to survive the conditions of poverty that they are experiencing.

Children from poor families are required to always help their parents in any way, especially when it comes to taking care of housework. We can see the children of Mujiati and Ana have to help with the housework because their mother is busy working so they don't have time to take care of the house. Children from poor families are used to doing housework such as washing dishes, washing clothes, cooking, sweeping, and other housework. This causes the child to miss out on socializing with the surrounding environment, where they can learn many things from friends their age however this is hindered because they are required to help their parents.

The similarities between the three families can also be seen from the mindset they have developed, that the poverty they are experiencing is a destiny from God that they must live up to, and they surrender their conditions to God. Ana and Sarah admitted that they were willing to accept and live with this condition of poverty. This type of thinking means that they do not have the ambition to work hard and earn better income, so their conditions of poverty continue and are difficult to escape from. This is also supported by the existence of social assistance which does not increase the recipient's independence in terms of the family's economic conditions.

The many similarities above, show that there is a culture of poverty among PKH recipients. A culture of poverty which can be seen from certain behaviors carried out by people from poor families in order to survive. This way of surviving will indirectly be passed down from generation to generation so that it becomes a culture of survival carried out by poor people which will ultimately form a culture of poverty, where it is difficult to escape the problems of poverty that they experience. Without them realizing it, behaviors such as dependence on PKH social assistance and going into debt can perpetuate the poverty they are experiencing.

Cultural Forms of Poverty

Based on Oscar Lewis's Cultural Theory of Poverty, there are several forms of cultural poverty among women who receive PKH social assistance:

1. Culture of Dependence on Social Assistance, the most prominent form of the culture of poverty, is dependence on PKH social assistance. This culture of dependence on PKH social assistance can be seen from behavior patterns that show an attitude of expecting PKH to always be disbursed on time and always hoping to receive PKH social assistance continuously accompanied by other complementary social assistance. If PKH aid is late or not disbursed, they feel annoyed and disappointed, and it is not uncommon for them to get angry and protest to the PKH administrators, asking why the aid is late or not disbursed. This dependency occurs because this assistance becomes an addiction for those who receive it, because once they receive social assistance from the government, they will continue to receive social assistance continuously in the form of other types of social assistance. Apart from that, the income they earn is not enough to meet their family's needs, so it is not surprising that they expect PKH to meet their living needs. They also try to register to get other types of social assistance. This dependence can be seen from the three informants who openly stated that they hoped to continue receiving PKH and other types of social assistance.
2. The culture of debt, meaning being in debt or borrowing money, is a shortcut to meeting family needs which was often done by the three informants, either by owing money to the bank or owing money to close friends or neighbours. Often, the informants used PKH to pay debts. The majority of PKH recipients do not have a steady income or even no income at all for the elderly. The majority of PKH recipients' jobs are farmers with small amounts of land, farm laborers or casual laborers, and small traders. The results they get from their work are only enough to meet their daily needs, or even less. It is not uncommon for them to be forced to owe money to family, friends, or neighbours so that their daily needs can be met.
3. The culture requiring children to help their parents arises because women in poor families have to work hard to meet family needs, which makes domestic matters less of a priority. In this case, mothers require their children to help take care of the house through washing clothes, cleaning the house, cooking, and other housework, causing children in poor families to miss out on a period of growth and development by helping their parents in any way. This can be seen from Mujiati and Ana, who told their children to do homework instead of playing with their peers. Apart from that, children from poor families also have to help the family finances, meaning that children work to meet their family's needs, not for their own future.
4. In the culture of women (wives or mothers) as the main supporter of the family among poor families, women play many roles at once, such as the roles of wife, mother, and worker. They have to work to help provide for the family financially. This can be seen from Mujiati who works with her husband in the rice fields and Ana who is a single parent so she has to work to meet her child's needs. In this case, women take part and play an important role in improving family finances, because if they only relied on their husband's income, it would not be enough to meet the family's needs.
5. Due to cultural mindsets, it is not uncommon for women to believe that the poor conditions they are currently experiencing are fates that must be accepted, and they should be grateful for what they receive. This can be seen from Ana who surrenders everything to Allah SWT. Ana is willing to go through all this, hoping that

God will always help her. Apart from that, this mindset assumes that social assistance is a salary, making them more lazy. They live in villages that are used to living very simply, so they have no ambitions for a better life and even seem resigned to the poor situations they live in.

CONCLUSION

Based on this research, women who receive PKH have a great dependence on social assistance. This can be seen from their behavioral patterns which show an attitude of expecting PKH social assistance to always be disbursed on time and hoping to receive PKH social assistance continuously accompanied by other complementary social assistance. There is a culture of poverty, defined by a culture of dependence on PKH social assistance, low self-esteem, debt, a culture of children having to help their parents, the wife being the main supporter of the family finances, and a mindset of accepting poverty as destiny. This culture of poverty continues without them realizing and is passed on to their children so that it becomes a culture that causes poverty in their families. However, we also can see that by having assistances from the government, these people can still continue their life.

However, further research still needs to do. This current research only showing about senior citizen who get benefit from government social assistance, while there is not many information about poor young people who become beneficiaries of government social assistance. So that we can see what is the progress of this young people who get this assistance in improving their life.

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Women's Leadership (Uwa/Uwatta) in the View of the Towani Tolotang Community

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Abstract. This study discusses Women's Leadership (Uwa or Uwatta) in the Towani Tolotang Community, using descriptive type qualitative research based on the results of data processing to clarify views on women's leadership in the Towani Tolotang community. Data from this research was obtained from related parties who understand in depth the material being studied to produce valid data on the Towani Tolotang Community's views on Women's Leadership in the Towani Tolotang Community. The results of this research show that the Towani Tolotang Community, which is a Bugis ethnic community, has patriarchal views and culture, but the Towani Tolotang Community, which is an ethnic group, is very strong in holding and maintaining the beliefs and traditions of its ancestors, not limiting gender differences in the power of UWA or UWATTA for women and man.

INTRODUCTION

In the Bugis cultural view, men and women are guided by their respective duties and functions, in their activities there are differences, but these duties and functions complement each other.[1] In principle, in Bugis society, it is almost the same as in other tribes, domestic functions are the responsibility of women while men act as family leaders and breadwinners, or public functions are taken over by men. This is a view of patriarchal culture which is often criticized by feminists, the criticism is based on the patriarchal system applying the traditional division of roles between men and women.

The parenting style that has been used since ancient times has created a barrier that differentiates the roles of women and men within Bugis society. Women are connoted as number two people who play a supporting role in men's success. This is interesting to study from the perspective of the Towani Tolotang Community. [2]

The Towani Tolotang community is a tribe/ethnicity that is very strong in holding and maintaining the beliefs and traditions of its ancestors. Tolotang belief is a belief in God that has been passed down from generation to generation, internalized, and developed by subsequent generations. An indigenous culture imbued with beliefs that adhere to monotheism (which he calls Dewata Seuwae). [3]

The strong patriarchal culture within the Bugis community and the Towani Tolotang Community which was born and developed within the Bugis community will be filtered to see the views of the Towani Tolotang Community in viewing the Leadership Position of Women in the Towani Tolotang Community.

Benefits of deepening women's leadership patterns in the Towani Tolotang Community

Based on the material explained above, this study was carried out in Sidrap Regency, which is the location for the development of the Towani Tolotang community. The strong patriarchal culture in the Bugis region will be in line with the views of the Towani Tolotang Community in their daily life regarding women's leadership. The Towani Tolotang social group believes that they are descendants of La Panaungi and have inherited the abilities and powers that have been bestowed by God (Dewata SeuwaE).[4] This belief has been passed down from generation to generation and is guarded by the Towani Tolotang Community so that all the teachings of their ancestors are not erased over time.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030046-1–030046-4; https://doi.org/10.1063/5.0242004
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

One tribe in Indonesia that still adheres to patriarchal culture is the Bugis tribe of South Sulawesi. This is in line with Bugis women who still adhere to the lontara and pappaseng who state that the position of Bugis women is only at the domestic level. This makes Bugis women become secondary creatures in social life. And the existence of these regulations often makes Bugis women surrender to accept reality. As a result, patriarchal culture is increasingly developing in the suburbs, especially in some rural areas.[5] which is believed to be an ancestral heritage will certainly give rise to the opinion that the Towani Tolotang Community also adheres to this culture. Therefore, this research will focus on discussing women's leadership in the view of the Towani Tolotang Community amidst the strong patriarchal culture in their environment.

The benefit that will be obtained is knowing the Towani Tolotang Community's view of the position of women. Examining the views of the Towani Tolotang Community regarding women's leadership which is very difficult to realize locally in Sidrap and even on a national scale in Indonesia.[6]

TOWANI TOLOTANG COMMUNITY

Towani Tolotang means tau = "people", and wani is the name of the village where this community began. So Towani means "Wani village people". Tolotang also comes from two different words, namely the word tau = "people" and lotang which means south. The term Tolotang is the nickname used by Addatuang (King Sidenreng) to refer to the Towani people. However, in subsequent developments, Towani Tolotang was adopted as the name of the sect given by other people.[7] Until now, the Towani Tolotang Community, or what is usually called Tolotang continues to exist and carry out its religious rituals in the district. Sidrap.

Towani Tolotang Group Formally they are registered as a Hindu religion, even though their religious practices are different from Hinduism in general.[3] Initially, the Towani Tolotang Community was a community originating from Kab. Wajo, but after Islamic teachings entered the district. Wajo, the head of the kingdom ordered all his people to embrace the teachings of Islam, this was opposed by the Towani Tolotang Community so they had to leave the district. Wajo and moved to Kab. Sidrap with the agreement that they must comply with Islamic law. This history has made it so that to this day the Towani Tolotang Community, especially men, in their religious practices use caps and sarongs like Islam when worshiping.

Historically, various literature states that the Towani Tolotang community received discrimination from the local government at the beginning and after independence, as evidenced in the form of prohibitions on carrying out religious rituals other than Islam. However, after multiculturalism efforts were made, the Towani Tolotang Community to this day can live side by side with the Muslim majority even though administratively they have to recognize religions they do not adhere to.[8] Until now, this community still uses Hinduism as the religion written administratively in population data even though the religious implementation is not like the teachings of Hinduism

UWA/UWATTA

The Towani Tolotang group believes to this day that they are descendants of La Panaungi and have inherited the abilities and powers that have been bestowed by God (Dewata SeuwaE). In belief, uwa is someone who can communicate with the God SeuwaE and ask him for health and prosperity in the afterlife.[9] Ordinary citizens will submit to all forms of guidance from uwa and always ask for guidance in matters of worldly and spiritual matters. Worship of the God SeuwaE, according to Towani Tolotang belief, is not carried out directly, but is carried out with certain ritual ceremonies and is led by the highest leader of the Towani Tolotang community called Uwatta and his assistants called uwa.[10]

The leadership role of uwatta and uwa covers all aspects of Towani Tolotang community life. In events related to the environment and nature, such as birth, marriage, death, entering a new house, descending a rice field, harvest, and ceremonies, the role of uwa, especially uwatta, is very decisive.[11] At a minimum, the implementation of the ceremonies must have the approval and blessing of the uwa or uwatta.

All forms of cultural activities and traditions adhered to by the Towani Tolotang community, including the establishment of customary laws (paseng with all its consequences), spiritual leadership (uwatta and uwa), use of expressions (language), use of traditional symbols, implementation of ritual ceremonies, and social relations between Towani Tolotang communities are instructions from traditional leaders (Uwa a d Uwatta).

Tolotang Community's view of Uwa/Uwatta leadership

Being selected as Uwa and Uwatta in the Towani Tolotang Community is a social strata classification that has been guided by generations. The strong belief in Dewata SeuwaE causes the position of Uwatta and Uwa to be seen as representatives of Dewata SeuwaE who are strictly obeyed by the people of the Towani Tolotang Community. Apart from lineage, the calcification of social strata is also based on the revelation that Uwa and Uwatta have received in leading their followers.[12] This selection does not look at gender but rather at strata classification. This is not limited to age. Because anyone who comes from a strata classification that is in the Uwa and Uwatta strata has the right to become Uwa and Uwatta.

This is determined by the revelation received and the leader's character which will be seen directly and the selection process is based on who can receive the revelation or teachings given by Uwa and Uwatta previously.[13] These revelations or teachings are not written and are only spoken once so that only selected people can carry out the mandate to be elected as leaders in the Towani Tolotang Community.

This view is in line with Multicultural Feminism (Tong Rosmarie Putnam 2008) which is based on multicultural thinking, namely an ideology that supports diversity.[14] The Towani Tolotang community, although throughout its history of development, has maintained its ancestral culture from generation to generation, it does not use patriarchal views as a guideline in selecting traditional leaders. The selection of Uwa and Uwatta from various genders and even ages shows that the Towani Tolotang Community inspired Multicultural Feminism Thought, which is carried out by Multicultural communities in religious customs and rituals.[15]

The view of gender equality in the leadership of the Towani Tolotang Community can be seen from the Towani Tolotang Community's acceptance of the leadership of women who are Uwa and Uwatta. In the view of patriarchal culture in Indonesia, which makes women play a role in domestic tasks, this will not apply to Uwa and Uwatta women. In the Uwa and Uwatta religious rituals, women will not carry out domestic duties but will carry out public duties as community leaders.[16] These domestic tasks will be carried out by the lower strata of society who will serve Uwa and Uwatta as a form of devotion to Dewata SeuwaE.

CONCLUSION

The Towani Tolotang Community is a community led by Uwa and Uwatta as representatives of God or Dewata seuwaE, Uwa, and Uwatta's leadership is based on lineage, social strata, and revelations or teachings that Uwa and Uwatta can accept, election to this position does not differentiate between male gender- both men and women. In the leadership of Uwa and Uwatta, gender will not be differentiated by their followers, all followers will submit and obey Uwa and Uwatta of any gender. This shows that the Towani Tolotang Community, which lives in a strong Bugis patriarchal environment, does not adhere to this in its leadership of women as Uwa or Uwatta. There are no gender differences in the leadership elements of the Towani Tolotang Community in Sidrap District.

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Salient Topics on Gender Equality Research Trends in Indonesia: A Bibliometric Study on Scopus Database

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Abstract: This paper explores the most salient issues in the research trends on gender equality in Indonesia based on the bibliometric study by analysing document research evidence taken from the scientific journal indexed in Scopus. The research found around 171 research documents and journal articles in the last two decades. From a number of research documents, several issues stand out, including issues regarding violence against women, equality in the workplace and women's participation in the public arena. The data found is visualised using the VOSviewer app. Study on research trends using this app is a unique method. Moreover, the data finding shows that the intensity of the document in each issue is different, indicating the changing number every time. Therefore, the result of this research will benefit researchers as a guide toward further research on gender equality and other issues related to gender studies.

INTRODUCTION

In recent years, there has been a growing interest in trend research on gender equality as more people become aware of the importance of this issue. It refers to the fact that despite progress towards gender equality, women still face significant unequal treatment in many areas. Gender inequality can manifest in various forms, such as unequal pay, violence against women, limited participation of women in the public arena or underrepresentation in leadership positions. [1], [2].[3]– [5]. According to the World Economy Forum in Gender Gap Report 2022, Indonesia ranked 92nd out of 146 countries with a gender gap point of 0,697[6].

Concerning the paragraph above, this paper seeks to analyse research trends in gender equality in Indonesia. Research trend here is defined as a collective action of a group of researchers who begin to devote close attention to a given scientific topic by reading, referring to, and publishing the results of their research.[7] Thus, to understand research trends on gender equality, this group conducted a bibliometric study by analysing document research evidence from the scientific journal that indexes in Scopus. This is chosen due to the reliability and quality of the document or articles. Scopus provides the largest curated abstracts and citations database, which includes scientific journals, conference proceedings and books. [8]. In addition to the definition of bibliometric studies, bibliometric techniques are regarded as helpful decision-making tools for determining research priorities, following the evolution of science and technology, allocating funds, and rewarding scientific brilliance, among other things.[9] Therefore, this research aims to examine the trend of scientific publication in the study of gender equality in the last two decades (1998-2022).

Previous studies have examined bibliometric analysis on gender equality but with different compositional limitations in the Scopus database and how to read its data findings. Research conducted by Abdul Rasyid (2022) focuses on global research on gender equality using the bibliometric technique. In his study, he explored the Scopus database to find journals and articles related to gender equality, which archived 11,914 documents from 1982 to 2022, consisting of 28 disciplines or subject areas [10]. Another study is “Twenty-five Years of Gender, Work and Organization: A Bibliometric Analysis” by Kataria et al.[11]. This study seeks to know documentation of evidence of research activities carried out by the Journal of Gender, Work, and Organization from 1994 to 2018 in the Scopus database using Gephi and VOSviewer software.[11]. Also, Peter Keenan and Ciara Heavin, entitled

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030047-1–030047-9; https://doi.org/10.1063/5.0241543
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

"DSS Research: a bibliometric analysis by gender" This research used a bibliometric approach to explore the research landscape by the gender of publishing authors in the Decision Support System (DSS) field over ten years (2011 to 2020). This presents information on the gender breakdown of authors publishing on DSS globally [12]. Lastly is a study that examined gender inequality in research on biomedical by Sebo P., Maisonneuve H. and Fournier J. They assessed the prevalence of female first authorship in general biomedical journals and examined its variations across a number of authors, articles and journal characteristics.[13]

Therefore, this research attempts to answer the central research question of what is the most salient topic that emerges as a research trend on gender equality in Indonesia. In response to this question, the study finds that the three most salient topics on the issues of gender equality include violence against women, unequal treatment toward women in the workplace and limited participation in the public arena. These three issues will be discussed in the following paragraphs.

METHOD

The method of this study is qualitative by conducting text analysis on publications, especially in the most salient of gender equality issues, which are published in Scopus-indexed journals. The research data was extracted from the Scopus database and analysed using bibliometric analysis (mapping method), which involves bibliographic data and is linked to a collection of papers taken from each field of study[14]. Moreover, bibliometric analysis could map many scientific literatures [15]. Furthermore, using bibliometric analysis could guarantee the quality of the information presented due to its strict techniques [16]. The researcher employs the bibliometric method because data-driven research investigations are deemed more significant than subjective evaluations, and traditional reviews can provide a synopsis of subjective and critical scientific publications. As a result, the bibliometric method aids in collecting scientific reviews.[17]. Therefore, using VOSviewer software as an analytical tool is to depict data networks (bibliometric maps) and links between study issues relevant to the research theme[10], [18]. The following figure describes the flow of this research:

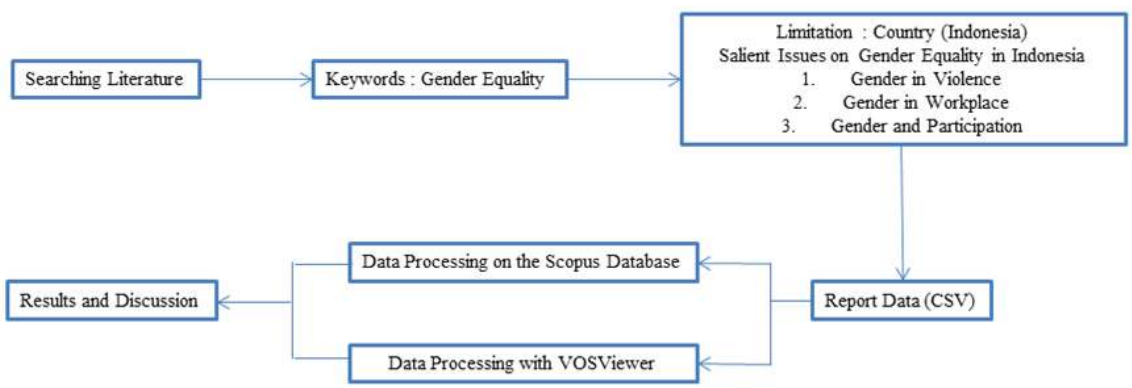

FIGURE 1. Research design and method
Source: Processed by the Authors

Figure 1 depicts the data mining roadmap and the steps of data processing. The first stage of this research is to identify scientific articles on gender equality in Indonesia published in Scopus-indexed journals. Secondly, the keyword "gender equality" is filtered into relevant keywords. The researcher focused on three significant issues: gender and violence, gender inequality in the workplace, and gender and participation in the public sphere. Thirdly, the data will be extracted using CSV document types. Lastly, the data is processed using VOSviewer software to create a data map using keyword specification. [19]

RESULT AND DISCUSSION

Trends of Publications

This study finds 171 articles related to the issues of Gender Equality in Indonesia captured in journals indexed-Scopus from 1998-2022. From 171 articles, we analysed the abstract and found that there are three main issues that appear most often, which are Gender equality in the workplace, gender violence, and gender and participation.

Furthermore, we are left with 57 of total articles with three most salient issues. From these findings, we argued that these salient issues are the most discussed gender equality issues in Indonesia.

Publication Trends by Document

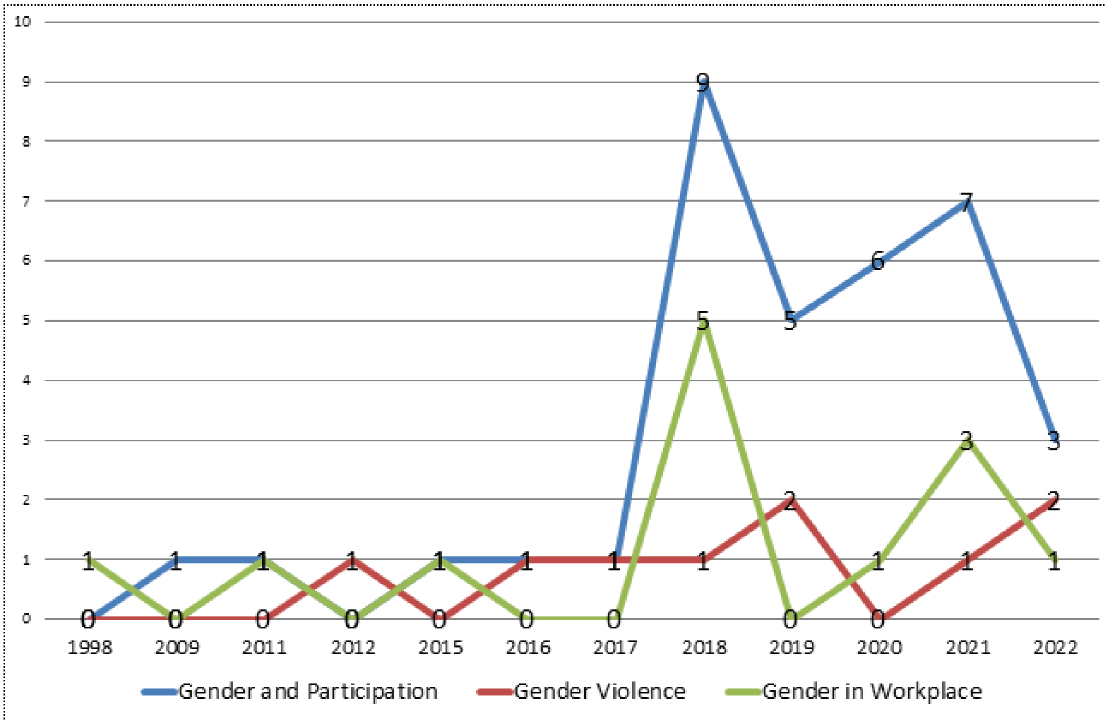

FIGURE 2. Trend publication by document, classified based on year of publication
Source: Processed by Authors (2023)

The data above shows trend publication by document. The blue line indicator represents gender and participation keywords, the red line represents gender violence keywords, and the green line represents gender equality in the Workplace. From 1998 to 2017, there was a stagnant number of publications within the three main keywords, between 0 and 1. However, since 2018, there has been a significant increase in publication.

In two of the keywords, namely gender and participation and gender in the workplace, there was a significant increase in publications between 2017 and 2018. There are eight additional publications on the topic of gender and participation and five additions on the issue of gender equality in the workplace. On the other hand, there is no significant increase in the number of publications on gender violence. This shows that gender violence is not much discussed, although there is an increasing concern about gender and sexual violence in Indonesia.

Publication Trends by Keywords

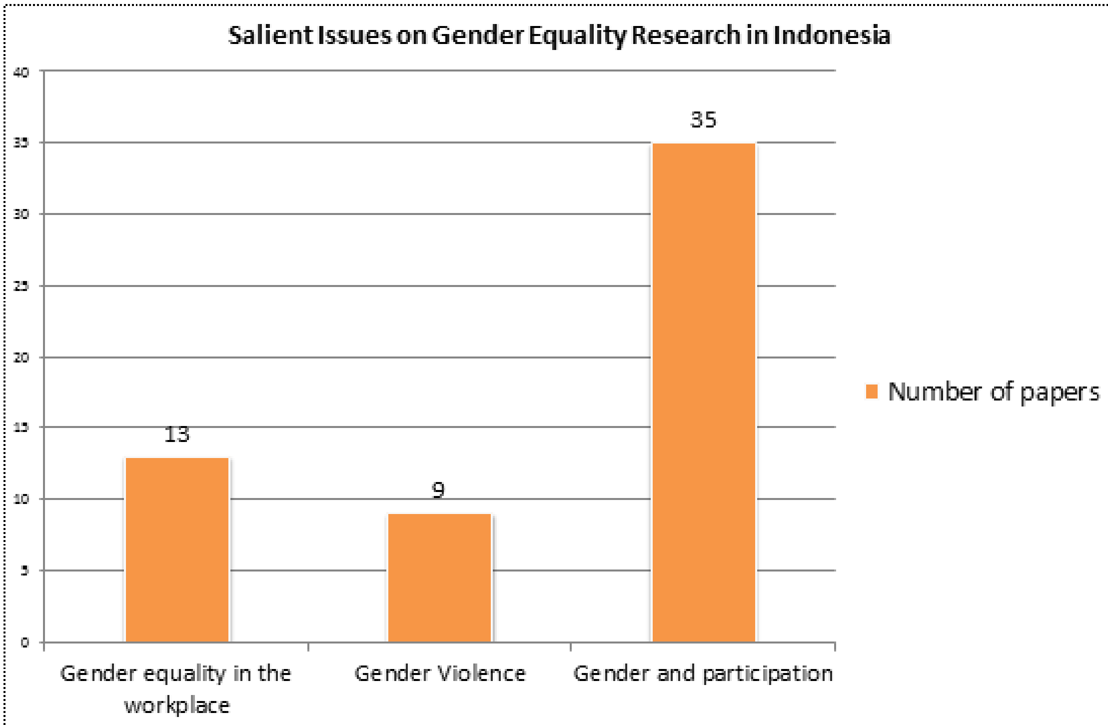

FIGURE 3. Salient issues on gender equality research in Indonesia
Source: Processed by Authors (2023)

The data above shows the number of publications by keywords. This study classified the findings narrowly into three main keywords, namely (1) Gender Equality in the Workplace, (2) Violence against women, and (3) Women's participation in the public arena. We found that these three issues have a different number of publications. First, there are 13 publications on Gender Equality in the workplace; gender violence contains nine articles and 35 articles on Gender and Participation. From the data above, it can be concluded that the keyword gender and participation has the highest number of publications. Therefore, the research trend in Indonesia under gender equality is gender and participation.

The most discussed topic in the research trend in Indonesia is gender and participation. These keywords mainly contain publications that discuss women's underrepresentation in the political stage of Indonesia. However, in recent years, there has been a growing concern about gender-based violence, such as sexual harassment and domestic violence, which resulted in public pressure on the legislation of the Sexual Violence Criminal Act (UU *TPKS)* (Adiputra et al., 2022). The research trend in Indonesia continues to discuss gender and participation. The topic of gender and participation explicitly discusses a quota gap between male and female candidates in local and national parliament. Although the constitution states that women must account for at least 30% of total parliament seats, this number is still hard to reach, which is why so much research is trying to assess this problem.

Publication Trends by Author and Affiliation

In this section, the aim to visualise the publication trends by author and affiliation is to determine which institution in Indonesia produced the most research under the topic about gender equality, specifically for the three main issues that the authors have classified. The result shows that the distribution of publication for gender equality research in Indonesia on Scopus Database is somewhat even, with the highest number of publications coming from Universitas Indonesia with 2 publications.

TABLE 1. Publication Trends by Author and Affiliation
Source: Processed by Authors (2023)

Author	Affiliation	Document
Husein, S.	Universitas Indonesia	2
Arbarini, M.	Universitas Negeri Semarang,	1

Author	Affiliation	Document
Armiwulan, H.	Universitas Surabaya	1
Bangun, W.	Universitas Kristen Maranatha	1
Chojimah, N.	Universitas Islam Negeri Sayyid Ali Rahmatullah Tulungagung, Indonesia.	1
Daraba, D.	Institut Pemerintahan Dalam Negeri (IPDN)	1
Darmastuti, A.	Universitas Lampung	1
Dhaniarti, R.	Universitas Narotama	1
Dzuhayatin, S. R.	UIN Sunan Kalijaga	1
Eidhamar, L. G.	Institut for religion, filosofi og historie, University of Agder, Kristiansand, Norway.	1
Fatorous, S.	Deakin University.	1
Fithriani, R.	Universitas Islam Negeri Sumatera Utara	1
Hayden, M. H.	National Center for Atmospheric Research, Boulder, Colorado	1
Hilman, B.	Australian National University	1
Ilo, S.	Howard University	1
Jauhola, M.	University of Helsinki	1
Judiasih, S. D.	Universitas Padjadjaran	1

The table above shows seventeen lists of authors with author affiliation and also the highest number of documents in Indonesia. The author with the highest publications is Husein, S. from Universitas Indonesia, who has published two papers. Meanwhile, the rest of the authors only published one article. Based on the data above, it can be concluded that the number of publications about Gender Equality in Indonesia is still minimal. The writer argues that there are a few reasons, including (1) Gender equality issues are not the main concerns in Indonesia, (2) There are only a few policies in Indonesia that support gender equality, namely the 30% quota for women's political participation in political parties and parliament, and (3) the conservative views about gender equality in Indonesian society. These reasons support why the number of publication of research about gender equality in Indonesia are still low.

Bibliometric Database on Research Trends of Gender Equality

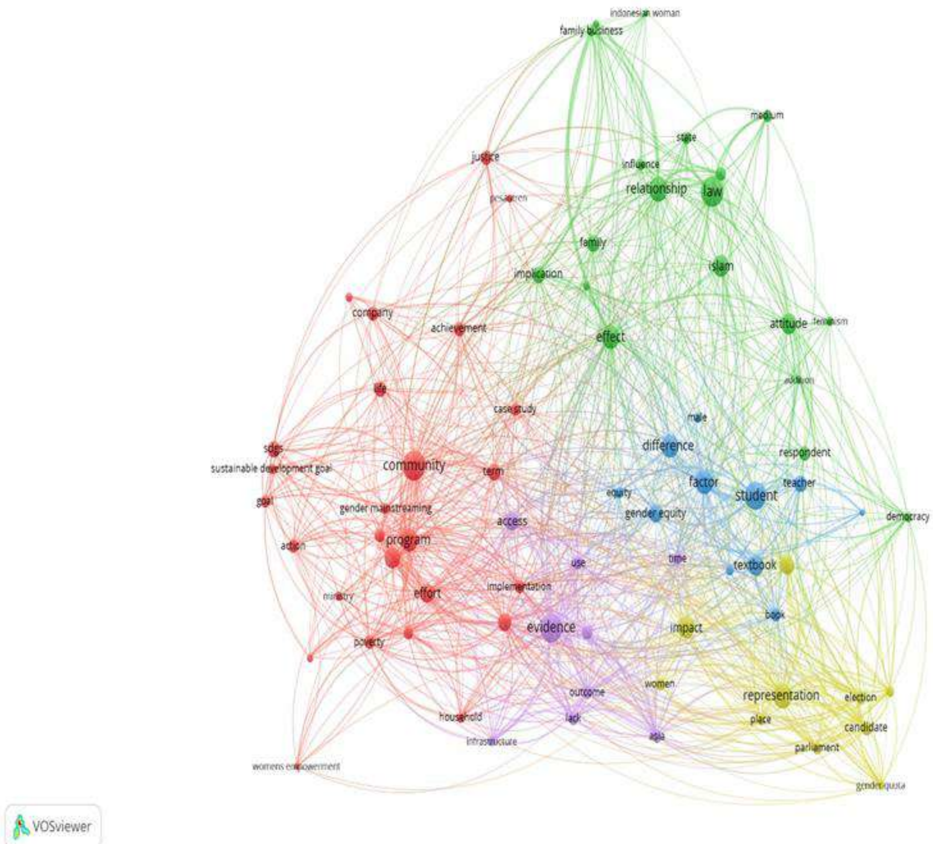

FIGURE 4. Bibliometric database on research trend of gender equality in Indonesia, visualised using VOSViewer
Source: Processed by Author (2023)

The figure above was captured using VOSviewer and shows the bibliometric data found on the Scopus database regarding the research trends of gender equality in Indonesia. With over 160 keywords found, the author limits the discussion to three main issues in Gender Equality in Indonesia, namely (1) Gender and Violence, (2) Gender Equality in the Workplace, and (3) Gender and Participation in the public sphere. These issues were selected because it is the most discussed topic with the most related keywords in the bibliometric data. Furthermore, the authors divided the publications into three clusters under the salient issues found in the bibliometric data. They analyse it further to determine which of these issues are the current trends for gender equality research in Indonesia.

Keyword Relations in Three Clusters of Salient Issues in Gender Equality Research

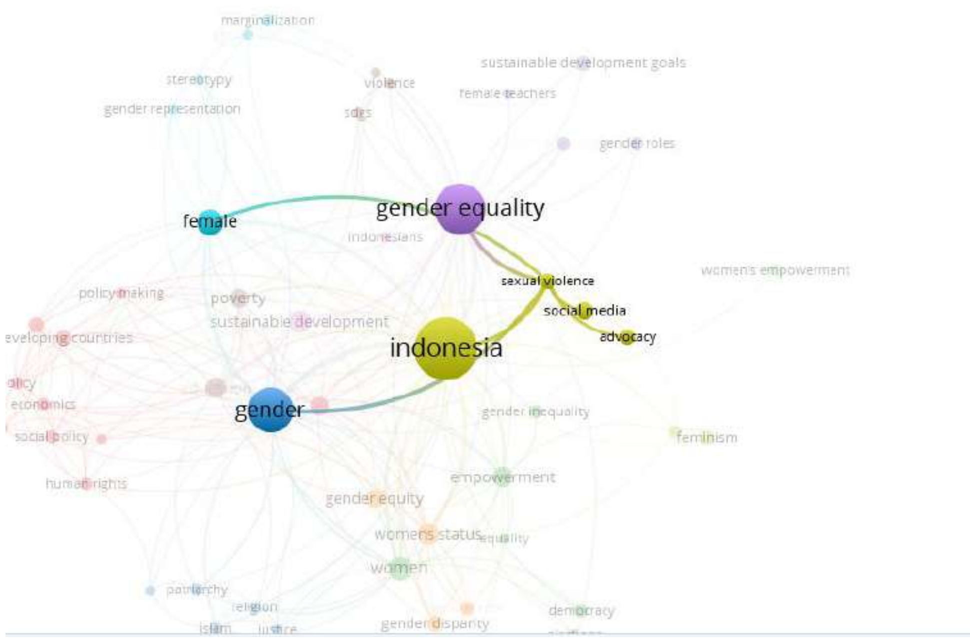

FIGURE 5. Salient Issue 1: Gender, Violence and its related keywords
(Source: Processed by Author, 2023)

The figure above shows highlighted keywords relations of Gender and Violence. There are seven keywords related to gender and violence research, namely (1) Gender Equality, (2) Indonesia, (3) Gender, (4) Female, (5) Sexual Violence, (6) social media, and (7) Advocacy. Based on the keywords relations above, it can be concluded that most of the research on gender and violence highlighted the issue of sexual violence against women and the advocacy to prevent it from recurring. This suggests that gendered violence is significant to consider in this region. It is depicted nicely in the book "Gender and Violence and Power in Indonesia", which argues that the complexity of social and historical background leads to gendered violence.[20]

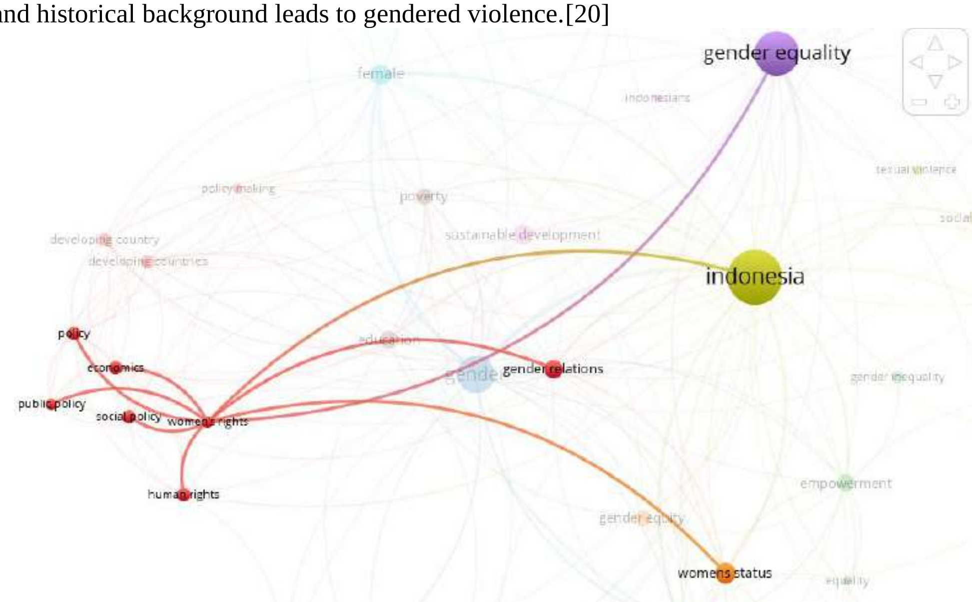

FIGURE 6. Salient Issue 2: Gender Equality in the Workplace and its related keywords
(Source: Processed by Author, 2023)

The figure above shows keyword networks regarding Gender equality in the workplace. The issue of inequality in the workplace takes many forms, such as unequal pay, disparity in promotion, incidents of sexual harassment and racism [21], [22]. Inequality in the workplace based on gender stands out as a hot topic of discussion among researchers about gender equality. In analysing this issue, the study uses ten keywords that include: (1) Gender equality, (2) Indonesia, (3) Women's status, (4) Gender relations, (5) Human rights, (6) Women's rights, (7) Social policy, (8) Public policy, (9) Economics, and (10) Policy. Although this issue has a wide range of keywords, the number of publications is still lower than gender and participation, which is 13 publications.

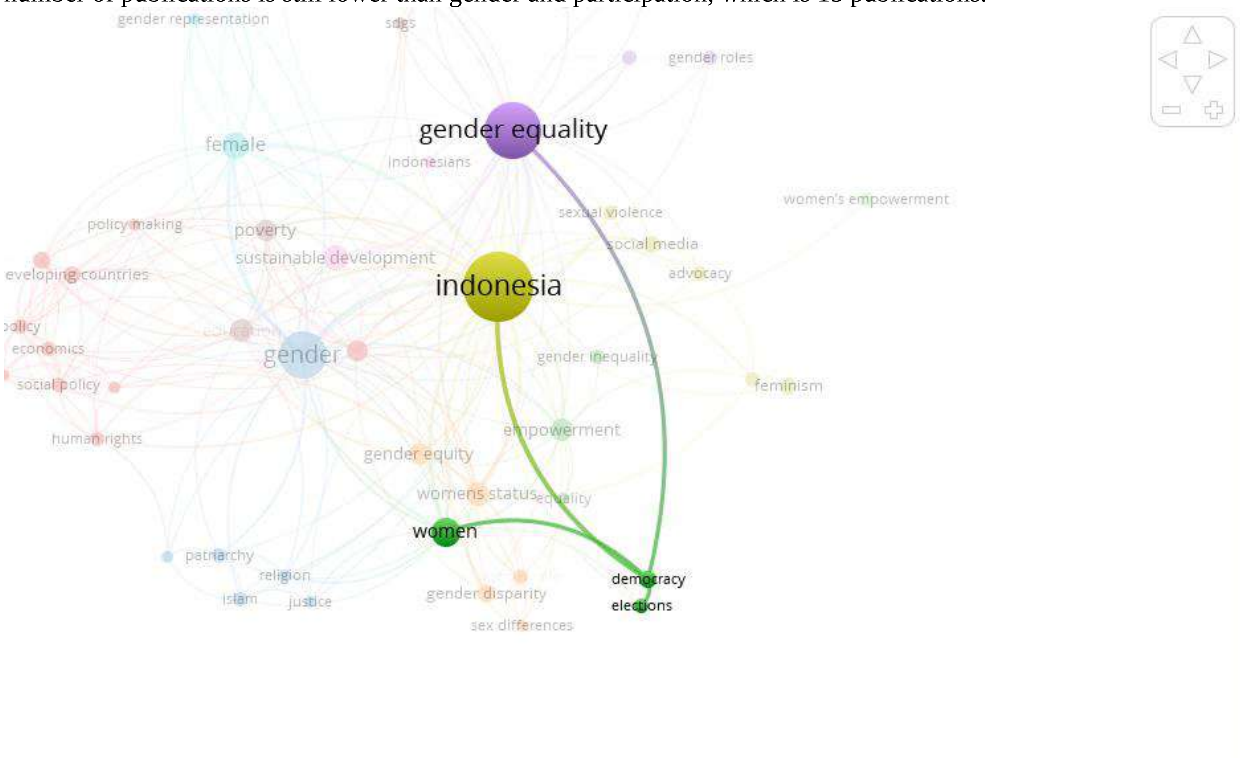

FIGURE 7. Salient Issue 3: Gender and Participation in the Public Sphere and its related keywords
(Source: Processed by Author, 2023)

The third most salient research topic is women's participation in the public sphere, which is usually associated with elections and democracy. Bosting democracy requires women's participation and encourages women to participate in the parliament to represent women's interests actively.[23] The picture above shows us that the keyword gender and participation is quite dominant in publications related to elections and democracy. Most publications on gender participation mainly discuss gender quotas and women's representation in leadership and politics. While this issue has been the most published, the scope of discussion is still relatively narrow compared to gender and violence and gender equality in the workplace.

CONCLUSION

In conclusion, three salient issues are the research trends about gender equality in Indonesia, namely (1) Gender and Violence, (2) Gender equality in the workplace, and (3) Gender and participation. From those issues, the author found that the issue of gender and participation is the most discussed, with 35 publications found over the span from 1998 to 2022, followed by gender equality in the workplace with 13 journals and nine publications for gender and violence. Based on these findings, the authors argue that gender and participation is considered the most prominent gender equality issue in Indonesia.

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Empowering Women "Srikandi" Coffee Farmers: Application of Adult Learning Principles

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Abstract. Women are potential human resources and contribute in all sectors. Empowering women by utilizing local resources, namely diversifying coffee foods, can increase women's creativity. The learning process of female farmers by applying an adult learning principles is able to develop the abilities of female coffee farmers. Training activities by encouraging participation, the need to learn, experience, paying attention to readiness and learning orientation as well as strengthening the motivation of women farmers are able to increase insight and social entrepreneurial spirit and encourage the development of creative ideas for women farmers.

INTRODUCTION

Coffee is an important agricultural commodity in Indonesia. Indonesia's coffee production ranks third in the world after Brazil and Vietnam [1]. Currently, the percentage of female agricultural workers is 45% of the agricultural workforce [2]. The role of women in the agricultural sector provides important income for the family. Based on International Coffee Organization (ICO) data in the coffee industry alone, female farmers contribute up to 70% of the workforce in major coffee producing areas. However, due to the impact of gender inequality due to economic barriers and safety risks in the field, only 20-30% of coffee plantations are managed by women [2].

So far, women have been raised under the shadow of gender and cultural constructions in society that place women in positions that often result in injustice towards women. Women feel very little access, control and benefits. Injustice creeps in and limits women from gaining access to themselves. Inequality between men and women is very visible in everyday life. Access to resources, information, work opportunities, educational opportunities on an equal footing with men. Likewise, inequality exists for women coffee farmers in gaining access to develop their potential. So far, the government has focused more on carrying out coffee farmer empowerment programs only for male farmers. The lack of access to women is not commensurate with the dominant role of women in the coffee industry [3].

From a cultural perspective, women only stay at home and take care of household affairs while men earn a living. However, the factors of poverty and the high needs of the family as well as the husband's salary being insufficient apart from taking care of affairs at home, women took the initiative to join in the work. If analyzed in depth, women do more work than men, so the limited time for activities outside the home is not possible. This condition closes opportunities for women to be active in organizations, deliberation meetings and other forms of skill development [4].

The "Srikandi" coffee farmer group was formed in 2018, through empowerment activities, women, wives and children of coffee farmers were organized in a group that was able to build a creative mentality, stimulate someone in the group so that with their awareness they were able to understand and criticize their own potential and creative thinking processes. In this case, the empowerment of women coffee farmers focuses on downstream products made from coffee as a form of diversification of processed coffee products. The "Srikandi" coffee farmer group carries out product development for various types of processed coffee, marketing of processed coffee products, product photo training and packaging of processed products.

Women's empowerment is expected to increase their dignity and escape from poverty and backwardness. Resources will be more useful and of higher value if society is able to manage existing resources well.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030048-1–030048-5; https://doi.org/10.1063/5.0241578
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Empowerment of women coffee farmers is carried out through training activities on processed coffee products. This training is intended to equip women farmers with the knowledge and skills to increase their abilities and creativity from existing local resources.

The learning strategies carried out in training for women coffee farmers certainly cannot be separated from the adult learning principles. It is very important to pay attention to the characteristics of female farmers as adults so that the training activities carried out can increase participation in the learning process of creating processed coffee products. Adult learning really pays attention to the experiences of these adults, so that adult learning focuses more on facilitating learning needs [5].

Based on the explanation of the problems presented previously, the involvement of coffee farmer families, especially coffee farmer wives, is still less empowered. Diversification of coffee-based processed products is the focus of empowering women coffee farmers through training. Training activities for women coffee farmers need to pay attention to an adult learning principles [6].

METHOD

This research was conducted on the "Srikandi" Women coffee farmer group in Sukorejo Village, Wringin District, Bondowoso Regency. The approach used by researchers is qualitative research to describe and explain (to describe and explain) [7]. This research uses descriptive research to explore information and describe [8], the process of empowering women coffee farmers through educational interventions, namely training that pays attention to adult education principles. The technique for determining informants in this research uses a purposive sampling technique. The key research informants were members of the "Srikandi" coffee farmer group and supporting informants, namely the head of the "Srikandi" coffee farmer group. Data collection techniques and data collection processes using interview, observation and documentation methods. Triangulation in this research uses source triangulation and technical triangulation to check the validity of the data. The data analysis technique carried out in this research uses the Miles and Huberman model technique which consists of data reduction, data presentation and drawing conclusions [9].

RESULT AND DISCUSSION

Women's empowerment programs will increase the role of women or involve women in development. This means that women's problems so far are due to the low quality of women's resources who are unable to compete with men in society, including in development. The existence of this empowerment program is an effort to improve the quality of women so that they have access and control over resources.

Women's empowerment is an effort to empower women with the ability to improve the economy, creativity and independence to change the fate of women, especially rural women, so that they are more empowered so that they can increase their income to meet basic needs and develop the potential and active role of women. Empowerment is (to give power or authority) giving power, transferring power or delegating authority to parties who are less/not yet empowered. (to give ability to or enable) provides ability or empowerment and provides opportunities for other parties to do something [10]. In this case, the "Srikandi" coffee group is a forum for providing empowerment to members and as a bridge to find opportunities and increase their role in development. These activities can be achieved through an empowerment process that takes into account the principles of adult learning, namely learner need to know, self-concept of the learner, prior experience of the learner, readiness to learn, orientation to learn, and motivation to learn so that these activities are carried out smoothly. good and able to increase women's creativity. The existence of this process can maximize the goal of empowerment, namely a "process of becoming" not an "instant process" [11]. Starting from this quote, the "Srikandi" coffee group has carried out stages of empowerment to maximize empowerment goals. The stages of the women's empowerment process are as follows:

1. Learner need to know

It is important for female farmers to know their learning needs in the empowerment process. This activity is identical to the awareness process. This is the initial stage in carrying out empowerment activities, where awareness is a process of changing and shaping people's behavior to become aware so that they understand and comprehend the importance of empowerment. So that in the awareness process awareness will be gained, namely the process where a person understands and understands a situation which makes the individual himself aware and understand what is happening and what will happen.

The awareness stage, which is the first step in empowerment, will open insight and awareness of the importance of empowerment so that people are willing to take part in empowerment activities. Apart from that, to recruit women to take part in empowerment, women's awareness is also needed so that empowerment can continue and develop and become more advanced. Having clear objectives and explaining the activities that will be carried out in empowerment through the “Srikandi” women farmer group means that the community will know the benefits of participating in these empowerment activities. In awareness activities, the founder and chairman made the community aware of the participant recruitment process with a family approach.

Awareness to understand the learning needs of women coffee farmers is carried out by providing cognitive knowledge, namely knowledge/understanding of knowledge, belief, namely belief, and healing, namely healing/solutions through empowerment programs. At the farmer group awareness stage, after the stage of providing knowledge using a family approach, it is continued with several stages, namely recruitment methods, level of community participation, implementation of outreach to motivate the community. The empowerment program with the formation of the “Srikandi” coffee farmer group has carried out several stages of awareness. The result of the awareness process achieved is that the community is encouraged by their awareness to take part or participate in the empowerment program. The awareness of women coffee farmers grows from themselves, namely from the desire of women coffee farmers who want to be creative and improve the farmers' own harvests. The awareness stage is the formation of behavior towards conscious and caring behavior [12].

2. Self-Concept of the Learner

Empowerment must be able to develop the self-concept of women coffee farmers. Empowerment activities do not just mean listening to tutors provide material but also facilitate the growth of interest in learning in women coffee farmers. Discussion, sharing, self-evaluation and expressing ideas by women have become routine activities carried out independently by women coffee farmers in empowering the “Srikandi” coffee farmer group.

Empowerment activities help women practice communication and have the courage to express opinions and ideas, even though at first the mothers felt embarrassed, but as the activities progressed, they began to express their opinions, such as discussing meetings, planning, implementing activities and making money from sales.

Growing women's self-concept in empowerment activities can provide changes in attitudes for the better and insights that are beneficial for each individual. Apart from that, the “Srikandi” coffee farmer group is able to improve the social spirit both with fellow members and with the wider community. Apart from that, understanding is very necessary to facilitate activities and practice significantly to improve creative thinking skills. The practice carried out can provide creative ideas that can make something more interesting.

In general, women's empowerment is defined as an effort to increase women's ability to gain access and control over resources, economic, political, social and cultural so that women can organize themselves and increase their self-confidence to play an active role and participate in solving problems so that they are able to build abilities and concepts. self [13].

3. Prior Experience of the Learner

Women coffee farmers have local wisdom resources related to simple coffee processing such as coffee brewing skills. However, regarding the processing of coffee products into other needs that are not so familiar. Thus, the learning model used by women coffee farmers is through training activities. This is based on experience and the need to strengthen the added value of coffee products. So far, sorted coffee has become a less valuable item. From this experience, women coffee farmers feel the need to learn to practice skills in diversifying coffee processing.

How to learn according to previous learning experiences. In accordance with the passage of time an individual grows and develops towards maturity and maturity [14]. On her journey, female coffee farmers experience and collect various bitter experiences of life in coffee farming, which makes a female coffee farmer a rich source of learning, and at the same time the female coffee farmer provides a broad basis for learning and gaining knowledge. new experience to be creative in diversifying processed coffee products.

In training activities, women are trained and accustomed to collecting information about an activity program or project to make a product. The results of training activities are useful for making decisions based on women's experience in coffee processing, such as further refinement of a product, or dissemination of an idea in diversifying coffee processing.

4. Readiness to Learn

Women coffee farmers are ready to learn in accordance with their social role. Women who are members of the “Srikandi” coffee farmer group understand that training in diversification of processed products is part of women's role in self-development towards the industrialization of coffee commodities. The process of empowering women coffee farmers in the form of an independent attitude, women coffee farmers carry out evaluations in every activity. Women have freedom of opinion, are able to work together, are able to find and solve problems, are able to express initiative ideas, this is a form of independent attitude which can later encourage women to find business opportunities. This activity can also increase women's understanding, openness of insight, ability to communicate well, develop creativity in their thinking, and establish good solidarity between women coffee farmers. The learning readiness of women coffee farmers is able to form initiative and innovative abilities to lead to independence.

The existence of readiness to learn, the assumption that adults become more mature over time and their life experiences has implications for readiness to learn. This condition of learning readiness is characterized by the possession of initial knowledge as a result of previous learning experiences that are relevant to the substance to be studied. Mentally, this condition shows readiness to enter new learning activities, whether continuously or not [14].

5. Orientation to Learning

The learning orientation of women coffee farmers in the empowerment process focuses on developing knowledge and skills in a variety of processed coffee products. How women coffee farmers learn through training activities. Increasing the capacity of women coffee farmers is carried out by providing materials and training in product making such as training in making coffee soap, coffee masks, coffee scrubs, various types of brewed coffee and other life skills training such as product photography and packaging. This stage is in the form of knowledge insight, skills skills to open up insight, basic skills (Wrihatnolo and Dwidjowijoto, 2007: 3).

Basically, the women of the “Srikandi” coffee farmer group are oriented towards being able to discover something new, provide insight and be able to find new solutions and opportunities for members to open businesses. There is a view that downstream products from sorted coffee are not being utilized, so the “Srikandi” coffee farmer group has found a solution by utilizing the used coffee sorting into coffee-based products that have a selling price and opportunities. The opportunities provided are opportunities that have new innovations and have their own uniqueness. In this case, the Srikandi coffee group already has several products which are the work of the women's group themselves, such as coffee soap, coffee scrub, coffee mask, other products which are also the result of collaboration with men's coffee farmer groups, namely matcha coffee, matt coffee, Ijen raung coffee, tsarima. This product is the result of the development of local village resources. With the empowerment activities, members have been able to develop their insight and have a desire to open a business with the “Srikandi” coffee farmer group products.

6. Motivation to Learn

Motivation is growing and emphasized to women coffee farmers that their women have the right to be able to face problems so that they understand that by participating in empowerment they can give them the ability to escape the cycle of poverty. Because people do not immediately want to take part in empowerment without their own awareness. Motivation is a precondition for society to participate in empowerment effectively. The awareness stage is expected to be able to change people's mindsets to achieve a better future by participating in empowerment and providing enthusiasm and a willingness to learn. At this stage it will be faster and more rational with continuous assistance to achieve a strong understanding.

There is motivation to learn. Motivation becomes capital for women coffee farmers to carry out activities to develop diversified processed coffee products, gain learning experience, so that they have the ability to respond to every challenge in their lives. Motivation is essentially a driver, selector and driving force to achieve goals and achievements as fully as possible, so that it can grow enthusiasm or energy dynamically in giving birth to an activity [14].

CONCLUSION

Empowerment programs help provide access to women to improve their abilities while being housewives. The women's empowerment program through the “Srikandi” coffee farmer group was achieved by implementing an adult learning principles. Training activities by fostering participation, the need to learn, experience, paying attention to readiness and learning orientation as well as strengthening the motivation of women farmers are able to increase women's creativity both in terms of communication, knowledge and skills which can encourage them to continue to behave productively.

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The Strengths of Female Characters in Indonesian Fairy Tales

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Abstract: Females are oftentimes seen inferior to males, as expressed in how they are treated in public and domestic spaces. This view is apparently inherited from ancient times. However, the deconstruction of patriarchy in Indonesia needs to be re-explored in view of evolving caveats. The phenomena and views of patriarchy in the Western world cannot immediately translate into Indonesian feminist theory, making it an appealing area of inquiry to discover the contextual uniqueness of such theory. In response to this gaping void, this study employed a phenomenological- anthropological design with an Indonesian feminist approach to analyze documented strengths of female characters in Indonesian fairy tales. Stories of female's courage and strength have been passed down since the rise of primordial cultures. This study traced feminism back to its outset in Indonesia. The findings portray that females are strong and influential characters in life, which is manifested in their sincerity, humility, acceptance of the will of power, chanting of prayer, intelligence, gentleness, and wisdom. The way females solve their problems shows that they are just as bold as males. This study argues that subordination is not universalized, and discourses on women's oppression need to ponder cultural contexts.

INTRODUCTION

For nearly two hundred years, the world has paid more attention to females. After Frederich Engels in 1884 had expressed his views on different treatment between males and females, females came under the spotlight amidst global development. Theories about females and their roles began to emerge. In the Western world, females are more progressive in expressing themselves. This drove scientists' attention, leading to the emergence of what was called feminism. To date, feminism has continued to develop and gained its traction. Topics associated with feminism vary to a large extent, ranging from roles, class, and status, to the treatment of females. These topics also influence the views of the majority of Indonesians. As a corollary, studies on the development of Western feminism are constantly on the rise.

Notwithstanding, it is questionable whether Indonesian females are treated differently to their Western counterparts. With different cultures and norms, society creates its own views about females so we cannot fully embrace a Western perspective in Indonesian cultures. In Javanese culture, the word "*wanita*" (females) comes from the Sanskrit "*empu*" meaning noble, highly knowledgeable, "creator of a masterpiece". In cultural practices, females play important roles such as elders or traditional leaders, shamans, and even queens. However, the introduction of Islam and global cultural developments have changed the views of Indonesian society towards females. The public is immersed in discourses from the Western cultures. This needs to be wisely addressed so Indonesians have a clear attitude towards Western feminist theory and Indonesian feminism. This discourse examines the patriarchal view in Indonesia by deconstructing the artifacts associated with primordial thoughts in Indonesian fairy tales to rediscover the true views and influence of females in Indonesian society.

A CLOSER LOOK AT THE REAL INDONESIAN FEMALES

In Indonesian society, different social constructs and values of females prevail. In Sanskrit, the word "wanita" comes from the word "*empu*" which means noble, highly knowledgeable, and maker of a masterpiece, while in Javanese etymology it means "*wani ditoto*" or permissive. Some people say that woman means "desirable". Who wants and what does a woman want? This is strongly political. This study delves into this question. The

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030049-1–030049-7; https://doi.org/10.1063/5.0241686
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

aforementioned views represent how culture works. Females are the desired “servants” for those who desire them. If men are put in the opposite position, perhaps that is what men want, a loyal woman who serves.

Every cultural sphere in Indonesia has distinctive perspectives towards females. Despite biological and domestic roles associated with females, such as giving birth and serving their couple, it is common for females to shoulder other roles. Balinese females are breadwinners. They are hard workers, good at managing their time, and sociable. Their socio-cultural environment already has such constructs, which seem to be a consensus among Balinese societies. Javanese females are famous for their gentleness and obedience. Javanese women are closely related to the term "*konco wingking*" with the 3M tasks "*macak, masak, manak*" (putting on makeup, cooking, and giving birth). Sundanese women are famous for their humorous and gentle nature, but they are deemed materialistic. A Makassar woman is seen tenacious and loyal. These views stem from varying characteristics attached women. This also happens according to how cultural society views females with a certain omnipresent subjective value. Furthermore, this view creates laws for women by prioritizing the common good in life. This is why culture is never apolitical. Theimages of today’s women are attached constructs, rather than grown from within.

Viewing Indonesian females requires different perspectives other than those of Levi Strauss who saw French females as a medium of exchange in marriage or Carl Marx who saw females as proletarians in the capitalist system. Strauss's view is strongly intertwined with the French social and political system, while Marx’s view arose in a polemic situation of imperialism. As a caveat to these two perspectives, this study invites reflection on females of the past, the image of genuine Indonesian females. Cases of feminismin Indonesia only emerged after the arrival of this ideology from the West (the door of colonialism). Peopleheld the beliefs from their respective cultures. Javanese women uphold Javanese cultural values, and Sasak women uphold their cultural values, as do others. As [1] contends, subordination is not universalized. The following sections document the vignettes of real Indonesian females.

THE MIGHTY OTHERNESS

The social meaning of inequality reinforces myths, stereotypes, laws, and practices that devalue females and encourage subordination. One definition of subordination is that one gender is seen as more important than the other. As a result, certain genders feel that their voices are ignored or used against them. There has been a perception that females have lower status than males. As narratives of females are based on their experiences, they can express their views on issues that directly affect their lives.

The majority of literature describes females as being inferior to males in many societal groups, and it is this bias that many researchers captured. Researchers already have thoughts about going to a research site and then involving the community to prove their thoughts, rather than studying what the community understands in gender relations [2].

This study employed analysis informed by an ethno feminism and examined data from Indonesian fairy tales showing female characters. With an ethnographic approach, this study interviewed several informants to investigate females’ experiences and perceptions of their daily lives. This centered on simple questions about giving birth, roles, expectations, how to overcome problems, and other things dominant in their lives, without discussing equality. Interviews were framed through a psychological approach and conducted by emphasizing personal intimacy. This study combined two methods to examine past ideas and the impulses females have today. Storytelling enabled primordial society to inherit values, ideals, and outlook on life. This can be a motive for females to find ways to deal with their current problems. Collective memory is inherited through symbols, language, and so on as a legacy of thought so that the nextgeneration can interpret and understand the past.

Giving birth is natural for females. Females who give birth never feel themselves to be an accessory, but rather a giver. Females realize that giving birth is a task that only they can bear. However, certain communities discount this pivotal duty and instead view it as a "biological obligation" or even a "social and cultural necessity". This view oftentimes also applies to educating and serving families. These crucial tasks denote an implication of the ability/expertise of an "*empu*" in solving problems around her. However, this is something that is looked down upon. Something sacred and high turns into responsibility. These biases arise due to political ways of thinking prevalent in many cultures.

In the Islamic context, mother has a very exalted position. In different contexts, many important terms are associated with the concept of "mother" such as Mother Earth, capital city, thumb, and ancestors. Each of these terms is associated with the word “*Ibu”* (mother) in Indonesia. In contrast, the concept of man is never used. Even in a cultural context, the head of a family does not have to be a man, since a queen (king in the current context) can be either male or female. This context does not exist in the Western world. Indonesian females have a different influence and position when compared to those in Western cultures. Both in government positions and religiosity, Indonesians understand the important roles of females. This is truly a glorious otherness, from a modern perspective. In the context of primordial society, this view is not an otherness. It is not something that violates the situation, but a genuine noble task adorned with inequality.

Indonesian females often occupy important roles. In religious spaces, blessings, and prayers are often focused on females (mothers, grandmothers, ancestors). Even in the domestic space, females are often the decision-makers. They are treated like hidden treasures. However, the cultural construct of patriarchal politics often makes females objects, not subjects. Humans form culture, and superordinates take advantage of their position to foment the assumptions about females. These assumptions become socio-cultural biases passed onto the next generations. These biases then lead females to recognize the concept of subordination, whether they like it or not, and raise their resistance. Nevertheless, such a concept is absent in the primordial history of Indonesia.

THE STRENGTHS OF FEMALE CHARACTERS IN NATIONAL FAIRY TALES:THE EVIDENCE

Fairy tales are often considered as products of fiction and exaggeration. As an imaginative literaryproduct, they are laden with mind-blowing illustrations. However, fairy tales with their values andteachings are beyond fiction as they represent memories, experiences, views, and ideals shared amongcommunity members in which they are created. Fairy tales are artifacts, memories, and wisdom, where norms are embedded. We need to understand the message people try to send across through fairy tales.Also, we need to acknowledge the scientific footing of knowledge development related to fairy tales, asBruner stated, because studies on fairy tales demand clear methods and lines of valid and reliable thoughts[3]. By examining the memories and messages embedded in fairy tales, this study aimed toexplain the genuine images and strengths of Indonesian females in several primordial cultural undertakings.

The data under analysis were documented oral fairy tales, some of which came from Indonesian fairy tale series rewritten by Bunanta et al and local government websites. This study analyzed eight fairy tales: (1) Princess Tadampali (Luwu, South Sulawesi), (2) Loke Nggerang (Manggarai, East Nusa Tenggara), (3) Lutung Kasarung (Central Java/Sunda), (4) Bita Nahak No Bikuku (East Nusa Tenggara), (5) Senggutru (Java), (6) Topitu (Central Sulawesi), (7) Mandalika (Lombok, West Nusa Tenggara), and (8) Timun Mas (Central Java) [4], [5], [6], [7], [8], [9]. These were chosen to represent the majority of fairy tales about Indonesian females. [10] states that any fairy tales share eternal and universal values across communities. This study put focal emphasis on the analysis of some of the abovementioned fairy tales as exemplification,leaving the readers with the rest for their independent reading. These fairy tales were analyzed using the theory of character strengths and virtues by [11]. This theory divides character strengths into 24 traits, *inter alia,* creativity, curiosity, open-mindedness, love of learning, perspective, intelligence, persistence, integrity, vitality, love, kindness, social intelligence, citizenship, justice, leadership, forgiveness, humility, wisdom, self-regulation, admirer of beauty, hope, humor, and spirituality. These fairy tales were scrutinized for the character's strengths consistently present. Next, the most dominant strengths in each fairy tale were documented.

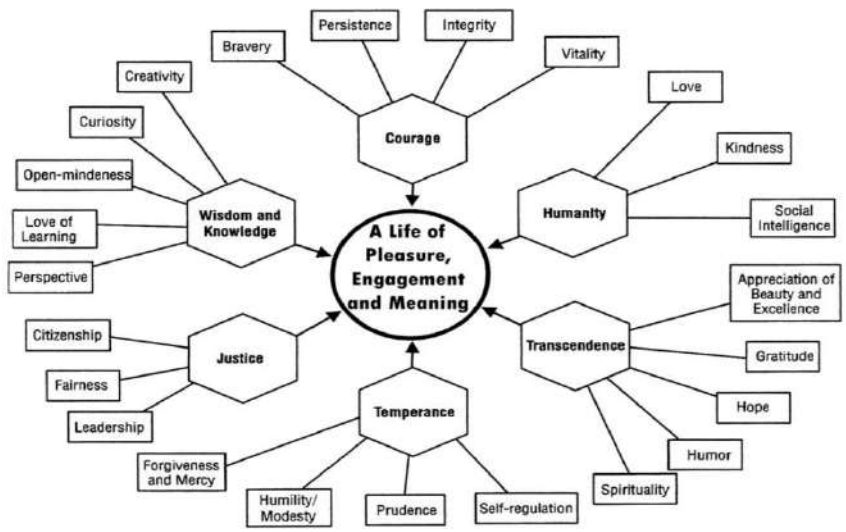

FIGURE 1. Character Strengths and Virtues

Some of these strengths were absent in the data. The analysis results are presented in the following table.

TABLE 1. Analysis Result

Fairy tales	**Characters**													
	C	**O**	**I**	**P**	**I**	**L**	**K**	**S I**	**F**	**M**	**P**	**S R**	**A B**	**S**
Princess Tadampali	-	+	+	+	+	+	+	+	-	+	+	+	-	+
Loke Nggerang	-	+	-	-	+	+	+	+	-	+	+	-	-	+
Lutung Kasarung	-	+	+	+	+	+	+	+	+	+	+	+	-	+
Bita Nahak No Bikuku	+	+	+	+	-	+	+	-	-(+)	+	+	+	+	+
Senggutru	-	-	+	+	-	+	+	-	-(+)	-	-	-	-	+
Topitu	+	-	+	-	+	+	+	-	-	+	+	+	+	+
Timun Mas	+	+	+	+	-	+	+	-	-(+)	-	+	+	-	+

Information:
C= Curiosity, O= Openness, I= Intelligence, P= Persistence, I= Integrity, L= Loving, K= Kinding, SI= Social Intelligence, F= Forgiveness M= Modesty, P= Prudence, SR= Self- Regulation, AB= Appreciation of Beauty, S= Spirituality

The table shows that dominant characteristics depicted in Indonesian females are curiosity, open- mindedness, intelligence, persistence, integrity, love, kindness, social intelligence, forgiveness, humility, wisdom, self-regulation, an admirer of beauty, and spirituality. The most dominant are open-mindedness, intelligence, persistence, integrity, love, kindness, social intelligence, forgiveness, humility, wisdom, self- regulation, and spirituality.

Princess Tadampali shows an open, intelligent, persistent, integrity, loving, and decent character. Princess Tadampali is a fairy tale of a princess named Tadampali who is extraordinarily charming. Knowing her beauty, the King of Bone sent an ambassador to propose to her. Initially, her father was hesitant to accept the proposal because a Luwu girl was not allowed to marry someone from the same village. However, he eventually accepted the proposal solely to avoid war. Suddenly Princess Tadampali suffered from a strange skin disease. No doctors were able to treat it. Datu Luwu decided to exile the princess. Even though she felt sad, Princess Tadampali obeyed her father's decision to be exiled for the sakeof Luwu land and its people. She then sailed until she found land which was later named Wajo and stayed there. One day, a white buffalo approached her while she was resting. The buffalo licked the princess's skin. Initially, the princess wanted to chase the buffalo. However, the buffalo was tame so the princess let itbe. Somehow, the buffalo's lick cured the princess's illness. She was so grateful to God and ordered the soldiers never to slaughter white buffalo. The return of her charming beauty attracted the prince of Bone. Tadampali's daughter sent a *keris* her father had given as a request for blessing. Her father would accept theproposal and approve their marriage, providing that he received the *keris*. Receiving the keris, he picked up his daughter and made her husband king.

The story of Princess Tadampali’s strength is slightly different from that in the fairy tale of Bita Nahak No Bikuku. Bita Nahak No Bikuku showed a bold and determined character. As a woman, she was able to fight and kill enemies. This fairy tale also showed the magical side of Indonesian people. Spirituality was evident in the chanting of prayers and magical powers.

Once upon a time, one day Bikuku met Princess Bita Nahak took her outside the palace to enjoy songs and dances, and she agreed. After strolling for some time, they arrived at a palace. Bita Nahak heard the crowing of a partridge followed by the voice "Bita Nahak, you will go far away from your father and mother." Bita Nahak asked Bikuku if she had heard that, but Bikuku urged her to ignore the partridge and continued strolling. Unable to refuse Bikuku, Bita Nahak continued her stroll. However, this happened three times. Bita Nahak invited Bikuku to come back, but Bikuku insisted. When they arrived at the palace, Bikuku suggested that they exchange clothes, and again she complied. At the palace, they were greeted with great fanfare. Bikuku ate every penang dish and food instantly with spoon, plate, and fork. As Bikuku wore beautiful clothes, everyone thought she was noble. Bikuku married the King and received privileges, while Bita Nahak was made gardener. Every time she received food, Bita Nahak did not eat it but gave it to the dog. When she wanted to eat, Bita Nahak went to the sea and said the wish "*Didi lo, tasi karone nain karone nain, tasi meti nen nain meti ne nain, lai nodi han etu modok sia mai, loi modi hau naan modok sia maiu*." Afterwards, the sea rose and there was yellow rice and yellow meat in front of her. One day someone found out about this and reported it to the King and Bikuku. The King turned curious. Hearing this news, Bikuku went furious and challenged Bita Nahak to a duel. Bita Nahak agreed, but he refused to start attacking. Each of them held a machete. Bikuku raised his machete and cut Bita Nahak's throat. Bita Nahak was not injured in the slightest. She turned forward and swung the machete at Bikuku's stomach. Bikuku's stomach split open and out came all the dishes she had eaten. Bita Nahak invited the servants and nobles to take her belongings back. This duel revealed who Bikuku was; she was none other than Bita Nahak's servant. Since then, Bita Nahak was married to the king and lived happily ever after.

Another tale is Senggutru, a small girl the size of a thumb. However, she was a diligent and intelligent child. One day when her mother went to the market, a giant came and destroyed her village as hewas looking for food. She immediately hid when she heard the giant's footsteps while praying to God that the giant would not find him. Senggutru took a knife to protect her. Suddenly the giant lifted the container where she was hiding and intended to eat her. When he tried to put Senggutru into his mouth, Senggutru immediately jumped into his throat and was immediately swallowed into the giant's stomach. She then panicked, but suddenly she remembered the knife. Then she tore the wall of the giant's stomach, making him moan and scream. He wondered why his stomach hurt so much. The giant then tried to cough and regurgitate what he ate. Instantly, Senggutru jumped out of the giant's mouth and ran away. Miraculously, her body slowly grew bigger and she became a normal-sized girl because her body absorbed some of fluid in the giant’s stomach. The giant fell and died, and Senggutru met her mother again. This story underscoredher intelligence, persistence, love, kindness, and courage.

Females in these fairy tales often encountered difficulties that demanded patience, sincerity, submission, and acceptance of God's will. Notwithstanding, these females managed to find a way out. With courage, intelligence, gentleness, and wisdom, they could overcome their problems, which was a strength generally missing in fairy tales about males. With submission and prayer, a woman is able to leave no stone unturned. These fairy tales imply that physical ability and the influence of cultural stereotypes are never ascribed to strength. Females possess their unique strengths, which is never equal to those of males.

THE WILL TO CHOOSE OR WEAKNESS?

Females from primordial perspective never see themselves as subordinate. They are present in every dimension of life. There have been many stories telling the greatness of Indonesian females. Bita Nahak, Calon Arang, and Queen Kalinyamat never felt imprisoned in the domestic space. There are many stories of Indonesian females who showcase freedom and achievements equal to males. Discussing patriarchy and inequality in Indonesia is like taking hundreds of steps backward. [12] explains that Anthony Reid also acknowledged this view. He describes the position and role of females in the pre-colonial era in Southeast Asia where Aceh, Demak, and Makassar had autonomy and dual roles, as did males. Works in the domestic and public (economic, political, and even military) spheres require mutual support between males and females. Females who ruled Aceh, Jambi, and Indragiri in the seventeenth century were deemed as vigorously as their male counterparts. As such, why do we still talk about females' weaknesses? Is it a manifestation of their helplessness, or is it their choice?

These findings show that the stereotypes the Western world tried to attach to Indonesian females need to be re-examined. These findings corroborate that Indonesian females have a strong character, and thus patriarchy commonly held in the Western world cannot be equated with the reality in Indonesian society. Acceptance, silence, and giving in to Indonesian females is a choice based on open-mindedness, intelligence, integrity, courage to face challenges, sincerity, and wisdom. This was manifest in the tale of Bita Nahak who chose to follow her servant and remain silent until the right moment came to her. Tadampali also chose to accept his father's decision to be exiled when he accepted King Bajo's proposal to avoid war which could endanger her people.

In modern contexts, through collective memory, we can witness the abovementioned characters infemales who shoulder pivotal roles in family. Crying is not a weakness, but rather acceptance and sincerity that females are ready to face reality. In one of the interviews, Mona (30 years old) quite persistently perceived obedience as a way to make her family happy. Obedience was what she could give sincerely. Serving family was a way for her to gain God's grace (spirituality), not because she was different. To her, serving at home is hard work that she and her husband shared. She just did what was necessary.

We know that the values in oral traditions are preserved to direct community's behavior. Intelligent, devoted, and religious females remain role models in Indonesian society. However, studies on females overlooked artifacts of the past. Perhaps the discussion of feminism in Indonesia started with Kartini, which was influenced by Western views. The study of females in the past cultures needs to continue, with apt approach, rationale, and cultural framework. This study underscores the strengths of Indonesian females as a response to the reported violence against females.

CONCLUSION

Today's society has its views about females. In large part, social and cultural changes have shifted the perspective on Indonesian females because of the openness of Indonesian society. Moreover, the construction of Indonesian society to date has changed due to the influence of evolving Western feminism.

Females in the Indonesian cultural settings are the "start", "root", "strength", and "expert" in facingall hardships. They are "able to accept" and "create", "give birth", and serve as the source of wisdom. These strengths can be interpreted positively or negatively across communities. The status of "princess" or "physically small" is not a barrier or something that subordinate them to males, but manifest strength. The ways by which females in Indonesian fairy tales solve their problems show that they are as strong, courageous, and independent as males. Anthropology as a social science and humanities discipline need to create wider space for females in ethnographic texts.

The constructs of Indonesian females need to be viewed more openly for ethnographic narratives seem to conceal this, making our feminist paradigm reliant on Western views. This study argues the need toraise and testify different frameworks that underline the boldness of Indonesian females.

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Postmodern Ecofeminism Examined in Angela Carter's The Nights at The Circus

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Abstract: Women are frequently associated with being close to nature, particularly in a perspective where women are seen as objects or bodies that can be easily replaced because they do not have freedom. Postmodern literature also provides insights into the past and present that have contributed to producing better steps for the future. This study aims to examine the violence and resistance in Angel Carter's; The Nights at the Circus, published in 1984. The analysis in this study is based on ecofeminism theory, which is based on the Aesthetic of Care theory presented by Josephine Donovan in 2016 to analyze the female protagonist in the novel. The descriptive method was used for this study, and the data was collected in the form of dialog between characters, monologues, and narratives from the novel's author. As a result of this study, the violence such as exploitation experienced by the female protagonist about how she uses her wings for performance in a circus and the resistance she used against the exploitation in the novel.

INTRODUCTION

Postmodernism and Ecofeminism are two interconnected theories. Postmodernism is a cultural movement that includes parody, intertextuality, entropy, and pluralism, whereas Ecofeminism is a theory that focuses on the negative consequences for humans as a result of patriarchy based on dualism theory, which devalues nature and women who are considered equal to nature, or in other words, women as expendable bodies.[1] listening to the animal voices and hearing their standpoint is the same as listening to the voice from the silenced voice of a woman inherently subversive of patriarchy. Animals and Woman shares the same common thing in that their voice is silent, cannot speak their mind, and exploited, people see them as inferior creature that can be replaced at any moment; woman who can only bear the child stay at home and doing chores while unable to express their voice, exploited by gender and inequality, sexuality, and sometimes is also abused due to the patriarchy culture same as the animals when human killed them to get jut to have something for decoration, make them extinct, abused by exploit their nature.

Examining postmodern literature can open up avenues about the past and present that have contributed to producing better steps for the future, such as how ecofeminism helps to ease the anxieties of the postmodern regarding the interaction between humans and animals or the surrounding environment where an ecofeminist approach to the postmodern can provide direction regarding variations of women and nature. [2], Postmodernism is a cultural style that reflects some of this epochal change, in the form of depthless, decentred, ungrounded, self-reflexive, playful, derivative, eclectic, pluralistic art that blurs the boundaries between 'high' and 'popular' culture, as well as art and everyday experience. The culture that has been mentioned in Ecofeminism such as patriarchy, violence, and abuse of

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030050-1–030050-7; https://doi.org/10.1063/5.0241708
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the environment which can destroy nature. [3] Postmodernism posed an important ontological challenge to reality, questioning what constitutes the real world while also interrogating the horizon of fiction's representation of this unstable reality. Nights in the title mean the boundary between reality and fantasy in which Fevvers is the anomaly that exists in the novel. However, some novels can also be categorized as postmodern novels from their style of writing, as explained by [4] postmodern novel is the type of novel resistant to interpretation. Moreover, the existence of a postmodern novel is also possible by using the world of the story that can be similar or different from reality in other words it can be a parallels or the other words that cannot be distinguished as reality or fantasy. Henceforth, [5] Fevvers' sarcastic situation is a characteristic of Postmodernism. After being tortured by the patriarchal system, she becomes tough and deceives everyone by convincing them that she is a bird or a human with wings. From a postmodern standpoint, it is interesting to see what happens when an existing culture is challenged or questioned without causing a cultural explosion, whereas ecofeminism asserts that humans should not only care about others but also about other creatures, so empathy between humans and animals in the novel.

[6] Ecofeminism is a philosophical framework that claims that ecofeminism is a study of how women, nature, and animals are treated and need to be impartial toward males and seeks for an intimate relationship between them. [6] also state that ecofeminists have developed a theory that draws a connection between women's dominance over nature and calls for equal rights and respect for nature. Ecofeminism teaches the relationship between humans and animals through the concepts of care and empathy, as proposed by Josephine Donovan in her book Aesthetic of Care, which states that ecofeminism's aesthetics are "non-violent, responsive, attentive to the environment, and viewing other creatures as subjects worthy of respect, listening to different voices.". [7] states ecofeminism focused to social justice and environmental health. It can be said that even a hybrid can also receive the social justice among human, the story about Fevvers' interactions as a half-human and half-swan can be seen throughout the novel as she travels to Tokyo to perform a circus show, fighting stereotypes as a woman and as a half-swan, which then becomes an interesting theory to analyze regarding the relationship between humans and animals. What is the exploitation Fevvers experienced and how did she resist the violence in the form of exploitation?

The difference between this study and the previous study is the theory used in this study is postmodern ecofeminism perspective. The writers tries to analysis about the exploitation and resistance experienced by the female protagonist by using the theory that believes humans and animals are equal, the writers focuses on analyzing the exploitation experienced by Sophia Fevvers as the female protagonist and compared to the animal condition in the novel The Nights at the Circus

LITERATURE REVIEW

In the book 'The Routledge Handbook of Ecofeminism and Literature' in the chapter on postmodernism and ecofeminism [8] postmodernism emphasizes social problems and life problems and struggles at the cultural, ethnic, and linguistic levels that are local, where this theory is also supported by ecofeminism, which also focuses on the eurocentric patriarchy that occurs and believes that women and nature are inferiors.

Ecofeminism [1] is an attitude of nonviolence, adaptability, attention to the surrounding environment, and seeing other creatures as subjects worthy of respect. Donovan also argues in her book that the voices of animals who are silenced or forced to be silent are similar to a woman who is forced to be silent and follow the patriarchy that has existed for generations and is exploited, just like animals.

Donovan also mentions ecofeminism in postmodernism as an alternative that can be used against movements supported by dualism, which is still prevalent in the modern era. While Vakoch mentions in the Routledge book that postmodernism does not contain historical or political elements, nor does it bring up elements of nostalgia, postmodernism is more focused on rethinking and not rethinking the presence of the past that questions the reality that is being shown.

In the [9] research, ecofeminism revives old mythologies and beliefs in which nature is regarded as great and sacred. Bharti elaborates in his research that ecofeminism sees injustice in social relations not only to women but also to nature. [9] also mentions it. Ecofeminism is a movement that sees a link between the exploitation and degradation of the natural world and the subordination and oppression of women; it combines elements of the feminist and green movements while also challenging both.

The study about ecocritical feminist reading [11] analyzed the novel The Erl-King from the same author as this study, focusing on Carter's employment of birds and the greenwood as a metaphor for gender roles and power relations in which Carter makes her caged birds emblems of women imprisoned by patriarchy. The study also mentioned that the alliance between ecopoetics and feminist vision forms a case of ecofeminism.

The study that analyzed the novel The Nights at the Circus also explained that Fevvers finally be able to achieve new woman status while traveling from one country to another, which proves to be a substantial prerequisite for the achievement of human subjectivity whether the female or the masculine one [12] Fevvers able to triumphs the metamorphose Walser from the traditional male figure who claimed that Fevvers is from bird origin into the postmodern man who believes in gender equality.

Postmodern Ecofeminism theory is one of the key theories for transnational and global cooperations because it analyzes the intersection of contemporary ecological problems, social systems, and gender problems [14]. Environmental nationalism, as a project, rejects all three forms of discrimination and proposes the idea of a supernatural and transnational union based on the need to solve ecological problems.

METHOD

The method used in this paper is qualitative research to collect the data until the writers finds the information needed. The data resources are divided into two categories: the primary data is *The Nights at the Circus* by Angela Carter from 1984, and the secondary data are taken from other sources that are related to the primary data, such as articles, websites, and journals. Before determining the character to be analyzed, the writers must carefully read the data in the novel, and finally, the writers must use the internet to search for some data to obtain more information from articles and journals. [8] qualitative research consists of answering questions by gathering evidence and determining an answer that was not predetermined. Furthermore, it seeks to comprehend the research problem or topic at hand and is effective in gathering culturally specific information about the values, opinions, behaviors, and social context of specific populations.

RESULT AND DISCUSSION

The writers finds the data in the novel *The Nights at the Circus* and analyses the data by interpreting the data using the theory that has been chosen to analyze the data and answer the topic. Here are the findings and discussions;

RESULT

The first data from the novel is how the female protagonist refused the offer when she and the other woman were kicked out of the house in which they lived and worked for seven years. When the owner of the house is dead, he is described as a cruel and unnatural brother who wants to inherit the house;

> *“He couldn't stand the sight of us sitting there, eating food he thought belonged to him. He overturned the pork pies and spilled on the carpets all Ma Nelson's vintage port that we had broken out. Announces he, our time is up; he gives us till nine o'clock next morning, such was the goodness of his heart, to pack ourselves up, bag and baggage, and make ourselves scarce. Leave the only home we knew and go out on the common. In this way, he planned to 'cleanse the temple of the ungodly', although he was kind enough to hint that his God might smile at any of us who cared to repent and stay on, because, with a singular poetic justice, he intended to make of his inheritance a hostel for fallen girls and he thought a repentant harlot or two would come in handy about the place, poacher turned gamekeeper, you might say.”*

After the death of Ma Nelson, the man who claimed to be the brother of the owner took over the place and forced Fevvers and all women to leave because it was inherited by him; moreover, he made an offer to let them repent and stay in the place. From this explanation, it can be said that the woman and the female protagonist were being looked down on by MaNelson’s brother, and the brothel became a hostel just for them as an example for other women who had fallen because they were working to satisfy men. Fevvers and the other woman were refused and chose to leave. They started to have their own lives, and in the novel, the female protagonist and her adoptive mother chose to join the circus. Their action is explained in [1] which states that animals and humans are equal, and the female protagonist, who was born as a half-swan, also has the same rights as the other woman from Nelson's brothel, who is seeking a new life. Therefore, the type of resistance is a conventional gender role because Fevvers take control of their destiny, such as when they choose to leave and join the circus, becoming popular aerialists. She also resists conformity, in which she refuses societal norms and lives on the outskirts of society, which is the form of her manifestation of resistance.

Fevvers who was raised in a brothel also received sexual exploitation in which she was looked at as an object or as a sexual satisfaction, based on the data below; "*As for myself, I worked my passage on Ma Nelson's ship as living statue, and, during my blossoming years, from fourteen to seventeen, I existed only as an object in men's eyes after the night-time knocking on the door began.*"

Fevvers, who was working at Nelson's house, became a living statue for symbolizing as the virtue of freedom, which made her become an object for a man. [7] state that women are equal to nature, just as animals are inferior and exploitable. Fevvers was a little girl who was exploited by being an object to be looked at since the owner of the house didn't permit her to follow the other women who were working at the brothel. Therefore, the type of exploitation is physical exploitation, in which people come to brothels and pay because they're curious about exotic creatures like fevvers. The living statue here reverses to standing without doing anything, she just breathes and becomes the symbol of pure love because of her beauty, the reason is explained in the data below, Nelson made her not do anything like follow the other woman inside the brothel.

The data below also shows the dialog from Fevvers when she was talking with Madame, who took a liking to Fevvers. "*…how I was Ma Nelson's flagship but always kept out of the battle, that Nelson never brought me to the block so I was known to all the nether side of London as the Virgin Whore.*"

According to the data above, for the seven years, Fevvers lived in Nelson's house, she became someone to be looked at. This means that Fevvers is also like the other women who work there just to satisfy a man who comes to visit the house. Sexual Exploitation is about a man who is drawn to Fevvers because of her beauty and alleged uniqueness and makes men frequently approach her, objectifying her as an erotic fantasy. [13] Brothel where Fevvers lives is a place for prostitute which sexual abuse and violence might happen so they're being stigmatised and exploited. The reason why Fevvers was being looked at as sexual satisfaction was because of her beauty which she made as her advantage to get whatever she wanted such as becoming a famous aerialist and known as the half-bird-woman in the circus.

However, Fevvers, as the female protagonist, also did something dangerous when the Sircus performance became dangerous when the rope she played in was broken by an unknown cause, making the circus panic full of people gasping, afraid that Fevvers would fall. She was able to finish her performance right when she could move without fear and believing that she could finish her part;

> *With her right hand, she caught hold of the rung of the trapeze.*
> *There was a clean, twanging snap. A rope broke. The Colonel, watching her, now, in besotted terror, as, a moment before, he'd gazed in besotted ecstasy, had judged it a publicity coup to use, not hack musicians, but the cream of the Petersburg Conservatoire for the pit band at this booking. The snag was, that these longhairs did not know the first rule of the spectacle -- that the show must go on. And now "The Ride of the Valkyries" (superbly played) broke down on an aghast discord as the trapeze dropped Fevvers a dozen feet and left her swinging to and fro like a pendulum above the tiny eye of sawdust, the vortex of gravity, down there, down below. Her wings quivered and the little feathers around the edges nervously whipped the air. But she showed no fear, even if she felt it. She twisted round and, with her free hand, waved, or, as they say in the circus, "styled" at the Imperial Box in an ironic gesture. She even poked out her tongue. Musicians, horns and fiddles dangling from their hands, the Colonel, Walser, watched, helpless, hearts in mouths, for an endless minute; the Charivaris, on edge, watched. Only in her own good time did she agitate her pendulum. She swung upon it, faster and faster, and, when she gained enough momentum, only then did she let go, and launched herself off, again, to arrive at the other side of the big top, where she landed upon her other trapeze, abruptly sat, briskly furled, folded her arms like a furious washerwoman and, vast, immobile, sulking, ignored the commotion that broke out below.*

From the data above, Fevvers shows the resistance to conformity. She joined the circus because she doesn't like societal norms. The reason she joined was to embrace a bohemian and unconventional lifestyle as an aerialist in the circus. Moreover, when people think that she can't finish her job because of the broken rope, Fevvers makes sure to finish her part along with the music as she dances as a battle angel in Greek mythology, which is Valkyrie. Her confidence in this data also shows Fevvers as a half-human and half-animal able to finish her job properly and as a symbol of her forcing her voice in the form of action. [1] the silence of a woman is the same as the silence of animals that get abused and exploited.

As a human, Fevvers feels nervous and agitated when the performance is interrupted not by a person but because of the broken rope as she was afraid to fall because the place she used for the performance is quite high. As explained above humans and animals do feel nervous when they do something in front of many people watching them playing the role of aerialist in the circus. [12] Fevvers was able to manipulate the stereotypes to transform herself into a spectacle while simultaneously making a profit and making her career choice.

> *"And I was full of wonder, sir."*
> *"But, though now I knew I could mount on the air and it would hold me up, the method of the act of flight itself was unknown to me. As babies needs must learn to walk so must I needs learn to conquer the alien element and not only did I need to know the powers of the limitations of my feathery limbs but I must study, too, the airy medium that was henceforth to be my second home as he who would a mariner be needs to construe the mighty currents, the tides and whirlpools, all the whims and moods and conflicting temperaments of the watery parts of the world.*
> *"I learnt, first, as the birds do, from the birds.*

From the data above, Fevvers show the resistance to gender role in which she decided to choose the path of her destiny such as how she learned from a bird to move her wings and how to use them properly, she took the same step baby who needs to learn how to stand then walk before running. She doesn't know how to fly and no one can teach her how to fly since she is the only one who has a pair of wings on her back. She must study in order to understand correctly how to use the wings and the only way that she could understand is by learning from birds, how she spread her wings, how she used her wings for entertainment for her advantage so she can gain something she wishes for with her wings. Not only did she learn from a bird, but she also decided to dye her feathers before she started her career as a trapeze or starting her career in the circus as an acrobat who played by two ropes hanging horizontally and placed in high places in the air.

> *"My feathers, sir! I dye them! Don't think I bore such gaudy colours from puberty! I commenced to dye my feathers at the start of my public career on the trapeze, in order to simulate more perfectly the tropic bird. In my white girlhood and earliest years, I kept my natural colour. Which is a kind of blonde, only a little darker than the hair on my head, more the colour of that on my private ahem parts.*

From the data above, Fevvers dyed her wings so they could resemble to tropic bird before she started her career in acrobats. She doesn't like the natural colour of her wings which resembles her hair colour. The resistance she shows in this data is resistance to conformity in which she decides to not follow the social norm and chooses to do what she wants as a woman who will start her career after she moves away from Nelson's house.

DISCUSSION

From the findings above the data can be interpreted that Sophia Fevvers as the main female protagonist experienced exploitation such as physical exploitation where she's an object to be looked at by a man symbolizing her as the pure and true form of love, the reason Ma Nelson is love her and took care of her by not letting her follow the other woman that was working in the house. The other exploitation she experienced was sexual exploitation when men only came at midnight just to see her beautiful face and her erotic body just for their sexual curiosity about Fevvers which is still an anomaly about her body, curious do Fevvers really human or bird since she have a pair of wings in tropical bird's color.

The resistance, it can be in any form [14] by voicing the courage and by challenging the stereotypes. Sophia Fevvers as the female protagonist shows her way to resist the exploitation she experienced before by deciding her own life by refusing the offer from Nelson's brother and choosing to become an acrobat in the circus as an aerialist because she wants to have a different life from the other woman who once worked in Nelson's house, she refuses to let her wings has its natural color which is blond so she dye it before joining the circus as a form of her resistance as a refusal to follow the social norm of the beauty decide her destiny by her own and she was able to achieve the popularity in the world as a famous acrobat in the circus and for her own beauty, manipulates those people who fall for her own advantage.

Henceforth, postmodern in this article is to question what will happen if the culture is challenged by ecofeminism, thus, the answer has been found as the answer that Sophia Fevvers as a hybrid lived by following the the rule and being exploited since children. Fevvers who thought that she could live by herself tried to earn money and popularity, refused to be exploited more, and showed that she could do anything on her own. As a result for challenging the culture of patriarchy, she was able to enjoy her life with the person who loves her.

CONCLUSION

From the discussion above, the female protagonist experienced violence in the form of exploitation, such as physical exploitation and sexual exploitation. She also resisted exploitation by showing resistance to gender roles and conformity. Fevvers, who was born half-human and half-swan, showed that she is also the same as the other people. [1] in short, says that humans and animals are the same; they have identifiable desires and needs, many of which humans and animals share. The resistance to gender roles showed that Fevvers could choose her path to walk on; she chose to refuse the offer and joined the circus to have a different lifestyle she never had before as a form of resistance to conformity.

Fevvers is the female protagonist who is independent in how she tries to pursue her goal, which is life in luxury since she was born to not believe in love. She tried to fulfill her greed, which is also true for animals that are greedy to eat or greedy for their territory. She was blinded by it and learned a lesson from what she experienced. [8] wherever patriarchy dominates, women are objectified and marginalized, defined only by their differences from male norms and values. Even though Fevvers's body is exploited and fetishized by men, she eventually finds freedom and self-liberation within her body [12], with the help of her lifelong friend and maternal figure, Fevvers becomes an international icon and dominates the commercial sphere and profits off her aerialist act.

As a postmodern novel, it challenges the culture of patriarchy and gender roles in how the female protagonist acts, how she acts when she receives exploitation, and how she resists patriarchy and exploitation in the novel. Postmodernism sees the world as a set of disunified cultures or interpretations that breed a degree of skepticism about the objectivity of truth, history, and norms, the givenness of nature, and the coherence of identities [2]. The challenged culture and perspective from the novel made Fevvers a bold and brave character who decided her own life and destiny. Thus, the fantasy in the circus ended with a mystery about her identity as a human.

ACKNOWLEDGEMENT

Thank you to the Institute of Research and Community Service (LPPM) University of Trunojoyo Madura for encouraging the writer to participate in the research and thank you to Dr. Suci Suryani S.S., M.Pd. as supervisor who has guided in the process of making the article.

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Femvertising: Exploring Feminist Self-Identity, Brand Advocacy, and Brand Attachment among the Z Generation

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Abstract. The objective of this study is to examine the impact of integrating feminist self-identity with brand principles on brand advocacy and attachment. When femvertising is implemented in a real manner and in accordance with a brand's core principles, it has the potential to bolster a brand's standing and establish trustworthiness among consumers who are actively seeking sincere connections. Utilising a sample size of 173 participants from the Z generation, this study applies a quantitative methodology to examine the complex interrelationships among these dimensions. The results indicate that those who possess a strong identification with feminist values demonstrate a higher propensity to engage in advocating for brands that correspond with said principles. The aforementioned connection highlights the growing significance of social concerns in influencing brand selections among the Z generation, surpassing mere product characteristics. The study reveals that brand attachment has a mediating role in the association between feminist self-identity and brand promotion. The establishment of an emotional connection between individuals and brands that uphold feminist principles emerges as a noteworthy catalyst for engaging in advocacy actions. This suggests that brands that cultivate a strong bond with their audience by aligning with shared values have the ability to use the collective influence of brand supporters within Generation Z.

INTRODUCTION

In contemporary times, the ideology of feminism has achieved widespread acceptance on a global scale. The movement has through a transformative process, emerging as a formidable entity that not only advocates for parity between genders but also exerts a substantial influence on societal patterns and personal outlooks. The ideology of feminism has surpassed conventional limitations and infiltrated diverse facets of society, encompassing domains such as politics, economics, culture, and interpersonal connections. The impact of this phenomenon is readily apparent in the increasing recognition of gender bias and discrimination, as well as in the endeavours to confront and deconstruct these deeply rooted systems. The increasing momentum of feminism compels individuals to engage in a process of reassessing their beliefs and behaviours, so contributing to the cultivation of a more inclusive and equitable global society. It fosters a disposition among individuals to critically examine prevailing social conventions and actively pursue a future characterised by fairness and equality, so fundamentally transforming our perceptions and interactions with the surrounding world.

The increasing knowledge of feminist ideals has a significant influence on consumer behaviour, namely in terms of their product preferences and brand selections, favouring those that actively promote feminism through their advertising efforts. The aforementioned phenomenon, commonly known as "femvertising," serves as a manifestation of the evolving cultural terrain. There is a growing recognition among brands of the significance of aligning themselves with feminist principles in order to establish a stronger connection with a consumer base that is more

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030051-1–030051-7; https://doi.org/10.1063/5.0241952
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

attuned to social consciousness. Femvertising refers to the practise wherein brands employ various strategies, either subtly or explicitly, to endorse feminist principles and advocate for gender equality inside their advertising campaigns [1]. These marketing efforts aim to establish a profound connection with consumers while simultaneously demonstrating a dedication to advancing social problems. Frequently, there is a tendency to question established gender norms, promote inclusivity, and emphasise the empowerment of women throughout diverse spheres of existence. The discernment of consumers is increasing, leading them to be attracted to businesses that not only provide high-quality items but also exemplify values that are congruent with their personal convictions.

Femvertising can be regarded as a manifestation of corporate social responsibility, rather than solely being perceived as a marketing tactic. Brands that authentically incorporate feminist ideals into their advertising campaigns make a meaningful contribution to the wider societal discourse surrounding gender equality and the advancement of women's rights [2]. Through leveraging their extensive influence and ample resources, individuals has the capacity to exert a beneficial impact by endorsing pertinent causes and activities. In doing so, they contribute to the cultivation of a society that is characterised by inclusivity and equity. The increasing recognition of feminism is not alone influencing consumer inclinations, but also motivating brands to assume a more engaged stance in advocating for social justice and gender equality. Consequently, this dynamic is developing a marketplace that is more progressive and characterised by fairness. The phenomenon of femvertising has the potential to significantly impact women's perspectives, hence cultivating a heightened sense of connection to the advertisements they encounter. The approach extends beyond conventional marketing strategies as it establishes a personal and ideological connection with the target audience. When individuals observe firms engaging in the promotion of feminist ideals and actively confronting gender stereotypes, it frequently elicits a strong resonance with their personal beliefs and values, so fostering a sense of connection and fostering brand loyalty.

The correlation between femvertising and consumer attachment transcends mere passive observation or interaction with advertisements. This phenomenon encourages folks to contemplate the products that are affiliated with these particular companies. Women, specifically, exhibit a greater propensity to endorse and acquire merchandise from firms that are in accordance with their feminist principles. The act of acquiring these products can serve as a means for customers to manifest their endorsement of gender equality and the empowerment of women [3]. The current recognition of the impact of femvertising on consumer behaviour and brand attachment highlights the need for further research on the complex interplay between feminist self-identity and brand attachment. However, the existing body of literature in this area is minimal. The examination of the relationship between an individual's personal identification with feminist ideas and their affinity towards companies that espouse these ideals is a multifaceted and dynamic field of research. There exists a positive correlation between an individual's level of feminist self-identity and their propensity to develop a robust affinity for brands that actively endorse feminist values [4]. The phenomenon of attachment can be observed in several manifestations, one of which is brand advocacy. Consumers that possess a robust feminist self-identity may exhibit a greater propensity to actively support and endorse the brand, thereby assuming the role of brand advocates who champion both the products and the underlying ideas they embody.

Prior studies have examined the complex relationships among feminist self-identification, brand attachment, and brand advocacy, providing insights into the interactions between these variables within the domains of consumer behaviour and social identity. Numerous scholarly investigations have been conducted to explore the phenomenon of individuals who exhibit a strong identification with feminist ideas and their propensity to develop more profound emotional connections with firms that align their marketing and advertising methods with those principles [5], [6]. Research investigating the correlation between feminist self-identity and brand attachment has revealed that those who consider themselves as adherents of feminism exhibit a heightened propensity to form a robust emotional connection with businesses that actively endorse principles of gender equality, women's empowerment, and social justice. These consumers frequently perceive these companies not only as suppliers of goods or services, but also as partners in their attempt to establish a fairer society. Consumers establish emotional affiliations with these companies, and such attachments have the potential to impact their purchase behaviours and brand loyalty [5].

Prior research has indicated that individuals who possess emotional attachment towards a brand exhibit a higher propensity to engage in brand advocacy [7]. These individuals assume the role of vocal brand champions, actively promoting the brand within their social networks and engaging in discussions both online and offline to defend its reputation. This form of advocacy can be expressed through different means, such as verbal recommendations, endorsements on social media platforms, and active involvement in brand-related events or initiatives. There is a want for a more extensive comprehension of the connections between feminist self-identity, brand attachment, and brand advocacy, particularly within the domain of femvertising. Although other studies have investigated the connections between these variables in diverse settings, a significant void exists in scholarly literature regarding the analysis of these dynamics specifically within advertising campaigns that overtly endorse feminist ideals. Previous research has predominantly investigated the concepts of brand attachment and advocacy in a broad context, without specifically considering the potential differential effects of femvertising as a distinct advertising method on these variables. The objective of this study is to address the existing disparity by focusing on the unique attributes of femvertising and its influence on feminist self-perception, brand loyalty, and brand promotion.

METHOD

This research study utilises a quantitative research methodology to examine the correlations between feminist self-identity, brand attachment, and brand advocacy among persons who have been exposed to femvertising content and possess adequate purchasing capacity. The researcher used purposive sampling as a method for participant selection in this study. The study's inclusion criteria include that eligible participants must be women who have previous exposure to femvertising content and possess the financial means to make product purchases. A total of 173 samples were included in the research study. The concept of Feminist Self-Identity pertains to the evaluation of individuals' level of identification with feminist ideas and values. The study on Brand Attachment investigates the affective bond and commitment that individuals develop towards brands that promote feminist principles in their marketing campaigns. The concept of Brand Advocacy involves assessing individuals' propensity and readiness to promote products that are in line with their feminist convictions. The collection of data for this study will be facilitated by the implementation of a standardised questionnaire. The participants will be required to evaluate their comments using Likert-type scales, which will encompass a range of possibilities from strongly disagree to strongly agree. The obtained data will be analysed using Structural Equation Modelling (SEM) with the utilisation of Partial Least Squares (PLS). The selection of the Structural Equation Modelling (SEM) technique is based on its capacity to effectively manage intricate associations among variables.

RESULT AND DISCUSSION

The research findings will encompass statistical details, validity assessments, considerations of reliability, and the outcomes of hypothesis testing.

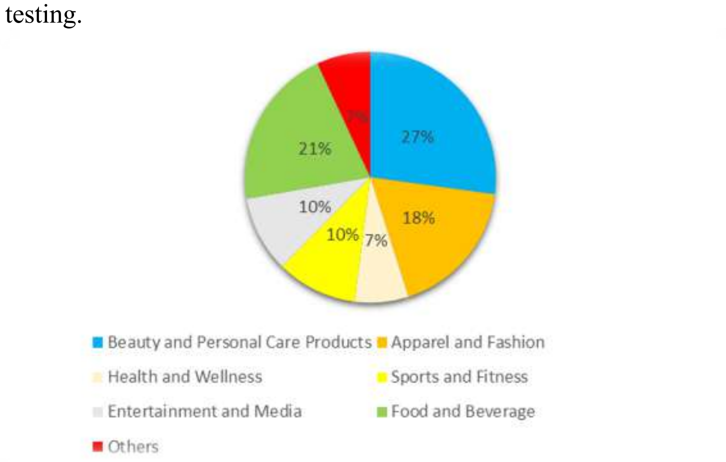

FIGURE 1. Consumer Opinion on Femvertising Product Suitability

Respondent trust in femvertising as an effective advertising strategy is evident across a diverse range of products. According to the Figure 1, a significant 27% of respondents find femvertising particularly well-suited for beauty and personal care products. This finding underscores the power of femvertising in reshaping beauty standards and promoting self-confidence among women. The influence of femvertising extends beyond the beauty realm, with 21% of respondents expressing that it resonates strongly with products in the food and beverage industry. Food and beverage brands have harnessed femvertising to break free from stereotypical portrayals of women in advertising, emphasizing empowerment, health-conscious choices, and diverse representations of women in their campaigns

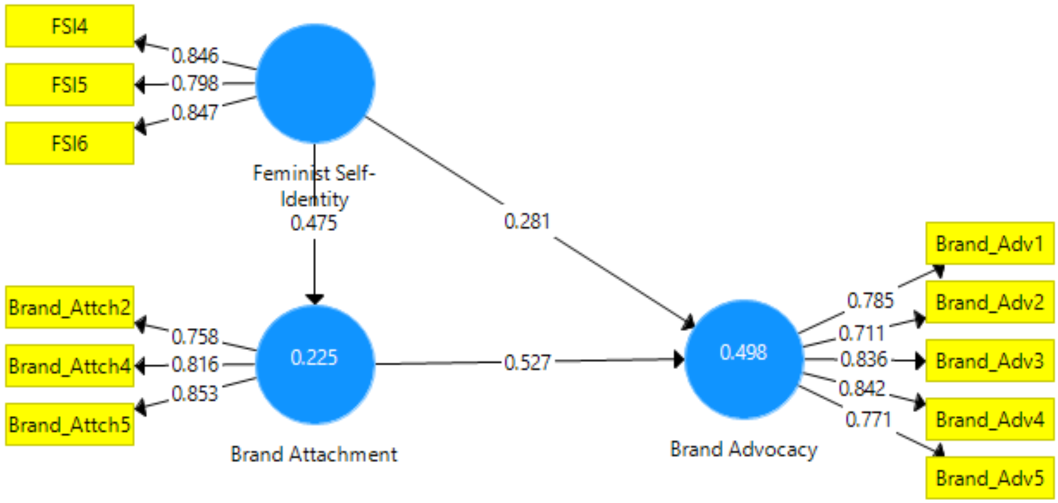

FIGURE 2. Loading Factor Result

In Figure 2, the loading factors of the indicators provide a compelling insight into the suitability of the measurement model. Notably, the loading factors indicate that each indicator not only meets but indeed surpasses the predefined criteria established for this study. This outcome underscores the robustness of our measurement model and the strong relationships between the observed variables and the latent constructs under examination. The established criteria for indicator loading, often set at a threshold of 0.7 or higher, serve as a benchmark to gauge the adequacy of measurement.

TABLE 1. Fornell-Larcker Test Results

	Brand Advocacy	Brand Attachment	Feminist Self-Identity
Brand Advocacy	0.790		
Brand Attachment	0.661	0.810	
Feminist Self-Identity	0.531	0.475	0.831

The Fornell-Larcker test results, as illustrated in Table 1, provide a comprehensive assessment of the construct validity within our research model. This rigorous analysis scrutinizes the relationships between latent constructs and their corresponding indicators, ultimately gauging the appropriateness of our measurement approach.

TABLE 2. Reliability Test Result

	Cronbach's Alpha	Composite Reliability
Brand Advocacy	0.849	0.892
Brand Attachment	0.736	0.851
Feminist Self-Identity	0.776	0.87

Our reliability test, often assessed through measures such as Cronbach's alpha and Composite Reliability, assesses the extent to which the items comprising each variable consistently measure the same underlying construct. In Table 2, we observe that all variables, without exception, surpass the established threshold, indicating that they exhibit a high degree of consistency.

TABLE 3. Direct Effect Test Result

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Brand Attachment → Brand Advocacy	0.527	0.535	0.059	8.982	0.000
Feminist Self-Identity → Brand Advocacy	0.281	0.275	0.067	4.203	0.000
Feminist Self-Identity → Brand Attachment	0.475	0.477	0.065	7.268	0.000

First and foremost, our analysis reveals a compelling link between feminist self-identity and both brand attachment and brand advocacy. The positive and statistically significant direct effects observed in Table 3 underscore that individuals who strongly identify with feminist principles are more likely to form emotional attachments to brands that align with their values. Brand attachment, as elucidated in Table 3, emerges as a robust predictor of brand advocacy.

TABLE 4. Indirect Effect Test Result

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Feminist Self-Identity → Brand Advocacy	0.250	0.255	0.046	5.417	0.000

Furthermore, our analysis also elucidates the mediating role of brand attachment in the relationship between feminist self-identity and brand advocacy. This mediating effect, as show in Table 4, highlights that brand attachment acts as a bridge, translating the values associated with feminist self-identity into tangible actions such as brand advocacy.

The findings of this study validate the substantial impact of feminist self-identity on brand attachment, consistent with previous research that has also established this association. This statement reinforces the notion that the self-identification as a feminist significantly influences how individuals interact with brands that endorse feminist values. Fundamentally, the self-identification of women as feminists functions as a framework through which they perceive and establish connections with various brands [8]. When firms include feminist principles into their advertising, they not only communicate a dedication to promoting gender equality but also cultivate a sentimental bond with consumers, thereby nurturing brand loyalty. The results highlight the significance of femvertising as a potent mechanism for the creation and consolidation of feminist self-identity within the realm of advertising. In an era characterised by discerning consumer behaviour, the concept of femvertising arises as a strategy for individuals to align themselves not just with feminist ideologies but also to articulate and reinforce their dedication to these ideas. Brands that employ femvertising campaigns provide a medium for individuals to harmonise their personal convictions and principles with their consumer preferences [9].

The present study offers empirical evidence on the impact of feminist self-identity on brand attachment in the specific context of femvertising. This statement highlights the significance of advertising efforts that promote feminist ideals, as a way for individuals to establish a more profound connection with firms and demonstrate their dedication to achieving gender equality. Brands who acknowledge and exploit the influence of femvertising not only enhance their consumer connections but also contribute to the wider societal discourse pertaining to feminism and the empowerment of women. The results of this study have implications that go beyond the mere association between feminist self-identity and brand attachment. They also demonstrate a notable impact of feminist self-identity on brand advocacy. This finding highlights the significance of feminist self-identity in driving customers to actively support brands that share their values, particularly those that promote women's rights and liberation [10]. This finding is consistent with the existing body of literature that shows persons with a strong sense of identification towards a particular cause or belief system are more inclined to participate in advocacy activities associated with that cause.

From a strategic standpoint, the aforementioned findings emphasise the significance of femvertising in the formulation of branding initiatives. Brands that acknowledge the impact of feminist self-identity on brand advocacy can deliberately utilise femvertising campaigns to not only attract consumers who are socially conscious but also to foster a committed group of supporters. This method surpasses conventional marketing practises by focusing on the establishment of a community comprised of individuals who possess similar beliefs and actively endorse the brand's principles. This collective effort ultimately plays a pivotal role in the brand's sustained prosperity. The findings of this study provide further insight into the complex association between brand attachment and brand advocacy, emphasising the importance of this link in the context of femvertising. The results clearly demonstrate that brand attachment significantly influences brand advocacy, underscoring the pivotal significance of emotional ties in shaping consumer behaviour and advocacy endeavours.

The study reveals that individuals, specifically women, who develop robust emotional connections with brands that promote feminist values are more likely to become champions for these products. The connection between attachment and advocacy underscores the frequent coexistence of brand loyalty and customer advocacy [11]. When consumers experience a strong emotional attachment to a brand, they are inclined to engage in active promotion and defence of the brand, effectively assuming the role of advocates. This advocacy is typically manifested through different channels, including word-of-mouth communication, social media platforms, and active participation in brand-related events [12]. This discovery holds significance as it emphasises the involvement of women as consumers who not only participate in the acquisition and utilisation of products but also establish profound affiliations with companies that align with their principles. Within the realm of femvertising, it becomes apparent that brands that genuinely endorse feminist principles possess the capacity to develop a committed network of supporters within their female customer demographic. These proponents, motivated by their deep brand affiliations, have the potential to make substantial contributions to the brand's prominence and standing.

The findings of this study contribute to a deeper understanding of the intricate connections between feminist self-identity, brand attachment, and brand advocacy. Specifically, the study suggests that brand attachment serves as a partial mediator between feminist self-identity and brand advocacy. This compelling discovery indicates that the direct impact of feminist self-identity on brand promotion is mediated by the emotional bond consumers establish with the company. Brand attachment serves as a connecting mechanism that partially elucidates the process via which feminist self-identity manifests in advocacy behaviours [6]. The aforementioned mediation effect highlights the significance of cultivating robust brand attachments within the realm of femvertising. In order to cultivate brand advocacy among customers who identify with feminist ideologies, it is imperative for brands to not only emphasise the promotion of feminist values, but also to establish emotional connections. By strategically developing and implementing campaigns and experiences that effectively connect with individuals on a personal level, these businesses have the potential to strengthen the emotional bond between consumers and the brand, ultimately leading to increased support and promotion of the brand.

CONCLUSION

The present study has undertaken an examination of the complex interconnections among feminist self-identity, brand attachment, and brand advocacy within the specific domain of femvertising. The study provides further evidence supporting the importance of feminist self-identity in influencing brand attachment and brand promotion. This finding highlights that individuals who possess a strong identification with feminist values exhibit a greater propensity to establish emotional affiliations with brands that endorse these ideals, as well as actively engage in advocating for them. The study emphasises the significant impact of femvertising on brand attachment and brand advocacy. Femvertising has emerged as a powerful approach employed by marketers aiming to effectively connect with consumers that prioritise social consciousness. The research findings also indicate that brand attachment serves as a significant mediator in the association between feminist self-identity and brand advocacy. Brands that acknowledge the significance of feminist self-identity, the potency of brand attachment, and the possibility of femvertising are strategically positioned to have a substantial effect in the domain of gender equality and women's empowerment, all the while cultivating enduring and devoted consumer connections.

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Adaptation To Climate Change Based On Indigenous Learning For Coastal Women In Jember District

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Abstract This article focuses on climate change adaptation experienced by coastal women as an effort to fulfill the strategic and practical needs of gender-based indigenous learning through their domestic, public and social roles. Where the background of the focus of the article is based on the condition that women and men have different perspectives in meeting different needs. Bearing in mind, so far the forms of climate change adaptation policies carried out by society and the government are still gender biased and have a masculine perspective and are not yet gender equitable. Coastal women's experiences in dealing with local and specific climate change become capital for coastal women to adapt to changes in the future.

INTRODUCTION

Geographically and astronomically, Puger District, Jember Regency is a coastal area that is vulnerable to climate change. These changes have the potential to cause ecological and ecosystem changes which are the economic resources of coastal communities. Apart from that, climate change in coastal areas has an impact on catch results, and has a direct impact on women who have the responsibility to look for alternatives to meet family needs when catch results are not available. Where, women receive a greater impact than men due to climate change. The role of coastal women in the economic chain requires women to carry out adaptation strategies in the face of increasingly uncertain climate change.

However, climate change adaptation is often not considered equal, and is even gender unequal. The differences in the needs of men and women have not yet become the basis for taking action to adapt to climate change. Differences in gender roles result in different perceptions in adapting to climate change in order to meet practical and strategic needs. Gender has not yet become the main consideration for society and policy makers as an adaptation effort. Coastal women not only contribute as support for the family's economic needs but are more seen as being involved as important actors in meeting the social needs of the community at the local level and have a big role in marine product processing activities which are very dependent on an uncertain and difficult to predict climate.

This article focuses on climate change adaptation based on indigenous knowledge and learning possessed by coastal women as a form of strategy to address needs at the family and community level. Adapting to climate change requires women's original learning approaches that hold noble values as cultural heritage. These noble values are obtained from a unique interaction process, thus forming local learning patterns. The need for learning must be increased among coastal women through local traditions and traditional values that are stable and rooted in social life. The local learning that coastal women have in facing climate change aims to preserve the potential of marine and coastal resources in a sustainable manner. Because a cultural heritage that has grown among women has high value to be preserved [1]. Coastal women's knowledge regarding climate change adaptation needs to

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030052-1–030052-4; https://doi.org/10.1063/5.0241994

utilize the original learning of local communities. This makes researchers interested in exploring information and data related to climate change adaptation through the use of indigenous learning among coastal women in Jember Regency.

CLIMATE CHANGE AND COASTAL WOMEN'S LOCAL KNOWLEDGE

Coastal women have local knowledge in adapting to specific climate changes. This is as conveyed [2] that local knowledge, local wisdom or traditional wisdom (indigenous knowledge) is specific knowledge that is owned by a community and develops over time as a result of a process of reciprocal relations between the community and its environment. Indigenous knowledge or local knowledge is a concept regarding all phenomena that are seen, felt, experienced, thought about and formulated based on the patterns and ways of thinking of a community group.

Coastal women's local knowledge of climate change relates to aspects of life in society related to domestic, public and social roles to meet practical and strategic gender needs. It is important to look at the needs of women and men differently. Local knowledge of coastal women in the form of positive behavior related to nature and the coastal environment comes from religious values, customs, ancestral advice or local culture Wietoler [3]. Local knowledge of coastal women related to climate change is a way for women to carry out activities as an effort to maintain life to adapt to climatic conditions. The phenomenon of climate change has a negative impact, especially for coastal women in seeking adaptation strategies to address family needs. This is different from men's perspective in facing climate change which cannot be separated from the need to go to sea to catch fish.

Coastal women have adaptations in dealing with climate changes by looking for other alternatives to meet their family's food needs through their social and public roles. The perception of coastal women switching from the sea to land is a form of adaptation in meeting the needs of their families and communities when there is no fish in the season. Perceptions are obtained from experience which are then used to solve the problems faced as a survival strategy. As stated by Amirudin in Sumarmi et al [4] that "Local wisdom is local knowledge that is used by the community to survive in an environment that is integrated with belief systems, norms, culture and is expressed in traditions and myths which is adhered to over a long period of time". Trust is a belief in something that is considered true by society, culture is a characteristic that becomes diverse and is born from the process of experience of a society in each region as an effort to survive, while norms are community rules that are decided through a process of thought and agreement to maintain order in society. community life.

Coastal women have different ways than men to adapt to climate change in the form of adjusting ecological, social and economic systems to respond to the impacts of climate change. Women have an important role in mitigation and adaptation efforts. Where women have valuable experience and knowledge about the surrounding environment, including local weather patterns and fishing seasons. Therefore, coastal women have different perceptions of facing climate change and interpret adaptation differently. So far, adaptation to climate change has been linked to livelihoods that still have a masculine perspective. Even though women are not directly involved in the fishing process, women are responsible for processing the catch in order to improve the family economy in a sustainable manner.

Coastal women have learning patterns that have been applied and trusted, learning from experience to then understand natural conditions, so that local knowledge emerges. Every community environment has original learning as a result of habituation carried out by the people in that environment as a form of adaptation for survival. Indigenous learning is native learning that originates from traditional culture and values, and seeks to increase awareness or appreciation of the life experiences of indigenous people with the view of creating a living environment so that there is understanding and trust among all residents.

Puger coastal women, Jember Regency, inherit culture through an original learning system in the form of a transaction process and adaptation to fellow communities and the environment. As Kolb said, experiential learning is the process of how knowledge is created through changes in the form of experience [5]. Knowledge results from a combination of understanding and transforming experience, how people understand what they experience from real experience of the perceived impacts of climate change.

For coastal women, the experience of adapting to climate change is a learning medium that can help coastal women find the right way or solution to deal with the impacts of climate change. The experience-based learning process is a learning process that suits the needs of coastal women. Coastal women have the potential where the learning process will include processes, starting from experiencing something in real terms from the impact of climate change, which then makes women think conceptually, observe things that happen through the experiences they experience when climate change occurs while thinking and trying new things. can be applied in dealing with the impacts of climate change [6]. Local knowledge is born from an experience-based learning process which is a source of innovation and skills that can be developed by coastal women for their welfare. Including coastal women in Puger, Jember Regency.

The impact of climate change can be captured by coastal women's knowledge which has been obtained from experience, for this reason different abilities are needed. Adaptation actions focus more on how coastal women adapt to the impacts of climate change. Climate change adaptation is one of the actions that coastal women need to take in facing climate change. Adaptation is carried out as an effort to avoid and minimize the negative impacts of climate change experienced by women and to deal with it in order to meet family and social needs in a sustainable manner without environmental damage.

INDIGENOUS LEARNING COASTAL WOMEN

Every community environment has original learning obtained from habits carried out by the community at the local level as a form of strategy for survival. Indigenous learning is learning from the results of traditional culture and values to increase awareness or appreciation of the life experiences of residents at the local level in designing and creating a similar living environment. The impact of climate change causes women to learn from experience to meet their needs. As stated by Hoover in Mikarsa [7], experiential learning is a learning process, a change process that uses experience as a learning medium, so that coastal communities will find the right way or solution to deal with the impacts of climate change. In the context of coastal women, life experience is knowledge to deal with the impacts of climate change in the future to be passed on to other people and the next generation.

Experiential Learning explains four stages in the experiential learning process which involves an adaptive learning style, such as: real experience, reflective, conceptualization, and experimentation [8]. Coastal women have the potential where the learning process will include a process, starting from experiencing something in real terms from the impact of climate change, which then makes them think conceptually, observe things that happen through the experiences they experience when climate change occurs while thinking and trying new things. can be applied to deal with the impacts of climate change. Through the learning process, coastal women are able to meet their needs in a sustainable manner.

At the stage of the Experiential Learning process, Kolb [8] explains the first stage of the indigenous learning process, namely real experience. The real experiences of coastal women can be known from various collections of events experienced when climate change occurs, how the impacts felt when climate change occurs on the lives of coastal women. The learning process starts from how knowledge is created through change to become knowledge due to a combination of understanding in transforming the experiences of coastal women. The real experience of coastal women in facing climate change can be interpreted as a process of local knowledge that can be combined with women's understanding to be used in creating change to meet practical and strategic gender needs.

Reflections on Climate Change Adaptation

The stages of the experiential learning process which start from real experience then become a reflection which is categorized as a discovery process. Fathurrohman [6] said that in the context of experience-based learning, it can be described as a learning process that reflects experience in depth and from this new understanding or learning processes emerge. Reflection is an observation activity before making a decision by observing the environment from a different perspective, with observations made by coastal women through real experiences they have had when climate change occurs.

Experience-based learning is centered on learning and is oriented towards personal reflection activities about an experience and formulating a plan to apply what is gained from coastal women's experiences regarding climate change. Experience-based learning utilizes new experiences and learning reactions to women's experiences to build understanding and transfer knowledge, new skills, and new attitudes or even new ways of thinking to solve new problems [6] . Coastal women can feel the impact of climate change events, so ideas emerge to interpret and analyze how to overcome the impacts of climate change. This can be a solution when climate change occurs in the future, coastal women can overcome it with the right activities, such as adapting to climate change.

From these several statements it can be concluded that reflections on climate change adaptation will emerge for coastal women from the experiences felt during climate change events. For this reason, women will reflect on various appropriate solutions in adapting to climate change to reduce or minimize impacts based on the knowledge captured by coastal women. Considering many things makes the actions taken produce maximum results.

CONCLUSION

Local knowledge of coastal women obtained from real experience can become a means and adaptation strategy effort in overcoming poverty and ignorance due to low access of coastal women to education. Considering that the target of local community knowledge is obtained through inheritance between generations, the approach used in the program is no longer a pedagogical approach, but an andragogie approach. Where the learning process is provided with the principle that adults have experience that can be used as a learning resource. Outsiders are not learning resources and are not educators, but have a role as motivators to develop the potential of learning citizens based on practical and strategic gender needs. Where in these program activities, women's capacity increases. Apart from that, women also have more skills to be able to access life resources. As a result, women have equal bargaining value with men. The bargaining value that women have can be one of the main foundations for women to be able to make more strategic decisions related to their lives. In this way, women will be free from problems of poverty, ignorance and helplessness. Apart from that, people have group habits which are manifested in the form of communities, so that the existence of community institutions has the potential to be a source of learning. Considering women's experience in meeting practical and strategic gender needs as well as social needs recognized by society. This can be a model for environmental ethics education as a form of climate change adaptation based on local knowledge. Where this experience has the potential to become capital to drive development.

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Interpreting *Martabat Kematian* by Muna Masyari: Reader's Reception to the Representation of Madurese Culture in Woman's Writing

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Abstract. Muna Masyari presents the complexity of Madurese culture in her collection of short stories, *Martabat Kematian*. She depicts both the positive and negative aspects of Madurese culture, allowing readers to understand the culture as a whole. Literature has an inseparable relationship with its readers because the interpretation of literary works is a result of the dialogue between the reader and the literary work itself. As a woman writer, Masyari offers a unique perspective on Madurese culture, particularly from a woman's point of view. Therefore, this research aims to explore the reception to the representation of Madurese culture in *Martabat Kematian*. By conducting a qualitative study involving readers from the same period as the literary work, this research seeks to uncover relatable interpretations of Madurese culture. The reader's reception will be analyzed using Hans Robert Jauss' reception theory. The representation of Madurese culture in *Martabat Kematian* shows that the foundation of Madurese culture is the strong emphasis on dignity and self-worth. Violation of this dignity often leads to resistance and, tragically, death. *Martabat Kematian* is not written to eliminate negative stigma or stereotypes about the Madurese people and their culture. However, *Martabat Kematian* is written to allow readers to understand all the factors that trigger conflicts or underlie the emotional behavior of Madurese people.

INTRODUCTION

The process of creative writing in literature always involves the connection between the author's imagination and the social conditions in which they live. Authors draw inspiration from the world around them, including the joys, struggles, and complexities of society, when creating their literary works. Literature serves as a powerful medium for authors to depict phenomena and realities that occur within a society. In doing so, literature transcends not only entertainment but also becomes a socio-cultural document that reflects the prevailing social conditions, values, and beliefs of its time. Thus, literary works contain moral messages to the readers regarding social truths [1].

The author's message in a literary work requires active interpretation from the reader to be fully understood. The role of the reader cannot be omitted from the understanding of literature and readers do not passively consume the meaning presented to them [2]. Through the reader's engagement and interpretation, the message is unveiled. The process of interpretation carried out by the reader is known as literary reception. In this approach, meaning is not predetermined or hidden in the text but rather emerges through the interaction between the reader and the text.

Hans Robert Jauss is one of the key figures in formulating reception theory. Jauss introduced the concept of the reader's horizon of expectations and seven theses in the method of literary reception. The horizon of expectations refers to the reader's preconceived notions and assumptions about literature. The reader's horizon of expectations is influenced by their familiarity with specific genres, narrative structures, and literary conventions. When a reader encounters a text that either aligns with or challenges their expectations, it can lead to a dynamic and transformative reading experience [3]. Moreover, the seven theses are used to indicate how literary history can be methodically written in a new way [4].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 030053-1–030053-7; https://doi.org/10.1063/5.0241710
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

By applying the reception theory formulated by Jauss, this study aims to explore how a reader responds to the representation of Madurese culture in the short story collection *Martabat Kematian* by Muna Masyari. Muna Masyari is one of the Madurese women writers who extensively explores Madurese culture, including its traditions, local wisdom, and the beliefs of its community. Muna Masyari not only presents the positive aspects of Madurese culture but also highlights the problems and dilemmas experienced by the Madurese community concerning that culture. Several issues addressed by Masyari in her short stories include the position of Madurese women in the culture, myths, and symbols in Madurese culture, and conflicts within Madurese culture [5][6][7]. In *Martabat Kematian*, Muna Masyari explores the perspective of women characters, therefore, this study aims to present the reception of a woman reader to provide relatable interpretations and a deeper understanding of the emotions embedded within the stories. The type of readers in this study consists of readers who come from the same period as the literary work. This allows for a comprehensive exploration of their horizons of expectations.

Martabat Kematian has been studied by several researchers before. Some of these studies discuss the position of Madurese women as daughters and mothers, using a gynocritical approach [8]. The findings of these studies indicate that Madurese women are bound by many cultural issues, one of which is early arranged marriage, leading to their domination and oppression. Further research examines the local cultural values of Madura found in Muna Masyari's short stories [9]. The culture addressed in this research includes "carok" (a form of conflict resolution), dowry in marriage, and dance rituals. The results of this research demonstrate that the exposure to local cultural values of Madura can help readers understand and explore Madurese culture, as well as foster a greater appreciation for interregional cultural learning. Another study discusses the representation of Madurese women in Muna Masyari's short stories [10]. This research describes the extent to which the portrayal of Madurese women in Muna Masyari's short stories relates to social class and femininity. The findings of this research explain that the representation of Madurese women in domestic and public spaces shows that patriarchy exists across lower, middle, and upper social classes.

This research examines the collection of short stories titled *Martabat Kematian*. It builds upon a previous study by exploring the cultural representations of Madura within the collection. However, this study specifically focuses on the readers' reception and interpretation of these cultural representations. To analyze this, Jauss' literary reception theory is employed, which has not been used in previous research.

Jauss's Literary Reception

Jauss' reception theory represents a critical perspective that examines the responses of readers toward literary works. It recognizes readers as essential agents who actively contribute to the creation and significance of artistic works through their interpretations [11]. Jauss's theory of reception derives from philosophical backgrounds, namely the phenomenological method of Edmund Husserl, a German philosopher, and the hermeneutics of Martin Heidegger, a German philosopher as well.

Literary texts are not static entities confined to bookshelves; rather, they are dynamic processes of meaning-making that come through the act of reading [12]. In this context, the reader's role is just as crucial as that of the author in enabling the emergence and realization of literature. According to reception theory, the act of reading is inherently dynamic, involving a multifaceted and evolving process that unfolds over time.

The objective of literary reception is to explore the diverse reactions and interpretations that different individuals have when engaging with a piece of literature. It also aims to understand how readers respond to literature when they read or watch it. Unlike a traditional/classical perspective focusing solely on the author's intentions, a reader response theorist recognizes the importance of the reader's role. They acknowledge that the beauty and meaning of a literary work emerge through the act of reading and the reader's subjective engagement [13].

The "horizon of expectation" is a central concept in Jauss's theory. According to Jauss, readers use different criteria, known as "Horizon and Expectation," to assess the literary value of a text or genre. He argues that no work can universally appeal to all readers as its significance may differ across generations. A literary work does not have a fixed meaning and can be interpreted differently by different individuals. The concept of history plays a crucial role in the horizon of expectations, as highlighted by Jauss. He suggests that literature and society are connected through readers' expectations. Jauss contends that the social function of literature becomes apparent when readers' experiences align with their horizon of expectation [13][14].

Furthermore, Jauss argues that it is essential to consider the historical context of texts when interpreting them, as they are influenced by and reflect the social realities of a particular era [11]. In other words, understanding the historical background in which a literary work was created provides valuable insights into its meaning and significance. By examining the social, cultural, and political conditions of the time, readers can gain a deeper understanding of the author's intentions and the broader societal influences that shaped the text. Jauss emphasizes the importance of considering the historical context as a valuable tool for readers to uncover the complex meanings within a literary work.

Moreover, Jauss also formulates seven theses to indicate how literary history can be methodically written in a new way [4]. Thesis 1 explains the renewal of literary history can be done by eliminating historical objectivism [15]. Historical objectivism refers to the belief that there is a single, objective truth about literary works that can be uncovered through historical analysis. This approach assumes that the meaning and value of a literary work are fixed and determined solely by the historical context in which it was produced. In contrast, an aesthetics of reception places greater importance on how literature is received, interpreted, and influenced by readers and broader societal factors. It recognizes that the meaning of a literary work is not fixed but rather emerges through the interaction between the text and its readers.

In thesis 2 Jauss argues that when analyzing how readers experience literature, it is better to take an objective approach and avoid potential psychological biases. Instead of only focusing on individual emotional reactions, the analysis should consider how a work is received and influenced within its historical context. This includes factors like the reader's familiarity with the genre, previous exposure to similar works, and the difference between the language of literature and everyday language [15].

Thesis 3 proposes that examining audience expectations helps determine the artistic nature of a work based on how much it affects them. When comparing audience expectations with the actual content of a new work, the difference is called the “aesthetic distance.” This difference can lead to a "change of horizons" by challenging familiar experiences or introducing new ones. We can observe this historical process by analyzing audience reactions and critical judgments, such as immediate success, rejection or surprise, mixed opinions, or gradual understanding over time [15].

Thesis 4 suggests that reconstructing the historical context of the period the work was created helps contemporary readers to have a deeper interpretation. It challenges the notion that there is a singular, universal interpretation of art based on classical or modernist standards. Instead, it highlights the dynamic nature of interpretation, showing that meanings can evolve. The true meaning of a literary text is not fixed but it evolves throughout different historical periods [15].

According to Jauss in thesis 5, the theory of aesthetics of reception reveals that a literary work is shaped by its historical context. It emphasizes the importance of considering how a work fits into the larger picture of literature to understand its significance. Rather than viewing a work in isolation, it should be seen as part of a series of works. Each new work is influenced by those who came before it, aiming to solve previous problems and introducing new ones for future works. In essence, literature can be seen as a conversation, where authors respond to each other's ideas and continually push the boundaries of writing [15].

Thesis 6 mentions that progress in linguistics helps in comprehending language's evolution over time and at a particular moment, which can be applied to studying literary history. By examining how past generations received older works and how contemporary readers interpret new works, the connection can be established. This enables us to categorize works from a specific era and identify the relationships among them, ultimately revealing significant moments of change in literary history. This approach offers a fresh perspective on showcasing and comprehending the evolution of literature over time [15].

In thesis 7 Jauss states that the goal of literary history is not only to analyze literature from different periods but also to understand its unique relationship to general history. This goes beyond recognizing that literature often reflects social aspects like idealized or satirical depictions of society. The true social function of literature is realized when readers engage with it, shaping their understanding of the world and influencing their actions in society [15].

DISCUSSION

The Horizon of Expectations on the Representation of Madurese Culture in *Martabat Kematian*

Martabat Kematian was published by Muna Masyari in 2019. This collection of short stories contains 17 stories. The titles mostly used diction related to the cultural symbols of Madura, such as *Celurit Warisan*, *Dukka Ronjangan*, *Sortana*, *Are' Lancor*, *Topeng Gulur*, and *Rokat Salera*. The diction used by Masyari indicates that the themes explored in *Martabat Kematian* revolve around the traditions and culture of Madura. This is consistent with Muna Masyari's popularity as a writer known for her distinctiveness in portraying stories with a Madurese cultural background [9].

Madura is known for the stereotype of its people being rough, emotional, tough, daring, and courageous. This stereotype emerged due to several conflicts involving the Madurese community, such as interethnic conflicts and the cultural practice of "carok." These stereotypes have created a negative stigma about Madura, leading to the widespread social association of Madurese people with criminality [16]. However, in contrast to this perception, Madurese society is also recognized for its religious devotion and adherence to Islamic teachings. Many religious scholars, known as Kyai or ulama, are from Madura and hold highly respected positions within the Madurese community [17]. The negative stigma and religiosity of the Madurese community are two inseparable aspects of Madura's image. These two facets are also reflected in the culture and traditions of the Madurese people, which are recognized by those outside of Madura.

Muna Masyari explores this phenomenon in several short stories in *Martabat Kematian*. In *Dukka Ronjangan*, Muna Masyari describes the tradition of playing the "dukka ronjangan", a musical instrument used to enliven wedding ceremonies, harvest festivals, and other events. One of the main characters of this story is Ibu Marinten, a talented “dukka ronjangan” player [18]. She became the center of attention for men and many young men in the village were captivated by her beauty and skillful use of musical instruments. However, she becomes the object of conflict between two men who both wish to marry her, leading to an almost violent conflict known as "carok" between them.

In this short story, Muna Masyari describes the reality of the Madurese people, who are easily provoked when their dignity is degraded. For the Madurese, dignity is a cultural value that is still respected today. Dignity is a fundamental value for Madurese individuals and is used as a measure of their existence [19]. Women are considered part of men's dignity. Madurese men will not accept any interference from other men regarding their chosen female partners and women can be one of the causes of conflict, including “carok”.

In terms of religiosity, one of the forms demonstrated by the Madurese community is their devotion to Kyai (religious scholars) or ulama. Madura has many Islamic boarding schools, and Islamic education is the preferred choice for the majority of Madurese people. As a result, the ulama or Kyai are highly respected and their words have great influence in Madurese society. The Madurese people adhere to the philosophy of "bappa`, bhabbu', ghuru, ratho" which represents their respect towards parents, teachers, and authorities [20]. In this context, teachers symbolize the Kyai or ulama.

In the short story *Celurit Warisan*, Muna Masyari explores the Madurese's obedience to Kyai. The story revolves around “celurit” (Kris), a symbol of Madurese cultural heritage, often used as a weapon of self-defense [18]. However, "celurit" is sometimes abused to kill people who have violated their dignity. In the story, a Kyai said that "celurit" should not be used to harm the guilty person. The story's protagonist follows Kyai's declaration, even though he faces a conflict that requires the use of "celurit". Despite the circumstances, the main character still follows Kyai's advice.

Furthermore, Madura adheres to a patriarchal culture in which men hold more power than women in all aspects of life. In this regard, Madura is known for its tradition of arranged marriages and early marriage for women. Madurese women are considered individuals who need protection and guidance, and all decisions in their lives are determined by their fathers or husbands [21]. Madurese women are prepared to become wives and mothers [22], limiting their opportunities to pursue higher education. Arranged marriage practices even begin when Madurese women are still in the womb [23]. Marriage takes place when Madurese women reach the age of 15 or after completing junior high school. This phenomenon also raises a new tradition where Madurese women are prohibited from rejecting arranged marriages, as it would result in being "sangkal" [24] or having no further marriage proposals, leading to the stigma of becoming an old maid. Being an old maid is a fear among Madurese people due to the negative stigma that exists within the community.

In *Martabat Kematian*, Muna Masyari extensively explores cultural aspects related to women, including arranged marriages, early marriages, and several life philosophies believed by the Madurese people. In the short story *Matinya Dhamar Kambang*, Masyari tells the story of the arranged marriage culture between Sum and Dulamin [18]. They have been engaged since childhood because their families are close friends, and the purpose of the arrangement is to maintain a good relationship between the families. In this story, Masyari presents the reality that arranged marriages can be a form of coercion, especially for women, as they are unable to refuse. Masyari also portrays the reality that rejecting an arranged marriage can lead to conflicts between the two families, which may result in death.

Masyari also presents the culture surrounding women and marriage in another short story. In *Kembang Pengantin*, it is depicted that there is seemingly nothing more unfortunate for a woman than becoming an old maid. It is as if there is nothing more distressing for a mother than having a daughter who remains unmarried. This story tells the story of a mother who tries various means to ensure that her daughter is quickly proposed to and married. She follows all the believed myths, such as requesting bridal flowers and adorning her daughter's hair with the flowers to facilitate finding a suitable match. She also forbids her daughter from sitting in front of the door, as it is believed to hinder the arrival of a potential partner. Through this story, Masyari portrays that the lives of Madurese women are constrained by the rules and traditions of their culture.

The cultural representations depicted by Masyari in her short stories truly capture the reality that exists in Madurese society. Masyari straightforwardly portrays all aspects of Madurese culture and provides space for readers to evaluate what is good and what is bad. Masyari prioritizes objectivity in her writing, without attempting to steer readers towards her idealism. There are always positive life values that can be taken from her stories, but her narratives also present the ways of thinking and behaving that are in line with the original character of Madurese society and the values they believe in. The readers' horizon of expectation regarding the representation of Madurese culture in the collection of short stories *Martabat Kematian* is similar. Although there may be depictions of Madurese culture that were previously unknown to those outside Madura, the main points of these cultural topics can be predicted, namely, discussions on dignity, conflicts, women's voices in marriage, and problem resolution through violence.

Martabat Kematian is not written to eliminate negative stigma or stereotypes about the Madurese people and their culture. However, *Martabat Kematian* is written to allow readers to understand all the factors that trigger conflicts or underlie the emotional behavior of the Madurese. Through *Martabat Kematian*, Masyari also shows readers that dignity is highly valued by the Madurese society. All the conflicts and issues presented in the short stories of *Martabat* Kematian arise due to the violation of dignity. From all the stories presented, Masyari imparts an understanding to readers that one should never play with the dignity of the Madurese people.

Historical Relativity in Interpreting *Martabat Kematian*

Historical relativity plays a significant role in interpreting *Martabat Kematian* written by Muna Masyari. This collection of short stories presents the cultural and societal realities of the Madurese people. In implementing historical relativity, it becomes evident that the stories cannot be interpreted solely through a universal or objective perspective. Instead, they require an understanding of the historical, cultural, and socio-political context in which they are situated. When applied to *Martabat Kematian*, historical relativity brings us to consider the historical and cultural factors that influence the portrayal of Madurese society and its values in the stories.

One aspect to consider is the historical context of Madura itself. Madura has a rich cultural heritage and distinct traditions that have developed over the centuries. By understanding Madura's historical context, including its interactions with neighboring regions and its colonial influence, we can better appreciate the nuances and complexities of the story. Historical events, such as colonization or political changes, can shape the social norms and values described in the text.

Furthermore, historical relativity encourages us to examine the multiplicity of perspectives within the stories. *Martabat Kematian* presents a range of characters and their experiences, reflecting the diversity within Madurese society. Each character may have their motivations, desires, and struggles influenced by their historical and cultural context. By embracing historical relativity, we can avoid imposing a singular interpretation on the text and instead appreciate the varied viewpoints presented by Masyari.

Interpreting *Martabat Kematian* through historical relativity also invites us to critically analyze power dynamics and social structures inherent in Madurese society. It prompts us to question how historical circumstances and cultural norms shape the relationships, roles, and expectations of individuals within the stories. By doing so, we can gain insights into the complexities of social hierarchies, gender dynamics, and traditional practices portrayed in the text.

Each story in *Martabat Kematian* reflects the complexities and intricacies of Madurese culture, addressing themes such as arranged marriages, gender roles, and societal expectations. Historical relativity reminds us that these cultural practices and beliefs must be understood within the specific historical context of Madura and the experiences of its people. Interpreting *Martabat Kematian* allows us to appreciate the diversity of perspectives and experiences within Madurese society. It helps us recognize that what may appear as controversial or problematic from an external viewpoint might hold different meanings and significance within the cultural framework of Madura.

CONCLUSION

In conclusion, the analysis of *Martabat Kematian* highlights the exploration of Madurese culture and society through a collection of short stories by Muna Masyari. The author effectively portrays various aspects of Madurese culture, including traditions, religious devotion, stereotypes, and gender dynamics. The stories shed light on the importance of dignity, conflicts arising from its violation, and the role of women in marriage. Masyari's writing provides an objective portrayal of Madurese culture, allowing readers to understand the factors that trigger conflicts and the values held by the Madurese people. The analysis also emphasizes the significance of historical relativity in interpreting the stories, considering the historical, cultural, and socio-political context of Madura. By embracing historical relativity, readers can appreciate the complexities and multiplicity of perspectives within the text, as well as critically analyze power dynamics and social structures present in Madurese society. Overall, *Martabat Kematian* offers insights into Madurese culture and invites readers to understand and respect its nuances and diversity.

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Designing a Digital Interactive Module With Javanese Culture Nuances to Improve the Numeration Literacy Abilities of Dysculia Students

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Abstract. Numeracy literacy skills play an important role for every student in solving problems especially for students with dyscalculia (facing difficulties in learning mathematics). The real truth stated that the development of these abilities was not optimal. This is partly due to the lack of mathematics teaching materials specifically for dyscalculic students so that teachers find it difficult to develop numeracy literacy skills. So the solution is that electronic-based textbooks are needed which are packaged in a modern and interactive way so that they are attractive to students. This digital interactive module contains mathematical material that is brought closer to students' daily life with nuances of Javanese culture (local Javanese wisdom). The aim of carrying out this research is to design a product in the form of a digital interactive module to improve the numeracy literacy skills of students with dyscalculia. This research is development research with research stages, namely define , design , develop , and disseminate . This research is limited to development with a limited trial scale (develop). The stage of conducting limited scale product trials was carried out on class V students at an elementary school in Kudus Regency. Based on the results of limited trials, the increase in the numeracy literacy skills of dyscalculic students after using this module in the learning process increased to the medium category.

INTRODUCTION

The results of Based on the PISA results, it is stated that students ' numeracy skills are still relatively low [1] . Indonesia is ranked 72nd out of 79 countries which states that the average student score is 396 in science , 379 in mathematics, and reading 371 . This score is below the average of the 79 PISA participating countries, namely 487 for reading ability, and 489 for mathematics and science ability [2]**.** Numeracy literacy skills must be improved by using appropriate learning strategies [3].

The development of literacy skills will be difficult to achieve if mathematics learning is still carried out conventionally, that is, students are required to in thinking at a low level [4]and is more shown in the memorization process. Even though the indicators for achieving numeracy literacy skills can be successful when students are able to carry out interpretation, application, and formulation vary mathematical conditions , using a useful facts, procedures, and concepts in making estimates, explaining and describing a condition or situation, carrying out reasoning in an observational way . [5]. Having the ability to carry out the understanding that has been obtained will be able to carry out solutions to problems that occur in real life [6]

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040001-1–040001-9; https://doi.org/10.1063/5.0242354
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Mathematical concepts are arranged hierarchically, where in studying them students can master the previous concepts (prerequisites) so that they can deepen the concepts given afterwards. In fact, each student has different abilities. Difficulty learning mathematics is called dysculia. Dyscalculic students need more time and repetition to be able to do academic and non-academic tasks . Student always does not imitate the pattern of Piaget's cognitive development. Meanwhile the existing curriculum in schools are often based on patterns of cognitive development. So , students are not yet capable doing cognitive tasks given by the school [7].

The results of observations in twelve elementary schools regarding the teaching materials used based on the characteristics of dyscalculic students only reached 5.71 % . Teachers often use similar teaching materials in carrying out learning for all students. Meanwhile, dyscalculic students need special educational services .

Many mathematics books in circulation do not contain cultural elements [8]. This is in line with the results of the questionnaire given to 30 teachers , which shows that most of the teaching materials used are in printed form and do not yet show the character of local culture. Teaching materials tend to be theoretical in nature and there is a lack of activities that invite students to get to know the surrounding culture, causing boredom. Apart from that, millennial students also prefer playing with cellphones rather than reading printed books. So, there is a need for innovative cultural and digital-based teaching materials that can be used, innovative, fun and interesting [9]. This is confirmed by the Indonesian Internet Service Providers Association in 2017, the percentage in school enrollment was 14.63 % , the percentage in online courses was 17.85% , the percentage in Sharing educational articles and videos was 21.73% , the percentage of viewing video tutorials was 49.67% , and the percentage of reading articles was 55.3% in using the internet in the educational sector. Based on these facts, digital technology can exercise control in the world of education, due to the significant increase in internet use . In this research, the module developed is a digital interactive module with Javanese culture nuances to improve the numeracy literacy skills of students with dyscalculia.

Interactive modules are teaching materials in the form of modules made from software programs so that they become interactive [1]. Modules are created using multimedia technology which allows one to add animation , video, images, graphics and text so that it can provide an interactive environment . Animations and images can be displayed describe the teaching material provided , therefore students can understand it more easily in understanding the contents of the module. Interactive conditions can foster very high communication value, which means that information is not only seen as print, but can also be heard. There is an animated presentation that has high graphic value which can increase user enthusiasm [10]. It is called interactive because users will experience interaction and become active, for example actively paying attention to films or videos, animations, sounds, writing that has a variety of colors/moving and images.

The digital interactive module developed has Javanese Culture nuances where researchers teach mathematics by applying mathematics learning with a Realistic Mathematics Education (RME) approach. Researchers utilize Javanese cultural knowledge in teaching mathematics at school by using this knowledge as reference material in delivering material and creating contextual problem solving questions. The RME approach is able to make it easier for teachers to relate material to situations in the real world and make students have a connection between knowledge and its application in real life as members of society. With this concept , learning outcomes are expected to become more meaningful for students [11]. The definition of dyscalculic students in this study is students who experience difficulties in learning mathematics who were previously categorized through the WISC (Wechsler Intelligence Scale for Children) test, which is a type of intelligence test commonly used by psychologists to measure intellectual function in children. Based on the background above, the researchers intend to design a digital interactive module with Javanese culture nuances to improve the numeracy literacy skills of students with dyscalculia. Thus, the problem formulation in this research is 1) what is the form of digital interactive module design with Javanese culture nuances ?; 2) what is the feasibility of a digital interactive module with Javanese culture nuances?; 3) Can digital interactive modules with Javanese culture nuances improve the numeracy literacy skills of students with dyscalculia?.

METHODS

This research is development research which aims to design a digital interactive module with Javanese culture nuances to improve the numeracy literacy skills of students with dyscalculia. The research stages used in this research are the 4D model, namely definition , design , development and dissemination . This research is limited to development with a limited trial scale (develop). The research was conducted on a limited basis to class V students at an elementary school in Kudus Regency with the research subjects being 10 students with dyscalculia. The data obtained from the research consists of quantitative data and qualitative data, namely assessments by mathematics learning media experts, mathematics content or material experts, and language experts, interview data, observation data and test data on improving the literacy and numeracy skills of students with dyscalculia. The instruments used in this research were questionnaires, interview sheets and numeracy literacy ability test instruments. Specifically for questionnaire instruments, there are three instruments specifically designed and aimed at validators, namely mathematics learning media experts, mathematics content or material experts, and linguistic experts which are tailored to the expertise of each expert.

Data analysis from experts was carried out using techniques, namely: 1) recapping the questionnaire assessment; 2) calculation of scores from experts analyzed based on value conversion benchmarks; 3) making data tabulations and; and 4) calculate the percentage value. The calculation of the percentage value is as follows.

$$\text{P(presentase)} = \frac{\text{nilai yang diperoleh x 100\%}}{\text{nilai maksimum ideal}}$$

After calculating the percentage value, the next stage is to classify and interpret the calculation. The following Table 1 is the interpretation.

TABLE 1. Interpretation of Media Feasibility Results

No	Percentage	Classification
1	81%-100%	Very Worth It
2	61%-80%	Worthy
3	41%-60%	Decent Enough
4	21%-40%	Not feasible
5	0%-20%	Totally Not Worth It

Meanwhile, data analysis on improving the numeracy literacy skills of dyscalculic students at an elementary school in Kudus Regency was carried out by calculating normalized n-gain scores and classifying them based on the n-gain values.

$$\text{Normalized gain (g)} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}$$

TABLE 2. Normalized Gain Classification

Normalized Gain (g)	Classification
$g \geq 0.70$	High
$0.30 \leq g < 0.70$	Medium
$g < 0.30$	Low

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RESULTS AND DISCUSSION

Based on interviews with teachers at an elementary school in Kudus Regency, the benefit of this digital interactive module with Javanese culture nuances is to help teachers provide learning media that can help students with dyscalculia better understand mathematics learning. With the existence of learning media, it can make students enthusiastic in the mathematics learning process because learning media has a good influence on students' psychology [12] . Apart from that , this learning media can be used as a companion module for students that can be used anytime and anywhere. The target audience in designing this digital interactive module is class V students at an elementary school in Kudus Regency. This digital interactive module will be used by students at school and at home as a learning companion. Products are made using multimedia technology so that someone can add animation , video, images, graphics and text so that they can provide an interactive environment . Display animations and images makes it easier to describe teaching material , so students can more easily understand the contents of the module. Learning that uses multimedia technology must pay attention to the content and the way students receive and process information so that the learning process can take place effectively [13] . Interactive conditions can foster very high communication value, which means that information can not only be seen in print, but can also be heard. There is an animated presentation that has high graphic value which can increase user enthusiasm [10] . In this way, students can easily understand mathematics material so they can improve their numeracy literacy skills.

The conclusion from interviews with class V teachers at SD 1,2,3 Samirejo and SD 2,3, 5 Puyoh is that the numeracy literacy skills of a number of class V elementary school students have not developed optimally, especially for dyscalculic students. Teachers have not used digital technology adaptations in learning activities. This is in line with what Aldeia, et al (2022) said that teachers are still unfamiliar with learning media, namely online learning media or digital technology [14] . Based on the results of the interview, the author then created a digital interactive module with Javanese culture nuances. The stages carried out in this activity are as follows.

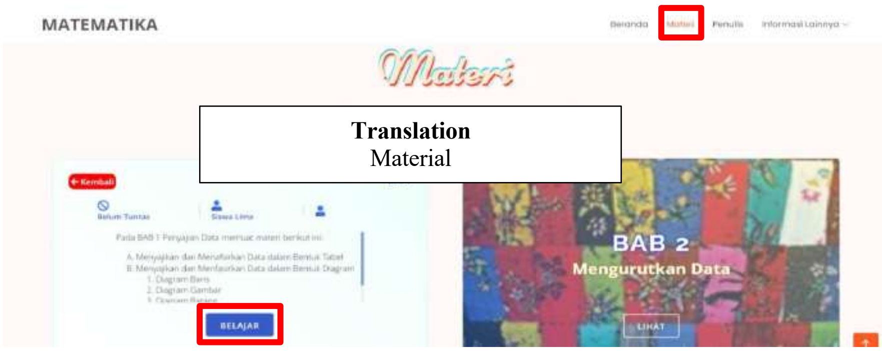
1. Digital Interactive Module Planning Stage with Javanese Culture Nuances
   The activities carried out at this stage are preliminary studies related to the research that will be carried out as well as product design concepts in the form of determining material, sub-material, KI, KD, class, determining questions based on numeracy literacy skills.
2. Digital Interactive Module Development Stage with Javanese Culture Nuances

Designing a digital interactive module draft product concept with Javanese culture nuances in each sub-material, layouting a digital interactive module draft with Javanese culture nuances in all chapters, carrying out expert validation, carrying out evaluations and improvements based on suggestions from validators and conducting limited scale trials on students with disabilities in class V an elementary school in Kudus Regency. The following is documentation of research activities

FIGURE 1. Documentation of Research Activities

The following is an overview of the Digital Interactive Module with a Javanese Culture nuance that was developed

FIGURE 2. Opening interface of the Digital Interactive Module Nuances Javanese Culture



Translation
Material

Translation
Chapter 1 Data Presentation contains the following material :
A. Presenting and Interpreting Data in Table Form
B. Presenting and Interpreting in Diagram Form
1. Line Diagram
2. Picture Diagram

Translation
Chapter 2 Sort Data
SEMAR (Material at a glance)

FIGURE 3. Description of the Digital Interactive Module Nuances Javanese Culture

The Digital Interactive Module with Javanese Culture nuances was first validated by three validators, namely learning media experts, language experts, and content or mathematics material experts. This validation activity is used as a basis for using digital interactive modules with Javanese culture nuances in research activities. In this activity, researchers can improve the module according to expert advice until the module is declared suitable for use. The expert validators used to validate the digital interactive module with Javanese culture nuances are mathematics learning media experts, mathematics content or material experts, and language experts.

TABLE 3. Recapitulation of Validation Results by Experts

	No	Aspects Of Assessment	Average	Description
Mathematics Materials Expert	1	Introduction	93%	Very Worth It
	2	Relevance	92%	Very Worth It
	3	Accuracy	98%	Very Worth It
	4	Serving Equipment	89%	Very Worth It
	5	Basic Concepts of Matter	100%	Very Worth It
				Very Worth It
	6	Suitability of presentation with student-centred learning demands	95%	Very Worth It
				Very Worth It
				Very Worth It
Linguist	1	Cover	100%	Very Worth It
	2	Straightforward	83%	Very Worth It
	3	Communicative	80%	Worthy
	4	Dialogic and interactive	100%	Very Worth It

	No	Aspects Of Assessment	Average	Description
Mathematics Materials Expert	1	Introduction	93%	Very Worth It
	2	Relevance	92%	Very Worth It
	3	Accuracy	98%	Very Worth It
	4	Serving Equipment	89%	Very Worth It
	5	Basic Concepts of Matter	100%	Very Worth It
	6	Suitability of presentation with student-centred learning demands	95%	Very Worth It Very Worth It Very Worth It Very Worth It
	5	Suitability to student development	90%	Very Worth It
	6	Conformity with Indonesian language rules	83%	Very Worth It
	7	Use of terms and symbols	80%	Worthy
Media Expert	1	Media Efficiency	88%	Very Worth It
	2	Media Equipment	80%	Very Worth It
	3	Media Contents	86%	Very Worth It
	4	Media Graphics	93%	Very Worth It
	5	Media Benefits	87%	Very Worth It

The validation results show that the Digital Interactive Module with Javanese Culture nuances can be used for research with minor revisions. After improvements were made, the Digital Interactive Module with a Javanese Culture nuance was tested on a limited basis on dyscalculic students at an elementary school in Kudus Regency. Following are the test results data

TABLE 4. Limited Scale Trial Result Data

No	Student's Name	Pretest Score	Post-Test Score	N-Gain Score	N-Gain Description
1	A	18	64	0,56	medium
2	B	18	64	0,56	medium
3	C	14	51	0,43	medium
4	D	18	64	0,56	medium
5	E	21	77	0,70	medium
6	F	14	51	0,43	medium
7	G	7	26	0,20	low
8	H	14	51	0,43	medium
9	I	14	51	0,43	medium
10	J	14	51	0,43	medium
Average		15	55	0,47	medium

Table 4 shows that the numeracy literacy abilities of dyscalculic students after using the Digital Interactive Module with Javanese Culture has increased in the moderate category. Based on the results of a limited trial on 10 dyscalculic students at an elementary school in Kudus Regency, it shows that the Digital Interactive Module with a Javanese Culture nuance is very popular with dyscalculic students. They are interested in this digital module because there are stories related to local culture, pictures, color, and it is more fun to learn with this digital module compared to printed modules. This is in line with research conducted by Munir, et al (2023), which states that with the digital module students are more interested in learning as evidenced by the increase in students' average scores [15] . Apart from that, this module is easy to understand because there are examples relevant to everyday life. The pictures and colors in the digital module make dyscalculic students interested in reading and learning. This is in line with research by Anindya et al which shows that innovative learning media can improve the numeracy skills of grade 1 students [16] .

CONCLUSION

The Digital Interactive Module with Javanese Culture nuances is a learning media that can be used by teachers as an alternative learning resource for fifth grade elementary school students with dyscalculia in an effort to improve numeracy literacy skills. The results of the assessment from the validator show that on average the mathematical material aspects, linguistic aspects and learning media aspects of the digital interactive module have a Javanese culture nuance is very good . Based on the results of limited trials, the increase in the numeracy literacy skills of dyscalculic students after using this module in the learning process increased to the medium category. The Digital Interactive Module with a Javanese Culture nuance displays illustrations and a combination of colors that match the characteristics of elementary school students so that it attracts and motivates students in learning. Suggestions for researchers who will continue this research are that advanced researchers can continue the research with wide-scale tests and develop Digital Interactive Modules with Javanese Culture nuances at different school levels and classes.

ACKNOWLEDGMENTS

Thanks to Kemdikbud Ristek and LPDP, that given us financial support for this Research (No: 141/E4.1/AK.04.RA/2021). Thanks to the research team from Universitas Muria Kudus and the partners who have cooperated in this research. Thanks to all the parties that assisted with this research.

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Designing PISA-Like Mathematics Problem Using Embun Glamping Tourism Context

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Abstract. The foundation of this study is the low PISA (Program International Student Assessment) achievement of Indonesian students, particularly in mathematics. This is a result of the fact that students are not used to answering PISA-style questions while they are studying. This study uses the context of Embun Glamping Tourism to generate legitimate and useful quantity content PISA-style questions. Students in the seventh grade at SMP PGRI Pagar Alam, ages 14 to 15, were the subject of this study. This study employs a design research development methodology that includes a formative evaluation phase in its initial stages. Student analysis, curriculum analysis, PISA question analysis, and instrument creation are done in the preliminary stage. Expert review, one-on-one and small group discussions, and self-evaluation are done in the formative evaluation stage. Question cards, lesson plans, assessment rubrics, question grids, and PISA-style questions were all used in this study. Walkthroughs, documentation, observations, tests, and interviews were used to gather field data. Three valid and useful quantity content questions about Embun Glamping tours were the result of this research and are in the format of PISA-type questions. The study concludes that teachers and students can use PISA-style questions on quantity content in the context of Embun Glamping for learning and assessment purposes to help them become accustomed to taking the PISA exam.

INTRODUCTION

Mathematical literacy is very important to understand the usefulness of mathematics in everyday life [1] as well as the usefulness of mathematics to face a changing world [2]. one of the programs that assesses mathematical literacy is PISA by OECD [3]. however, the results of PISA in the past few years, especially in the country of Indonesia, revealed a gap in Indonesia's education system. Based on the results found from the PISA report, it shows that Indonesia's mathematics performance is weak, with Indonesian students getting only a score of 379 while the average international score reaches 489 [4]. Some of the causes include students' unfamiliarity with working on PISA-type questions in learning [5], and assessment [6];[7], students' lack of ability to solve higher order thinking skills (HOT) or non-routine problems [8];[9]. In addition, there is a shortage of teachers trained to design PISA-like problem related to authentic context and language structure [10]. Referring to these facts, most teachers can only provide materials and practice problems at the lower level [11].

One way to help implement PISA-based learning with the aim of familiarizing students is to provide PISA questions both in learning and in terms of assessment. To familiarize students with PISA model questions in learning, the use of context is also very important. This is because one of the characteristics of PISA is context-based questions [4]. In addition, it can encourage students to think mathematically and attract students to learn by linking context to mathematical problems [12];[13]. Therefore, teachers are required to design problems using contexts that are close to the students' environment [2];[14]. Supported by the Indonesian government who took the initiative to update the curriculum and make PISA an assessment in Indonesia, the Ministry of Education, Technology and Research [3].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040002-1–040002-9; https://doi.org/10.1063/5.0244849

In accordance with Government Regulation (PP) No. 10 of 2009 concerning tourism related to improving the regional economy. This policy is also in line with the most recent curriculum, known as the independent curriculum, which emphasizes flexible learning among other things to adapt to local contexts and content, particularly in South Sumatra. To support this, the context used is Pagar Alam city tourism. The large number of tours in Pagar Alam City can be used as a reference source for building school mathematics learning using the context of tourism. The city of Pagar Alam has many diverse potential contexts [15]. The Embun Glamping tourism context, situated in Pagar Alam City, is one of the contexts that can be utilized. This millennium, a career in natural tourism is an option. Given that it is the newest tour available in Pagar Alam, one option is the Embun Glamping Context tour. Today's tourists are particularly interested in the Embun Glamping context, which is a nature tour that can be enjoyed in the cool air day or night. utilizing Embun Glamping in a way that is relevant to everyday requirements. For instance, comparing prices makes sense when deciding which tent package to purchase.

Various studies on the development of PISA-type math problems have been carried out. Among them is the development of tests using certain contexts, namely developing PISA-type questions in the context of Bangka Belitung regional culture [1], smartphones [16], Asian Games context [2], taekwondo [17], natural and cultural heritage [18], LRT [5], the context of the spread of COVID-19 [14] and the maps are covid [19]. In addition, the sal developed also focuses on student strategies [20], reasoning and argumentation processes [21], mathematization processes [22] there are also other studies that focus on developing questions with reasoning levels [8]. That being said, this is the first time the independent curriculum has been used in conjunction with the Embun Glamping context. Furthermore, the PISA 2022 framework—which emphasizes reasoning—is employed. Consequently, in order to create PISA-type questions that are legitimate, useful, and may have an impact on numeracy skills, researchers are interested in creating using the Embun Glamping tourism context.

METHOD

This research is a development studies type research which focuses on two stages of development, namely the preliminary stage and the formative evaluation stage [23];[24];[25].

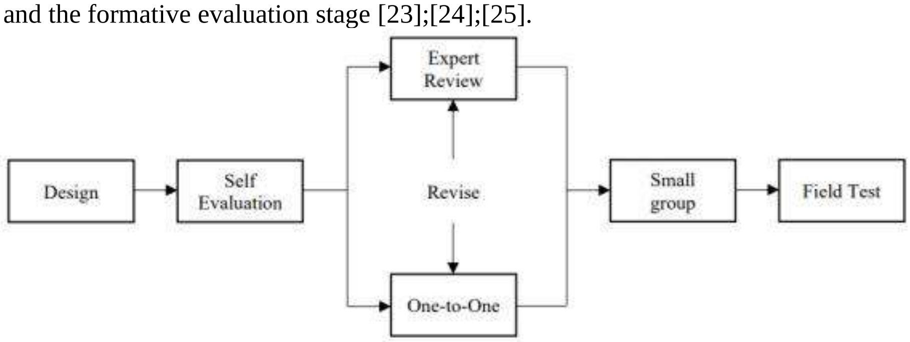

FIGURE 1. Flow of development research

This research focused on one school that was analysed, namely VII grade students of SMP PGRI Pagar Alam. Furthermore, researchers conducted a curriculum analysis regarding PISA questions, what materials are suitable. then guided by PISA 2000-2022 questions, researchers analysed the PISA 2022 framework consisting of content, context, and cognitive levels at the reasoning level and developed it at the preliminary stage. Then after that the researchers produced PISA evaluation questions, question cards, grids and assessment rubrics. The results were then used to make the first product evaluation questions along with other supporting instruments such as question grids, question cards, assessment rubrics, interview question guidelines and validation sheets.

Furthermore, the second stage is formative evaluation which consists of 5 stages, namely self-evaluation, expert review, one-on-one, small group, and field test. However, this study only reached the small group which resulted in a valid and practical product. At the self-evaluation stage, researchers improved the first prototype that had been designed to be even better, analysing in terms of writing errors, sentence errors that caused double meanings, then produced prototype 1. Then prototype 1 was sent to experts, namely Sriwijaya University postgraduate students, doctoral students and mathematics teachers who teach at SMP PGRI Pagar Alam via email at the expert review stage. This was done to test prototype 1 in terms of content, construct, and language to apply PISA-type questions. The third stage, namely one-to-one, was carried out simultaneously with the expert review, three students with different abilities were selected who were PGRI Pagar Alam Junior High School students focused on content, construct, and language. From the results of comments and suggestions at the expert review and one-to-one stages, revisions were made so as to produce a valid prototype 2 and will be used at the small group stage. Furthermore, to test the practicality of PISA-type questions, the questions were tested at the small group stage with a total of 9 students from SMP PGRI Pagar Alam who had different abilities and each student gave his answer. Researchers conducted interviews with students to see how well students understood the evaluation questions given. The small group trial stage is carried out for improvement before heading to the field trial stage or what is called prototype 3.

RESULT AND DISCUSSION

This research focuses on the context of Embun Glamping which consists of three questions.

Preliminary

At the preliminary stage, researchers conducted research at a school in the city of Pagar Alam, which is the PGRI Pagar Alam Junior High Schol. The researcher made observations at the junior high school to determine the subject selection, time and flow of teaching and learning activities required and to obtain the necessary permits as an administrative requirement. Next, the researchers analyzed the PISA type questions and developed them using the context of Embun Glamping in Pagar Alam City.

A direct visit to PGRI Pagar Alam Junior High School was carried out by researchers. Then the school determines which students contribute to data collection, for example by carrying out one-on-one and small group teaching under the guidance of the teacher in charge of the class. Three students with varying abilities are selected for the one-on-one stage. six students with different abilities are selected for the small group stage simultaneously. This is intended to measure the success of the PISA type questions developed by researchers for each student with different abilities based on the level of difficulty of each student by taking into account the diversity of students' abilities.

The independent curriculum is the curriculum used at PGRI Pagar Alam Junior High School, then the focus of the study is narrowed to teaching materials based on the material in the curriculum used at PGRI Pagar Alam Junior High School. Learning material for integer arithmetic operations is contained in Chapter I of the Independent Curriculum. Up to this point, the assessment questions that have been made are based on the PISA 2012 questions in the form of PISA questions with the context of a memory stick as in figure 1 which was then used as an illustration in the making of this research.

Question 1: MEMORY STICK *PM00AQ01*

Ivan wants to transfer a photo album of 350 MB onto his memory stick, but there is not enough free space on the memory stick. While he does not want to delete any existing photos, he is happy to delete up to two music albums.

Ivan's memory stick has the following size music albums stored on it.

Album	Size
Album 1	100 MB
Album 2	75 MB
Album 3	80 MB
Album 4	55 MB
Album 5	60 MB
Album 6	80 MB
Album 7	75 MB
Album 8	125 MB

By deleting at most two music albums is it possible for Ivan to have enough space on his memory stick to add the photo album? Circle "Yes" or "No" and show calculations to support your answer.

FIGURE 2. Original PISA 2012 questions on content Memory Stick

Figure 2 Is a PISA question that describes a memory stick, a compact portable data storage device. The photo album will be copied to the memory stick. However, it requires more free space on the memory stick and only two music albums can be deleted.

In this original PISA problem, the issue was whether there was enough free space on the memory stick after deleting at most two seasons of albums. Students are asked to answer Yes or No and show the calculations for the answers they have obtained. There are many possible music albums that can be deleted, so students can decide which music albums to delete. Students must reason in determining which music album should be deleted, namely choosing the music album with the largest size so as not to try several available possibilities. In this problem, the concept of integer counting operations is needed. The research will develop PISA type questions using the Embun Glamping tourism context based on these questions.

Self – Evaluation

Researchers are required to examine and evaluate the PISA-style questions that were created with an emphasis on the quantity content utilized in the context of Embun Glamping before moving on to the self-evaluation phase. Considerations including topic, construct, and language are necessary when crafting PISA-style questions. Errors like typos, poor word choice, or the quantity of sentences the researcher needs to finish will enhance the PISA-style questions created. PISA-style questions were given to the students, and after making improvements based on the results of the self-evaluation, the researcher created Prototype 1, which is depicted in Figure 2 below.

EMBUN GLAMPING

Embun Glamping is a tourist spot for camping but still with luxurious / glamorous facilities. There are several packages for camping but you can also do independent camping. Below you can see some of the prices for the luxury facilities at Embun Glamping..

Fasilitas	Harga
Camping ticket	35k
Springbad	100k
Mattress	25k
Tent lights	100k
Bonfire	100k
Chairs + table inside the tent	35k
Electricity + charger cable	85k
Dinner	50k
Breakfast	50k

While in the city of Pagar Alam, Fairah spent 515k on food, 300k on transportation, 1275k on accommodation, 375k on other expenses. Fairah wants to try glamping last night at Embun Glamping and rent all the facilities. But she only has 535k remaining. Fairah only wants to remove 2 of the lits above.

a. How much money did Fairah prepare for a holiday in the city of Pagar Alam?
b. Can Fairah try with the remaining money she has? make a calculation method
c. Is Fairah's remaining money after trying glamping less than 1/10 of the money she had prepared? explain

FIGURE 3. prototype 1 of PISA type problem fokus on quantity content

Researchers must first examine and evaluate the PISA-style tasks and activities created with an emphasis on quantity content using the Embun Glamping context, as shown in Figure 2, during the self-evaluation stage. A question's topic, structure, and language should all be taken into consideration. Errors like misspellings, bad word selections, or an excessive number of sentences that the researcher is unable to finish will raise inquiries and activity. The first prototype is being refined further through the expert review and one-on-one stages.

Expert Review and One-to-One

At this stage, the experts involved are M. Hasbi Ramadhan, S.Pd., M.Si., Laela Sagita, M.Sc., and Agus Puji Astuti, S.Pd. The goal is to verify the researcher's prototype 1, prototype 1, for content, structure, and language. According to [20], valid questions for content, structure, and language were created through expert review and one-on-one validation. In order to meet the PISA framework questions, content criteria must take into account the quantity of content, the material that is tested, and the counting indicators. The construct aspect criteria, which evaluates the suitability of PISA-type questions with the ability level of seventh grade students, contains questions that mimic PISA features, such as pictures, tables, graphs, etc., in a clear, legitimate, and functional manner. Furthermore, language criteria are employed to assess if the sentences' words are clear, uncomplicated, communicative, and do not lend themselves to multiple interpretations. PISA-style tasks and questions can be used for Enhanced Indonesian Spelling (EYD). Following the expert review, a one-to-one review with Prototype 1 was carried out to examine the comments and suggestions made on the created questions and gather input from the students. A trial of prototype 1 involved three students with varying skill levels. Prototype 2 was developed based on the outcomes of the expert review and one-on-one interviews. The researcher modified the Prototype 1 questions to make them legitimate.

TABLE 1. *comment, suggestion and revision decisions*

Validation	Comment and Suggestion	Revised Decision
Lectures and Taecher	• Add source to the context image. • Correct non-standard sentences such as k in sentences so that students are not confused. • correct sentences or commands in questions that violate mathematical rules.	• Add sources to existing photos • correct non-standard sentences or words such as "k" to "Rp/IDR". • correct sentences or commands in questions that violate mathematical rules, by clarifying the sentences
Student	• differences in meaning of questions between researchers and students, lack of clarity in the sentences given.	• correct sentences that make students confused and that have double meanings

According to experts who are teachers, lecturers, and students, table 1 above shows that although PISA-style questions are generally positive, they still require improvement. [20], it seems that when evaluating qualitative validity, three factors must be taken into account. The first component is content, which includes information on how Embun Glamping tourism and integer arithmetic operations are related. The concept of evaluating the degree of difficulty of questions pertaining to the PISA 2022 framework constitutes the second aspect. The third point is that the language has well-chosen and appropriate sentence construction.

Small Group

At the small group stage, questions will be tested that have been revised at the expert review and one-to-one stage, namely prototype 2.

EMBUN GLAMPING

Source : https://jadesta.kemenparekraf.go.id/atraksi/embun_glamping

Embun Glamping is a tourist spot for camping but still with luxurious / glamorous facilities. There are several packages for camping but you can also do independent camping. Below you can see some of the prices for the luxury facilities at Embun Glamping.

Fasilitas	Harga
Camping ticket	IDR 35.000
Springbad	IDR 100.000
Mattress	IDR 25.000
Tent lights	IDR 100.000
Bonfire	IDR 100.000
Chairs + table inside the tent	IDR 35.000
Electricity + charger cable	IDR 85.000
Dinner	IDR 50.000
Breakfast	IDR 50.000

While in the city of Pagar Alam, Fairah spent IDR 515.000 on food, IDR 300.000 on transportation, IDR 1.275.000 on accommodation, IDR 375.000 on other expenses. Fairah wants to try glamping last night at Embun Glamping and rent all the facilities. But she only has IDR 535.000 remaining. Fairah only wants to remove 2 of the lits above.

a. How much money has Fairah prepared for a holiday in the city of Pagar Alam based on the information above?
b. Can Fairah try to stay overnight with the remaining money she has if she only wants to delete 2 from the list above? make a calculation method
c. Is Fairah's remaining money after trying glamping less than 1/10 of the money she had prepared? explain how to calculate it

FIGURE 4. Prototype 2 of PISA type problem fokus on quantity content

Based on figure 3 above, which is prototype two, it was tested on three small groups consisting of two students each with varying abilities, used to test the prototype two PISA type questions. Some students correctly understood the meaning of the question and gave the right answer, while there were others who gave inaccurate answers as in figure 4, figure 5 and figure 6 below.

515+300+1275+375 = 815+1275 = 2100+375 = 2475+535 = 3.000
Jadi jumlah uang fairah yang disiapkan untuk liburan dikota pagar alam adalah 2475K
ditambah 535 sisa = 3.000.000

Translation :

515 + 300 + 1.275 + 375 = 2475 + 535 = 3.000

so the amount of fairah money prepared for a holiday in the city of Pagar Alam is 2475 plus the remaining money you have 535 = IDR 3,000,000

FIGURE 5. FA answer on Embun Glamping context part (a)

Based on figure 4 above, students have understood the problem well as can be seen from the FA students who have answered correctly the problem given by reading the information that has been given and the students have also provided their conclusions.

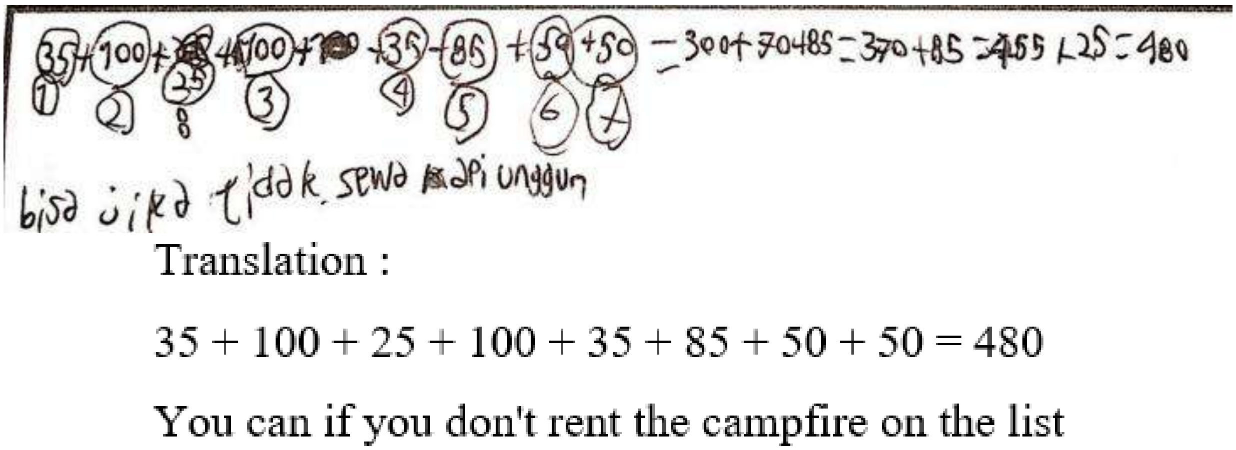

FIGURE 6. FA answer on Embun Glamping context part (b)

Figure 5 shows the results of students' answers to the Dew Glamping question part (b). It can also be seen that students understand the problem clearly by giving the correct answer, and all indicators of numeracy ability appear. Students can draw conclusions and explain why they chose which apps to delete. The results of students' answers varied in choosing which application to delete, namely one of them, as in Figure 5, FA students chose the campfire. Students who have good reasoning skills will immediately choose the one that is quite expensive compared to the others, but there are also those who use a trial and error strategy. According to [8], students usually use the trial and error method because they do not know the pattern or formula of the questions; as a result, they search through trial-and-error for potential solutions.

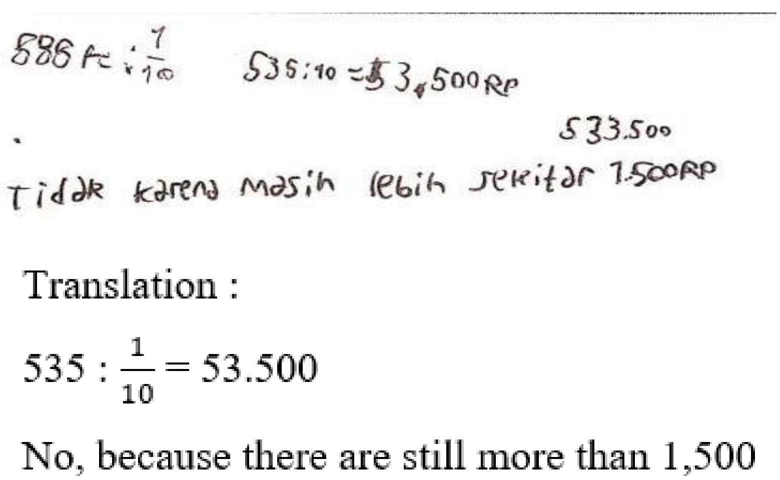

FIGURE 7. FA answer on Embun Glamping context part (c)

Based on Figure 6 above, it can be seen that students still do not understand the problem given, as can be seen from the students' answers. Students think that the remainder referred to in the question is the remainder before Fairah's stay, even though on the contrary the remainder referred to is the remainder after Fairah's stay in Embun Glamping Tourism.

EMBUN GLAMPING

Source : https://jadesta.kemenparekraf.go.id/atraksi/embun_glamping

Embun Glamping is a tourist spot for camping but still with luxurious / glamorous facilities. There are several packages for camping but you can also do independent camping. Below you can see some of the prices for the luxury facilities at Embun Glamping.

Fasilitas	Harga
Camping ticket	IDR 35.000
Springbad	IDR 100.000
Mattress	IDR 25.000
Tent lights	IDR 100.000
Bonfire	IDR 100.000
Chairs + table inside the tent	IDR 35.000
Electricity + charger cable	IDR 85.000
Dinner	IDR 50.000
Breakfast	IDR 50.000

While in the city of Pagar Alam, Fairah spent IDR 515.000 on food, IDR 300.000 on transportation, IDR 1.275.000 on accommodation, IDR 375.000 on other expensesand she only has IDR 535.000 remaining.

a. How much money has Fairah prepared for a holiday in the city of Pagar Alam based on the information above?

Fairah wanted to try glamping one night at Embun Glamping and rent all the facilities, but she only had IDR 535,000 left. Fairah decided to remove a maximum of 2 from the list above.

b. Can Fairah try staying at Embun Glamping with the remaining money she has? create a calculation method
c. Is Fairah's remaining money after trying glamping less than 1/10 of the money she had prepared? explain how to calculate it

FIGURE 8. Prototype 3 of PISA type problem fokus on quantity content

Figure 7 is the result of improvements after observing at the small group stage and conducting interviews with several students. The researcher made improvements by moving the information sentence: "Fairah wanted to try glamping one night at Embun Glamping and rented all the facilities, but she only had IDR 535,000 left. Fairah decided to delete a maximum of 2 from the list above" after part a of questions. This was done because in the small group process, the researcher observed that several students answered the questions incorrectly due to misunderstandings when reading the questions. To ensure this, researchers also confirmed this by conducting interviews with students. The following are the results of student interviews conducted at the small group stage.

(S : Student ; R : Researcher)
R : From the answer you wrote, why did you answer part A like that?
S : because in part a you are asked about the total amount of money used while in the city of Pagar Alam ma'am.
R : okay, thank you, for part b, how did you conclude that you would delete the campfire from the list?
S : because, if you delete the others, you're afraid it won't be enough, ma'am
R : In the question it says a maximum of two from the list, which means you can still delete the other lists, right?
S : yes, that's right ma'am
R : If, for example, you moved the sentence "fairah will delete a maximum of two from the list" after question part a, would you choose the other one? because if you think about it, a campfire is something that is needed when we are going glamping.
S : oh yes ma'am, this is easier to understand.

According to the interview's findings, it seems that the student misinterpreted the issue because some information was included that was unrelated to the question phrase. As a result, the researcher changed the problem's sentence structure based on the findings of the student interview and reorganized the problem's information structure. According to [22], when students solve problems that take the form of pictures, they read the problem directly, comprehend it, pay attention to it, and come up with a solution based on the pertinent details in the picture. Additionally, they eliminated other possible answers and selected the response that was closest to the calculation process when they could not find an option that complied with the process.

CONCLUSION

With an emphasis on quantity content, this study creates PISA-style questions using the Embun Glamping tourism context. This question was created with the memory stick context and quantity content in mind, drawing inspiration from the original PISA question from 2012. Students can learn to integrate real-world situations into mathematical contexts, solve mathematical puzzles, and develop mathematical solutions by developing PISA-style problems within the framework of Embun Glamping tourism. Prototype 1 of the PISA-type problem developed in this case was emailed to lecturers and teachers, tested on three students with varying abilities, and so on. This allowed the product to be validated. Prototype 2 was then revised and tested up to the small group stage, where students demonstrated their understanding of the questions by answering correctly, conducting interviews with multiple students on Prototype 2, and finally refining it into Prototype 3, which is already functional. In order to help teachers and students prepare for and feel more comfortable taking the PISA test, PISA-style questions within the framework of Embun Glamping can be used for learning and assessment purposes.

ACKNOWLEDGMENTS

The students and faculty at PGRI Pagar Alam Junior High School are thanked for their contributions to this study, as are the researchers' mentors and colleagues. Thank you to Sriwijaya University for providing financing for this study under agreement/contract no. 0187/UN9.3.1/SK/2023.

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The Development of Problem-Based Calculus E-Modules to Improve Students' Numeracy Literacy Skills

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Abstract. This study aims to develop a problem-based E-Module to improve students' numeracy literacy skills in Calculus courses. This research was development research using the Plomp model which consists of three stages. The first stage is the preliminary research stage which aims to identify the needs required for the development of E-modules. The second stage is the prototyping stage, and designing problem-based E-modules. The third stage is, where E-module trials are conducted consisting of small group trials and broad group/field trials. At the assessment stage, a final assessment supplement that meets the criteria of valid, practical, and effective will be obtained. The research was conducted at the Mathematics Education Study Program, PGRI Madiun University in the even semester of the 2022-2023 academic year. The instruments used in this study included validation sheets for E-modules, response questionnaires to measure the practicality of E-modules, questions, and learning outcomes tests to measure the effectiveness of E-modules. The research results show that the E-module developed meets the validity criteria (the average results: 85.71%), meets the practicality criteria (the average results: 90.15%), and meets the effectiveness criteria (the average results: 85.23%). Based on the research results, it can be concluded that the problem-based E-Module is suitable for developing students' numeracy literacy skills in Calculus courses.

INTRODUCTION

In solving a problem, literacy skills are needed. Literacy is a set of abilities that includes reflective information discovery, understanding how information is produced and assessed, and the use of information in creating new knowledge and participating ethically in learning communities [1]. A student can be said to be responsive to information if he can recognize, access, and evaluate information sources, and use them effectively to solve problems. Literacy for students can be interpreted as an individual's ability to use all the potential and skills they have in their life, not just the ability to read and write. An individual's ability to read, write, speak, calculate, and solve problems at the level of expertise required in work, family, and society [4].

Literacy skills currently developed such as reading literacy, numeracy literacy, cultural literacy, scientific literacy, financial literacy, and digital literacy. Numeracy literacy is a 21st-century life skill that improves the quality of human resources and improves the standard of living, thereby determining the progress of a nation. Strategies to improve numeracy skills need to be carried out on an ongoing basis and involve all school members, families, and all components of society. According to [5], numeracy literacy is the skill of analyzing information displayed in the form of graphs, charts, and so on as well as the skill of interpreting the results of the analysis to make decisions.

Basic numeracy or mathematics skills are essential for solving problems [6, 7]. The research results [8] concluded that there was a significant positive relationship between numerical ability and student learning achievement. Basic abilities in manipulating numbers and solving simple mathematical equations are very important because these skills help individuals in carrying out daily activities [9]. Numeracy literacy skills have an impact not only on individuals but also on society as well as the nation and state. Literacy skills make a real contribution to social, and economic growth and welfare for individuals or society. By having a population that can apply mathematical understanding in

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040003-1–040003-6; https://doi.org/10.1063/5.0243257
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

the context of economics, engineering, science, social, and other fields, employment competitiveness and economic prosperity will increase.

However, several studies show that students' literacy skills are still low [10, 11, 12]. The low numeracy literacy ability is caused by the teacher's ability [13]. And students are not used to solving problems related to numeracy literacy questions [14]. Teachers as good facilitators for students must have good numeracy skills. Apart from that, the cause of low numeracy literacy is teachers are not interested in conducting the learning models and media used [15]. Teachers are required to be able to guide students in using, informing, and interpreting mathematical ideas to solve various problems in everyday life related to their numeracy competencies.

In measuring a person's numeracy literacy abilities, clear indicators are needed to describe each ability contained therein. According to [5], indicators of numeracy literacy abilities include using various kinds of numbers and symbols related to basic mathematics to solve problems in various contexts of daily life; analyzing information displayed in various forms (graphs, tables, sections, diagrams, and so on); and interpreting the results of the analysis to predict and make decisions. These numeracy literacy indicators are not visible in Mathematics Education students at PGRI Madiun University. Students' low numeracy literacy skills occur when learning calculus. This can be seen in students having difficulty analyzing information from problems presented in image form when asked to determine the volume of a spatial shape using integration techniques. When students make mistakes in analyzing and interpreting images, this will result in errors in determining integration limits which ultimately causes the final results to be wrong.

This is because lecturers rely more on textbook or package book components as a teaching guide. Meanwhile, in terms of content, there are still several weaknesses, such as the content of textbooks tends to only contain material information. To overcome these weaknesses, lecturers must utilize other learning resources to complement existing deficiencies, one of which is by packaging modules electronically. Electronic Modules (E-Modules) can help students understand the material [16]. According to [17] e-modules modules in digital form, consisting of text, images, or both containing digital electronic material accompanied by simulations that can and are suitable for use in learning. Presenting modules online can make it easier for students to access material from anywhere [18, 19]. Students are more likely to use electronic learning resources than printed learning resources, considering that electronic learning resources are capable of displaying interactive text, images, animations, and videos [20].

The development of this e-module will help students in carrying out the learning process. The developing e-Module contains a collection of planned learning experiences designed to help students master specific learning objectives and develop numeracy literacy skills. The e-module developed contains material equipped with learning videos, example questions, practice questions, and the use of the Maple application in solving problems. Based on these problems, this research was aimed to develop e-modules for calculus courses that are valid, effective, and practical, so it can develop students' numeracy literacy skills.

METHOD

This research was development research using the Plomp model with 3 stages [21]. The first stage, the preliminary research stage, was aimed to identify the needs needed for e-module development. Activities carried out include analysis of potential problems, analysis of student characteristics, and analysis of initial information. The second stage was the prototyping stage, where e-module planning and design are carried out and instrument for preparation is carried out. The third stage was the assessment stage, where the e-module was tested in groups/classes. The e-module development procedure in this research is as in Figure 1.

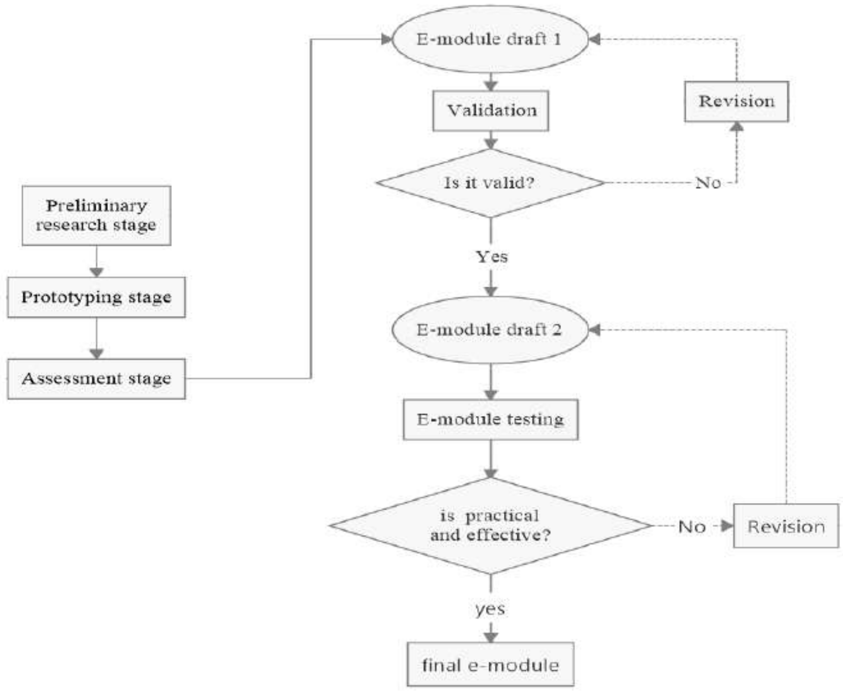

FIGURE 1. Development Research Procedure

The e-module trial was carried out at the Mathematics Education Study Program, Universitas PGRI Madiun in the even semester of the 2022/2023 academic year. The products tested are products that have been declared valid. E-module validity data were obtained using the e-module Validation Sheet. There were 2 validators to validate e-modules, namely media expert and material expert. The formula was used to process validation data [22] is stated as follows: $V = \frac{TSe}{TSh} \times 100\%$; V: validation percentage; TSe: total empirical score (sum of assessment scores by validators); TSh: Total expected score (maximum number of scores). An e-module is said to be valid if the average score from validators is more than 70% [22].

The data taken in the e-module trial were data on the practicality and effectiveness of the E-Module. Data on the practicality of e-modules were obtained from a response questionnaire filled out by Mathematics Education students after attending Calculus lectures using e-modules. In practicality and data analysis, the aspects assessed were presentation, use, readability, and time [23]. The practicality level of e-modules used the following formula (24):: $P = \frac{A}{B} \times 100\%$; P: percentage of student response; A: total score obtained; B = total ideal score. Learning tools meet the criteria of practicality if the criteria achieved ≥ 70% of students classically give a positive response.

Data on the effectiveness of this e-module were obtained using tests. This test was taken by Mathematics Education students after attending calculus lectures using e-modules. The achievement of students' numeracy literacy skills, can be calculated using the formula [24] $KB = \frac{T}{Tt} \times 100\%$; KB: percentage of learning completeness; Q: Total score obtained; Tt: Total score. Next, the percentage score of effectiveness results was analyzed according to the effectiveness criteria guidelines [25].

TABLE 1. Percentage of Effectiveness Result Score

Percentage (%)	Effectiveness Level
90 – 100	Very effective
80 – 89	Effective
70 – 79	Effective enough
60 -69	Less effective
< 60	Ineffective

RESULT AND DISCUSSION

The development of e-modules in calculus courses to develop students' numeracy literacy skills using the Plomp model were conducted three stages [21]. In the first stage, namely preliminary research, problems were found, including that some students were still weak in understanding concepts; students had difficulty analyzing information from problems; students misinterpreted information: some students were less able to determine integration limits and made mistakes in integral calculations; students' problem-solving abilities were still low. Apart from that, learning was still dominated by lecturers who provide material and example questions and then ask students to work on the questions. The learning resources used by lecturers were only textbooks or package books as teaching guides which only contain material information. The material developed in the e-module was double integrals over rectangular areas.

The second stage is the prototyping stage. At this stage, e-module planning and design were carried out as well as instrument preparation. The media used to present e-modules was E-Learning UNIPMA (ELMA). According to (Setyansah & and Apriandi, 2019; Dabbagh & Kitsantas, 2012; and Greenhow & and Lewin, 2016), learning media can improve students' understanding. By using ELMA students can access e-modules anywhere and at any time and apart from that it will be integrated with student activities in ELMA such as collaboration rooms, discussion forums, and assignments. The learning media developed included the presentation of material, explanatory videos, practice questions, and application of the Maple application in solving problems. The e-module format developed contained learning achievements, double integral material over rectangular areas, repeated integral material, video explanation of the material, example questions, solving questions manually and using Maple software, practice questions, and a bibliography.

Before product trials were carried out, the e-module needed to be validated by experts. The e-module validation sheet contains 4 aspects, namely: appropriateness of the content, ease of access, language, and presentation. The following expert validation results are presented in Table 2.

TABLE 2. Expert validation results

Expert	Aspects that are Measured				TSe	TSh	V
	Content Eligibility	**Presentation**	**Presentation**	**Presentation**			
1	12	13	11	11	47	56	83,93%
2	14	14	10	10	48	56	85,71%
3	13	14	11	11	49	56	87,50%
Average							85,71%

Based on Table 2, the validation percentage is 85.71% with valid criteria (22). The e-module has met the feasibility in terms of validity for media validation. Thus, e-modules can be tested in class to determine the level of effectiveness and practicality of e-modules

The third stage was the assessment stage. At this stage, an e-module trial was carried out in groups/classes in the calculus course. A total of 31 students took part in learning with the e-module that had been developed, after which the students were asked to take a numeracy literacy test to see the effectiveness of the e-module. The following are the results of the numeracy literacy test.

TABLE 3. Numeracy Literacy Test Results

Indicator	Score
Use a variety of numbers and symbols to solve problems	87.33
Analyze information displayed in various forms (graphs, tables, sections, diagrams, and so on)	84.62
Interpret the results of the analysis to predict and make decisions.	83.75
Average	85.23

Based on the results presented in Table 3, a test score of 85.23 was obtained with effective criteria. The use of interactive E-module media has a very good influence on students. Students become more enthusiastic about learning, have learning independence and high self-confidence, can develop their learning creativity, and are more motivated to solve the problems they face [29]. The e-module developed [30] can increase students' numeracy literacy. E-modules are an appropriate alternative to help students learn independently. This is because e-Modules can contain information in the form of writing, images, and videos which can help students to be more interested in studying lessons independently. E-Modules can help students understand the material [16].

After students complete the numeracy literacy test, students fill out a response questionnaire to see the practicality of the e-module. This e-module practicality test considers presentation, readability, use, and time [23]. The following are the results of the student response questionnaire.

TABLE 4. Results of Student Response Questionnaires

Aspect				Score Total
Presentation	**Readability**	**Use**	**Time**	
90.15	92.25	88.75	89.45	90.15%

Based on Table 4, the student response to learning with e-modules obtained a score of 90.15% with practical criteria. This shows this e-module is easy to use. These results also state that the e-module meets practical criteria. [31] states that products equipped with animations, videos, and images make it easy for students to open them anywhere and anytime. Through the e-module media developed, the essence of mathematics, which is abstract, becomes easier for students to understand because it is presented in a concrete form.

CONCLUSION

The e-module on two-fold integral material over rectangular areas that has been developed is suitable for use in learning because it meets the levels of validity, practicality, and effectiveness. The e-module validity level is 85.71% with valid criteria, the e-module practicality level is 90.15% with practical criteria and the e-module effectiveness level is 85.23 with effective criteria for developing students' numeracy literacy skills. In general, the use of e-modules has a very good influence on students. Students become more enthusiastic about learning, have learning independence and high self-confidence, can develop their learning creativity, and are more motivated to solve the problems they face.

ACKNOWLEDGMENT

Thank you to LPPM Universitas PGRI Madiun for providing research funding with contract number: 039/I/LPPM/UNIPMA/2023.

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The Role of Problem-Centered Design to Improve Critical Thinking Ability of Economic Education Students: An Overview of Variations in Design Core Curriculum (V-DCC)

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Abstract. The ability to think critically (critical thinking) is one of the important skills that must be possessed by students in the VUCA era (Volatility, Uncertainty, Complexity, and Ambiguity). Students' critical thinking skills are supported by higher education units, especially through the role of the curriculum, so that the curriculum must be designed according to student needs. Review this article using secondary data sourced from online journal sites such as Google Scholar, Sinta Journal, Research Gate, Scribd, and other credible journal sites. In this case, the authors reviewed 20 international and national scientific articles in the 2010 - 2023 period. The findings from the review of this article are the problem-centered design curriculum, various the social problems core play a role in improving the critical thinking skills of economic education students, because with this curriculum design, students will try to provide critical assessments from the point of view of different social and personal value systems so as to increase their thinking power and analysis.

INTRODUCTION

Critical thinking skills is one of the important skills that must be possessed by students in this era full of uncertainty. The VUCA era (Volatility, Uncertainty, Complexity, and Ambiguity) really requires us all to think quickly and precisel [1], so that the improvement of soft skills becomes the concern of various layers of society, especially in the field of higher education which must produce graduates that are relevant to the needs of the job market [2] . The ability to think critically has an important role and has even become one of the goals of education in various countries. According to data from a consortium consisting of twenty psychology colleges and one research institute in Indonesia, Indonesia is ranked 64 out of 65 countries with a score of 382 only. This proves the low critical thinking skills of the Indonesian people. In addition, in the international study of Trends in International Mathematics and Science Study (TIMSS) it was stated that students were weak in solving problems related to contextual, demanding reasoning, argumentation and creativity in solving them. Based on TIMSS results in 2015, Indonesia is in 44th position out of 49 countries with an average score of 397. TIMSS divides the achievement of survey participants into four levels of criteria: low (low 400), medium (475), high (high 550) and advanced (625 advanced). The data shows that the position of students' mathematical critical thinking skills in Indonesia is still at a low level.

Students' critical thinking skills are supported by higher education units, especially through the role of the curriculum, so that the curriculum must be designed to facilitate, encourage, and develop vital learning experiences of all kinds of experiences to achieve the expected results and achievement of learning achievements. Because the curriculum serves as a tool to achieve educational goals, and absolutely must exist in an educational program [3]. Education as a dynamic process, it is necessary to have a curriculum that is updated and developed continuously to keep up with changing times. The curriculum development process varies, but must still be based on strengthening character, using digital-based educational strategies, and strengthening educators with an understanding of traditional and cultural values, as well as the ability to innovate learning media [4].

The author found research gaps in articles written by [5] which states that in the education process youth tend to be passive and less than optimal in critical thinking even though youth is an age group that is seen as capable of participating in solving social problems, whereas according to [6] critical thinking skills are not only important for youth, but can also be honed even since students enter elementary school age, namely through the problem-based

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040004-1–040004-6; https://doi.org/10.1063/5.0243694
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

learning model in integrated thematic learning, so this is contrary to the concept of critical thinking skills. This research gap is the subject of discussion in the study of this article, namely how the role of problem-centered design improves students critical thinking skills, especially students of economics education.

There are many types of curriculum design variations, such as curriculum design models subject-centered design, learner-centered design, and problem-centered design, but variations of the design core curriculum (V–DCC) in the context of economic education, which are suitable for development are problem centered design or the social problem core. The design of the curriculum development of the social problem core is based on a philosophy that prioritizes the role of humans (man centered), based on the assumption that humans are social beings who always live with other people, and the contents of the curriculum are dominated by social problems faced by today's children and which will come. Therefore, the author wants to conduct a scientific article review to analyze the role of problem-centered design in improving critical thinking skills at the tertiary level, especially students of economics education. The role of other curriculum design development models such as subject-centered design & learner-centered design has not been analyzed and could become a topic for further article development.

LITERATURE REVIEW

Critical Thinking Ability

Critical thinking skills are important to use especially when making decisions. In the decision-making process, individuals need to go through considerations that have been thought through in depth, use high reasoning power and have been seriously reflected within the individual [7]. Critical thinking is defined as a thinking process that will support the production of rational decisions so that they can be used as a reference in believing or taking an action [2]. Individuals are said to think critically when they are able to: (1) formulate the main issues; (2) disclose existing facts; (3) choosing logical arguments; (4) detecting bias with different viewing angles; to (5) draw conclusions.

The learning process in lectures at the majority of tertiary institutions in Indonesia tends to still be through the teacher-centered learning model [8], where lecturers only use text books in implementing the curriculum, descriptions of learning concepts are only described as limited to writing on the blackboard, and some others have started using computer media but are still limited to developing power point presentations, so students tend to be passive and only receive information from the lecturer, even though it is the students who should act as the main characters in the learning process, conveying ideas, opinions, or questions. So that the learning process is more interactive and the lecturer only functions as a facilitator who develops critical thinking skills in learning.

Critical thinking skills is very important for students of economics education, namely to make decisions logically related to economic concepts and problems that are often encountered in everyday life. According to [9] prospective teacher students who have the ability to think critically are expected to be able to solve problems related to their didactic concepts. So that teachers or lecturers should not have a tendency to provide solutions to problems so that students become accustomed to thinking critically, especially for those who are not accustomed to re-checking the correctness of the answers they get. It is important for educators to emphasize students know how the process is not the result.

Critical thinking skills aside from playing a role in the decision-making process, are also useful in helping students to acquire knowledge, improve theories, strengthen arguments, help express and formulate questions clearly, help collect, assess, interpret and communicate information, ideas, opinions or solutions effectively, and familiarize students to be open-minded. It is the importance of this critical thinking ability that makes the educational process must be directed towards it, by developing a curriculum design that fits the needs of students.

Core Curriculum Design Variations

Curriculum development is a process that never has a starting point and finally because the development of this curriculum is a process that based on the elements in the curriculum, which includes objectives, method, material, assessment and feedback. Curriculum development design is an arrangement or model design the curriculum is designed in accordance with the vision and mission of the school which in its development goes through a process of validation, implementation and evaluation. There are several curriculum design patterns, namely first, subject-centred design,which can be developed into subject design, discipline design, and board field design, second, learner-centered design, namely a student-centered curriculum as a learner, and third, problem-centered design which centers on the role of humans as part of a group unit (social beings).

Variation core curriculum design also various include:

a) The separate subject core

Curriculum designs that are developed with separate core lessons tend to be traditional in nature, and are still thematic or integrating.

b) The correlated core

Curriculum designs developed with correlated cores can usually take the form of linear, spiral, project-based and competency-based designs.

c) The fused core

The unified curriculum design is based on an interdisciplinary or holistic approach by integrating the main points. This curriculum design can increase understanding, has high relevance, and emphasizes cross-skills.

d) The activity/experience design

Activity or experience-based curriculum designs can take the form of projects, field trips, simulations and games, as well as collaboration between classes.

e) The areas of living core

Curriculum design that integrates the core areas of life or life skills. Variations in this curriculum design can be in the form of an integrated thematic approach, life skills, extracurriculars and special fields, as well as an integrated character approach.

f) The social problem core

Curriculum design that emphasizes solving social problems, can be social project-based, case-based, simulation-based, and games, problem-based, and research and mapping.

g) Becker's humanistic design

Curriculum design that prioritizes individual student experiences and needs so that it tends to emphasize real-life contexts, active and collaborative learning, as well as self-understanding and appreciation.

h) The un-encapsulation design

Curriculum design is synonymous with wrapping based on themes, concepts, skills, projects or assignments.

The review of this article will focus on patterns problem-centered design precisely the variation of the social problem-based core design. In the social problems core, students will try to provide critical assessments from the point of view of different social and personal value systems so as to increase thinking and analysis. This is also suitable in learning economics education students because some examples of social problems that are the theme of this core design model are poverty, hunger, inflation, and other economic problems. These issues are controversial matters of the pros and cons. These social problems can also grow and improve critical thinking and analytical sharpness of economic education students in facing the demands of the times.

METHOD

The approach used in the study of this article is descriptive qualitative. The qualitative approach is intended to explore, understand, and interpret various previous studies. By using a qualitative approach, the author wants to collect rich information and get a detailed picture of the issues, cases or events involved. Because in this study an appropriate way is needed to collect rich information and explain it in the context of the role of problem-centered design in improving the critical thinking skills of economic education students, a qualitative approach was chosen.

The object of research in this article is the role of curriculum *problem-centered design* and students' critical thinking skills. Variable student critical thinking ability is the dependent variable in the study of this article, so that it becomes the observed output or result. Problem-centered design curriculum variables as independent variables. Review this article using secondary data sourced from online journal sites such as Google Scholar, Sinta Journal, Research Gate, Scribd, and other credible journal sites. In this case, the authors reviewed 20 international and national scientific articles in the 2010 - 2023 period.

RESULTS AND DISCUSSION

According to [10] the learning process in class is still directed at the child's ability to memorize information, so that the child's brain is forced to understand the information he remembers to relate it to everyday life, even though each individual has his own way of thinking so that the way they make decisions is different. One of the important learning skills to be mastered by students is the ability to think critically. The ability to think critically (critical thinking) includes efforts to seek, find, and build knowledge independently of the things students need to solve the problems they face [11].

Critical thinking skills are important for students to have at the elementary school level because the problem-based learning model can provide opportunities for students to actively develop the ability to collect information, manage information, and conclude it, so that the use of problem-based learning has a positive effect on the critical thinking skills of elementary school students [6]. In addition, the application of problem based learning is also positively related to improving critical thinking skills in integrated science learning for junior high school students [12]. At two levels of lower secondary education, the application of problem-based learning has proven to have a positive impact and can improve students' critical thinking skills.

In learning at the senior high school level, there is also a positive influence between the application of problem-based learning and students' conceptual understanding and critical thinking [13], besides that critical thinking skills are also made effective through problem-based learning with the help of student worksheets and student discussion sheets [11], while at the higher education level, students' critical thinking skills are needed in preparing themselves to enter the world of work [14] because the role of higher education institutions is to produce a workforce that is educated and in accordance with the needs of the labor market, generates new knowledge through research activities, and strives for access to and utilization of knowledge so that it continues to develop.

Education experts and practitioners think about how to enable youth to be actively involved in solving social problems by designing a curriculum that fits those needs. [5], so that curriculum design needs to be developed through student activities in observing social problems that occur in their environment. Activities that can be developed through learning in the classroom and outside the classroom. If it is in the classroom, it can be through discussions on social issues, whereas if it is outside the classroom, it is through observation or field observations. According to [8], Real life video evaluation with an e-learning system can improve students' critical thinking skills, because giving videos as problem material to students will develop an analysis of the problem and think to make the right decisions in solving the problems given.

Curriculum design by emphasizing problem-based learning means that students are exposed to an inquiry learning type, in which students identify the root causes of certain problems and look for alternative solutions and make decisions about which solutions the most applicable [15]. According to research [16], the advantage of problem-based curriculum design is developing high-order thinking skills, ranging from finding, evaluating, and using appropriate learning resources to analyze and solve complex problems. Strengthening character for education graduates is also important, namely through curriculum design that is oriented towards traditional values, culture in shaping the character of students in facing the era of Society 5.0 [4].

Curriculum development is a curriculum planning process in order to produce a broad and specific curriculum plan [3]. In addition, curriculum changes and development show the dynamics of the education system. The development of a curriculum design to be precise with a problems centered design pattern based on a philosophy that prioritizes the role of humans and emphasizes humans in group unity, namely the welfare of society **(Sholikah, 2017)**. One variation of the core curriculum is the social problem core which is designed to meet the needs of educators and students. This curriculum design was also developed by [17], with the name Problem-Centered Thinking Skill (PCTS) to improve high-level reasoning skills.

In the 21st century, massive educational curriculum collaborations with technology [18], so that the curriculum design that is developed needs to pay attention to the elements of technology in learning. Learning with a problem-based learning model based on Socio-Scientific Issue (SSI) influences critical thinking skills, written and verbal communication, as well as cognitive learning outcomes [19]. According to [20], the abilities that must be possessed by a graduate include creativity, innovation, curiosity, intelligence and adaptability, especially career adaptation in the world of work.

According to [21], problem-based learning learning models can improve mathematical literacy skills. In middle and lower level education, the role of parents is still very much needed in coordinating with educators or teachers at school, and aims to create an atmosphere that is conducive to the learning process both at school and at home. The focus of student teacher skills is the ability to think critically in order to solve problems [9]. Because teachers of the 21st century must be adaptive and able to keep up with the times.

CONCLUSION

Students' critical thinking skills are supported by higher education units, especially through the role of the curriculum, so that the curriculum must be designed to facilitate, encourage, and develop learning experiences to achieve the expected results and achievement of learning achievements. The ability to think critically is very important for students of economics education, namely to make decisions logically related to economic concepts and problems that are often encountered in everyday life. Of the various existing curriculum design patterns, as well as their variations, the review of this article is focused on patterns problem-centered design precisely the variation of the social problem-based core design (the social problem core). Where students will try to provide critical assessments from the point of view of different social and personal value systems. This is also suitable in learning economics education students because some examples of social problems that are the theme of this core design model are poverty, hunger, inflation, and other economic problems.

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Analysis of Mathematical Comprehension Ability in Terms of Self-Responsibility

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Abstract. Mathematics is a bridge that relates to various kinds of knowledge because in mathematics students must be able to think logically, critically, creatively, and systematically in solving a problem. One of the important factors in mastering mathematics is increasing the ability to understand mathematics. In an effort to develop students' mathematical comprehention abilities, they must have awareness of their own responsibilities as students because apart from the influence of external factors in the form of teachers and parents, internal factors, namely self-awareness, greatly influence students' mathematical comprehension abilities. So the lack of student self-responsibility will result in students being forced to learn which results in less than optimal knowledge being absorbed which also has an impact on students' mathematical comprehension abilities. The purpose of this study was to analyze the mathematical comprehension ability of elementary school students in terms of self-responsibility. This research used qualitative descriptive research in grade V of Public Elementary School 5 of Bae in Kudus. The sampling technique was carried out by purposive sampling technique. Data collection employed tests and interviews that had been developed by teachers, psychologists, and mathematicians. The validity of the data using credibility checking techniques through triangulation of data sources. The data analysis technique used analysis, data reduction, data presentation, and conclusions. The results in this study is that there is an imbalance between self-responsibility and students' mathematical comperehension ability. Students with a high level of self-responsibility do not necessarily have high mathematical comprehension abilities. Students with a moderate level of self-responsibility do not necessarily have moderate mathematical comprehension abilities. However, students with a low level of self-responsibility have low mathematical comprehension abilities.

INTRODUCTION

Education is one of the efforts to improve the quality of a nation [1]. Education is the main factor that the government pays attention to as evidenced in the 2022 National Education System Bill in the national education goals which states that the goal of national education is to educate the nation's life, form a religious society, uphold diversity, be democratic and dignified, and advance civilization as well as the welfare of mankind physically and spiritually. In line with the first stanza which is written to educate the nation's life means the importance of education for a nation. One of the functions of national education is to develop the potential of students with Pancasila characters so that they become knowledgeable and critically thinking human [2]. Several lessons can train students to be able to reason critically, one of which is mathematics.

Mathematics is a subject that is given at all levels of education from elementary school to university. Mathematics is a bridge that relates to various kinds of knowledge because in mathematics students must be able to think logically, critically, creatively, and systematically in solving a problem [3]. However, students often feel that mathematics is a difficult lesson because many formulas that must be memorized which makes students reluctant to study mathematics[4][5]. Whereas in reality mastery of mathematics is needed by someone. One of the important factors in mastering mathematics is increasing the ability to understand mathematics[6].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040005-1–040005-9; https://doi.org/10.1063/5.0242528
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

The ability to understand mathematics is the student's knowledge of concepts, principles, and procedures and the ability of students to use strategies in solving a problem presented where the student already knows what has been learned, the steps that must be taken, and can use the concept in the context of mathematics and outside mathematics [7]. One indicator of the ability to understand mathematics according to Sari is being able to restate a concept, classify objects according to certain characteristics (according to the concept), determine examples and nonexamples of concepts, present concepts in various forms of mathematical representations, develop necessary or sufficient conditions for a concept, use and select certain operations, and apply concepts to solve problems [8]. The ability to understand mathematics is a mandatory and important ability to master in learning mathematics[9]. The ability to understand mathematics can make it easier for students to solve a problem by associating concepts that have been understood. On the contrary, when students do not understand a concept it can result in students experiencing difficulties in selecting and using procedures and applying concepts and problem-solving algorithms [10].

Efforts in developing students' mathematical comprehension abilities can be influenced by external factors that are closest to teachers and parents[11]. The teacher's role is to transfer knowledge[12], but what is conveyed by the teacher does not necessarily make students understand, so independence or awareness of students in learning is needed. Student independence or awareness can increase with the character of responsibility where the benefits of this self-responsibility character increase the disciplined attitude of caution, cooperation, student learning outcomes, and student independence [13]. So the lack of self-responsibility of students will make students forced to learn which results in the knowledge being absorbed being less than optimal which also has an impact on students' mathematical understanding abilities.

Self-responsibility is the obligation to complete a task given by someone to an individual which has consequences in the form of failure [7]. Meanwhile, according to Mualifatu [8] argues that self-responsibility is a person's behavior to carry out obligations as best as possible which is accountable to oneself, society, the environment, the State and God. So that it can be concluded that self-responsibility is an individual behavior to carry out obligations as well as possible which will later be accountable to oneself, society, the environment, the State and God and has the risk of failure. Self-responsibility has several indicators, namely (1) making reports on every activity carried out in oral or written form, (2) carrying out the tasks requested, (3) showing initiative to solve problems, and (4) avoiding cheating in carrying out tasks [9]. Meanwhile, according to Harahap [16] self-responsibility contains several indicators in the form of (1) completing all assignments and exercises that are his responsibility, (2) carrying out instructions as well as possible during the learning process, (3) being cooperative, (4) being serious and doing something . Based on the several indicators above, they lead to self-responsibility towards student academics, so researchers use indicators of self-responsibility for student academics according to Fitri [11] who answers the indicators as follows. (1) doing assignments or homework well, (2) students are responsible for every action, (3) students complete assignments according to a predetermined schedule, and (4) students work on group assignments together. This statement is also reinforced by Rustam's [22] statement which argues that indicators of students with high academic responsibility can be in the form of using time effectively, making preparations before learning, carrying out individual assignments received, carrying out the discussion process, working on questions or problems carefully.

In addition, students who have academic responsibilities can direct themselves to have a good personality, improve the quality of learning, independence, be able to complete academic assignments, and have increased achievement. However, it is different with students who have low academic responsibility. According to Kusumadewi [23] students with low academic responsibility can be reflected in the following indicators: (1) students often delay doing homework, (2) students often chat during class hours, (3) students never carry out pickets, and (4) students do homework at school. The benefits of self-responsibility [6] are to make students more disciplined, active, independent and diligent in learning. Based on this phenomenon, research is needed in the form of analysis related to student self-responsibility.

METHOD

This research was conducted at Public Elementary School 5 of Bae in Kudus by using a qualitative descriptive method. Qualitative research is research that produces analytical procedures that do not use statistical analysis procedures or other quantification methods. This descriptive qualitative research is research that seeks to describe, explain and interpret an object or information obtained following what it is. The purpose of this research using qualitative research is to analyze and describe students' mathematical comprehension in terms of self-responsibility.

This study used a purposive sampling technique in selecting research subjects. The data collection technique used in this study was in the form of tests and non-tests which have been validated by experts, namely teachers, psychologists and mathematicians. On the non-test instrument, the researcher used interview techniques in the form of interviews related to self-responsibility and mathematical understanding abilities. Where before that expert validation was carried out on the instrument, both tests and non-tests. The results of expert validation of the research instrument in the form of a mathematical understanding ability test obtained an average score of 0.81 in the valid category, the mathematical understanding ability interview obtained an average score of 0.78 in the valid category and the self-responsibility interview obtained an average score as much as 0.71 with the valid category. So it can be concluded that the research instrument is suitable for use.

In this study, the researcher used a technique to check the validity of the data according to Lincoln dan Guba [19] as the degree of truth of the data through data triangulation. In addition, the research refers to the data analysis model according to Miles dan Huberman [13] with stages in the form of data reduction, data display, and drawing aconclusion.

RESULT AND DISCUSSION

The self-responsibility of fifth-grade students at Public Elementaru School 5 of Bae is categorized into high, medium and low. Based on the interviews that have been conducted by researchers, 4 students who have high self-responsibility, 2 students have moderate self-responsibility and 7 students have low self-responsibility which are presented in the following table.

TABLE 1. Self Responsibility Analysis of Class V Students at Public Elementary School 5 of Bae Kudus

Indicator	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Doing homework and assignment	-	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓
Students are responsible for every action	-	✓	✓	✓	-	-	-	-	-	-	✓	-	✓
Complete assignment on schedule	-	✓	-	✓	-	✓	-	-	-	-	✓	✓	✓
Do group assignments together	✓	✓	-	✓	-	✓	-	✓	✓	✓	-	-	✓
Use time effectively	✓	✓	-	-	-	-	-	-	-	-	✓	-	✓
Do the task carefully	-	✓	✓	✓	-	-	-	-	-	-	✓	-	✓

Based on this analysis it can be concluded that students who are classified as having self-responsibility fulfilling 5-6 indicators in this have in common both fulfilling the first, second, third, and sixth indicators. For students who are classified as having self-responsibility while fulfilling 3-4 indicators, this has in common that they both fulfill the first indicator. Students who are classified as having low self-responsibility fulfilling 1-2 indicators do not fulfill the first, second, and sixth indicators.

After the interview stage was carried out, students were then given a mathematical understanding ability test to measure the level of students' mathematical understanding. This stage was strengthened by conducting interviews related to the tests that had been carried out to strengthen the results obtained by the researcher. The following is the result of a test for the mathematical understanding ability of the fifth-grade students.

TABLE 2. Analysis of the mathematical comprehention ability tests of fifth-grade students at Public Elementary School 5 of Bae

Indicator	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1	*3*	*3*	*3*	*0*	*0*	*3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
2	*2*	*1*	*2*	*2*	*0*	*1*	*1*	*0*	*1*	*1*	*1*	*0*	*1*
3	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*
4	*1*	*3*	*1*	*3*	*2*	*3*	*0*	*1*	*1*	*1*	*2*	*0*	*3*
5	*1*	*3*	*1*	*3*	*1*	*3*	*0*	*1*	*1*	*1*	*0*	*0*	*3*
6	*0*	*1*	*3*	*1*	*2*	*1*	*2*	*2*	*2*	*2*	*0*	*0*	*3*
7	*0*	*1*	*3*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*3*
Total	*9*	*14*	*15*	*12*	*7*	*14*	*5*	*6*	*7*	*7*	*5*	*1*	*15*
Score (%)	*47*	*74*	*79*	*63*	*37*	*74*	*26*	*32*	*37*	*37*	*26*	*5*	*79*
Category	*R*	*T*	*T*	*S*	*R*	*T*	*R*	*R*	*R*	*R*	*R*	*R*	*T*
Mean							*47%*						
General Category							*Low*						

Based on this analysis, it was found that 4 students were in the high category of mathematical understanding, 1 student was in the moderate category, and 8 students were in the low category. As such, the overall average score of students is 47%, which means the mathematical understanding ability is low.

In this study, 7 subjects were selected who had different levels of self-responsibility . Then the subject was analyzed further related to the ability of mathematical understanding which was reviewed based on student selfresponsibility. The following is a self-responsibility analysis based on self-responsibility indicators on 7 subjects that the researcher has selected from all of the fifth-grade students at Public Elementary School 5 of Bae.

Doing Assignment and Homework Well

In the first indicator, ST1 subjects can do their assignments and homework well without delaying doing assignments and understanding the learning process so that they can be declared as fulfilling the first indicator. In ST2 subjects can do assignments and homework well without delaying doing assignments and understanding the learning process so that they can be declared to fulfill the first indicator.

In the first indicator SS1 subjects were able to do their assignments and homework well without delaying doing assignments and understanding the learning process so that they could be declared as fulfilling the first indicator. In SS2, students can do their assignments and homework well without delaying doing assignments and understanding the process of learning so that they can be declared as fulfilling the first indicator.

In the first indicator, subject SR1 could not do the assignments and homework properly because he often delayed work and did not understand the process of learning, so he was said to have not fulfilled the first indicator. SR2 could not do the assignments and homework properly because he often delayed work and did not understand the learning process, so he was said to have not fulfilled the first indicator. SR3 could not do the assignments and homework properly because he often delayed work and did not understand the learning process, so he was said to have not fulfilled the first indicator. Some students do not meet the indicators of awareness of their obligations as students, in this case, students tend not to be confident in their answers so some students who have low responsibility prefer to search for answers on Google without trying first so students tend not to understand the learning process itself [14].

Based on the description above, it can be concluded that the subjects who met the indicators of doing their assignments and homework well were ST1, ST2, ST3, SS1, and SS2. Meanwhile, SR1, SR2, and SR3 did not meet the indicators of doing their assignments and homework well.

Students are Responsible for Every Action

In the second indicator, the ST1 subject is very responsible for every action taken, in this case, ST1 knows the mistakes that have been made, admits, and is responsible for all the risks that exist so that it can be said to fulfill the second indicator. Subject ST2 is responsible for every action taken, in this case ST2 knows the mistake that was made, acknowledges and is responsible for all the risks that exist so that it can be said to fulfill the second indicator. ST3 is responsible for every action taken. In this case, ST3 knows the mistakes that have been made, acknowledges and is responsible for all the risks involved, so it can be said that it meets the second indicator.

In the second indicator, subject SS1 is responsible for every action taken. In case SS1 knows the mistakes that have been made and, admits that he is responsible for all the risks, which means he fulfill the second indicator. SS2 is quite responsible for every action taken, as SS2 knows the mistakes have been made but he has done it repeatedly so he has yet to meet the second indicator.

In the second indicator, subject SR1 is less responsible for every action taken, since SR1 knows the mistakes he has made, but does it repeatedly and does not dare to take responsibility. As such, he has not met the second indicator. SR2 lacks responsibility for every action taken because SR2 knows the mistake that was made but does it repeatedly and does not dare to take responsibility, meaning he fails to meet the second indicator. SR3 lacks responsibility for every action taken since, SR3 knows mistakes have been made but does it repeatedly and does not dare to take responsibility, which again implies the failure to meet the second indicator.

Based on the description above, it can be concluded that subjects who fulfill the indicators of being responsible for every action are ST1, ST2, ST3, and SS1. Meanwhile SS2, SR1, SR2, and SR3 have not met the indicators of being responsible for every action.

Completing Tasks On Schedule

In the third indicator, ST1 can complete assignments according to the schedule given by submitting assignments according to a predetermined timeframe so that it can be said to fulfill the third indicator. Subject ST2 can complete assignments according to the schedule given by submitting assignments according to a predetermined deadline so that it can be said to fulfill the third indicator. Subject ST3 can complete assignments according to the schedule given by submitting assignments according to a predetermined deadline so that it can be said to fulfill the third indicator.

In the third indicator, the SS1 subject has not been able to complete the task according to the schedule given by submitting assignments within a predetermined timeframe but with appropriate blank answers so it can be said that he has not fulfilled the third indicator. Subject SS2 can complete assignments according to the schedule given by submitting assignments according to a predetermined deadline so that it can be said to fulfill the third indicator.

Subject SR1 can complete assignments according to the schedule given by submitting assignments according to a predetermined deadline so that it can be said to fulfill the third indicator. SR2 has not been able to complete the task according to the schedule that has been given by submitting assignments within a predetermined time limit but with appropriate blank answers so it can be said that he has not fulfilled the third indicator. SR3 has not been able to complete the task according to the schedule that has been given by submitting assignments more than the predetermined deadline and is said to have not met the third indicator.

Based on the description above, it can be concluded that the subjects who met the indicators of completing assignments on schedule were ST1, ST2, ST3, SS2, and SR1. Meanwhile, SS1, SR2, and SR3 did not meet the indicators of completing tasks on schedule.

Doing group assignments together

In the fourth indicator, ST1 can work on group assignments together by discussing and dividing the job descriptions of each group member and summarizing the results obtained. ST2 can do group assignments together by discussing and dividing the job descriptions of each group member and summarizing the results obtained. At ST3, you can work on group assignments together by discussing and dividing the job descriptions of each group member and summarizing the results obtained.

SS1 was, quite active in doing group assignments together by discussing and dividing the job descriptions of each member, but SS1 did not dare to express opinions about the answers to questions or tended to be passive and follow the answers of other friends. SS2, can work on group assignments together by discussing and dividing the job descriptions of each group member and summarizing the results obtained.

In SR1, they did not actively work on group assignments together by not discussing and not carrying out the job descriptions that had been divided between each member and SR1 did not dare to express opinions about the answers to questions or tended to be passive. In SR2, they did not actively work on group assignments together by not discussing and not carrying out the job descriptions that had been divided between each member and SR2 did not dare to express opinions about the answers to questions or tended to be passive. SR3 was quite active in doing group assignments together by discussing and sharing the job descriptions of each member, but SR3 did not dare to express opinions about the answers to the questions or tended to be passive and follow the answers of other friends. This phenomenon is in line with Rustam's research in the form of a reluctance to carry out group assignments and tends to be hesitant and passive in students who have low levels of responsibility [22].

Based on the description above, it can be concluded that the subjects who met the indicators of doing group assignments together were ST1, ST2, ST3, and SS2. Meanwhile SS1, SS2, SR2, and SR3 did not meet the indicators of doing group assignments together.

Using Time Effectively

In the fifth indicator, ST1 uses time effectively and, can optimally divide time for each activity. ST2 uses time effectively because ST2 can optimally allocate time for each activity and does not use time to play excessively. ST3 has not been able to use time effectively, as ST3 can divide time quite optimally for each activity but often delays carrying out activities so that it sometimes forgets about other activities.

SS1 does not use time effectively, since SS1 cannot allocate time for each activity because it takes too long to play and often delays carrying out activities so it sometimes forgets other activities. SS2 has not been able to use time effectively since, SS2 can divide time quite optimally for each activity but often delays carrying out activities so that it sometimes forgets about other activities.

SR1 has not been able to use time effectively as SR1 plays on phones too often and forgets other activities including studying. SR2 has not been able to use time effectively. SR2 can divide time quite optimally for each activity but often delays carrying out activities so that they sometimes forget about other activities. SR3 has not been able to use time effectively because, SR3 plays too often and forgets about other activities including studying. Some of the results obtained are similar to Kusumadewi's research which explains that low levels of responsibility are characterized by frequent procrastination in doing assignments, chatting during class hours and doing homework at school. [23].

Based on the description above, it can be concluded that the subjects who met the indicators of using time effectively were ST1 and ST2. While ST3, SS1, SS2, SR1, SR2, and SR3 did not meet the indicators of using time effectively.

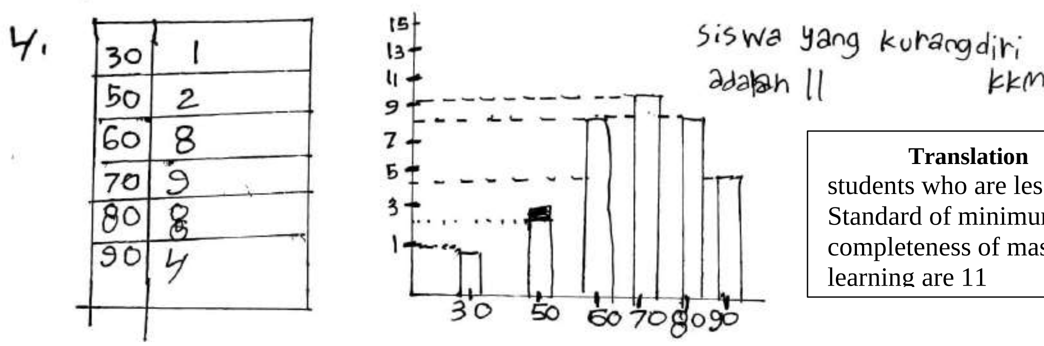
Careful Tasks

In the sixth indicator ST1 was able to complete assignments carefully where in each ST1 always rechecked the answers and understood carefully the intent of the questions given ST2 students can complete assignments carefully where in each task ST2 always recheck their answers and understand carefully the intent of the questions given. ST3 students can complete assignments carefully where in each task ST3 always recheck their answers and understand carefully the intent of the questions given.

In the sixth indicator, SS1 can complete the task carefully where in each task SS1 always rechecks the answers and understands the intent of the questions given. In SS2, one cannot complete the task carefully whereas in each SS2 task the task only checks whether it has been answered or not and does not understand carefully the intent of the questions given.

SR1 could not complete the task carefully as in every task SR1 did not re-check his work or understand carefully the intent of the questions given. SR2 could not complete the task carefully whereas in each task SR2 did not re-check his work or did not understand carefully the intent of the questions given and immediately looked for answers on Google. SR3 could not complete the task carefully where in every task SR3 did not re-check his work or did not understand carefully the intent of the questions given and immediately looked for answers on Google.

Based on the description above, it can be concluded that the subjects who met the indicators of using time effectively were ST1, ST2, ST3, and SS1. Meanwhile, SS2, SR1, SR2, and SR3 did not meet the indicators of using time effectively. Here is one of the most thorough student work on a test of mathematical comprehension ability.



Translation
students who are less than Standard of minimum completeness of mastery learning are 11

FIGURE 1. Work with the highest accuracy

The data is presented randomly and students are asked to represent the data into a diagram and determine which students have incomplete scores, if the completion score limit for mathematics lessons is 70. Based on the picture above, students are very careful in working on the questions coherently and precisely. Students calculate data that is still random and arrange it into table form and then represent it in a bar chart very well. After that, students looked for scores that were below the completion limit and got the results of 11 students who did not complete.

TABLE 3. Subjects of self-responsibility

Subject	Indicator Fulffilled	Category
ST1	6/6	High
ST2	6/6	High
ST3	5/6	High

SS1	3/6	Medium
SS2	3/6	Medium
SR1	1/6	Low
SR2	0/6	Low
SR3	0/6	Low

Based on the table above, there are 7 students with different categories that have been determined by the researcher. Students who have high self-responsibility are ST1, ST2, and ST3. Students who have medium self-responsibility are only SS1and SS2. The students with low self-responsibility involve SR1, SR2, and SR3.

The ability to understand mathematics according to Turmuzi et al [4] is an initial ability required for the success of a systematic learning objective. This means that when students do not understand a concept, it can have an impact on not understanding the next material. Meanwhile, according to Rifal et al [24] mathematical understanding is students' knowledge of the basics or concepts, principles, and procedures, and students' abilities to implement the problem-solving strategies given. So it can be concluded that the ability to understand mathematics is a basic ability regarding concepts, principles, and procedures that are implemented in a mathematical problem by using various solutions following their respective understandings. In this study, indicators of mathematical understanding were used according to Devita [25] which consisted of (1) Translation. The indicators of mathematical comprehension included in this component were (a) Restating a concept (b) Classifying objects according to certain properties (according to the concept) (c) Giving an example and not an example of the concept. (2) Interpretation, indicators of mathematical understanding included in this component are (a) Presenting concepts in various forms of mathematical representation, (b) Developing necessary or sufficient requirements for a concept. (3) Extrapolation, indicators of mathematical understanding included in this component are (a) Using, utilizing and selecting certain procedures or operations, (c) Applying problem-solving concepts or algorithms. These indicators are used as a reference in data collection in the form of tests of mathematical comprehension abilities that have been predetermined based on their self-responsibility. The following are the criteria for grouping scores on the mathematical understanding ability test [25].

TABLE 4. Criteria for Grouping Mathematical Comprehension Ability

Category	Achievement of Mathematical Comprehension Ability
High	x >70%
Medium	$55\% < x \leq 70\%$
Low	$x \leq 55\%$

Based on the mathematical comprehension ability test that has been carried out, an ability score is obtained in Table 3 Subjects of self-responsibility Currently SR2 Achievement of Mathematical comprehension Ability students' mathematical comprehension as follows.

TABLE 5. Grouping of Mathematical Comprehension Ability Scores

Subject	Indicator Fulfilled	Score	Category
ST1	5/7	79%	High
ST2	5/7	74%	High
ST3	5/7	63%	Medium
SS1	6/7	79%	High
SS2	5/7	74%	High
SR1	0/7	5%	Low
SR2	2/7	26%	Low
SR3	3/7	37%	Low

Based on the analysis of mathematical comprehension abilities in terms of self-responsibility carried out in fifth-grade students at Public Elementary School 5 of Bae, it was found that there was an imbalance between mathematical comprehension abilities and students' self-responsibility. Students with a high level of self-responsibility do not necessarily have high mathematical comprehension abilities. Students with a moderate level of self-responsibility do not necessarily have moderate mathematical comprehension abilities. However, students with a low level of self-responsibility have low mathematical comprehension abilities. This description is based on research that has been conducted on 8 objects which have resulted in unequal results between students' mathematical comprehension abilities and self-responsibility. In the category of high self-responsibility, ST1 subjects have high mathematical comprehension abilities, ST2 subjects have high mathematical comprehension abilities, and ST3 has medium mathematical comprehension abilities. Meanwhile, in the moderate self-responsibility level category, SS1 has high mathematical comprehension abilities and SS2 has high mathematical comprehension abilities. However, in the self-responsibility level category, SR1, SR2, and SR3 have low mathematical comprehension abilities.

CONCLUSION

Based on the research that has been done, it is found that there is an imbalance in students' mathematical understanding abilities and self-responsibility. Students with a high level of self-responsibility do not necessarily have high mathematical comprehension abilities. Students with a moderate level of self-responsibility do not necessarily have moderate mathematical comprehension abilities. However, students with a low level of self-responsibility have low mathematical comprehension abilities.

ACKNOWLEDGMENTS

The researcher would like to thank the Mathematic Education Department, at Muria Kudus University for facilitating the implementation of research activities. The researcher also thanked Public Elementary School 5 of Bae Kudus for participating in this research activity.

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Tracing Indonesian Students' Mathematical Literacy through the Minimum Competency Assessment (AKM): A Literature Review

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Abstract. To answer the PISA challenge, the Indonesian government made an assessment like PISA, that is the Minimum Competency Assessment (AKM) which evaluates students' reading literacy and mathematical literacy abilities. This research aims to analyze the content of 30 articles about Minimum Competency Assessment in mathematical literacy published in journals and proceedings indexed by Scopus, SINTA 1, and SINTA 2, as well as non-Scopus-indexed international proceedings from 2021 to 2023. This study employed content analysis with literature review. The instruments used in this research are article documents which are analyzed using content analysis guidelines which contain six main aspects to be reviewed. The results of the analysis can be concluded that the number of publications about AKM over the last three years has increased and will continue to do so. Most publications are on SINTA 2. The method most often chosen is qualitative research, followed by development research. The subjects studied were 8th grade students and analysis of students' abilities in working on AKM was the topic most researched. Almost all content, context, and process domains are used in the questions created. The ability of most students at all levels to work on AKM was still low. Several studies have been carried out to support students' AKM abilities, such as developing AKM tasks and learning media. Teachers are also given training on how to produce AKM tasks and school facilities have also been improved, even though there are still many obstacles. Recommendations to future researchers are to increase the diversity of research on AKM and improve students' mathematical literacy skills using other ways.

Keywords: Mathematical Literacy; Minimum Competency Assessment**;** Literature Review

INTRODUCTION

The times are developing and the need for human ability is not only to understand a concept but also to develop other important abilities as mentioned in the Programme for International Student Assessment (PISA) framework 2022 which includes eight abilities needed in the 21st century. These abilities are communication, critical thinking, systematic thinking, creativity, research and investigation, reflection, use of information, initiative, persistence, and self-direction [1]. These eight abilities have been incorporated into mathematical literacy skills which are internationally measured by the Organization for Economic Co-operation and Development (OECD) on the PISA test which is conducted every three years. The purpose of PISA is not to measure students' mastery of academic content but to measure each student's ability to apply abilities in various real-world contexts (Grek on [2]). PISA was created to prepare students to become lifelong learners and be able to play an active role in life and society, ready to face work

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040006-1–040006-11; https://doi.org/10.1063/5.0241707

with a focus on reading literacy, mathematical literacy, and scientific literacy. Indonesia has taken the PISA test since 2000. The average result of Indonesia's mathematical literacy on the PISA test fluctuates. The results were astounding in 2018, Indonesia got a mathematical literacy score of 379 which places Indonesia in rank 74 out of 79 participating countries [3].

To respond Indonesia's low PISA achievements and the importance of training core skills like mathematical literacy and reading literacy from an early age, the Government of Indonesia created a Minimum Competency Assessment (AKM) program as a basic ability that every Indonesian student must possess. Mathematical literacy and reading literacy are very important for students to develop because they help them reason logically and systematically, apply the concepts and knowledge they have acquired, and understand, categorize, and use information critically. Students receive training in improving their reading literacy and mathematical literacy skills through AKM by solving problems in various situations so that they can deal with international literacy questions, that is PISA.

The AKM questions do not only measure specific topics or content, but various content, cognitive levels, and contexts. Based on the PISA 2022 mathematics framework [1], the formal definition of mathematical literacy is as follows:

> "*Mathematical literacy is an individual's capacity to reason mathematically and formulate, use, and interpret mathematics to solve problems in a variety of real-world contexts. It includes concepts, procedures, facts and tools to describe, explain, and predict phenomena. It helps individuals to know the role that mathematics plays in the world and to make the reasoned judgments and decisions required by constructive, engaged, and reflective 21st-century citizens*."

The content, cognitive level, and context of AKM are similar with PISA. That way, students will be familiar with questions adapted from PISA. For content, AKM divides into numbers, geometry, data and uncertainty, and algebra. Then there are three cognitive levels of mathematical literacy, such as knowledge and understanding, application, and reasoning. The context describes life features or circumstances for the content used. AKM divides context into three categories: personal, sociocultural, and scientific.

Until now, research on AKM has used subjects from elementary school to teachers, has examined students' AKM abilities in terms of various variables [4]–[15], developing tasks [16]–[23], developing worksheets [24]–[27], developing Android applications [28], teacher training [29], supporting school facilities[30], analyzing prospective teachers' abilities in working on AKM tasks [31], and teacher attitudes towards AKM [32]. Research in Ahyan et al [33] has discussed the portrait of mathematical literacy in Indonesia in the period 2011 to 2021 using bibliometric analysis but has not discussed AKM in more depth because at the time of writing that article, AKM had just been launched. There is a need for a portrait of the ability of Indonesian students' mathematical literacy at AKM in one article so that it becomes a reference for the government, teachers, and researchers in determining the ability of Indonesian students' mathematical literacy in general. This research aims to answer the following questions: (1) What is the number of research regarding AKM from year to year? (2) What database articles are the most AKM articles published in? What research methods are used in AKM research? (3) What subjects are most researched in AKM research? (4) What are the most popular topics in AKM research? What types of process, content, and context domains are often used in the AKM questions created? (5) How are students' abilities in working on AKM questions? (6) What has been done to train mathematical literacy skills in AKM?

METHOD

This research uses a literature review method that focuses on content analysis of 30 articles on the AKM topic which were published in scientific journals in Indonesia and internationally. This research is similar to research by Susetyarini & Fauzi [34], who examined trends in critical thinking skills in biology education. The data collection technique is by searching for article titles that contain "AKM", "Minimum Competency Assessment", or "Minimum Competency Assessment" in scientific journals with a limit of 2021 - 2023 because the AKM policy has been implemented since 2021. The "search" column on the Science journal website and Technology Index (SINTA) 1 and 2, makes it easier for researchers to search for the title of the intended article. Of 34 journals indexed in SINTA 1 and 2, 16 articles were obtained. Then, to search for AKM articles in international journals or international proceedings, researchers used the Publish or Perish application with restrictions on Scopus journals and international proceedings. After filtering, researchers found 2 articles in Scopus journals, 8 articles in Scopus proceedings, and 4 articles in non-Scopus international proceedings. Researchers only limited the search to SINTA 1, SINTA 2, Scopus, and international proceedings because they were based on index levels and researcher limitations. The instruments used in this research are article documents which are analyzed using content analysis guidelines that contain six main aspects to be reviewed. The content references to be analyzed are adapted from Susetyarini & Fauzi [34] in Table 1 with aspects including (1) number of publications per year, (2) number of publications per database articles, (3) type of research, (4) research subject, (5) AKM content domain, context and process, (6) research topic. Categories in aspects (1), (2), (3), (4), (5) were determined before data was collected while (6) after the articles were collected. In addition, aspect (3) is divided into two sub-aspects, including (3a) qualitative research design and (3b) development research design. For data analysis, articles are classified based on aspects of the instrument, then the data is presented in the form of bar charts and tables which are then analyzed in more depth.

TABLE 1. Aspects and Categories for Content Analysis in the Study

Aspects	Categories			
Year of Publication		A.1-2021		A.3-2023
		A.2-2022		
Database Articles		B.1-Scopus Journal		B.3-SINTA 1 dan 2
		B.2-International Proceeding Scopus		B.4- International Proceeding non-Scopus
Types of Research		C.1-Development		C.3-Quantitative
		C.2-Qualitative		C.4-Mix Method
Research Subject		D.1-elementary school		D.6-11th grade
		D.2-7th grade		D.7-12th grade
		D.3-8th grade		D.8-undergraduate
		D.4-9th grade		D.9-teachers and staff
		D.5-10th grade		
AKM content domain, context, and process	content	E.1-Measurement and Geometry		E.6-Personal
		E.2-Numbers		E.7-Scientific
		E.3- Uncertainty and Data	Process	E.8-Knowing
		E.4-Algebra		E.9-Applying
	context	E.5-Social culture		E.10-Reasoning

RESULTS AND DISCUSSION

Number of Publications

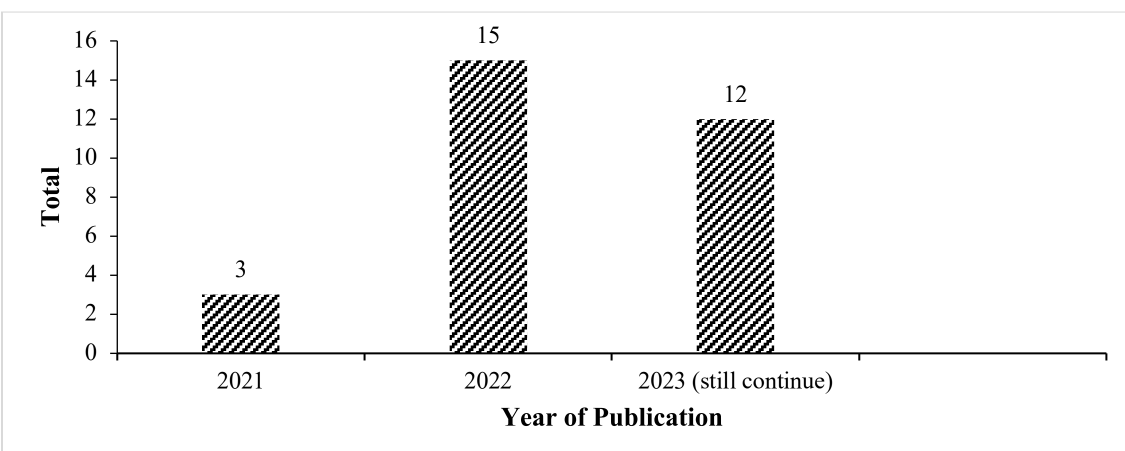


FIGURE 1. Number of Publication

The number of publications in Figure 1 states the number of published articles about AKM for each year with a limitation of 2021 – 2023 and limiting the search to only SINTA 1 & 2 journals, Scopus journals, Scopus proceedings, and non-Scopus international proceedings. Research on AKM began in 2021 because AKM has been implemented since 2021 until now. From the diagram, there has been a significant increase in publications from 2021 to 2022.

Likewise, for 2023, which will continue, it is predicted that it will exceed the number of publications in 2022. This happens because the AKM is urgent to be researched as an effect of the AKM replacing the National Examination for all of Indonesia. Massive research on AKM is needed to improve mathematical literacy skills in the right way. Coburn & Penuel [35] mention that the ultimate goal of research is to improve education.

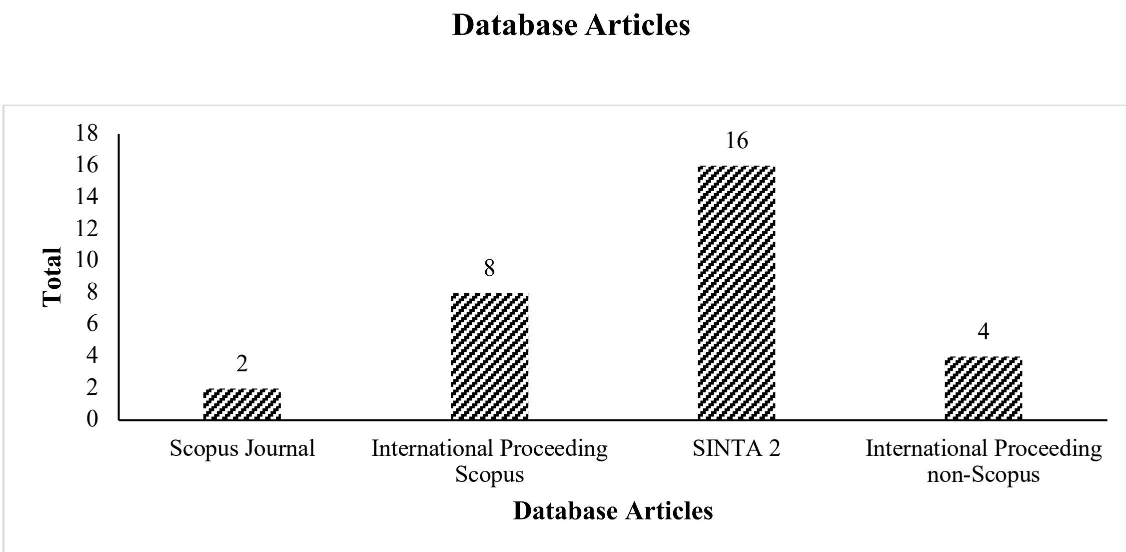


FIGURE 2. Database Articles

The journal that is the place for publication of articles about AKM needs to be analyzed so that Indonesian researchers know whether the AKM research trend is only in Indonesia or has spread internationally. Based on Figure 2, the publication of articles about AKM is still rare in international journals because most of them are published in Indonesia. This could be an opportunity for future researchers.

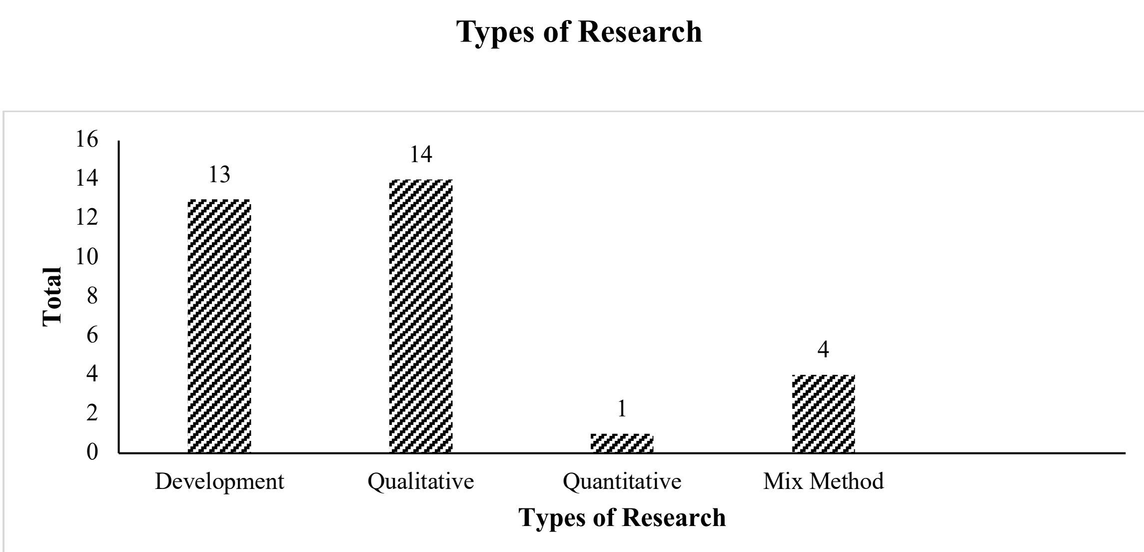


FIGURE 3. Types of Research

Research type in Figure 3 means what research methods are trending to be used in AKM research. Of the 30 selected articles, the qualitative method was the most widely used, followed by development methods which differed slightly with the number of qualitative articles. This result is aligned with Chen et al research [36], but this is in contrast to the statement of Susetyarini & Fauzi [34], GÖKTAŞa et al [37], Uzunboylu and G. Aşıksoy [38] who acknowledge that quantitative method is the method most widely used in education. In the AKM research only one quantitative was found and the quantitative used was descriptive quantitative which is the basis of statistics. Qualitative and developmental trends in AKM research make sense because the development method is related to developing solutions to improve mathematical literacy skills and the qualitative method is related to the current level of ability of Indonesian students in working on AKM which is important to know currently. Because qualitative and developmental are the most frequently chosen methods, the researchers want to discuss in more depth the research designs chosen for both.

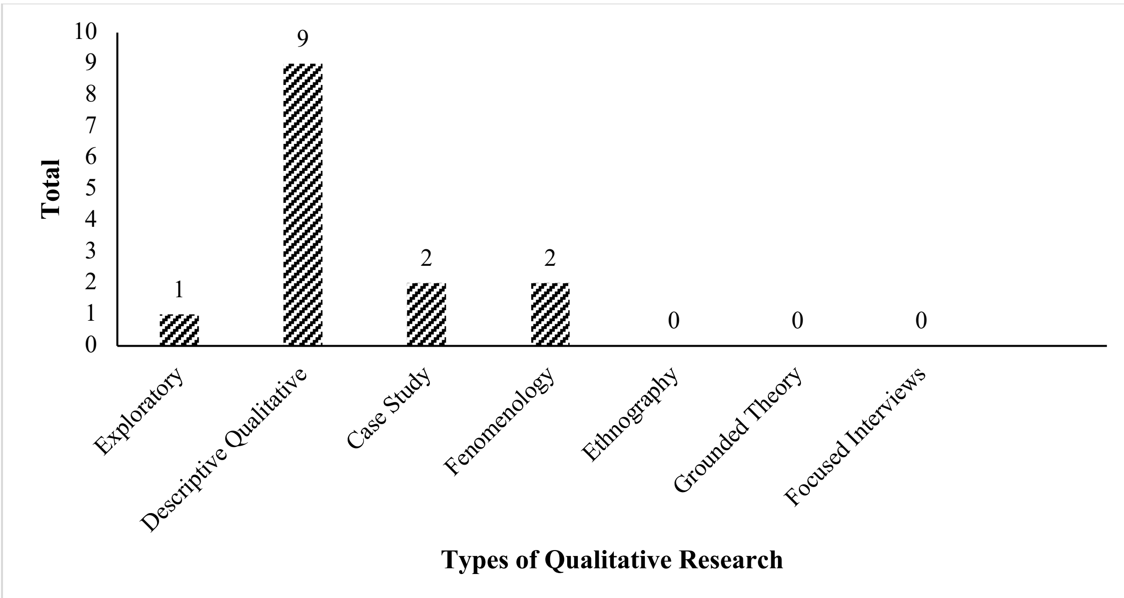


FIGURE 4. Types of Qualitative Research

From Figure 4, the most frequently chosen qualitative research design was descriptive qualitative with nine articles compared to exploratory, case study, and phenomenology designs which were much fewer and almost the same in number. Qualitative descriptives are most often chosen in AKM research because they describe students' mathematical literacy abilities in working on AKM questions, which is important information for each school so that they can follow up and use appropriate methods to improve their students' mathematical literacy abilities. Research Turmuzi et al [39] also agree that the qualitative descriptive design is the most popular. The variables used in the AKM qualitative descriptive research article are: (1) learning style, (2) reasoning, (3) spatial abilities, (3) Action, Process, Object, And Schema (APOS) theory, (4) mathematical representation, (5) critical thinking, (6) Polya steps, (7) number sense, and (8) mathematical abilities. The variables in AKM research are factors that influence mathematical literacy abilities. The factors that influence mathematical literacy have been widely researched in recent years, confirmed by Ulger et al [40]. There are still many other important variables from an affective, cognitive, and psychomotor perspective that have not been integrated into AKM research. The other qualitative research designs, which are ethnography, grounded theory, and focused interviews have not been selected for AKM research.

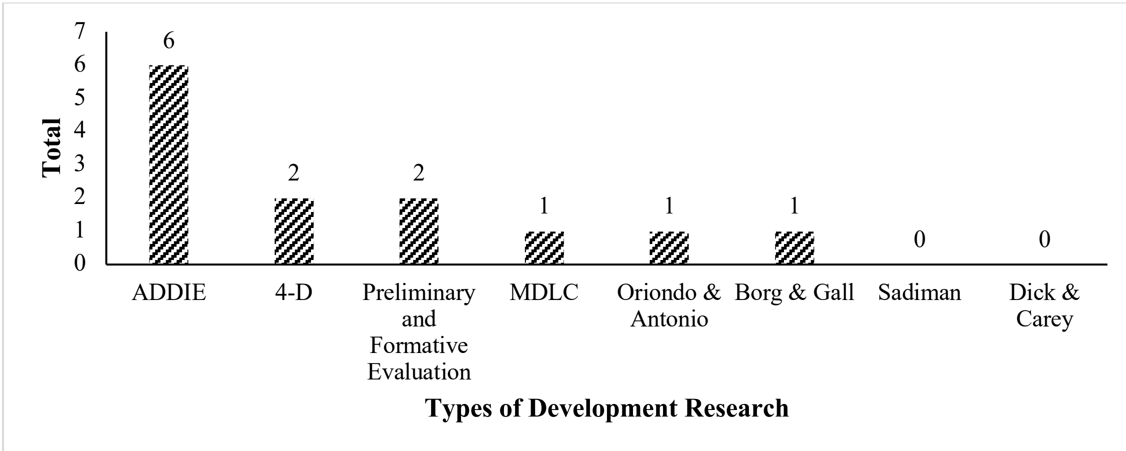


FIGURE 5. Types of Development Research

The second most common research is development methods. The most frequently chosen development design is ADDIE, followed by four-D and Tessmer development, which are preliminary and formative evaluation in second place. ADDIE is most often chosen because it is the most popular among other development designs. This result is not by Turmuzi's research which uses ADDIE in ethnomathematics research. This happens because each research topic in mathematics education has a different trend. Other research designs such as Sadiman, Dick, and Carey have not been selected for AKM research.

Research Subjects

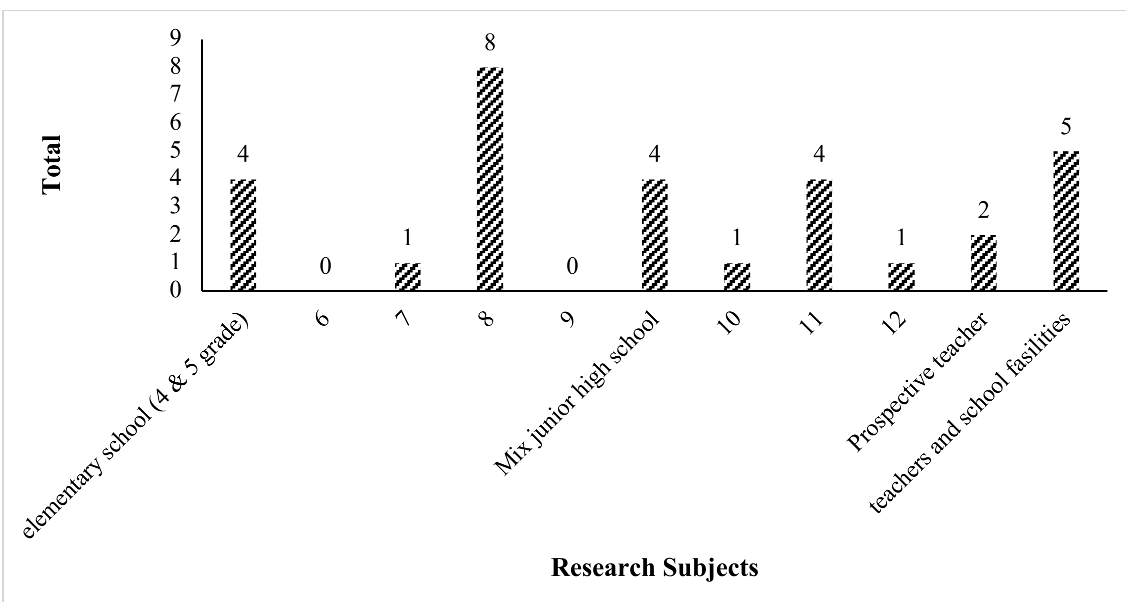
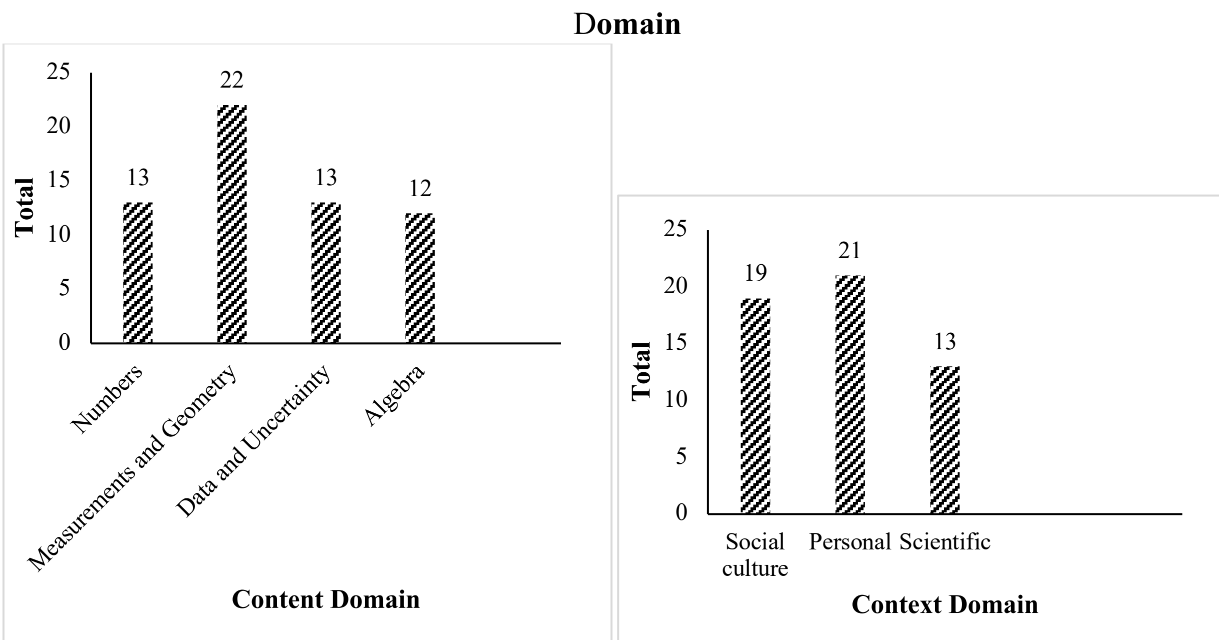


FIGURE 6. Research Subjects

Because AKM is an assessment for students, the subject that is most widely used is students. The qualitative research method that is most widely used is indeed suitable for examining the current level of Indonesian mathematical literacy skills so that we can choose appropriate ways to improve mathematical literacy skills through media development or other efforts. In Figure 6, data is obtained that those most often chosen as subjects are students in 8th

grade. Most subjects chosen are in 8th grade because it is one of the class levels that take AKM apart from 5th grade and 11th grade. This is different from the research results [40] in that junior high school students are in the second position and university students are in the first position. This difference could occur because Ülger et al [40] researched mathematical literacy in general while the researchers in this study limited it to the AKM test.

However, there is an imbalance because research in class 5 and class 11 is not as much as research in 8th grade. Figure 6 also shows that 6th grade, 9th grade, and 12th grade which are the highest classes at each level are rarely researched, only 12th grade which have been studied once. This phenomenon often occurs because most schools do not allow researchers to conduct research in these classes due to the busy schedule for graduation exams. Apart from students, prospective teachers, teachers, and staff were also researched to find out their readiness to face AKM. The most research on these 2 types of subjects is research on teachers and school facilities. This happens because teacher readiness and school facilities directly influence students' mathematical literacy abilities [41].



(a) (b)

FIGURE 7. Research Subjects

AKM has 3 domains, which are content, context, and process. The content domain relates to mathematical material, which are numbers, algebra, uncertainty, data, measurement, and geometry. The context domain is related to the situation used, which are personal, socio-cultural, and scientific. The process domain is related to the cognitive level of the problem. In Figure 7, the content domains most frequently used in AKM research questions are measurement and geometry. The most frequently used context domain is personal. For the process domain, all questions in the AKM article use the three process domains, so researchers do not display the process domain in a bar chart.

Topics of Research

TABLE 2. Topics of Research in AKM

Types of Research	Topics of Research	Number of studies
R and D	Development tasks	9
	Development module or worksheet	3
	Android Application for Try-out	1
Qualitative	Analysis of students' abilities in working on Minimum Competency Assessment	11
	School readiness	2
	Teacher’s problem posing in making Minimum Competency Assessment tasks	1
Descriptive Quantitative	The ability of prospective teachers to work on Minimum Competency Assessment tasks	1
Mix Method	Teacher’s attitude	1
	Correlation between logical thinking ability and Minimum Competency Assessment results	1

The research topics listed in Table 2 are the research topics discussed in the 30 selected articles. The topics are grouped based on research methods and the number of articles discussing the same topic is also stated. Based on Table 1, the analysis of students' mathematical literacy skills in solving AKM questions was the most discussed topic, which are evident in 11 articles, followed by the topic of developing AKM questions in second place, totaling 9 articles. Students' mathematical literacy remains under-researched so that the government knows the current condition of students in working on AKM questions. Chen et al [36] contend that student achievement in working on mathematical literacy questions is the most researched topic. Then, a lot of research needs to be done to develop AKM tasks to train mathematical literacy because The need for a variety of AKM questions is due to the limited practice of AKM questions provided by the Ministry of Education, Culture, Research, and Technology Research Ahyan et al [33] also states that mathematics literacy research is also dominated by tasks development. There are still many gaps for future researchers to research AKM using other important topics.

Student Work Results in AKM

General conclusions regarding mathematical literacy skills in AKM are needed to become a reference for the government and stakeholders to take further policies and actions regarding AKM. At the elementary school level, research results from 12 students in Klarita & R. Syafi’ah [42], students have moderate mathematical literacy skills with a percentage of 58.33%, with the highest ability in number indicators and data and uncertainty indicators, and the lowest ability in geometry and measurement indicators. The subjects studied by Putika & Sayekti [43] stated that students had difficulty working on questions because they did not match the material taught in class. Same with the results of research Putri et al [44] the majority of students have not reached the minimum competency limit in terms of mathematical literacy.

Next, for junior high school level, low-level abilities are also found in several studies, such as Syafriah & Hadi [45] which revealed that out of 134 students, 41% of students were at the low ability level in eighth grade at SMPN 134 Jakarta. Additionally, research Yulianto & Juniawan [46] shows that the problem-solving abilities of junior high school students in solving AKM mathematical literacy-type questions based on the Polya Stages are in the low category. Low results were also obtained in research looking at number sense and mathematical representation. When viewed from number sense ability, grade 8 students are still relatively low based on Hastuti & Setyaningrum [5], and if based on mathematical representation ability, only students with high and medium mathematical representation can meet the mathematical literacy indicators in AKM [11].

Different from the elementary and middle school levels, in high school many students have mastered sufficient mathematical literacy skills. Based on the results of data processing by Megawati & Sutarti [47] on AKM mathematics questions that students had worked on, 63% of the 54 students of 11^{th} grade students had high mathematical literacy skills. These results also follow Henry et al [10], claiming that 11^{th} grade students satisfy the AKM according to the indicators. However, the results of other research in high schools also demonstrated that there were high school students who were not able to meet the indicators, such as research by Inganah et al [9] reporting that 11^{th} grade students who had low mathematical abilities were unable to solve problems based on Polya and 10^{th} grade students who had a kinaesthetic learning style. does not meet the indicators [4].

How to Improve Mathematical Literacy

Various methods have been carried out to improve students' mathematical literacy skills, for example using media. Based on the results of Miftah & Setyaningsih [24], a product was obtained in the form of AKM-based worksheets on junior high school geometry material that met valid and practical criteria and had the effect of increasing students' mathematical literacy skills. The increase in mathematical literacy skills occurred by 24.8 with an average of 53.3 to 78.1. To succeed in implementing AKM, not only are students ready to deal with it, but teachers are also prepared in advance to train their students to work on AKM questions. Efforts to prepare teachers in AKM can be through training. [48] stated that the training method was effective for training in making math literacy questions based on AKM. Not only to practice but training is carried out for reflection and evaluation as researched by Ulum et al [49]. Teachers' responses and behavior towards AKM also need to be examined to find out how far the teacher's focus and attention are on the existence of AKM. Teacher behavior that has been researched by Herman et al [32], states that teachers have fairly good knowledge of the Minimum Competency Assessment. Good affection from teachers is also inseparable from good cognitive components from teachers. 54% of teachers have a good opinion. This shows that more than half of the teachers know that there is a Minimum Competency Assessment and have a good opinion about the Minimum Competency assessment. Moreover, up to 91.9% of the public supports the national evaluation as a substitute for the national exam which is scheduled for 2021. However, AKM implementation in schools is hampered by unreliable internet connections, the dearth of learning modules, lecturing teachers, a lack of preparation time, teachers' challenges creating assessments and compiling AKM-based questions, and some students who struggle with reading [50]. After various trainings and knowing the teacher's response to AKM, it is necessary to know how the teacher's ability to develop AKM questions. Teachers have taken various ways to train students to meet AKM, but the problem is that teachers still do not know the expected achievement indicators [51]. On the other hand, the results of research by Fauziah et al [52], states that 100% of teachers know what AKM is, 87.5% of teachers know what components are measured in AKM, and as many as 12.5% of teachers do not know. Students' habituation to AKM questions also needs to be adjusted to the student's level of ability. Students at the basic level need to be trained to apply solutions in real life, students at the proficient level need to hone their reasoning, and students at the advanced level need to be trained to generalize solutions by analyzing various problems [53].

CONCLUSION

To address the 8 basic skills that the world community should have, such as communication, critical thinking, systematic thinking, creativity, research and investigation, reflection, use of information, initiative, persistence, and self-direction, PISA and national assessments have been created the Minimum Competency Assessment. Based on the results of the review, the number of publications about AKM is increasing every year and will continue to increase in 2023. Most publications are in SINTA 2 indexed journals, but there are still a small number of publications in international journals. The most popular type of research is qualitative research, followed by development research in second place. In qualitative research, the most widely applied design is descriptive qualitative, and most development research follows the ADDIE model. For research subjects, 8^{th} grade is the most researched. In terms of domains, almost all domains are used in AKM research with the measurement & geometry domain and the personal domain being the most frequently chosen. The topics most discussed were analyzing students' mathematical literacy skills on AKM and then research on developing AKM questions. Based on the articles collected, students' mathematical literacy skills in solving AKM questions are still low. Efforts that have been made to improve mathematical literacy skills include developing worksheets, Android applications, AKM questions of various types, teacher training, and school facility readiness. This research has limitations, that is the number of articles analyzed so future researchers are expected to examine more articles with other journal indexes. With the results of this review, it is hoped that future researchers can research gaps that have not been filled.

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Examining Pre-Service Secondary Mathematics Teachers' Performance in Combinatorial Problems

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Abstract. Combinatorics is considered as an important topic in discrete mathematics course, yet it is considered as one of the more challenging topics of mathematics to teach and to learn. The objective of this case study was to examine the performance of forty-two pre-service secondary mathematics teachers in solving combinatorial problems. They are in fifth semester students' mathematics education study program at one public university in Jakarta Indonesia. Employing test administration, they were given three problems from three different topics in discrete mathematics, namely, binomial theorem, combination, and the pigeonhole theorem. Using content analysis, participants responses were analyzed to shed light on the correctness and strategies/concept used. The findings indicated that most participants encountered difficulties in dealing with the problems. Besides, they considered and leveraged different concepts and strategies to solve each problem. Their success in solving problems relies on their comprehension of concepts and encountered problems and choosing and executing the strategy appropriately. Referring to these findings, we suggest several recommendations for delivering the topics of combinatorics in discrete mathematics course to promote proper understanding and students success in problem solving.

INTRODUCTION

Combinatorics is mostly described as a branch of mathematics that focuses on the theory of enumeration, combination, and permutation to solve problems related to the possibility of arranging objects that satisfy specified conditions. Combinatorics has an essential place in discrete mathematics courses. It is also delivered in the secondary level mathematics curriculum which mostly consists of enumeration, permutation, and combination. Meanwhile in higher education level, it includes such topics as binomial theorem, the Pigeonhole principle, and so on.

The topics combinatorics might assist students in developing reasoning abilities, such as making conjectures, generalizations, and systematic thinking. It also might promote their understanding of concepts about mapping, function, etc. [1]. Likewise, Lockwood et al. [2] emphasized five advantages of the combinatorics problems i.e., involving simple language and terminology and require straightforward prior knowledge of mathematics; facilitating students to develop diverse mathematical thinking abilities; supporting the desired mathematical activity; supporting positively the idea of equality in mathematics education; and helping students develop thinking skills and computational activities. Therefore, it shows that this topic receives serious attention in mathematics education [2].

Specifically, one of the fundamental abilities in dealing with combinatorics problems is combinatorial thinking. In the literature, several theories have been proposed to explain combinatorial thinking. Lockwood [3] argues that it includes counting process, using formula/expression, and set of outcomes. Rezaiye and Gooya [4] have also tried to explain combinatorics thinking by categorizing it into four levels of understanding, conducting an inquiry into some cases; convincing themselves that they have counted all the cases; constructing all cases regularly; and converting the problem into another combinatorial problem.

However, this topic is still considered difficult by most students as it has been found to relate to undesirable experiences. The process of determining permutations and combinations can frequently lead to confusion between the two concepts. A plethora of studies have been carried out to investigate students' difficulties, errors, and in

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040007-1–040007-6; https://doi.org/10.1063/5.0242002
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

dealing with combinatorial tasks. For instances, Usry, Rosli, and Maat [5] found five major mistakes that students made in dealing with the problem of permutation and combination i.e., inaccuracies in interpreting the problem, errors in identifying the object used, errors in using arithmetic operations in the process of finding a solution, errors in using the formula, and errors and meaninglessness of the answers provided. Further, Syahputra [6] found that most students do not understand a given problem, do not use the enumeration process in calculating, do not construct a mathematical model for the subject, and always take shortcut formulas for granted to solve the given problem.

Furthermore, the demonstration of interpreting a combinatorial expression in multiple ways and using the similar combinatorial operation in various settings was also lacking [7]. Most importantly, despite the fact that students have already finished their learning in basic mathematical concepts related to combinatorics, they were not yet able to effectively utilize fundamental features of binomial coefficients while solving combinatorial problems [7]. In addition, Wasserman and Galarza [8] observed that students often exhibit reduced consistency and encounter greater difficulty in effectively employing and providing justifications for combinations involving a set of ordered indistinguishable objects, as compared to combinations involving a set of unordered distinct objects.

As a matter of fact, a diverse range of approaches can be employed by students to tackle a combinatorial problem. A given problem may possess a unique solution that can be approached through various techniques [9]. Several previous studies have revealed the strategies that students have implemented in solving combinatoric problems. For example, Lamanna et al [10] found students' various strategies dealing with combinatorial task. These include the application of combinatorial formulas, referencing other related problems, decomposing the problem into smaller sub-problems, utilizing the arithmetical laws of sum, product, and quotient, as well as employing a tree diagram. In addition, several studies examined the approaches employed by students when solving counting issues through the utilization of systematic listing techniques [11,12,13]. In addition, Mashiach, Eizenberg, and Zaslavsky [14] revealed that verification might assist in reaching a correct solution. They listed various verification strategies such as reviewing the solution, adding justification to it, assessing its reasonability, changing some parts of it, and using a different solution approach and comparing.

Several publications also have appeared in recent years documenting pre-service mathematics teachers combinatorial thinking. For example, McGalliard and Wilson [15] studied written work of pre-service teachers and found that a significant number of them refrained from utilizing their enumeration procedure as a means of generalizing. Other studies also investigate Indonesian pre-service teachers on other specific topics such as Logarithms [16], Absolute Value [17], Function [18], Graph [19], Higher Order Thinking [20], Algebra [21], Mathematical Modelling [22], and Combinatorics [23]. However, very few publications can be found in the literature that address the issue of Indonesian pre-service secondary mathematics teachers' performance in dealing with combinatorial problems. To fill this gap, the aim of this research is to analyze the performances (in terms of correct solutions) and the strategies or concepts used by a sample of Indonesian pre-service secondary mathematics in solving three combinatorics problems.

This research makes contributions both in practice and theory. Theoretically, this research can be perceived as a valuable addition towards the advancement of a more comprehensive and profound comprehension of the performance of Indonesian pre-service secondary mathematics teachers in solving combinatorics problems including combinations, binomial theorem, and Pigeonhole principle. Practically, this study has the potential to offer valuable guidance to educators in designing instructional approaches for discrete mathematics courses, with the aim of reducing students' difficulties in comprehending the topics and enhancing their combinatorial thinking abilities.

METHODS

This case study was conducted to investigate participants' performance in dealing with combinatorial problems. The participants were forty-two pre-service mathematics teachers in mathematics education study program in which thirty of them were female students and the rest were male students. Their ages ranged from 18 to 20 years. They were in the fifth semester of the 4-year program. Previously, they took basic to moderate mathematical based courses such as Calculus, Logic, Statistics, and so on. The context of the study was in a Discrete Mathematics course which related to counting principles, binomial theorem, generating functions, recursive relation, Boolean Algebra, and Graph.

Data collection was conducted by test administration. The test consisted of three problems and was administered for 90 minutes. The first problem was related to binomial theorem. It was to ask the participants to determine the coefficient of the multinomial given. As a matter of fact, multinomial coefficients were generalizations of binomial coefficients, with a likeness combinatorial meaning. The second problem was related to the application of combinations. The third problem was related to the pigeonhole theorem. All the problems or things like those were not presented beforehand as examples or assignments in classroom. The problems were adapted and taken from previous research and discrete mathematics coursebook. Besides, the problems have been confirmed its content and face validity.

The following were three problems proposed to the participants.

Problem 1

a. Determine the coefficient of p^3q^5r in the expansion of $(p+q+r+s)^9$

b. Could you interpret the combinatorial meaning of the obtained coefficient?

Problem 2

In the final football match. Team A beat Team B 5:3. How many distinct ways can the course of the match have?

Problem 3

A box contains 10 red balls and 10 blue balls. A man picks a ball randomly without looking into the box.

a. How many balls should be picked up to ensure that at least three are of the same color?

b. How many balls should be picked up to obtain that at least three are blue balls?

Upon collecting participants answer sheets, content analysis was conducted. The presented data were categorization and the percentage of participants corresponding to those categories. Besides, each response was interpreted to identify factors that lead to their success and failure in struggling with the problems. There were two analyses conducted. The first analysis was concerned with strategies or concepts selected and employed by the participants regardless of the correctness of the answers. Therefore, the categories formed were combination, systematic listing, permutation, tree diagram, and so on. The categorizations and its percentage were presented in pie diagram. The second analysis was focused on the correctness of the answers. The answer is considered correct if the participant managed to set down strategy and final answer correctly. Subsequently, various strategies employed to reach correct answers were highlighted and presented in a table.

FINDINGS AND DISCUSSION

Based on the Figure 1, surprisingly each of these problems was solved differently. As a matter of fact, in dealing with combinatorics problems various strategies can be put forth to arrive at a single correct answer [9]. This is in line with the results of previous research, where students used various strategies, such as listing and formulas. Additionally, participants might take their reasoning into account to solve the problems. Nevertheless, looking closely at their answers, it appears that their understanding of the problems contradicts each other.

The first problem asked the participants to determine the four-variable multinomial coefficient. To do this, a specific formula could be employed. Subsequently, they were requested to interpret the meaning of the coefficient obtained. Based on the participants responses (see Figure 1a), there were five categories formed, namely, binomial theorem formula (56%), no response (19%), expansion (9%), tree diagram (9%) and combination (7%). 45% of the participants provided the correct answer in which they use the binomial theorem formula. This low percentage indicates that most participants are still unable to apply the binomial theorem formula to the problems they have just faced. In addition, the no response percentage to this problem is quite high. The finding is consistent with findings of past studies by Semanišinová [7], which identified suboptimal students' capacity to effectively employ binomial theorem while solving combinatorial problems, despite the fact that they have already accomplished fundamental mathematical knowledge in combinatorics.

The above problem was followed with a question which asked participants to interpret the meaning of the coefficient obtained. Unsurprisingly, they take into consideration definition of coefficients that they understand in calculus course. Based on the Figure 1b, 45% of the participants said that 504, the intended coefficient, was the sum of the terms of p^3q^5r . This answer might arise due to overgeneralization where the existing or previous concepts are applied directly in the new context. Overgeneralization was also found in the previous research [17,18]. Besides, the no response category for this question is the highest (41%). Only 7% of participants could reveal the correct answer that the coefficient indicates number of possible ways of arranging three object *p*, five object *q*, and one object *r*. This is in line with research conducted by Semanišinová [7] who found similar result that the proficiency in interpreting a combinatorial expression across many interpretations was inadequately established by the students.

The second problem required participants to use the concept of combination. In fact, it could be addressed using a formula or systematic listing approach. Based on Figure 1c, the participants provided dissimilar responses including combination (45%), permutation (24%), listing (17%), tree (2%), generating function (3%), derangement (2%), and description (2%). Meanwhile there were two people who did not provide an answer (5%). The most chosen category was combination although the process and final answer varied.

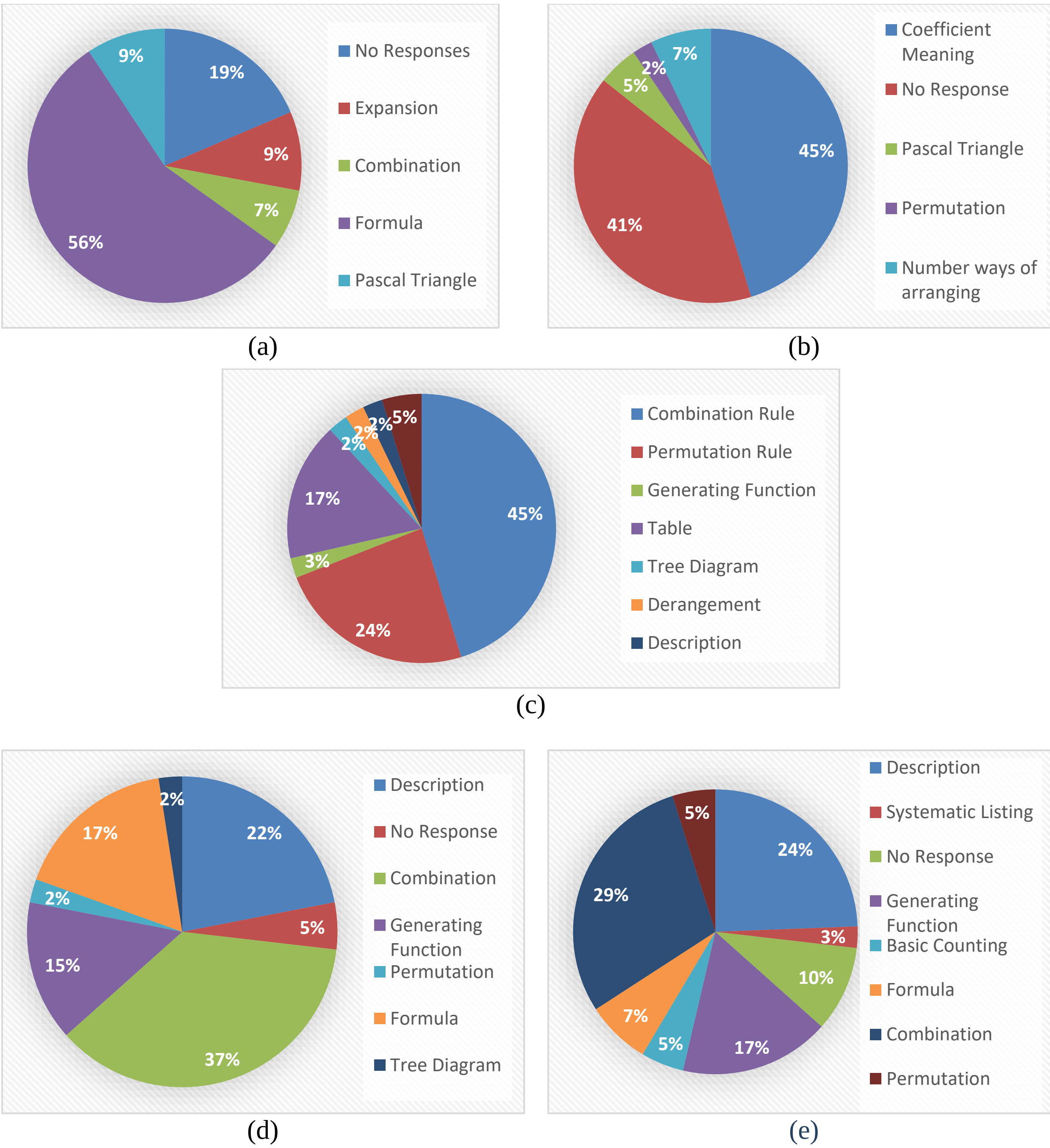

FIGURE 1. Categories and Percentages of Students Responses

In fact, this problem is another form of the problem about determining the number of possible paths in the mxn matrix. The correct answers are those who use the formula $\binom{m+n}{n}$ or $\binom{m+n}{m}$ or those who construct systematic listing correctly. Only 17% reached the correct answer and it was a low percentage. Most of them employed the combination formula. Meanwhile, only 2% of them applied a systematic listing correctly. To construct systematic listing, caution is important. The results are compatible with study by Lockwood [11] who document that the implementation of partial lists in the enumeration of outcomes resulted in notable enhancements in students' problem-solving abilities, suggesting that the adoption of a systematic listing approach may be beneficial for them as they develop their counting skills.

The participants' failure to address this problem might be due to partial understanding of the problem. They tended to select and use formulas mindlessly, incoherently, and indiscriminately, regardless of their appropriateness to the problem. In the discrete mathematics course, they were equipped with rich concepts and formulas. Unfortunately, it doesn't seem to contribute positively to them employing it appropriately. Understanding the problem correctly is an important key, in addition to knowledge of concepts and/or formulas in discrete mathematics. Lockwood, Wasserman, and McGuffey [24] revealed that exposing students to formulas early on might be counterproductive if they are not invited to comprehend those formulas.

It is observed that most participants tended to address the problems by means of the concept of permutation or combination. They seem to think that all combinatorics problems could be solved using combination or permutation formulas. This could be due to inaccurate understanding of the problems and overgeneralization of the concepts of combination and permutation.

The third problem examined participants' understanding of Pigeonhole principles. This problem consisted of two sub problems. Like the previous problems, the participants responded to this problem in distinct ways. There were seven categories found in participants answers (see Figure 1d) i.e., combination (37%), description by reasoning (22%), The Pigeonhole principle formula (17%), generating function (15%), no response (5%), permutation (2%) and tree diagram (2%). Meanwhile, participants' responses to problem 3b seemed to be more diverse than that of problem 3a (see Figure 1e). There are at least eight categories found i.e., combination (29%), description by reasoning (24%), generating function (17%), no response (10%), the Pigeonhole principle formula (7%), permutation (5%), basic counting (5%), and systematic listing (3%).

In fact, the two problems (3a and 3b) are similar. Nevertheless, based on the participants' answers, we see differences in the answers given. Most participants considered that the problems could be addressed using combination rules as the event of picking up the ball in the box is usually a combination case. The variety of answers given also shows that most of them have never been given problems like this before. The percentage of correct answers to these problems are 29% for 3a and 31% for 3b.

TABLE 1. Strategies/Concepts used to reach correct answers.

Problem No	Strategies to Correct Answer
1a	Binomial Formula
1b	Understanding of combination
2	Combination Formula and Systematic Listing
3a	Description by Reasoning, Pigeonhole Formula, and Tree Diagram
3b	Description by Reasoning, Pigeonhole Formula, and Systematic Listing

The above table displays various strategies/concepts employed by the participants in solving the problem successfully. Prior research has established that when confronted with combinatorics problems, students might employ diverse strategies that ultimately yield the proper solution. A similar finding was observed in this present study. Particular attention is paid to the idea that combinatorial problems are accessible. In addition, what all participants in this study did not undertake was to verify their obtained result. In contrast to some reports in the literature, verification is required to ensure the correctness of the obtained result [14].

CONCLUSION

The aim of this study is to investigate participants' performance in solving combinatorics problems. Using content analysis of participants' answers which focused on accuracy and strategies used, several findings were obtained. The findings of the data analysis assert that most participants encountered challenges in solving combinatorial problems. The largest percentage of correct answers is the first problem which is a routine problem. The more unfamiliar the problem is, the more difficult it is to deal with. In addition, the concepts and strategies used were very diverse, indicating their lack of understanding.

Based on the correct answers, the supporting factors for their success were a robust understanding of the corresponding concepts and encountered problems. In addition, choosing and executing the strategy properly assists in reaching the intended result. Besides, overgeneralization might be considered as the most possible cause of participants failure in addition to not verifying the obtained answer.

In the light of these findings, in addition to presenting solely formulas at the beginning, students are required to comprehend the underlying concept and the application of these formulas to the relevant context. They also need to be exposed to a wide variety of problems, so they come across different experiences and contexts. It might promote their self-confidence and ability to come to grips with novel problems or situations. Finally, this research has thrown up many questions in need of further investigation. Further work needs to be done to investigate the development of combinatorial thinking of preservice teachers in discrete mathematics courses.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the generous financial support of Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Negeri Jakarta (36/SPK PENELITIAN/5.FMIPA/2023).

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The Effect of Application Design and Ease of Use on Student Interest in Using the TajwidQ Application

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Abstract. This study aimed to determine the effect of application design and eae of use on student interest in using the tajwidQ application. This research applied a quantitative method using numerical or statistical calculations. This research was conducted at the University of Muhammadiyah Prof. DR. HAMKA among the 1st semester students in the 2022/2023 academic year. The sample technique was saturated sample technique. Sixty students were taken as participants as research subjects. The instrument was a questionnaire contained 45 statements using a Likert scale. The analysis technique was analyzed using SPSS. The results of this study yield that the application design and ease of use of the application have a positive and significant effect on student interest in learning. The more attractive the application design and the ease of use of the application are, the higher interest in learning of the University of Muhammadiyah Prof. DR. HAMKA 1st semester students to use the tajwidQ application in learning tajwid.

INTRODUCTION

Education is the essential foundation in the intellectual, emotional [1], social, and spiritual development of individuals [2]. In the 21st century, education has undergone a significant transformation in the form of the necessity of utilizing technology in learning. [3]. Mobile learning is one form of learning evolution in terms of accessibility. This phenomenon has changed the way we work in accessing, comprehending and presenting learning materials.

The advances in mobile technology have influenced learning at different levels of education. The connectivity of mobile devices integrated with learning materials helps to promote meaningful learning encounters in various fields ofstudy. [4]. Mobile technology in learning has benefits for submitting homework, reflecting on hands-on learning experiences, and sharing ideas. [5]. Mobile technology can be used to enhance and understand learning [6]. The concept of mobile learning provokes learning become flexible, so that students can have the opportunity to learn more easily andas needed. Mobile technology offers opportunities to facilitate student-centered learning. [7]. In a study, it was mentioned that the use of mobile technology contributed to higher cognitive, affective and behavioral learning outcomes. [8]. The implementation of learning with *e-learning* media, made students more motivated, more enthusiastic, easier for them to understand the material, and attracted interest in participating in learning [8]. The results of [9], and [10] also declare to haveimpacts on improving students' learning achievement [11], [12].

In the context of religious learning, mobile learning participates in facilitating the accessibility of religious materials that have been difficult to achieve. This is a place for someone who wants to understand religious material individually, including in understanding *tajweed* materials. In a previous study, it was found that there were still students who did not comprehend *tajweed* material that well. [13]. This will have an impact on the ability to read the Qur'an as mastery of *tajweed* will make it easier for someone to read the Qur'an properly. [14]. In Islam, reading the Qur'an is a way to acknowledge and understand the Divine message. On the contrary, mistakes in reading the Qur'an

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040008-1–040008-9; https://doi.org/10.1063/5.0244931

will be such misinterpretation or change true meaning of the verse(s). Therefore, the science of *tajweed* is important for Muslims to learn.

In the digital era, there have been various developments in *tajweed* learning media with technology, such as audio-visual-digital based *tajweed* books, websites [15], *tajweed* application [16], [17] as well as android-based *tajweed* educational games [18]. This development is an answer to today's education world challenges. The learning device is presented with features and displays that attract users' attention. This provides a more enjoyable feelings and moments of learning *tajweed*. In digital learning, there are three main components that must be considered. These components are the readiness of learners and instructors, learning management and support systems. [5]. Therefore, the application design and ease of use of the application are crucial to note. This is due to the perceived usefulness and ease of use, enjoyment, suitability of technology that will affect the use of mobile learning for continuing education [19], [20]. This means that the features, appearance, material content, and all components in the learning application will have an impact on the user's desire to learn using the application media. Additionally, learning interest is a main factor in learning success [21], as high motivation and interest can improve the quality of student learning. If a person has interest and motivation to learn a material, then the person tends to have better results in learning [22]. [22]. Therefore, it is suggested to understand the quality of application design and the level of ease of use which can affect student interest in learning. A growing interest in learning will motivate students to be willing to learn the material in the learning application [10].

The application design also includes aesthetic aspects, such as the selection of graphic styles, colors and other visual design elements. Good aesthetics can increase the visual appeal of the application [23]. Therefore, digital platforms in the learning process must pay attention to application design and ease of use. In this case, many learning applications are specifically designed with divergent designs and different ease of use levels. The visual appearance of an application is also influential in managing comfort, communicating and delivering concepts, and attracting the attention of its users since many digital platform users are reluctant to access an application which is considered unattractive, especially in design issues and ease of use [24].

One of the digital platforms that combines technology with *tajweed* learning is "TajwidQ". It is an application that was created and designed to make it easier for users to learn *tajweed*. Basically, *tajweed* science is the basic foundation in reading the Qur'an properly by actualizing the reading of *makharijul* letters, the characteristics and procedures for reading the Qur'an appropriately. This is important to learn and be understood well so that students can read the Qur'an properly and correctly. However, learning the Qur'an and *tajweed* are considered quite difficult by some people and it also takes a long time. [25]. Therefore, the development of effective learning media for teaching *tajweed* is very relevant to use. The students can easily and widely access *tajweed* material anytime and anywhere. It can assist students learn independently according to their learning tempo [16].

Mobile learning has become a necessary instructional technology component in higher education. This research was explored to find out what influences students' interest in learning using the tajwidQ application. Thus, the formulation of the problem in this study, as follow:

a. Is there an effect of application design on student interest in using the tajwidQ application?
b. Is there an effect of ease of use on student interest in using the tajwidQ application?

METHODS

This research applied a quantitative method. This method is a research method that uses numerical or statistical calculations. This research was conducted at the University of Muhammadiyah Prof. DR. HAMKA for the 1st semester students in the 2022/2023 academic year. In the current research, researchers took the entire population of students who would be the target in the study. The sample technique was the saturated sample technique, which was a sampling that requires all members of the population and they became the subject of the study. The research sample was taken, namely 60 students. The type of instrument was a questionnaire contained 45 statements using a Likert scale. The researchers tested the instrument first before the research was conducted, to get its validity and reliability tests. The analysis technique was the data analyzed using SPSS program with multiple linear regression analysis. It represented the number of independent variables which had two variables, then analyzed with the normality test and multicollinearity test. Furthermore, after the analysis tests were carried out, they were analyzed with hypothesis testing. The hypothesis tests were using the t-test, f-test, and the coefficient of determination test, then drew conclusions whether there was an effect of the research conducted.

RESULTS AND DISCUSSION

Along with the development of science and technology, a *tajweed* application was created specifically for learning *tajweed* easily and flexibly. It can be accessed easily anywhere and anytime [26]. TajwidQ is an application that contains teaching *tajweed,* and can be practiced directly because there are features thatcan record the reading of the Qur'an users. The tajwidQ application has application design and features thatare designed to be easily practiced by its users. This study examines the effect of application design and ease of use on student interest in using the tajwidQ application. It was examined to find out whether there is an effect of application design and ease of use on student interest in using the tajwidQ application. This research is expected to provide information on technological advances, namely the use using tajwidQ application on students' interest in learning *tajweed*.

This section describes the analysis and discussion as well as statistical data processing. Based on the results ofthe research that has been conducted by researchers, the following research results were yielded:

In this study, the authors used a multiple linear regression analysis with the model:

1. Vx1 (Application Design)
   a. Validity Test

TABLE 1. Application Design Validity Test Results

Variables	Item	Rhitung (Pearson Correlation)	Rtabel	Description
X1 (Application Design)	X11	0.817	0.361	Valid
	X12	0.931	0.361	Valid
	X13	0.837	0.361	Valid
	X14	0.763	0.361	Valid
	X15	0.716	0.361	Valid
	X16	0.829	0.361	Valid
	X17	0.817	0.361	Valid
	X18	0.727	0.361	Valid
	X19	0.874	0.361	Valid
	X10	0.680	0.361	Valid
	X111	0.896	0.361	Valid
	X112	0.910	0.361	Valid
	X113	0.842	0.361	Valid
	X114	0.793	0.361	Valid
	X115	0.856	0.361	Valid
	X116	0.787	0.361	Valid

Based on the table above, it is known that 16 items from the application designquestionnaire have been tested for validity. All of these items were examined to be valid where each item had a r_{count} greater than the r_{table}.

   b. Reliable

TABLE 2. Reliability Test Results

Cronbach's Alpha	N of Items
.965	16

Based on the table above, it was confirmed that the statement items from the application design questionnaire were declared reliable. It is said to be reliable if the Cronbach Alpha (a) value is greater than 0.7. It can be seen that the *Cronbach Alpha* value is 0.965

2. Vx2 (Ease of Use)
   a. Valid Test

TABLE 3. Ease of Use Validity Test Results

Variables	Item	R_{count} (Pearson Correlation)	R_{table}	Description
X2 (Ease of Use)	X21	0.804	0.361	Valid

Variables	Item	R_{count} (Pearson Correlation)	R_{table}	Description
	X22	0.832	0.361	Valid
	X23	0.870	0.361	Valid
	X24	0.804	0.361	Valid
	X25	0.677	0.361	Valid
	X26	0.863	0.361	Valid
	X27	0.842	0.361	Valid
	X28	0.867	0.361	Valid
	X29	0.800	0.361	Valid
	X210	0.876	0.361	Valid
	X211	0.913	0.361	Valid
	X212	0.820	0.361	Valid

Based on the table above, it is known that 16 items from the application designquestionnaire have been tested for validity. All of these items were examined to be valid where each item had a r_{count} greater than the r_{table}.

b. Reliable

TABLE 4. Reliability Test Results

Cronbach's Alpha	N of Items
.955	12

Based on the table above, it was certified that the statement items from the user convenience questionnaire were declared reliable. Where it is said to be reliable if the Cronbach Alpha (a) value is greater than 0.7. It can be verified that the *Cronbach Alpha* value was 0.955.

3. Variable Y (Learning Interest)

a. Validity Test

TABLE 5. Learning Interest Validity Test Results

Variables	Item	R_{count} (Pearson Correlation)	R_{table}	Description
Y (Learning Interest)	Y1	0.777	0.361	Valid
	Y2	0.835	0.361	Valid
	Y3	0.881	0.361	Valid
	Y4	0.781	0.361	Valid
	Y5	0.805	0.361	Valid
	Y6	0.793	0.361	Valid
	Y7	0.909	0.361	Valid
	Y8	0.806	0.361	Valid
	Y9	0.828	0.361	Valid
	Y10	0.890	0.361	Valid
	Y11	0.889	0.361	Valid
	Y12	0.901	0.361	Valid
	Y13	0.851	0.361	Valid
	Y14	0.851	0.361	Valid
	Y15	0.752	0.361	Valid
	Y16	0.845	0.361	Valid
	Y17	0.804	0.361	Valid

Based on the table above, it is pictured that 17 items from the application designquestionnaire have been tested for validity. All of these items were examined to be valid where each item had a r_{count} greater than the r_{table}.

b. ReliabilityTest

TABLE 6. Reliability Test Results

Cronbach's Alpha	N of Items
.970	17

Based on the table above, it is affirmed that the statement items from the study interest questionnaire were declared reliable. It is said to be reliable if the Cronbach Alpha (a) value is greater than 0.7. It can be discovered that the *Cronbach Alpha* value was 0.970.

4. Classical Assumption Test

a. Normality Test

The data is defined to be normally distributed if the residual value is> 0.05. Then it means the data is normally distributed. The results showed a significant value of 0.30>0.05 so that it can be stated that the data is normally distributed. Thus, the regression analysis stage for hypothesis testing can be carried out.

The normality test can be drawn from the test results which state that the Kolmogorov-Smirnov value is 1,447 with a significance of 0.30. Thus, it can be concluded that the independent variables such as application design and ease of use and the dependent variable is learning interest, have met the requirements of the normality test. This means that the standardized residual value is declared to spread normally.

TABLE 7. Normality Test Results

		Unstandardized Residual
N		60
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	3.98816192
Most Extreme Differences	Absolute	.187
	Positive	.100
	Negative	-.187
Kolmogorov-Sminov Z		1.447
Asymp. Sig. (2-talied)		.030

a. Test distribution is Normal.

b. Calculated from data.

Based on can be concluded normally the table above, it that the data is distributed, named with a value of 0.30>0.05.

b. Multicollinearity Test

Data that is said to have no multicollinearity is presented to have a tolerance value> 0.10 and a VIF value < 10.

TABLE 8. Multicollinearity Test Results
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	T	Sig.	Tolerance	VIF
1	(Constant)	1.168	5.377		.217	.829		
	Design	.477	.160	.399	2.986	.004	.224	4.474
	Ease of Use	.748	.197	.508	3.802	.000	.224	4.474

a. Dependent Variable: Learning Interest

Based on the table above, it can be concluded that there is no multicollinearity because each variable has a tolerance value> 0.10 and a VIF value < 10, namely variables X_1 and X_2 tolerance value 224> 0.10 and VIF value 4,474 < 10. To sum up, the independent variables such as application design and ease of use, have met the classical requirements regarding multicollinearity.

5. Multiple Linear Regression Test

This test is conducted to see whether two independent variables and one dependent variable have a linear relationship or not. The following are the results of multiple linear regression analysis.

TABLE 9. Multiple Linear Regression Test Results
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.168	5.377		.217	.829
	Design	.477	.160	.399	2.986	.004
	Ease of Use	.748	.197	.508	3.802	.000

Based on the multiple linear test results above, there is a regression equation as follows:

$$Y= a + b\ X_{11} + b\ X_{22} + e$$

$$Y= 1.168 + 0.477\ X_1 + 0.748\ X_2 + e$$

The regression equations can be demonstrated:

a. The constant value a = 1.168 means if the design and ease of use variables are not included in the study, the students' interest in learning still increases by 1.168%.
b. The regression coefficient of the design variable is 0.477. It means that every time the value of the design variable increases by 1, their interest in learning will boost by 47.7%, assuming that the other independent variables are constant.
c. The regression coefficient of the ease of use variable is 0.748, which means that every time the value of the design variable increases by 1, the interest in learning will increase by 74.8%, assuming that the other independent variables are constant.
d. The significant value of the design variable coefficient table and user convenience is below or smaller than 0.05, so it can be concluded that application design and ease of use have an effect on learning interest.

6. Hypothesis Test

a. T-Test

The t-test is conducted to determine whether the hypothesis occurs partially (individually) or not. The basis for decision making is to use the t-table value obtained from df = n-k-1 (60-2-1 = 57) with a significance value of 0.05, so that the t table is 2.002. The criteria for saying that variables X_1 and X_2 have an influence on Y is if $t_{count} > t_{table}$. The t-test results are as follows:

TABLE 10. T-Test
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	1.168	5.377		.217	.829
	Design	.477	.160	.399	2.986	.004
	Ease of Use	.748	.197	.508	3.802	.000

a. Dependent Variable: Learning Interest

Based on the table above, it can be derived that:

1.The design of the test results shows that the t_{value} is 2.986> 2.002 t_{table}, and the sig. value of 0.04 <0.05, so it is specified that there is a significant influence on variable Y, namely learning interest.
2.The ease of use of the test results shows that the t_{value} is 3,802> t_{table}, and the sig. value of 000 <0.05,so it is declared that there is a significant influence on variable y, namely learning interest.

b. F-Test

The test is used to determine whether the independent variables simultaneously explain the dependent variable. The f-test is yielded by comparing F_{count} and F_{tabel}. The basis for taking the f value of df = n-k (60-3 =57) with a significant value of 0.05.

TABLE 11. Test result of F value
ANOVA[b]

Model	Sum of Squares	Df	Mean Square	F	Sig.

1	Regression	3195.913	2	1597.956	97.060	.000[a]
	Residuals	938.421	57	16.464		
	Total	4134.333	59			

a. Predictors: (Constant), Ease of Use, Design
b. Dependent Variable: Learning Interest

From the table above, it is demonstrated that the value of F_{count} 97.060>3.16 F_{tabel}, and the sig. value of 000 <0.05. Thisshows that application design and ease of use simultaneously have a significant effect on interest in learning.

c. Coefficient of Determination (R-squared) Test

R-squared test aims to measure or determine how much the percentage between application design variables and ease of use on interest in learning. The results of the R-squared test are as follows:

TABLE 12. Test result of Coefficient of Determination
Model Summary

Model	R	R-Squared	Adjusted R-Squared	Std. Error of the Estimate
1	.879[a]	.773	.765	4.058

a. Predictors: (Constant), Ease of Use, Design

Based on the table above, the resulting value is .773 which is seen from the R-squared value, the amount of influence given is 77.3%.

Based on the results of the hypothesis testing that has been presented previously, it elaborates that the applicationdesign and ease of use variables have a positive and significant effect on students' interest in learning to use the tajwidQ application. It can be stated that the hypothesis in this study is accepted. This shows that the application design in the tajwidQ application has successfully created interest among the 1st semester students of University of Muhammadiyah Prof. DR. HAMKA in learning *tajweed*. Therefore, an attractiveapplication design surface can increase students' interest in learning. The same thing was also found in research conducted by Magdalena and Napitupulu [27]. The discovered that *e-learning* dimensions consisting of technological, pedagogical, ethical and interface design have a unidirectional or positive influence on students' learning motivation. This result means that sufficient *e-learning* facilities and infrastructure will have an impact on enhancing students' learning motivation. Thus, it can be concluded that students tend to be moremotivated when implementing e-learning. If students are motivated to learn, then they will be more involved in learning so that learning objectives will be more easily achieved. [28]. In the context of digital learning, M-learning also focuses on the effectiveness and its design of mobile learning systems. [29]. M-learning facilitates students to learn *tajweed* independently. Therefore, the desire to use the tajwidQ application becomes a stimulus for students to learn *tajweed*. This application *tajweed*-based learning is a real form of 21st century learning.

CONCLUSION

Based on the analysis, it can be concluded that the application design and ease of use have a positive effect on students' interest in using the tajwidQ application. The majority of students were active users of mobiletechnology. This can be used as a basis for lecturers to develop creative and enjoyable learning for students. So, the application design and ease of use variables can be practiced as a reference for lecturers when choosing the *tajweed* application as a supporting learning media as students' interest in learning is an essential asset to achieve learning goals.

This study has the benefits by using students who are the highest level in education as research subjects to fill in the gap. While the weakness of this study is the number of populations less than 100 causing the use of saturated samples in this study.

ACKNOWLEDGMENTS

The researcher would like to thank the various parties who have supported this research, especially The University of Muhammadiyah Prof. DR. HAMKA. The support provided brought this research to the completion

deadline. Hopefully, the results obtained from this research will benefit further researchers and the community in general.

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Wallas Model Problem-Solving to Identify Prospective Mathematics Teachers 'Expectations of Students' Creative Thinking Processes

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Abstract. The mathematical thinking processes of prospective teachers in solving mathematical problems vary, especially the thinking processes they expect from their students. The four stages of the Wallas Model creative thinking process are preparation, incubation, illumination, and verification. The purpose of this research is to describe the creative thinking process that prospective teachers expected from their students in solving mathematical problems based on the Wallas model. The research technique employed is a mixed-methods approach. The participants in this study were 34 aspiring math teachers in mathematics education study program at Ibrahimy University. The Miles and Huberman model was used to evaluate the data collected from observation, test results, and interviews was confirmed using triangulation. The results of this study show that:(1) Prospective teachers expect their students to be able to carry out the four steps of the Wallas model of the creative thinking process when solving mathematical problems; (2) the expectations of the subject of the majority of high groups want students to be able to meet all stages of the Wallas model; (3) medium and low group subject expectations tend to desire the three-stage Wallas model reasonably; (4) the percentage of achievement indicator of the thinking process creative expected by prospective teachers to students in problem-solving based on the Wallas model were obtained for Preparation (73.53%), Incubation (91.18%), Illumination (82.35%), and Verification (44.12%). This research results findings should be followed up in a teacher or lecturer meeting to learn students' creative thinking expectations in mathematics and other disciplines.

Keywords: Creative Thinking Processes; Expectations of Thinking; Mathematics Teachers'; Problem-Solving; Prospective Teachers'; Wallas Model.

INTRODUCTION

Mathematics learning in educational units is always synonymous with improving students' ability to solve problems, both math problems and contextual problems, that use the concept of mathematics to solve them. There is a procedure of understanding and controlling thinking about how pupils approach problems, choose strategies for finding answers, and question themselves about them. The problem-solving process is comprehending and structuring one's thinking on how students address issues, selecting strategies for finding solutions and asking oneself about them [1], [2]. According to Putra and Zakia, problem-solving encompasses all aspects of human activity, including science, health, education, literature, sports, industry, business, law, and so on [3]. Tohir argued that an issue is deemed a mathematical problem if it incorporates mathematical ideas that require an indirect approach to solving [1], [4]. Thus, the capacity to solve mathematical problems is viewed as integrating mathematical rules with the difficulties faced.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040009-1–040009-12; https://doi.org/10.1063/5.0241448
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Meanwhile, researchers in math education continue to investigate problem-solving to understand better the strategies a problem-solver uses; many aspects of this problem-solving procedure are based on Polya's model, which describes four stages: (i) understanding the problem, (ii) developing a plan, (iii) executing the plan, and (iv) reviewing the overall execution [5]. The four stages of Polya impact various problem-solving frameworks, including Wallas model problem-solving frameworks. According to Wallas, creativity has four stages: (i) preparation, (ii) incubation, (iii) illumination processes, sometimes known as experience, and (iv) verification [6]. Researchers studying the teaching of mathematics in elementary and secondary schools have utilized the Wallas stage to examine problem-solving, and mathematicians have acknowledged that they go through comparable stages in their mathematical thinking [7], [8]. The creative thinking process is directly related to the creation process, and the creation process is closely related to creativity. In Anderson's view, organizing the components into new patterns or structures through generation, planning, or production is considered the act of creation [9]. These three ideas describe three cognitive processes that are the same as the process of creative thought.

Logic and divergence are two cognitive abilities that can be blended into creative thinking. According to Siswono, divergent thinking searches for ideas to solutions problems, whereas logical thinking verifies those ideas into an innovative solution [10]. The Voogt, Fisser, Good, Mishra, and Yadav explains that one's creative thinking skills can be improved by understanding his creative thinking process and through proper practice [11]. The Wallas creative thinking process is a theory often used to comprehend the creative thought process, which contains four stages: preparation, incubation, illumination, and verification [12]. Therefore, students' roles as prospective teachers are vital in studying various models of innovation and creativity to sustainably sharpen and develop students' creative thinking abilities.

The research results by Mardianti, Masriyah, and Wijayanti show that the high-category student can solve the problem well, correctly, and under the Wallas stage. Students in the moderate category, take a relatively long time to solve the problem. Meanwhile, students in the low group continue to require direction from teachers or friends [13]. In addition, According to Sitorus' research, there is a preparation stage in which students do activities such as data collection and information gathering. Students gain cognitive knowledge in the incubation stage by reviewing and comprehending the preparation stage procedure and synthesizing it with prior information. Students examine and synthesize a portion of a mathematical concept at the illumination stage. At the verification stage, students double-check their results, revise invalid mathematical ideas, and look for alternate possible solutions [8]. Moreover, Borodina, Sibgatullina, and Gizatullina found that the level of creative thinking formation of prospective teachers is insufficiently effective for applying creative approaches to professional activities. However, the results of the experiment show that in the educational environment of higher education, the opportunity has not been utilized to the maximum, causing a decrease in student creativity in the learning processes [14].

Based on the description above and past studies, further research is urgently needed to explore prospective math teachers thinking processes and how they use creative thinking while solving math issues. It is vital to understand that prospective math teachers explain their creative thinking process while solving math problems as an expectation of their students' creative thinking process. This research uses the stages of the Wallas model to characterize the expectations of aspiring mathematics teachers regarding their students' creative thinking processes in solving mathematical problems.

METHOD

Research Design

This research method uses mixed methods using embedded strategies simultaneously. According to Creswell, a concurrent embedded approach is a mixed-method strategy employing quantitative and qualitative data-collecting phases [10]. Based on the stages of the Wallas model, descriptive qualitative approaches were utilized to characterize the creative thinking process expected of pupils while solving mathematics problems. According to Saryono, a qualitative approach is investigating, describing, explaining, and discovering the traits or advantages of societal effects that cannot be characterized, measured, or described by quantitative methods [15]. However, this qualitative research focuses on outcomes rather than processes, and it is used by examining student performance on various activities to acquire information on creative thinking skills. While the quantitative methods aimed at analyzing data obtained from GPA (grade point average) of students and observation results of learning syntax. According to Creswell, one sort of educational research is quantitative research. In this research style, the researchers choose what to study, formulate precise questions, place restrictions on the questions they may ask, gather quantifiable data from participants, evaluate the data using statistics, and carry out unbiased, objective investigations [16].

Participants

This research included 34 potential teachers of mathematics. The prospective teachers are the Mathematics Education Study Program students. They describe in detail the creative thinking processes students expect when facing mathematical problems to be solved well and correctly.

Data Collection

Data collecting techniques are a crucial component in a study since they impact the effectiveness of getting correct data; afterwards, the data were analyzed given the context of the answers. Data were collected by providing tests. The test was provided to gather information about prospective mathematics teacher's creative thinking processes. Reduction, presentation, conclusion, and verification of the data were done. Triangulation of methods, peer checking, and increased observation were used to verify data. Triangulation is a strategy used to examine the correctness of information or data obtained by researchers from many perspectives by reducing as much deviation as possible during data collection and processing [1]. Table 1 explains indicators of the creative thinking process expected by prospective math teachers based on the Wallas model of problem-solving.

TABLE 1. Indicators of the creative thinking process based on the Wallas model

Stages of the Creative Thinking Process	Creative Thinking Process Indicators
Preparation	● Collecting information under the primary notion of the problem at hand. ● Mentioning anything that is known and asked on the issue.
Incubation	● Taking a break from the times by thinking of the right and sensible solution in problem-solving. ● Pausing to associate with previous knowledge.
Illumination	● Finding solutions with the right techniques in problem-solving. ● Answering the problem by thinking of alternative solutions to other solutions in problem-solving.
Verification	● Reviewing the answers' results thoroughly to the completion procedure for the best solution. ● Evaluating answers by finding alternative solutions to other solutions in problem-solving.

Data Analysis

Presentation of data from qualitative research might take the shape of summaries, graphs, correlations between categories, flowcharts, and the like. Miles and Huberman underline that narrative was the most often utilized type of data presentation for qualitative research data [15]. Data analysis was done after the written test, then the results were used as a reference to develop interview guidelines. The interview guidelines had been validated by three doctorate professionals qualified in the related field. The creative thought process of potential teachers in solving mathematical issues was described using data analysis. Data were reduced, presented, and conclusions were drawn as part of this study's qualitative data analysis. Data presentation entailed categorizing and identifying data and generating data sets that were structured and classified to draw conclusion. The findings afforded information for performing follow-up research.

RESEARCH RESULTS

The initial data gathered in this study was the final test score of odd semesters. Based on the test scores obtained, students were grouped into three categories, namely the high, medium, and low achievement categories. The observation results of learning syntax during three meetings were the second data obtained in this study. The third data collected in this study was a problem-solving test of mathematics to identify the creative thinking process of prospective teachers that are expected to students, then the data were analyzed and tripped with interviews and combined with observation results to obtain valid and trustworthy data. The descriptions of the creative thinking process in solving mathematical issues were investigated using Wallas model indicators of the creative thinking process. The success of markers of the creative thinking process of prospective math teachers for high, medium, and low group subjects was studied. Table 2 displays the outcomes of prospective math teacher final test scores for all three categories of subject groups.

TABLE 2. The results of prospective teacher's final exam scores

Categories	n	Minimum	Maximum	Sum	Mean		SD	Variance	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
High	11	84	92	957	87.00	0.9244	3.0659	9.400	-1.532	1.279
Medium	12	79	84	982	81.83	0.4051	1.4034	1.970	0.203	1.232
Low	11	69	78	808	73.45	0.8776	2.9107	8.473	-1.041	1.279

Table 2 above shows that the average test scores of the high, medium, and low group categories were 87.00; 81,83; and 73.45. The data explains a difference in scores between the three group categories, which were 5.17 and 8.38. The results of this test show that the ability between groups of subjects was significantly different. The second data obtained in this study is the observation of prospective teachers' learning syntax and lecturers' performance. The observations are shown in Table 3.

TABLE 3. Learning Syntax Observation Results

Activities	Meeting I	Meeting II	Meeting III
Prospective Teachers	70.8	72.6	80.8
Lecturer	67.4	69.8	82.4

Based on Table 3 above, the prospective teachers' activities and lecturers' performance in learning creative thinking processes were significantly improved. At the first meeting, the activity score of prospective teachers was 70.8; while the performance of lecturers amounted to 67.4. At the second meeting, the activity score of prospective teachers was 72.6; while the performance of lecturers obtained a score of 69.8. At the third meeting, the score of prospective teachers was 80.8; while the performance of lecturers obtained a score of 82.4.

Based on the overall interview findings, the following reflects the outcomes of the analysis of creative thinking process exam responses that are expected of students.

The Creative Thinking Process During the Preparation Stage

The creative thinking process expected by the subjects of the high group began with knowing the core concept of the problem based on the information included in the problem by saying what information can and cannot be utilized in problem-solving at the preparation stage. According to the topics, the problem was connected to the material of the two-variable parallel system based on the information associated to the problem. It might, however, be traced to mathematical logic. Then, the subjects mentioned what was known and asked on the question.

The creative thinking process expected by the medium group subjects was initiated during the preparation stage by reading the question numerous times to determine the problem's primary idea and highlight the key information on the topic. Still, most failed to relate the information that could be used and what information was not used in problem-solving. Only a small percentage of subjects mentioned what was known and asked on the question but while most of them were directly engaged in the stage of solving the problem by mentioning the formula used.

The creative thinking process expected of low-group subjects begins during the preparation stage by reading the question repeatedly to determine the problem's primary concept. Still, most of them did not understand the information in the problem, so they failed to provide any information, what could be used, and what information was not used in problem-solving. All participants did not mention what was known and what was asked because they directly answered the question by mentioning the formula used.

The Creative Thinking Process During the Incubation Stage

The creative thinking process expected by high-group subjects during the incubation stage was that individuals paused by questioning and recalling knowledge received previously to explore new ideas, such that the subjects had no trouble finding the best answer in problem-solving at hand.

The creative thinking process expected by the subjects in the medium group during the incubation stage was that they tended to stay silent, halt, and scratch their head while attempting to think of a solution to the challenge confronted. They still had trouble finding the correct answer to the question, and it took them a bit longer to discover a solution.

The creative thinking process expected by low-group subjects during the incubation stage was that subjects tended to be silent and pause for a while by trying to think of solutions to the problem. Still, they struggled to answer the questions, so they took a long time to find a solution.

The Creative Thinking Process During the Illumination Stage

The creative thinking process expected of high-group topics begins at the illumination stage, identifying answers using the appropriate approaches and making sense of the challenges faced. The subjects were able to prepare a second alternative solution if the first solution failed and the second solution could also be used to check the results of the solution. The subjects mentioned that solution on the questions could be done in several ways, namely methods of elimination, substitution, graphics, and logic.

The creative thinking process expected by the group's subjects at the illumination stage was creating answers using the correct tools based on their comprehension of the problem encountered. Subjects got a solution by remembering the example that had been taught. The subjects mentioned that solution on the questions could be done in several ways, namely through elimination, substitution, and using graphics.

The creative thinking process expected by low-group participants during the illumination stage was finding a solution straightforwardly. It was based on their understanding of the problem by recalling the information obtained before addressing the challenge. The subjects had no other solutions to solve the problem if the solution created could not solve the problem as it was. The subjects mentioned that solutions on the questions could be done through elimination and substitution methods.

The Creative Thinking Process During the Verification Stage

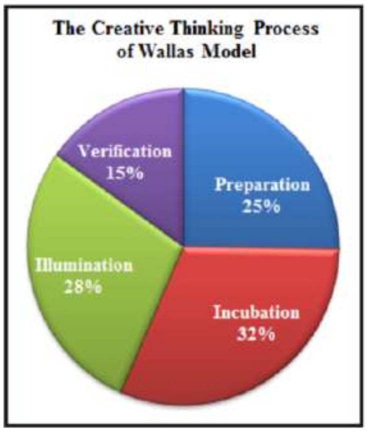
The creative thinking process expected of high-profile topics was re-examining the questions and outcomes of their work extensively on the finished procedures that had been meticulously performed at the verification stage. When they encountered mistakes in working on a problem, they tried to correct it by reworking the problem until it was correct. Some subjects re-examined their work using alternative solutions to verify that the answer was valid so that they got the best results.

The creative thinking process expected by the group's subjects began at the verification stage by re-examining the outcomes of their work by attempting to rework in the same way to feel that the solution was accurate. However, most subjects did not attempt to use other alternative solutions to check the validity of the answers obtained. A small part of the answer obtained was incorrect because of a mistake in solving it.

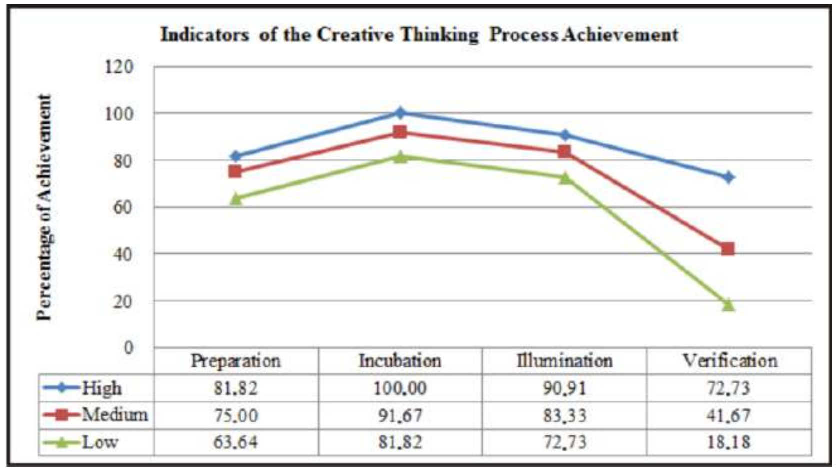
The creative thinking process expected of low-group individuals began at the verification step by re-examining the results of their work. Still, they did not verify the validity of the answer. Most subjects did not solve the answer because they could not gather information correctly, so only a small percentage of subjects got the right answer.

Achievement Indicators of the Creative Thinking Process

Figure 1 show the statistics on the attainment of creative thinking process indicators expected by prospective teachers based on the problem-solving Wallas model.



(a)



(b)

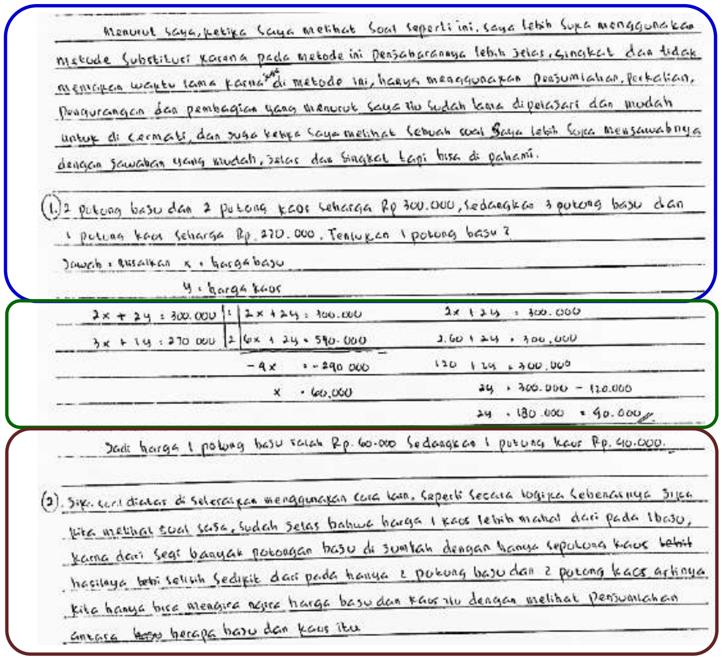
FIGURE 1. (a) Diagram of Creative Thinking Process in percentage (b) Indicator achievement of prospective teachers' creative thinking

Based on Figure 1 above, the average percentage of achievement of the creative thinking process of prospective math teachers had significant differences among subjects of high, medium, and low group categories. The achievement results at the preparation stage were 81.82%; 75.00%; and 63.64%; respectively. So, the difference in achievement was obtained by 6.82% and 11.36%. The achieved results at the incubation stage were 100%; 91.67%; and 81.82% respectively. Thus, the difference in achievement was 7.58% and 10.61%. The achievements at the illumination stage were 90.91%; 83.33%; and 72.73% respectively. So, the difference in achievement was obtained by 8.89% and 13.33%. At the verification stage, the scores were 72.73%; 41.67%; and 18.18%. Thus, the difference in achievement was obtained by 31.06% and 23.48%. Therefore, the smallest percentage of the achievability difference was at the incubation and verification stages.

DISCUSSION

Figure 2 presents one example of the results of a high-category subject's answer, the answer described by the subject was the expectation of the creative thinking process for the student when facing a math problem to be solved.

Original Answer from Subject



Menurut saya, ketika saya melihat soal seperti ini, saya lebih suka menggunakan metode substitusi karena pada metode ini penjabarannya lebih jelas, singkat dan tidak menyita waktu lama karna yang di metode ini, hanya menggunakan penjumlahan, perkalian, pengurangan dan pembagian yang menurut saya itu sudah lama dipelajari dan mudah untuk di cermati, dan juga ketika saya melihat sebuah soal saya lebih suka menjawabnya dengan jawaban yang mudah, jelas dan singkat tapi bisa di pahami.

(1.) 2 potong baju dan 2 potong kaos seharga Rp 300.000, sedangkan 3 potong baju dan 1 potong kaos seharga Rp. 270.000. Tentukan 1 potong baju ?

Jawab : misalkan x : harga baju

y : harga kaos

$2x + 2y = 300.000 \mid 1 \mid 2x + 2y = 300.000$ $\qquad 2x + 2y = 300.000$

$3x + 1y = 270.000 \mid 2 \mid 6x + 2y = 540.000$ $\qquad 2.60 + 2y = 300.000$

$-4x = -240.000$ $\qquad 120 + 2y = 300.000$

$x = 60.000$ $\qquad 2y = 300.000 - 120.000$

$2y = 180.000 = 90.000$

Jadi harga 1 potong baju ialah Rp. 60.000 sedangkan 1 potong kaos Rp. 90.000.

(2). Jika cara diatas di selesaikan menggunakan cara lain, seperti secara logika sebenarnya jika kita melihat soal saja, sudah jelas bahwa harga 1 kaos lebih mahal dari pada 1 baju, karna dari segi banyak potongan baju di jumlah dengan hanya sepotong kaos lebih hasilnya lebih selisih sedikit dari pada hanya 2 potong baju dan 2 potong kaos artinya kita hanya bisa mengira ngira harga baju dan kaos itu dengan melihat penjumlahan antara ~~baju~~ berapa baju dan kaos itu

Translation

In my opinion, when I see questions like this, I prefer to use the substitution method because in this method the explanation is clearer, shorter and doesn't take long. This method only uses addition, multiplication, subtraction and division methods, which I think has been studied for a long time and it is easy to observe, and also when I see a question, I prefer to answer with an answer that is easy, clear and concise but can be understood.

Two pieces of clothes and two pieces of shirts for Rp. 300,000, while three pieces of clothes and one piece of t-shirt cost Rp. 270,000. Determine the price of one piece of clothing!

Answer:

X: The price of clothes

Y: T-shirt price

Preparation

The first statement of the subject's expectations of the student's creative problem-solving method.

Incubation

Pay attention to the information on the question and recall the information obtained earlier to solve the problem by thinking about the procedure of solving it.

FIGURE 2. Results of one of the highest category subject's answers in the preparation and incubation process

$$\begin{array}{r|c|l} 2x + 2y = 300{,}000 & 1 & 2x + 2y = 300{,}000 \\ 3x + 1y = 270{,}000 & 2 & 6x + 2y = 540{,}000 \end{array}$$

$$-4x = -\ 240.000$$
$$x = 60.000$$

$2x + 2y = 300{,}000$
$2(60{,}000) + 2y = 300{,}000$
$120{,}000 + 2y = 300{,}000$
$2y = 300{,}000 - 120{,}000$
$2y = 180{,}000$
$Y = 90{,}000$

So, the price of one piece of clothing is Rp. 60,000, while 1 piece of t-shirt is Rp. 90,000

Illumination
Find a solution and apply the selected work around procedure to get the correct answer

If the question above uses another method, such as logically. If we look at the clothes, it is clear that the price of 1 shirt is more expensive than 1 shirt, because in terms of how many pieces of clothes are added up with only one piece of shirt, the result is a little difference than just 2 pieces of shirt and 2 pieces of shirt, meaning we can only estimate the price of the clothes and the shirt by looking at the sum of how much the shirt and the shirt cost.

Verification
Verify the answer and draw the conclusion that the answer is correct as well as think of other alternative solutions.

FIGURE 3. Results of one of the highest category subject's answers in the illumination and verification process

Based on Figure 2 and Figure 3, the author interviewed subject A about what he actually expected to the creative thinking process of students in solving math problems. Hereunder is the interview excerpt.

Researcher : Can you mention the main idea of the problem in the problem?
Subject : The main idea of the problem is to find the price of shirts and T-shirts based on the question asked and should have known the price of some shirts and T-shirts that have been purchased before.
Researcher : Can you inform us about what is not used or is not needed in answering the question?
Subject : In the presentation is a question of the story that is needed in the question which is written in known other than it is things that are not used or not needed in answering the question.
Researcher : Have you written what is known and asked about?
Subject : The known and asked statement was written in advance to help solve the question and we could know the important things needed in the work of the question.
Researcher : Do you know the solution with the right techniques in answering the question? Let's just say it!
Subject : The solution that I used is by substituting method, elimination, mixture, graph, and logic. However, before I found the right solution, I had a moment to stop by estimating which method to use, which was to fall on the choice of mixed method because this method could make it easier to know the price of the shirt or T-shirt in the question.
Researcher : Are you sure you can find the correct answer to the question? What's the reason?
Subject : Sure, the answer to such a question can be corrected with the strategy I used.
Researcher : Did you double-check your answer?
Subject : Rechecking the results of the answer is important to know the inaccuracy due to answering or calculation errors.
Researcher : Have you concluded that your answer is correct? How did you to prove it?

Subject : I have, it's by substituting results of x and y that have been already known at the beginning or to equation 1 and 2.

Based on the findings of the answers, analysis, and interviews with the high group subjects, it is clear that the expected creative thinking process finely meets all markers of the creative thinking process based on the problem-solving Wallas model. The subject grasped the problem well throughout the preparation stage by saying the core concept of the problem, mentioning facts connected to the problem, and being able to note what is known and ask the supplied question. The findings of this study support the conclusions of Nuha, Waluya, and Junaedi's research, which demonstrated that in the preliminary stage, all research subjects could accurately convey the core of the problem and choose appropriate information to address the issue [10]. According to Maharani, Sukestiyarno, and Waluya's research, students creative thinking abilities comprehended difficulties accurately. They could convey well-obtained information and use their language [17]. The findings of this study are consistent with the results of Wulantina's research, which showed that students with high ability in the preparatory stage could recognize the problem posed properly, chose the information needed, and solve the situation appropriately [4], [15].

At the incubation stage, high-group subjects paused by debating the information. Yet, finding the right technique did not take long because the subject had understood the problem well and perfectly recalled the information obtained earlier. The silent expression was the first step in which the subject let their mind calm down for a short break and tried to develop a new idea. This study's results align with the research by Ratnaningsih who showed that students paused to think about problem-solving at the incubation stage and associated it with the previous material [12]. This is under the opinion of Sunaringtyas, Asikin, and Junaedi who said that the incubation stage was defined as the stage where students temporarily detach themselves from the problem to obtain inspiration which is the starting point of a new discovery from the pre-conscious area [18]. According to Savic, incubation allows conscious and subconscious thoughts to mix, representing the brain when spontaneous solutions are brought to consciousness [7].

During the illumination stage, the subject of the high group discovered a solution and used his concept to solve the problem with confidence that the response received was correct because the subject had also prepared numerous alternative answers, which initially failed to give the correct answer. The results of this study clarify the results of research obtained by Mardianti, Masriyah, and Wijayanti, who showed that students of the high group at the illumination stage were looking for solutions from mathematical models with appropriate mathematical methods to get the right answer. According to Tohir, students need to apply a certain strategy to other problems or try with a new strategy that is simpler or easier to understand because thus the student's thinking process can always be improved and used well so that his thinking skills elevate to a higher level as well [19]. The findings of this study are supported by Sunaringtyas, Asikin, and Junaedi, who said that the stage of illumination is defined as the stage in which pupils solve problems, followed by the development of inspiration and new ideas [18].

At the verification stage, the high group subject thoroughly re-examined the work results on the completion procedure, then re-examined carefully and carefully whether there was a procedure that passed or there was an error to draw valid conclusions. The results of this study are in congruence with the opinion of Sunaringtyas, Asikin, and Junaedi that the stage of verification is interpreted as the stage which students tested or examined the problem-solving of reality that required critical thinking and convergence [18]. The findings of this study corroborate the findings of Tohir's study, which demonstrated that the thinking process of subjects with high mathematical abilities examined the work that had been created, a process known as assimilation, to check the result before and after completion by retracing calculations that had been done efficiently through mental calculations [4]. At the verification stage, students in the creative group improved their work by reworking the question until it was correct [20], [21]; the student evaluated the answer question using other means [12], [22], [23].

According to the findings of the answers, analysis, and interviews with the group participants, one or two stages of the Wallas model were forgotten or neglected to put on the answer sheet. During the preparation stage, the subject attempted to comprehend the problem through reading, and highlighting key material on the question. Still, most of them could not relate to other information and the results of some of the small known notes and asked the answer sheet. The findings of this study were explained by the results of Maharani, Sukestiyarno, and Waluya's research, which showed that students could grasp the problem but still employed the language of the question to transmit the knowledge received [17]. During the incubation stage, the subject tended to remain silent for an extended period while trying to recall what had been taught previously to solve the situation at hand. The findings of this study are consistent with the results of Maharani, Sukestiyarno, and Waluya's study, which revealed that during the incubation period, students in the medium group stayed silent for a long time to think about the solution and focus on the problem [17]. During the illumination stage, the subject identified a solution by recalling previously taught concepts and writing the answers directly on the answer sheet. The findings of this study are consistent with the results of Warner and Kaur's research, which demonstrated that students generated ideas for issues they created and applied them to the problem with confidence and a generally right answer [24]. At the verification stage, subjects tended to check by reworking the completion procedure and were less likely to attempt to work with other alternative solutions. The research results by Maharani, Sukestiyarno, and Waluya showed that students re-examined the solution, but when they found a mistake, they tended to replace or make other solutions [17].

According to the findings of the replies, analysis, and interviews with low-group subjects, not all issues could fulfill all indications of the creative thinking process based on the Wallas problem-solving model. During the preparation stage, the subject comprehended the problem until it was read aloud several times. Nonetheless, the majority of them did not grasp the facts contained in the question, so they could not link to other information collected before, and the majority of subjects did not write what was known and asked on the question. The results of this study are relevant with the results of research obtained by Setiawani, Fatahillah, Oktavianingtyas, and Wardani showing that students who belonged to the very low category could not mention the complete preliminary information [25]. At the incubation stage, subjects were very difficult to find solutions in answering the question, so they took a long time to think about the solution of the problem at hand. The results of this study agree with the study by Maharani, Sukestiyarno, and Waluya finding that students tended to stop a little longer and thought about what to do [17]. At the illumination stage, the subject found a solution based on his understanding of the problem. Siswono and Kurniawati showed that students were less clear in applying ideas obtained into a problem. However, students tended to be confident with the problems they created even if they solved them [26]. At the verification stage, the subject tried to double-check the results of his work, but he assumed that the answer was correct when most of them got the wrong answer. This is analogous to Tohir's idea that one may lose acquired information if he fails to transform short-term memory into long-term memory due to a lack of repetition or the inability to organize or assemble the knowledge gained [1], [4].

The analysis results in Figure 1 show that subjects of higher groups were more dominant in completing the four stages of the Wallas model. As for medium and low group subjects did not appear to use all four stages of the Wallas model. This happens because the creative thinking process demanded of potential instructors has varying mindsets depending on the amount of creative thinking, which is impacted by internal and external circumstances. Similarly, Nuha, Waluya, and Junaedi demonstrated that students' mathematical creative thinking patterns differ depending on their distinct degrees of creative thinking at each stage of the Wallas Model [10]. This study strengthens Tohir’s study that factors affecting the creative thinking ability of students who follow the coaching of the mathematics Olympiad include carefulness and solving test questions, students' tendency to rely on memorization, imitation, and motivation [19]. As for developing students' creative math thinking skills, among others, can be achieved by increasing motivation in developing concepts that have been obtained before, working on questions continuously, and reading carefully the problems faced so that the ability to identify and analyze problems will be better [27]. According to Tohir, solving mathematical problems is the ability of students to understand issues by identifying what is known, stated, and the sufficiency of elements required, creating solutions and representing them, choosing/implementing solving strategies to obtain answers, and checking the accuracy of solutions and reflecting on them [1], [15].

CONCLUSION

Based on the findings of the study and discussion, this study has concluded: (1) that all group topics expected students to continually hone their creative thinking process skills continuously in solving mathematical issues; (2) that subjects for distinct group categories have varying expectations of creative thought processes in solving mathematical issues based on the Wallas model; (3) that subjects in the high group category may complete the Wallas model's four steps: preparation, incubation, illumination, and verification. Issues in the middle and low groups tend to be able to meet all three stages of the Wallas model: preparation, incubation, and illumination; (4) that at the preparation stage, most subjects can state the main idea of the problem by mentioning the information contained in the problem and the relevant information in solving the problem. At the Incubation stage, the subject considers the solution of the problem faced by requiring a variety of time in recalling relevant information. At the Illumination stage, the subject finds a solution based on his or her understanding of the creative thinking level of the problem at hand. At the Verification stage, the subject re-examines the results of the work based on his creative thinking level, including: rechecking the results of his work using other alternative solutions to verify the results to identify whether they are the same or not, reworking based on the procedure of completion in the same way whether the results are the same as well, and rechecking the system if there is no error in each step of problem-solving and the validity of the count; and (5) that developing the expectations of prospective teachers to the creative thinking process can be done by increasing their learning motivation, and by process of research-based learning as well as learning based on HOTS (Higher Order Thinking Skills) under the skills of the 21st century, namely critical thinking, creative thinking, communication, and collaboration.

ACKNOWLEDGMENTS

We want to thank the support from the Education Faculty, Ibrahimy University, Sukorejo-Situbondo, Indonesia, 2023.

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The Development of Learning Video on Comparison Material Using Palembang *Jumputan* Fabric Context

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Abstract. This study is motivated by the difficulties experienced by students in learning comparison materials due to the lack of utilization of technological media in learning activities and the lack of application of mathematics in real life, so the need for learning videos as learning media containing problems with real contexts. This research uses the context of Palembang distinctive culture, namely Palembang *Jumputan* fabric. This type of research is design research type development studies. The purpose of this research is to produce a learning video on comparison material using the context of Palembang *Jumputan* fabric that is valid and practical. This research also used PMRI approach and collaborative learning in the learning process. The subjects of this study were seventh-grade students with heterogeneous abilities of Sumsel Jaya Junior High School Palembang in the academic year 2023/2024. This research was conducted during the odd semester of the 2023/2024 school year offline. The learning video development procedure used in this research consists of two stages, namely the preliminary stage, and the formative evaluation stage. The preliminary stage consists of the preparation stage, analysis stage, and design stage. The formative evaluation stage which consists of self-evaluation, expert review, one to one, and small group tryout. There are two data collection techniques used in this research, namely observation and interviews. The data analysis technique is observation data analysis and interview data analysis. The results showed that the learning video on comparison material using the context of Palembang *Jumputan* fabric produced was valid and practical. The use of learning videos using Palembang *Jumputan* fabric makes students interested in participating in learning activities.

INTRODUCTION

One of the important junior high school mathematics materials for students is comparison material. Comparison material can be made in the form of non-routine problems related to contextual and close to students' daily lives, so that students can get new challenges and learning experiences [1]. One of the comparison concepts that is often found in real life is in food recipes, namely determining the ratio of the amount of flour and sugar used to make a food [2]. But in reality, students still experience many difficulties in learning comparison material, namely students have not been able to compare the value of two fractions [3]. This is because the learning is still using the lecture method [4], while-discussion activities in the classroom are rarely done and learning media are not sufficiently employed [5]. Therefore, there is a need for appropriate learning on comparison materials.

In its learning, the Realistic Mathematics Education (RME) approach provides real problems, thus making students more active and motivated to learn [6]. In Indonesia, RME is known as Indonesian Realistic Mathematics Education (PMRI). The PMRI approach includes an innovative and active approach [7]. PMRI is a theory that starts with real problems that emphasize the skills of discussion, collaboration, and process, and exchange ideas with friends [8]. Mathematics learning will be more meaningful if it is related to real life which makes real problems as an introduction at the beginning of learning [9]. The use of contextual problems that are very close to students' daily lives makes students more familiar with the problems given [10]. For example, the use of a typical Palembang cultural context, namely Palembang *Jumputan* cloth. *Jumputan* fabric is one of the typical Palembang fabrics that has its own

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040010-1–040010-10; https://doi.org/10.1063/5.0244869
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

characteristics and peculiarities, both in terms of color and motif [11]. In this study, researchers will use the context of Palembang *Jumputan* fabric as a starting point and innovation in comparative learning.

In the field of education, the need for 21st century learning aims to realize a 21st century generation that has skills in collaboration, communication, creativity, and critical thinking [12]. One of the 21st century skills is collaboration. Collaborative learning is a learning process in a group where each member provides ideas and abilities [13]. When learning using collaborative learning, students are formed into groups of 4 members [14]. In collaborative learning, students who do not understand must ask for help from their friends who understand by saying "Please Teach Me" [15]. Collaborative learning consists of two tasks, namely sharing tasks to achieve learning objectives, and jumping tasks that contain problems to improve students' abilities [16]. Therefore, the PMRI approach and collaborative learning can be applied together.

In the 21st century, teachers are required to have the ability to create appropriate learning media for students [17]. Learning media can help students to more easily understand comparison material [18]. One of them is a learning video. Learning videos can make students interested in participating in learning because they contain text, sound, images, and animation [19]. Learning by using learning videos can develop students' minds and imaginations [20]. Learning videos are media in the form of videos that are used to make students achieve learning objectives, and can understand learning materials [21].

There are several previous studies, namely: research on the learning design of rhombus material using Palembang *Jumputan* cloth for seventh grade students [22], research on the learning design of comparison material using the context of *empek-empek* recipes to support the reasoning ability of junior high school students [10], and research on the development of Banjar culture-based comparison material learning videos for seventh grade junior high school students [23]. However, in previous studies there has been no research that combines the Palembang cultural context, namely Palembang *Jumputan* cloth with comparison materials and learning videos. Therefore, researchers are interested in conducting research on "The development of learning video on comparison material using Palembang *Jumputan* fabric context". This research also uses PMRI approach and collaborative learning.

METHOD

This type of research is design research type development studies. The purpose of this research is to produce a learning video on comparison material using the context of Palembang *Jumputan* fabric that is valid and practical. The subjects of this research were seventh grade students with heterogeneous abilities of SMP Sumsel Jaya Palembang in the 2023/2024 academic year. This research was conducted at SMP Sumsel Jaya Palembang during the odd semester of the 2023/2024 school year offline. The learning video development procedure used in this research consists of two stages, namely the preliminary stage, and the formative evaluation stage [24]. The preliminary stage consists of the preparation stage, analysis stage, and design stage. The formative evaluation stage which consists of self-evaluation, expert review, one to one, and small group tryout. In the preparation of the research, researchers made an initial observation of the research site, namely at Sumsel Jaya Palembang Junior High School. Prior to the implementation of the research, the researcher met the principal of SMP Sumsel Jaya Palembang to ask for permission to conduct research and discussed with the teacher regarding the time of the research and students who could be used as research subjects. From the results of these discussions, the researcher obtained information that the implementation of the research would be carried out offline with 3 heterogeneous class VII students as one to one trial subjects and 6 heterogeneous class VII students as small group tryout trial subjects. There were two data collection techniques used in this study, namely observation and interviews. Observation at the one-to-one stage was aimed see and assess the validity of the learning video, while observation at the small group tryout stage was intended see the practicality of using the learning video developed. Interviews at the one-to-one stage were conducted to find out students' difficulties in seeing and solving problems contained in the learning video to improve the learning video being developed. Interviews at the small group tryout stage were perfomed to see the use of the developed learning videos. The data analysis technique was observation data analysis and interview data analysis.

RESULTS AND DISCUSSION

This research produced a learning video on comparison material using the context of Palembang *Jumputan* fabric that was valid and practical. In this research, there are two stages carried out in developing learning videos, namely the preliminary stage, and the formative evaluation stage which will be explained as follows:

- **Preliminary Stage**

In the preliminary stage, there are three stages carried out by researchers, namely the preparation stage, analysis stage, and design stage.

- **Preparation Stage**

At this stage, researchers prepared learning tools and research instruments. Furthermore, researchers observed the school that would be used as a research site by asking about the research subject and implementation time. Finally, the researcher took care of the research permit.

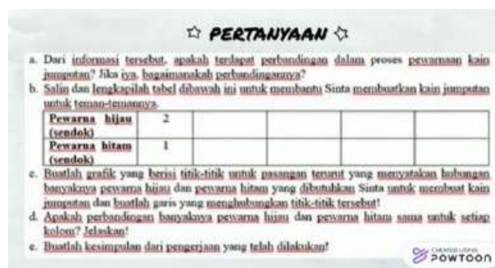
- **Analysis Stage**

At this stage, researchers analyzed 5 components, namely student analysis, curriculum analysis, content/topic analysis, media analysis, and context analysis. At the student analysis stage, the researcher discussed with the math teacher in order to find out the students' abilities. At the curriculum analysis stage, the researcher obtained information from the mathematics teacher regarding the curriculum used in seventh-grade class of Sumsel Jaya Palembang Junior High School is the independent curriculum. Curriculum analysis aims to determine the learning outcomes and learning objectives to be achieved. At the content/topic analysis stage, researchers analyzed the material used in developing learning videos on comparison material which was found in the very grade and was closely related to contextual problems. At the media analysis stage, teachers at Sumsel Jaya Palembang Junior High School still rarely used learning videos as learning media, so the learning media used in this study were learning videos. At the context analysis stage, researchers used the context of Palembang Jumputan fabric.

- **Design Stage**

The design stage was carried out to initially design a learning video on comparison material using the context of Palembang *Jumputan* fabric. The results of product design are called prototypes which focus on three characteristics, namely content, construct, and language. The Figure 1 below is the appearance of the initial prototype that has been made by researchers.

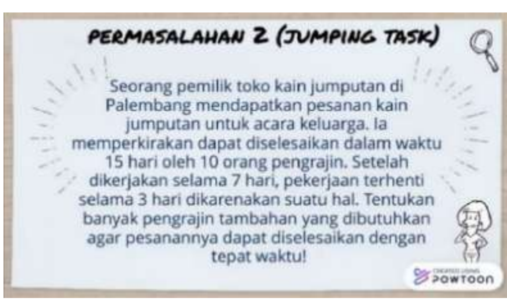
Translation
PROBLEM 1 (SHARING TASK)
Sinta is a *Jumputan* fabric craftsman. The following is one of the *Jumputan* fabrics that Sinta has made.
To make a *Jumputan* fabric with this color, you need 2 spoons of green dye and 1 spoons of black dye. Sinta will make *Jumputan* fabric for her friends with the same colors as in the picture.



Translation
QUESTION
a. From this information, is there a comparison in the dyeing process of *Jumputan* fabric? If yes, how does it compare?
b. Copy and complete the table below to help Sinta make *Jumputan* fabric for her friends.

Green dye (spoon)	2				
Black dye (spoon)	1				

c. Construct a graph containing points for ordered pairs that represent relationshipshow much green dye and black dye does Sinta need to make *Jumputan* fabric and draw a line connecting the dots!
d. Is the ratio of the amount of green dye to black dye the same for each column? Explain!
e. Draw conclusions from the work that has been done!



Translation
PROBLEM 2 (JUMPING TASK)
A *Jumputan* fabric shop owner in Palembang received an order for *Jumputan* fabric for a family event. She estimated that it could be completed within 15 days by 10 craftsmen. After working for 7 days, work stopped for 3 days due to something. Determine how many additional craftsmen are needed so that the order can be completed on time!

FIGURE 1. Initial Prototype on Comparison Materials Using the Context of Palembang *Jumputan* Fabric

- **Formative evaluation Stage**

In the formative evaluation stage, there are four stages carried out, namely self-evaluation, expert review, one to one, and small group tryout.

- ***Self*-Evaluation**

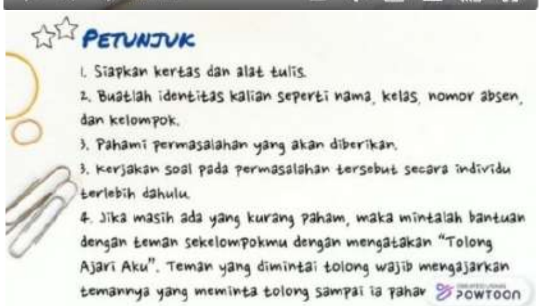
At this stage, the product that has been designed at the previous stage will be evaluated by the researcher himself. For example, there are errors in writing or so will be revised first. Based on the results of the evaluation carried out by the researcher, the product still has to be revised, namely as follows: (1) adding video duration, (2) adding the Sriwijaya University logo throughout the video display, (3) correcting errors in writing numbers in the instructions, (4) correcting the problem sentence in the first problem, and (5) adding images to the second problem. The results obtained at this stage are called prototype 1 are shown in Table 1.

TABLE 1. The Display of Learning Videos Before and After Revision at the Self-Evaluation Stage

<table>
<tr><th>Before Revision</th><th>After Revision
(Prototype 1)</th></tr>
<tr><td>

</td><td>

</td></tr>
<tr><td>



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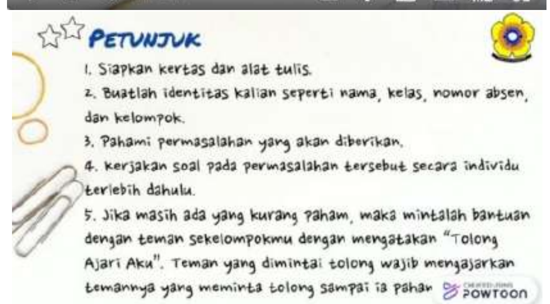


</td></tr>
<tr><td>

Translation
INSTRUCTION
1. Prepare paper and stationery.
2. Create your identity such as name, class, roll number and group.
3. Understand the problem that will be given.
3. Work on the problem individually first.
4. If there are still people who don't understand, then ask your group friends for help by saying "Please Teach Me". The friend who is asked for help is obliged to teach the friend who is asking for help until he understands.

</td><td>

Translation
INSTRUCTION
1. Prepare paper and stationery.
2. Create your identity such as name, class, roll number and group.
3. Understand the problem that will be given.
4. Work on the problem individually first.
5. If there are still people who don't understand, then ask your group friends for help by saying "Please Teach Me". The friend who is asked for help is obliged to teach the friend who is asking for help until he understands.

</td></tr>
<tr><td>

Translation
Let's do a comparison problem.

</td><td>

Translation
Let's do a comparison problem.

</td></tr>
</table>

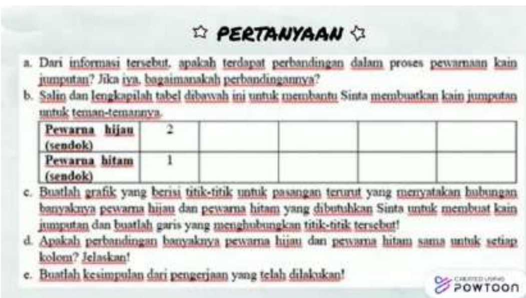
Before Revision

Translation

PROBLEM 1 (SHARING TASK)

Sinta is a *Jumputan* fabric craftsman. The following is one of the *Jumputan* fabrics that Sinta has made.

To make a *Jumputan* fabric with this color, you need 2 spoons of green dye and 1 spoons of black dye. Sinta will make *Jumputan* fabric for her friends with the same colors as in the picture.



Translation

QUESTION

a. From this information, is there a comparison in the dyeing process of *Jumputan* fabric? If yes, how does it compare?

b. Copy and complete the table below to help Sinta make *Jumputan* fabric for her friends.

Green dye (spoon)	2				
Black dye (spoon)	1				

c. Construct a graph containing points for ordered pairs that represent relationshipshow much green dye and black dye does Sinta need to make *Jumputan* fabric and draw a line connecting the dots!

d. Is the ratio of the amount of green dye to black dye the same for each column? Explain!

e. Draw conclusions from the work that has been done!

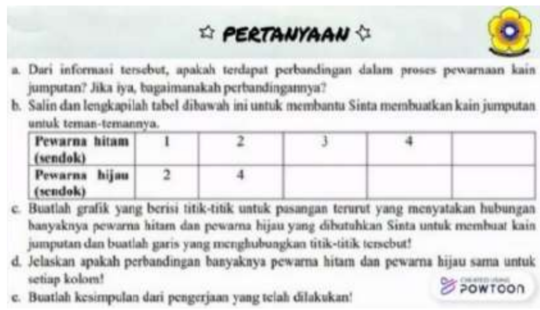
After Revision (Prototype 1)

Translation

PROBLEM 1 (SHARING TASK)

Sinta is a *Jumputan* fabric craftsman. The following is one of the *Jumputan* fabrics that Sinta has made.

To make a *Jumputan* fabric with this color, you need 1 spoons of black dye and 2 spoons of green dye. Sinta will make *Jumputan* fabric for her friends with the same colors as in the picture.



Translation

QUESTION

a. From this information, is there a comparison in the dyeing process of *Jumputan* fabric? If yes, how does it compare?

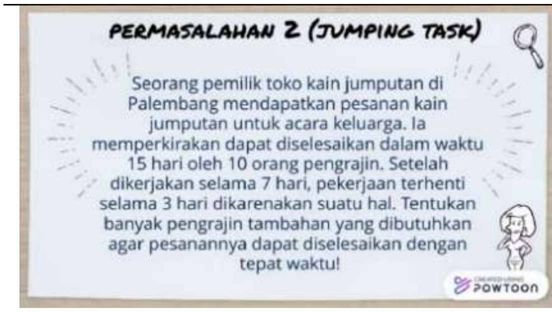
b. Copy and complete the table below to help Sinta make *Jumputan* fabric for her friends.

Black dye (spoon)	1	2	3	4	
Green dye (spoon)	2	4			

c. Construct a graph containing points for ordered pairs that represent relationships how much black dye and green dye does Sinta need to make *Jumputan* fabric and draw a line connecting the dots!

d. Explain whether the ratio of the amount of black dye to green dye is the same for each column!

e. Draw conclusions from the work that has been done!

Before Revision	After Revision (Prototype 1)
	
Translation PROBLEM 2 (JUMPING TASK) A *Jumputan* fabric shop owner in Palembang received an order for *Jumputan* fabric for a family event. She estimated that it could be completed within 15 days by 10 craftsmen. After working for 7 days, work stopped for 3 days due to something. Determine how many additional craftsmen are needed so that the order can be completed on time!	**Translation** PROBLEM 2 (JUMPING TASK) Asri is the owner of a *Jumputan* fabric shop in Palembang. She received an order for *Jumputan* fabric and estimated it could be completed within 15 days by 10 craftsmen. The work had been carried out for 7 days, but after that the work was stopped for 3 days due to some reason. Determine how many additional craftsmen are needed so that the order can be completed on time!
	
Translation Thank you	**Translation** Thank you

- ***Expert Review***

At this stage, the learning videos that have been developed are given to experts for validation. The experts who were involved as validators in this study were Dr. Refi Elfira Yuliani, S.Si., M.Pd., Dr. H. Muslimin Tendri, M.Pd., and Nur Elisyah, S.Pd., M.Pd. The validators provided comments and suggestions on the learning video that the researchers developed on the validation sheet provided based on content, construct, and language. Suggestions and input from the validators will be used to revise the developed product. The comments and suggestions from the validators on the learning videos that have been developed, as well as revision decisions from researchers can be seen in Table 2.

TABLE 2. Comments and Suggestions, and Revision Decisions at the Expert Review Stage

Expert	Comments and Suggestions	Revision Decision
Dr. Refi Elfira Yuliani, S.Si., M.Pd.	• Video can be added with researcher's voice • Video duration can be increased	• The researchers have added an original voice • The researchers have extended the duration of the video

Expert	Comments and Suggestions	Revision Decision
Dr. H. Muslimin Tendri, M.Pd.	• The video is too fast • Add the researcher's original voice • Just delete the numbers in the table	• The researchers have extended the duration of the video • The researchers have added original sound • The researchers have removed the numbers in the table
Nur Elisyah, S.Pd., M.Pd.	• The sentence arrangement is adjusted to ensure easily navigable layout. • Colors are adjusted so that they are more attractive. • Set the video speed so that students do not get dizzy while reading instructions or text in the video. • Add a video that provides an explanation of the context.	• The researchers have adjusted the sentence layout. • The researchers have changed some backgrounds to make it look more attractive. • The researchers have extended the duration of the video. • The researchers have added a video explaining the context of Palembang *Jumputan* fabric.

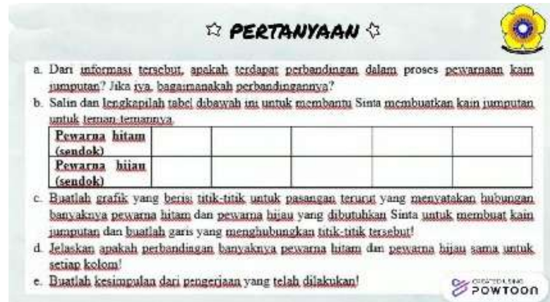
- ***One-to-One***

At this stage, prototype 1 will be tested on 3 students of Sumsel Jaya Palembang Junior High School with heterogeneous abilities. Furthermore, researchers conducted interviews with students by asking about comments and suggestions regarding the learning video. The results of observations and interviews that have been conducted will be used as material for revising the learning video. The overall results of student observations and interviews regarding learning videos, as well as revision decisions can be seen in Table 3.

TABLE 3. Observation and Interview Results, and Revision Decisions at the One-to-One Stage

No.	Observation and Interview Results	Revision Decision
1.	Students still have difficulty understanding the sentences contained in the second problem	The researcher has changed the sentence in the second problem
2.	The video is good, the writing on the video is also clear, but the video is too fast	Researchers have extended the duration of the video

After the learning video was validated at the expert review stage and tested on students at the one-to-one stage, revisions were made to produce prototype 2 which could be declared valid in terms of content, construct, and language. The appearance of prototype 2 can be seen in Figure 2.



Translation

PROBLEM 1 (SHARING TASK)
Sinta is a *Jumputan* fabric craftsman. The following is one of the *Jumputan* fabrics that Sinta has made.
To make a *Jumputan* fabric with this color, you need 1 spoons of black dye and 2 spoons of green dye. Sinta will make *Jumputan* fabric for her friends with the same colors as in the picture.

Translation

QUESTION
a. From this information, is there a comparison in the dyeing process of *Jumputan* fabric? If yes, how does it compare?
b. Copy and complete the table below to help Sinta make *Jumputan* fabric for her friends.

Black dye (spoon)					
Green dye (spoon)					

c. Construct a graph containing points for ordered pairs that represent relationships how much black dye and green dye does Sinta need to make *Jumputan* fabric and draw a line connecting the dots!
d. Explain whether the ratio of the amount of black dye to green dye is the same for each column!
e. Draw conclusions from the work that has been done!

Translation

PROBLEM 2 (JUMPING TASK)
Asri is the owner of a *Jumputan* fabric shop in Palembang.
He received an order for *Jumputan* fabric and estimated it could be completed within 15 days by 10 craftsmen.
It turned out that after 7 days of work, work on the order was stopped for 3 days due to some reason. Determine how many additional craftsmen are needed so that the order can be completed on time!

FIGURE 2. Prototype 2 on Comparison Materials Using the Context of Palembang *Jumputan* Fabric

- ***Small group tryout***

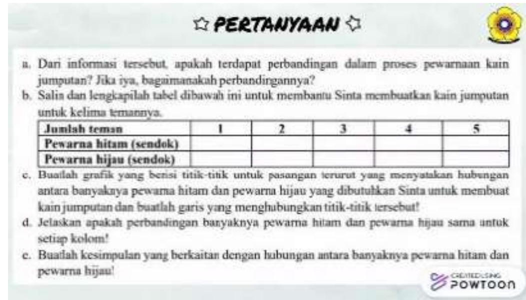
At this stage, prototype 2 will be tested on 2 groups where each group consists of 3 heterogeneous students. Furthermore, researchers conducted interviews with students by asking about comments and suggestions for learning videos that have been displayed. The results of observations and interviews that have been conducted will be used as material to revise the learning video. The overall results of student observations and interviews regarding learning videos, as well as revision decisions can be seen in Table 4.

TABLE 4. Observation and Interview Results, and Revision Decisions at the Small group tryout Stage

No.	Observation and Interview Results	Revision Decision
1.	Students still encounter difficulty understanding the sentences contained in the first problem.	The researchers have changed the sentence in the first problem
2.	Students are still confused about the table in the first problem.	The researchers have. added a column for the number of friends to the table in the first problem
3.	The photo of the *Jumputan* fabric in the first problem is not very clear in color.	The researchers have replaced the photo with one that shows the colors more clearly.
4.	The video is good, but the sound is too low.	The researchers have increased the volume of the sound.

After the learning video was tested on students at the small group tryout stage, revisions were made to produce a valid and practical prototype 3. The appearance of prototype 3 can be seen in Figure 3.

Translation
PROBLEM 1 (SHARING TASK)
Sinta is a *Jumputan* fabric craftsman. The following is one of the *Jumputan* fabrics that Sinta has made.
To make a *Jumputan* fabric with this color, you need 1 spoon of black dye and 2 spoons of green dye. Sinta will make *Jumputan* fabric for her five friends with the same colors as in the picture.



Translation
QUESTION
a. From this information, is there a comparison in the dyeing process of *Jumputan* fabric? If yes, how does it compare?
b. Copy and complete the table below to help Sinta make *Jumputan* fabric for her five friends.

Number of friends	1	2	3	4	5
Black dye (spoon)					
Green dye (spoon)					

c. Make a graph containing dots for ordered pairs that express the relationship between the amount of black dye and green dye that Sinta needs to make *Jumputan* fabric and draw a line connecting the dots!
d. Explain whether the ratio of the amount of black dye to green dye is the same for each column!
e. Make conclusions regarding the relationship between the amount of black dye and green dye!

Translation
PROBLEM 2 (JUMPING TASK)
Asri is the owner of a *Jumputan* fabric shop in Palembang. He received an order for *Jumputan* fabric and estimated it could be completed within 15 days by 10 craftsmen.
It turned out that after 7 days of work, work on the order was stopped for 3 days due to some reason. Determine how many additional craftsmen are needed so that the order can be completed on time!

FIGURE 3. Prototype 3 on Comparison Materials Using the Context of Palembang *Jumputan* Fabric

This research developed a learning video on comparison material using the context of Palembang *Jumputan* cloth Figure 3. Learning videos containing text, sound, images, and animations can make students interested in learning [19], and can develop students' thoughts and imaginations [20]. In addition, this research has also been adjusted to the principles and characteristics of PMRI, as well as collaborative learning. Collaborative learning consists of two tasks, namely sharing task and jumping task [16]. The learning video developed already contains sharing task and jumping task problems related to the real context. This means that it is in accordance with PMRI where PMRI is a theory that starts with real problems that emphasize the skills of discussion, collaboration, and process, and exchange ideas with friends [8]. Mathematics learning will be more meaningful if it is related to real life which makes real problems as an introduction at the beginning of learning [9]. Therefore, this research uses the context of Palembang *Jumputan* fabric as a starting point and innovation in comparison learning presented in the form of a learning video. Researchers have gone through two stages, namely the preliminary stage (preparation stage, analysis stage, and design stage), and the formative evaluation stage (self-evaluation, expert review, one to one, and small group), so that the learning video on comparison material using the context of Palembang jumputan cloth produced is valid and practical.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the learning video on comparison material using the context of Palembang *Jumputan* cloth developed is categorized as valid and practical. This learning video can make students interested in participating in learning.

ACKNOWLEDGMENT

The authors would like to thank the validators, namely Dr. Refi Elfira Yuliani, S.Si., M.Pd., Dr. H. Muslimin Tendri, M.Pd., and Nur Elisyah, S.Pd., M.Pd. who have provided comments and suggestions on the learning video developed, so that it can be used in the research. The authors would also like to thank the principal, school operator, and mathematics teacher of class VII SMP Sumsel Jaya Palembang who have helped a lot during the research.

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The Urgency of Zonation Policy in Online Acceptance of Senior High School Level Students and its Impact on Equivalent Education Quality in the Province of the Special Capital Region of Jakarta

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Abstract. Education is a right for all children of the nation as stated in the goals of the founding of the state by our founding fathers, but now education has become a commodity that can only be enjoyed by those who can afford it, the presence of a state which allocates a budget of 20% of the state budget cannot be felt by all children of the nation, especially those who do not have access and opportunities for certain communities in Jakarta. The zoning restriction policy in Admission of New Students for high school children is felt to not fulfill the element of justice in education and even tends to ignore the rights of people who do not have access or costs. This study intends to unravel the tangled threads of education issues from a social, economic and political perspective This research uses a qualitative descriptive research type with a case study approach that occurred in Jakarta, especially regarding zoning policies in the Admission of New Students stem New Student Admissions. The results of the study show that not all people can easily get the opportunity to get a good and affordable education, especially that of the government or the private sector. Economic problems, limited access to administrative issues are often the scourge that haunts the opportunity for the lower classes to get the best education in accordance with their constitutional rights. Administrative reasons are often a weapon to get rid of the rights of certain groups of people.

INTRODUCTION

Education is the right of every citizen guaranteed by the constitution, so the state must constitutionally be responsible for education. It is also a mandate that must be carried out by the state as stated in the preamble of the 1945 Constitution, namely the intellectual life of the nation. there are more stories of pros and cons in educational matters,Education is a very important thing in life, both in the family, society, nation and state. Education is the spearhead of the progress of a nation, the more advanced the education, the more it reflects an advanced nation because it is able to prepare and develop human resources (HR) which is the main capital for the development of a nation.Education plays an important role in improving the quality of human life in sustaining the economic evolution and social development of a country [1] .Education is a sizable investment for most countries [2].

Education is an important part of development. Whether education is progressing or not is very important for the survival and progress of the nation, especially for developing countries. This shows how important the role of education is for every nation. As Indonesian citizens, the government is obliged to fulfill the rights of its citizens to obtain education to determine their future quality of life, in accordance with the 1945 Constitution, which states that the government is obliged to fulfill the rights of its citizens to obtain education. Education is a strong foundation needed for the progress of the nation and as a provision to face the times in every process.Law of the Republic of Indonesia Number 20 of 2003, Regarding the National Education System (UU Sisdiknas) states that, education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control , personality, intelligence, noble character, and skills needed by himself, society, nation and state. Basically, getting quality education is the right of every citizen guaranteed by the constitution, in accordance with the fourth paragraph of the Preamble to the Constitution of the Republic of Indonesia which states that education is the right of all nations, therefore every citizen is given equal opportunities to pursue education. which is a basic right of citizens(UU Sisdiknas).

Essentially education is to develop children's abilities, skills and character so that they can participate in the life of a democratic nation.Quality education is of great concern in many societies around the world. Highly competitive education sector, the success of academic institutions depends on the quality of education [3]. More than that,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040011-1–040011-10; https://doi.org/10.1063/5.0242930
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

education is expected to equip individuals with the ability to recognize their potential and develop their creativity. That is, the definition of educational quality is related to meeting the needs and expectations of students [4].

Some opinions state that school facilities play a very important role in determining the success of education. Glewwe (2021) states that educational facilities are one of several factors that influence student learning [5]. Students will have a more optimal learning experience if the learning facilities are adequate, such as the availability of comfortable classrooms, and the availability of learning supports such as computers and laboratories [6]. Therefore, it is necessary to make improvements to inadequate school facilities. Related to this, research results suggest that the government needs to identify which facilities need to be prioritized if funds are limited [7].

In facing the new school year, the government through the Ministry of Education and Culture issued Permendikbud No 17 of 2017 which regulates the zoning system that schools must apply in accepting prospective new students. The rules for this zoning system explain that schools organized by the regional government are required to accept prospective students who live in the closest zone radius from the school of at least 90 percent of the total number of students accepted. The domicile of the prospective student is based on the address on the family card issued no later than six months before the implementation of Admission of New Students. The nearest zone radius is determined by the regional government according to the conditions in the area (Permendikbud No 17 of 2017

The Ministry of Education thinksthat the previous Admission of New Students system, which used test scores as the basis for admission selection, tended to accept students with relatively high academic achievements who generally came from well-to-do families. As a consequence, students with low abilities, especially those from underprivileged families, are forced to attend private schools or are even at risk of dropping out. In other words, public schools which are of relatively good quality and are fully funded by the government are enjoyed mostly by the well-to-do population. Meanwhile, most students from underprivileged families attend paid private schools with relatively low quality. The government wants to end this access injustice.

Public policy is part of the study of state administration but is multidisciplinary because it borrows many methods, theories and techniques from studies of social sciences, political science, economics and psychology. [8]. Public policy according to Agustino (2004) is whatever the government chooses to do or not to do [9] whereas Subardono (2015) implies that (1) public policies are made by government agencies, not private organizations, (2) public policies regarding choices that should or should not be made by government agencies [10].

According to Winarno in Mujianto (2015: 152) public policy is a policy developed by government agencies and government officials who are influenced by non-government actors and factors. Policies must pay attention to the aspirations of actors outside the government, and the influencing factors must be studied beforehand. The implementation of public policy is the implementation or implementation of a public policy through programs, activities, actions or actions in a mechanism that is tied to a certain system [11]. Policy implementation is one part of a series of policy-making processes. The purpose of policy implementation is to set directions so that policy objectives can be realized.

Broadly speaking, there are several factors that influence policy making, namely: (1) The influence of outside pressure (2) The influence of old habits (conservatism) (3) The influence of personal characteristics. 4. There is influence from outside groups [12]. There are several criteria that can be used in determining policies including (1). Effectiveness, measuring an alternative target that is achieved with an alternative policy can produce the desired final goal. (2). Efficient, the funds used must be in accordance with the objectives achieved [8]. Donald Van Meter and Carl Van Horn are of the view that what influences the performance of public policy implementation. Policy size and objectives Performance of policy implementation can be measured if the level of success is only if the size and objectives of the policy are socioculturally realistic at the level of policy implementers [13].

Policy implementation is part of the policy making process (policy making process). As stated by Hasbullah (2015), that the policy-making process is a political process that takes place in the stages of political policy-making, where this political activity is explained as a policy-making process, and is visualized as a series of stages that are interdependent on one another, arranged according to time sequence. , such as agenda setting, policy formulation, policy adoption, policy implementation, and policy assessment [14].

William N. Dunn (2003) suggests that successful policy implementation can be achieved if two things are considered, namely (1). Policy stakeholders, namely individuals or groups of individuals who have a stake in policy, because they influence and are influenced by environmental government decisions where policy will be applied. (2). Policy environment, namely the special context in which events surrounding a policy issue will be mutually influenced by public policy [15].

In formal education, the initial stage for starting an education level is carried out through New Student Admissions. Acceptance of new students is a selection process that will determine students who are accepted at a school. aims to provide the widest possible opportunity for the school-age population to obtain the best possible service in obtaining education. In line with this, the purpose of Admission of New Students as stated in article 2 of the Minister of Education and Culture 14 of 2018 is to guarantee that the acceptance of new students must proceed in an objective, transparent, accountable, non-discriminatory and fair manner, this is of course not only effective and efficient but can be accounted for. This is a very good idea although of course the implementation level is not as easy as we imagine, many records still to be completed. It is in this context that we should be criticized, bearing in mind that the location of public schools is not directly proportional to the distribution of the population (where the prospective students live).

The Admission of New Students zoning system replaces the Student Achievement Tracking System which was implemented the previous year by each region by selecting using The Pure of Ebtanas Value as known as Nilai Ebtanas Murni (NEM). This selection is simpler because it only takes into account the NEM and test results of prospective new students. However, the system has drawbacks, in this case the issue of educational inequality. Admission of New Students zoning aims to ensure that the acceptance of new students runs in an objective, accountable, transparent and non-discriminatory manner so as to encourage increased access to education services. Admission of New Students can be done in two ways. First, registration through the network (online), namely through the official Admission of New Students website for each area. Second, offline registration (outside the network/offline), namely by registering directly at the school.

With this zoning system, it is hoped that the acceptance of new students can proceed without discrimination and is able to provide equal opportunities for every student to receive formal education, regardless of low cognitive or economic abilities. However, in reality, Permendikbud Number 17 of 2017 is considered inappropriate by some people because the distance between the actual quality of education is not within the scope of the district/city, but occurs at the provincial level, this is what later led to the birth Governor Regulation number 32 of 2021.

In its implementation, the zoning system is often bombarded with expressions of dissatisfaction from the parents of prospective students and also the prospective students. The reason is that the principle of meritocracy that has long been applied through the selection of students based on National Examination (UN) scores is no longer valid and implicitly, the zoning system policy has neutralized the effort and hard work of prospective students. In addition, taking into account the multidimensional level of inequality that contributes to inequality in the quality of education in Indonesia, the zoning system is considered premature in its implementation.

Inequality in the quality of education can be explained through a causal relationship between social and economic factors found in society towards the end result of education. Muttaqin (2018) in his study suggests that inequality in quality and access to education stems from differences in characteristics at each level of society and also from variations in resources which are classified into five types, namely economic, human, social, political, and infrastructure. However, it is important to note as stated in Hanushek's research that the role of better education, a central part of most development strategies, has been controversial because expanding the reach of schools has not guaranteed an improvement in economic conditions [16].

the relationship between learning achievement and input factors such as school quality and resources, characteristics of the family environment and friendships, and socio-economic status found that although there were indications of inefficiency in education which resulted in not optimal learning achievement, no clear causality was found between input and output in education. For example, even though the socio-economic status of students can provide easy access to education, without a curriculum, good teacher competence, and the provision of adequate educational facilities, the final results of education cannot be said to be good. The effect of facilities is relatively small (and becomes insignificant) compared to family characteristics and socio-economic conditions in developed countries [17].

What should be noted together is whether there is a significant correlation between the level of the economy and the quality of one's education, or is it just a matter of distance traveled by students or due to inadequate infrastructure or due to other factors? The complexity of the problem of inequality in the quality of education in Indonesia needs to be seen from various perspectives. With the current zoning system policy, efforts to equalize the quality of education are only limited to the distribution of students and with efforts to increase competency and school facilities which are still minimal. Data release from BPS (2018) shows that since the zoning system policy on Admission of New Students in 2017, there are still some significant disparities in several categories, especially based on location (urban/rural), economic status,

In every policy there are consequences that must be faced by policy makers and implementers, even though this is based on general aspects, it is unavoidable that policies can really want several parties but at the same time can also be detrimental to several parties. If what is meant is an effort to equalize opportunities so that all people can obtain equal rights, has this goal been fulfilled? What about the system created? Can it help parents in sending their children to school according to their choice or on the contrary, parents are confused because of this Admission of New Students system. The implementation of zoning-based Admission of New Students which is carried out online also creates a headache for parents, in some cases parents often experience difficulties because they have to register online considering that not all parents of students understand digital technology understand the internet or have compatible smartphones to access registration. Admission of New Students online. If not then you have to get ready to queue from dawn to get a queue number.The Online New Student Admission System (Admission of New Students Online) was designed with the aim of making it easy for the general public to register at school, by providing a transparent and accountable process. However, in its implementation, many people cannot understand how this process can be carried out, so it is still far from the goal of providing convenience and satisfaction to the community, especially in the Special Capital Region of Jakarta Jakarta.

In terms of new students who are accepted through zoning Admission of New Students, they live closer to public schools than achievement-based Admission of New Students. However, the composition of students who were accepted through the zoning system had lower scores and were more diverse than students who were accepted through the achievement system. This situation requires teachers in public schools to adapt quickly. Teachers who used to teach students with high average abilities, now have to teach students with low average scores with very diverse abilities. In fact, the skills needed by teachers who teach high-ability and low-ability children are different. Highly capable children need new challenges and enrichment from the teacher in order to be motivated and improve their abilities. On the other hand,

What's more, the teacher's challenges in teaching children with diverse abilities are more severe than those of children with relatively homogeneous abilities. Teachers who teach homogeneous classes tend to be able to teach all students in parallel. However, when the class being taught is relatively heterogeneous, the teacher must adjust the teaching pattern to accommodate children who are fast and slow in learning. The greater the gap in children's abilities, the greater the teacher's burden in teaching.

The problem is, the adjustment of the teacher's ability to teach cannot be done in a short time. As a result, the learning process in class cannot run optimally and creates shock which actually disrupts the learning process in class. Apart from the problems faced by teachers, students also experience challenges due to heterogeneous class composition. Students who are slow in learning can fall behind their friends and become uncomfortable in learning. Then, students who are fast in learning can lose motivation if they don't get challenges.

In its implementation, the zoning system is often bombarded with expressions of dissatisfaction from the parents of prospective students and also the prospective students. The reason is that the principle of meritocracy that has long been applied through the selection of students based on National Examination (UN) scores is no longer valid and implicitly, the zoning system policy has neutralized the effort and hard work of prospective students. In addition, taking into account the multidimensional level of inequality that contributes to inequality in the quality of education in Indonesia, the zoning system is considered premature in its implementation. On the other hand, at the implementation level, the unpreparedness of the infrastructure and other supporting devices made implementing schools overwhelmed in dealing with the problem of soaring Admission of New Students enthusiasts. this is what later gave rise to a lot of disappointment both among parents and among implementers. the attitude of acceptance or rejection of policy implementations greatly influences the success or failure of public policy implementation. From the description of the problem above, the problem can be formulated as follows:

Is there a significant correlation between the implementation of the zoning system policy in Admission of New Students and the distribution of the quality of children's education?

What are the main factors behind the desire of parents to pursue Admission of New Students in public schools.

RESEARCH METHODOLOGY

This research uses a type of qualitative descriptive research, qualitative research, emphasizing more with the term authenticity rather than validity. Because authentication is more significant in providing fair and honest descriptions, information, information. This means that the results of the data obtained and interpreted must be precise, so that the descriptions written are based on real data, not the result of the researcher's own composition. According to Sugiono Quantitative methods are suitable for research on large populations, the problems are clear, observable, measurable, and the researcher intends to test hypotheses [18].

Reliability in qualitative research can be seen from the aspects of sharpness, observation, text analysis, interviews, and transcripts from the acquisition of data obtained from the natural environment. So, reliability in qualitative research has something to do with observation, so researchers must really master the field, know exactly what is happening in the field, and know the culture being studied [19].

The method of data collection was carried out through interview techniques, distribution of questionnaires and direct observation in the field at the time of Admission of New Students in 2022 ago, interviews were conducted with parents and schools implementing Admission of New Students by taking random sampling of several public schools in the the Special Capital Region of Jakarta area, while questionnaires were distributed either directly face to face with the parents of prospective Admission of New Students students or online via the Google form. The data analysis technique used is data reduction, data presentation and conclusion. The technique of checking the validity of the data uses a research triangulation technique, which is an approach that uses a combination of more than one strategy in one study to capture data/information.

DISCUSSION

Jakarta which is the capital of the Republic of Indonesia is a province that has the most populous population in Indonesia, with a population of more than 10 million people [20]. According to the division of the Special Capital Region of Jakarta which is divided into five administrative city areas and one administrative district, East Jakarta is the largest area with an area of 27.51%. East Jakarta is followed by South Jakarta in second place with an area of 23.24%. The extent of East Jakarta is one of the factors that supports the large number of people living in this area. Thus, there are many government-provided facilities in East Jakarta such as health, sports, education and other public facilities. Meanwhile, the Thousand Islands is the smallest administrative area in the Special Capital Region of Jakarta with an area percentage of 1.53%. The Thousand Islands itself is located 45 km north of the Special Capital Region of Jakarta.

The people of Jakarta are very heterogeneous, with various ethnicities, religions, races and groups living and residing in Jakarta, both those who live temporarily (contracts or boarding houses) or those who have been officially registered as citizens of Jakarta. [20] . The large number of residents living in Jakarta with various professional and occupational backgrounds also has an impact on the number of schools in Jakarta. The number of schools in Jakarta according to their level of education can be seen from the infographic below:

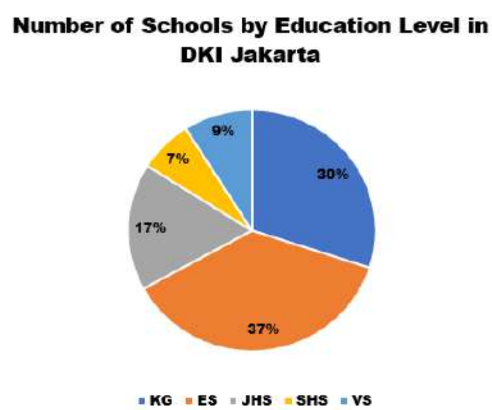
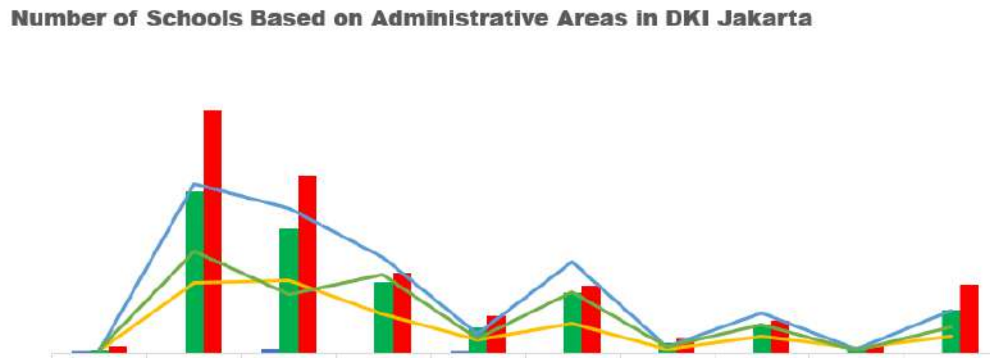


FIGURE 1. Percentage of the number of schools in Jakarta at various levels

The distribution of the number of state schools at the senior high school level which is also not directly proportional to the growth rate of Jakarta's increasingly dense population also makes the zoning-based on Admission of New Students mechanism determined by the government still felt to be less effective. The implementation of the Admission of New Students zoning policy in the the Special Capital Region of Jakarta Region has even left a number of serious problems that have not been resolved even though the the Special Capital Region of Jakarta provincial education office has held it several times. Various problems ranging from the uneven readiness of school infrastructure to the tendency of parents to prefer the image of a superior school as a priority over the distance close to where they live.



	KG		ES		JHS		SHS		VS	
	PRIVATE	PUBLIC	PRIVATE	PUBLIC	PRIVATE	PUBLIC	PRIVATE	PUBLIC	PRIVATE	PUBLIC
THOUSAND ISLANDS	9	1	14	0	7	0	1	0	1	0
SOUTH JAKARTA	12	401	309	178	66	151	29	75	18	108
EAST JAKARTA	20	603	439	201	95	169	40	83	21	173
CENTRAL JAKARTA	9	177	181	97	36	76	13	43	14	44
WEST JAKARTA	8	421	359	240	50	228	17	100	11	107
NORTH JAKARTA	11	253	147	197	39	154	17	72	8	68

FIGURE 2. Number of schools in DKI Jakarta by Administrative Region

From the data we got, at least currently in Jakarta there are 490 high school schools consisting of 117 public high schools and 373 private high schools. East Jakarta has the most high schools with a total of 123 schools, while the Seribu Islands is the area with the fewest high schools with only 1 school. The 117 public high schools are spread across five municipalities, namely Central Jakarta, North Jakarta, South Jakarta, East Jakarta, West Jakarta and the Thousand Islands district, although there is only one school as listed in the following table:

TABLE 1. Number of high school level schools in DKI Jakarta Region 2022-2023

N0	Region City/Regency	Amount
1	Central Jakarta	13
2	North Jakarta	17
3	West Jakarta	17
4	South Jakarta	29
5	East Jakarta	40
6	Thousand Islands	1
	Total	

In general, the assessment of the quality of schools, both from the perspective of parents and others, is seen from the level of final exam scores, if the final exam scores are generally between one student and another student, it is almost evenly distributed with equally good grades and can enter the leading tertiary institutions. then the school will be seen as a quality school. So the standard of school quality is measured based on the final test scores of children's graduation, which currently in the Special Capital Region of Jakarta uses a computer-based test exam (CBT).

There are at least the 20 best public high schools in the the Special Capital Region of Jakarta area with the highest average 2021 of CBT scores are:

TABLE 2. Public High Schools with the highest CBT in DKI Jakarta

No	School Name	CBT Value
1	M.H. Thamrin Featured High School	635,675
2	Public Senior High School 8 Jakarta	630,860
3	Public Senior High School 28 Jakarta	611,727
4	Public Senior High School 81 Jakarta	607,402

No	School Name	CBT Value
5	Public Senior High School 34 Jakarta	601,490
6	Public Senior High School 68 Jakarta	598,806
7	Public Senior High School 2 Jakarta	596,367
8	Public Senior High School 78 Jakarta	595,711
9	Public Senior High School 61 Jakarta	594,675
10	Public Senior High School 48 Jakarta	589,804
11	Public Senior High School 26 Jakarta	589,339
12	Public Senior High School 21 Jakarta	581,557
13	Public Senior High School 47 Jakarta	580,882
14	Public Senior High School 12 Jakarta	578,890
15	Public Senior High School 70 Jakarta	577,481
16	Public Senior High School 65 Jakarta	577,345
17	Public Senior High School 13 Jakarta	577,111
18	Public Senior High School 39 Jakarta	576,860
19	Public Senior High School 14 Jakarta	575,534
20	Public Senior High School 38 Jakarta	575,283

In the implementation of the zoning-based Admission of New Students policy in the Special Capital Region of Jakarta, schools have prepared at least five Admission of New Students pathways, both online and offline, consisting of (1) academic achievement track with a quota of 18% (2) non-academic achievement track with a quota of 5% (3) track Affirmation with a quota of 25% (4) self-zoning path with a quota of 50% (5) a transfer path for the tasks of parents and children of teachers with a quota of 2%. Whereas forVocational High Schools are not subject to a zoning system with details of the following division of pathways (1) Academic achievement track quota of 50% (2) non-academic achievement track quota of 5% (3) Affirmation track quota of 43% and assignment path of parents and child teachers of 2%. Referring to this data, the zoning policy is only specifically for non-vocational schools (SMA).This the Special Capital Region of Jakarta Admission of New Students regulation is listed in Governor Regulation number 32 of 2021 concerning technical instructions for admitting new students (Admission of New Students) based on Regulation of the Minister of Education and Culture RI no 1 of 2021 (Disdik the Special Capital Region of Jakarta , 2021).

Based on data from the the Special Capital Region of Jakarta Provincial Statistics Center, the School Enrollment Rate (SER)) is the proportion of a certain age group currently attending school to the corresponding school-age population. School Enrollment Rate (SER) aims to determine the number of residents who have received educational facilities. In addition, School Enrollment Rate (SER) also describes the quality of education in a region. Because the higher the School Enrollment Rate (SER) score, the higher the number of people who attend school. In 2022, the School Enrollment Rate (SER) in the 7-12 year age group will be the highest with 99.25%. Then the second largest School Enrollment Rate (SER) is the 13-15 age group with 97.95%. In this group there is also an increase of 4.16% in the period 2012 to 2022. The 16-18 year old group is the group with the lowest School Enrollment Rate (SER), namely 72.03% in 2022.

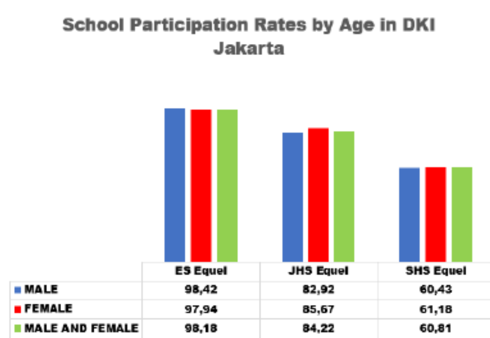


FIGURE 3. School Participation Rates by Age in DKI Jakarta

Apart from School Enrollment Rate (SER), another way to find out the level of population participation in schools is to use the Net Enrollment Rate (NER). NER is the proportion of the population of a certain school-age group who are attending school at the proper level of education (according to the age of the population with the provisions of school age at that level) to the population of the corresponding school-age group. PPG is useful to find out how many residents go to school on time and according to the age specified at the level taken. In 2022, the NER for junior high school level is the second highest, the second highest is for junior high school equivalent with 84.22%. The PPG in this group increased by 13.82% and became the group with the highest increase among the other levels. Meanwhile, the PPG with the lowest score occurred at the senior high school level with 60.81%. The increase at this level is also the smallest with 7.20%. This figure shows that there is an School Enrollment Rate (SER) gap between the junior high school level which reached 84.22% and the high school level which only reached 60.81%, meaning that the distance is 24%. consists of public schools and private schools.

In its implementation, policies often cause new problems, so the potential for new problems must be anticipated from the start so that they do not interfere with the implementation of these policies. Public policy contains a risk of failure. Both share two notions of policy failure, namely (1) Non-implementation. policies that are not implemented according to plan and ultimately result in implementation that is ineffective and difficult to fulfill. (2) Unsuccessful implementation. Unsuccessful implementation usually occurs when a certain policy has been implemented according to plan, but due to external factors, the policy ultimately fails to achieve the desired results [21].

So to better understand how to increase policy support, it is important first to appreciate the nature of policy failures as logical reasons why things don't work out as expected. So a solution must be found that can solve the problem. Failure is more newsworthy than success, and political analysis is generally more interesting when it includes (at least to some degree) strong aspects of failure whether they are the result of erroneous policies, corrupt practices, or public officials exposed for misjudgment. Policy analysis itself is a diverse practice, with different traditions and goals of advising policy makers in the interests of societal betterment [22] .

The development of multiple interests can also lead to policy failure [23] . "failure" is at the extreme end of the success-failure spectrum where it is characterized by absolute failure. Such situations are not uncommon. As he observes, "failures are seldom decisive and absolute…even policies that have become known as classic policy failures also produce small and modest successes.

Policies formulated at the national level may face the challenge of ensuring a certain level of consistency in delivery at the subnational level, a highly complicated process in which the subnational level has separate levels of political authority [24] . Meanwhile Sausman et al. (2016) describe the concept of "local universality" to describe the process by which general rules, products, or guidelines are shaped and adapted to fit the local context and put into practice. What is less clear is how central authorities can respond to this reality, especially where it is hidden from the point of view of policy-making authorities [25] .

This is very possible because the policies implemented are not the result of the formulation of local residents who are well aware of the problems and problems they feel. However, public policies are usually top down in nature, which allows decision makers to not know or even be able to touch the needs, desires or problems that must be addressed. Resolved [13].

According to Edward III in Winarno (2002:142-143) suggests "tendencies or dispositions are one of the factors that have important consequences for effective policy implementation". If the executors have a positive tendency and attitude or there is support for policy implementation then there is a high probability that policy implementation will be carried out as expected, and vice versa if the executors are negative or refuse policy implementation because of a conflict of interest then policy implementation will face obstacles. serious [26] .

In some public policy literature it is also stated that policy evaluation contributes to our understanding of the methods, tools and techniques of how we assess whether a policy is successful or not rationally and measured scientifically. The results of a policy are usually also assessed from the initial goals a policy was born. The implementation of zoning Admission of New Students in the Special Capital Region of Jakarta, whether done online or in person, requires the awareness and cooperation of all parties, both parents, the government, in this case the education office and schools as implementers of zoning-based Admission of New Students.

It is possible that policy support programs will be easier to develop in some contexts, and in some situations, and in certain locations than in other locations. Policies that seem relatively simple for good purposes may require a lot of approval from many parties and may also have little or no support. May require a flexible staffing model able to respond to needs and demands that differ from the local context of needs.

In the context of improving the quality of education or more clearly the output of education research conducted by Coleman et al (1996) that without a curriculum, good teacher competence and adequate educational support facilities can affect the final outcome of education is also not too significant when compared to family characteristics and social economy, environmental conditions and so on, then the most important thing in improving the quality of education must depart from the family environment. So education must be interpreted as a collaborative effort between parents, teachers, the family environment and the school environment.

The presence of government policies that are based on paying attention to the needs of the people at least is proof that the government is present and responsible for the future of education, but no matter how great a policy, support from the community is the key to success. Support will emerge when there is full people's trust in the state. both at the central and regional levels must be able to convince the people. although we realize that not all policies can be accepted by all the people.

CONCLUSION

The success of an educational process is not only seen from how great the school facilities are or how close the school is from where they live, but involves many things, parental factors, family environment and place of residence and association also contribute to the success of an educational process, so collaboration between all parties involved Having an interest in education is the key to the success of education, especially in the the Special Capital Region of Jakarta area. In implementing the zoning policy in the high school level Admission of New Students in the the Special Capital Region of Jakarta area, the the Special Capital Region of Jakarta government has regulated provisions zoning route with a quota of 50%, this the Special Capital Region of Jakarta Admission of New Students Regulation is listed in Governor Regulation number 32 of 2021.

In its implementation, a number of obstacles emerged, including the tendency of students' parents to prefer certain schools which were their priority, even though the distance was relatively far from where they lived compared to choosing public high schools which were closer to where they lived. The main factor is that all parents, whether they have a weak economic background, are mediocre or are economically well-established, want quality and low-cost schools, so the choice is public schools because they receive subsidies from the government.

ACKNOWLEDGMENTS

We especially thank the provincial education office for the Special Capital Region of Jakarta and several high school principals in the Jakarta area who have helped a lot in carrying out this research, also to the parents of students who are prospective 2023 zoning PPDB participants andarents of students participating in 2022 zoning PPDB participants also to all the respondents who have provided a lot of useful information in completing this research

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The Development of Learning Video on Rotation Material Using Palembang *Tanjak* Context

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Abstract. The fact that students are still struggling in learning rotation material due to lack of technology utilization and less attention to student abstraction, so that appropriate learning is needed such as the use of learning videos with real context problems is what inspired this study. The use of context in problems and the right approach. This type of research aims to produce a legitimate and helpful learning video on rotation material using the Palembang *Tanjak* context and investigate whether using the learning videos can enhance students' mathematical reasoning abilities. The reason for conducting this research is that a large number of students still struggle to comprehend the rotation material, lack access to learning resources, and fail to apply mathematics in real-world situations. Palembang *Tanjak*, one of Palembang's unique cultural contexts, was used in this study. Collaborative learning and the PMRI approach are also used in this study's learning process. Students can use creativity to enhance the quality of their learning outcomes and support the learning process by using the instructional videos. The study, which was conducted offline in the 2023–2024 academic year, involved 9th grade students from Sumsel Jaya Palembang Junior High School. The process of creating instructional videos involves two steps: preliminary stage and formative evaluation. Self-evaluation, expert review, one-to-one and smaall group are all part of the formative evaluation process used during the evaluation stage. Interviews and observations were used as data collection methods. This study used both interview and observation data analysis.

INTRODUCTION

One significant kind of geometric transformation is rotation material, which can be applied to everyday objects [1]. In addition, rotation is an important material where changes are presented based on images [2]. However, in practice, students still have some trouble understanding geometric transformation concepts, such as having trouble visualizing how an object would shift from its initial position to its shadow position [3]. In addition, students have difficulty in applying procedures or steps to solve problems in the problem [4]. Several things contribute to this, one of which is instruction that is still teacher-centered and ignores the needs of students in terms of abstraction [5]. Additionally, one of the things making students struggle, lose interest use of technological media in the classroom [6]. Therefore, appropriate learning is needed on rotation material.

In the learning process, an approach that emphasizes meaningful learning is PMRI approach [7]. PMRI is a method that, through an exercise designed to increase student comprehension, can assist students in grasping ideas and procedures [8]. In addition, applying the PMRI approach can bring out thoughts and provide the widest possible opportunity for students to understand mathematical material [9]. The PMRI approach was chosen because mathematical ideas and real-world applications are related, making it a useful tool for learning and applying newly acquired concepts [10]. In PMRI there are Five features include the use of student contributions, models, contextual problems, interaction, and integration with other subjects [11]. The PMRI technique can be tailored to the specific cultural circumstances and settings found in Indonesia [12]. There is a connection between mathematics and culture in that the former becomes a component of the latter through application and analysis of novel ideas [13]. The starting

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040012-1–040012-11; https://doi.org/10.1063/5.0244938
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

point for this research is the Palembang *Tanjak* context, and the innovative mathematics learning material is rotated. In South Sumatra, one of the Malay cultures is represented by the tanjak palembang, a headband that has evolved in both type and shape over time. It stands for the Sriwijaya Malay people's struggle, resistance, and strength against both political power and rich cultural traditions [14].

There are four skills in the 21st century, as an example, collaboration [15]. If students want to succeed in the twenty-first century, one of the most crucial skills they need to learn is collaboration. This involves helping classmates who are having trouble with their assignments in addition to carrying out their individual group duties [16]. Students support one another. Those who are unsure will specifically ask the more knowledgeable members of their group to "please teach me." Students who have studied the subject before will then help to explain it. Additionally, material sharing and jumping tasks are given to the students [17].

In the twenty-first century, educational materials that enhance students' learning are essential [28]. One type of educational media that has emerged with technological advancements is instructional videos, which have the potential to boost students' motivation to learn [19]. According to a different viewpoint, educational videos incorporate various elements like sounds, visuals, and even some animations used as illustrations [20]. There are a number of earlier studies, including Learning Design for Rotation Materials with the PMRI Approach in Class IX and the Palembang Songket Fabric Motif Context [21]. Moreover, a number of studies have been conducted on learning videos [22] and the Development of Mathematics Learning Videos [23]. There are also several studies related to rotation material [24] and research related to student activeness in the application of the use of rotation [5] and research related to Palembang *Tanjak* [14]. Nevertheless, no combined research involving rotation materials, learning videos, and the application of Palembang *Tanjak* context has been done in prior studies.

The background information provided above indicates the researcher's desire to carry out research on the Development of Learning Videos on Rotation Materials using the Palembang *Tanjak* Context. Collaborative learning and the PMRI approach are also used.

METHOD

The objective of this study is to create learning videos on rotation material within the Palembang *Tanjak* context, utilizing a design research type development study methodology that is both valid and practical. The study, which was conducted offline in the 2023–2024 academic year, involved 9th grade students from Sumsel Jaya Palembang Junior High School. The process of creating instructional videos involves two steps: preliminary stage and formative evaluation [25]. Self-evaluation, expert review, one-to-one and small group are all part of the formative evaluation process used during the evaluation stage. Prior to the research, the researcher made observations to the school and met the principal of Sumsel Jaya Palembang Junior High School to ask for permission and discuss the time and subject of the research. Based on the discussion's outcomes, it was discovered that three class IX students participated in the one-to-one tryout trial and six students participated in the small group tryout trial of the research. This study used both interview and observation data analysis. One-to-one observation is used to assess the learning video's validity, while small-group observation is used to assess the learning video's practicality. One-to-one interviews are used to learn about students' weaknesses and challenges in problem-solving after watching instructional videos. Small group interviews is to ascertain how created instructional videos are being used. This study used both interview and observation data analysis.

RESULTS AND DISCUSSION

The formative assessment stage and the preliminary stage are the two phases

- **Preliminary Stage**

Preparation, analysis stage, and design stage are the three phases that comprise the preliminary stage.

- **Preparation Stage**

Researchers set up tools and educational materials, observed the school, inquired about research subjects and implementation schedules, and handled the school's letter of authorization during the preparation phase.

- **Analysis Stage**

Researchers analyzed five components at the analysis stage consisting of student, curriculum, content/topic, media and context analysis. Student analysis was conducted by discussing with the math teacher to find out the students' abilities. Curriculum analysis was conducted by asking the math teacher about the curriculum used at Sumsel Jaya Palembang Junior High School. From the results of the discussion, information was obtained that the implementation of learning for grade IX SMP uses the 2013 curriculum. Curriculum analysis aims to determine the basic competencies, indicators of competency and learning objectivess to be achieved. Content/topic analysis used in relation to the development of learning videos is the transformation of rotational geometry. The selection of this material is related to contextual problems found in class IX in the odd semester. The study used learning videos as a medium for media analysis. The choice of educational videos stems from the fact that Sumsel Jaya Palembang Junior High School teachers still don't always incorporate educational videos into their lesson plans. Researchers used the Palembang *Tanjak* context during the context analysis phase.

- **Design Stage**

Researchers used the Palembang *Tanjak* context to create learning videos on rotation as part of their design stage. Three features content, construct, and language are the main emphasis of the prototype. Figure 1 depicts the prototype:

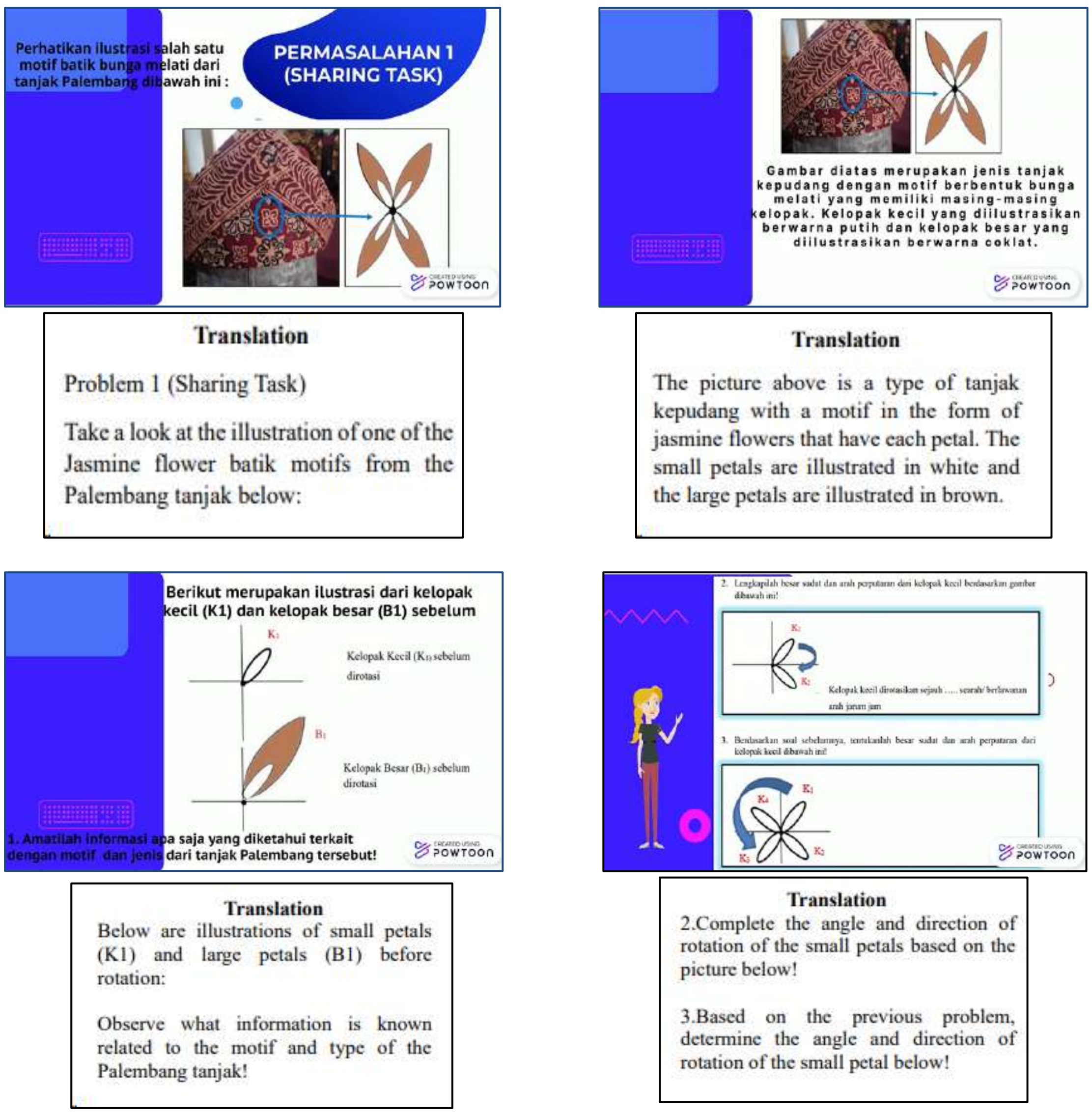


FIGURE 1. Initial Prototype on Rotation Materials Using the Palembang *Tanjak* Context

- **Formative Evaluation Stage**
  - **Self-Evaluation**

Researchers conduct their own evaluation of the product that has been designed. If there are errors in sentence writing or so will be revised by the researcher himself. The study's revision results led to the conclusion that the learning video had been improved in a number of ways, including the following: The background was changed (2) on all video displays, the Sriwijaya University logo was added.; (3) the duration of the video was extended.; (4) The question phrases were made better.; (5) The length of the sentences was increased; and (6) the sentence writing was placed in a more optimal location. Table 1 is the outcome of this revision at this point.

TABLE 1. Learning Videos Before and After Revision at Self-Evaluation Stage

Before Revision	After Revision (*Prototype* 1)

(a)

(b)

Translation

Problem 1 (Sharing Task)

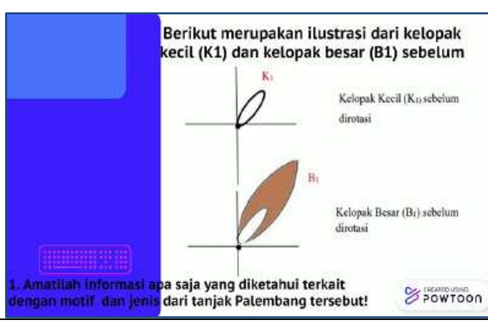
Take a look at the illustration of one of the Jasmine flower batik motifs from the Palembang tanjak below:

(c)

Translation

Problem 1 (Sharing Task)

(d)



Before Revision	After Revision (*Prototype* 1)

Translation

Below are illustrations of small petals (K1) and large petals (B1) before rotation:

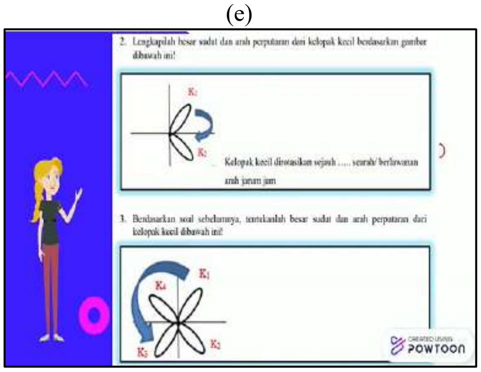
Observe what information is known related to the motif and type of the Palembang tanjak!

(e)

Translation

The small petals (K1) illustrated are white and the large petals (K2) illustrated are brown.

(f)

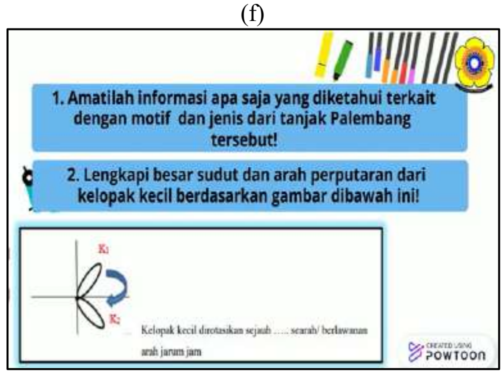


Translation

2.Complete the angle and direction of rotation of the small petals based on the picture below!

3.Based on the previous problem, determine the angle and direction of rotation of the small petal below!

(g)

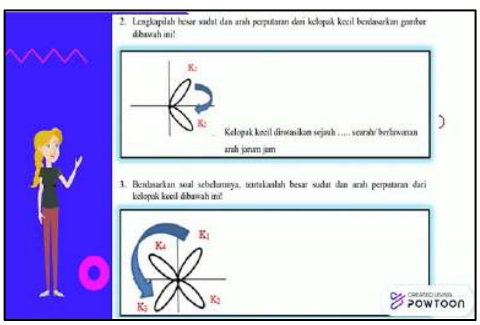


Translation

1. Observe what information information related to the motifs and types of the Palembang tanjak!

2. Complete the angle and direction of direction of rotation of the small petals based on the picture below!

(h)

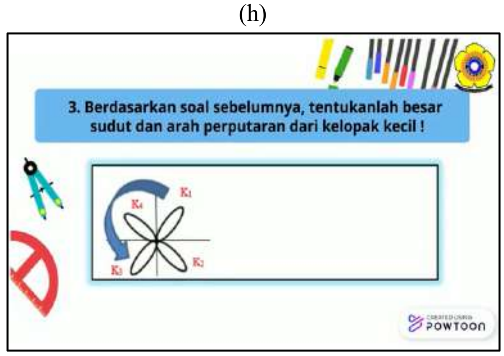


Translation

2.Complete the angle and direction of rotation of the small petals based on the picture below!

3.Based on the previous problem, determine the angle and direction of rotation of the small petal below!

(i)

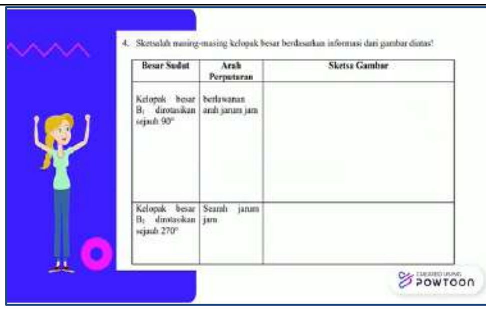


Translation

3. Based on the previous problem, determine the angle and direction of rotation of the small petal

(j)

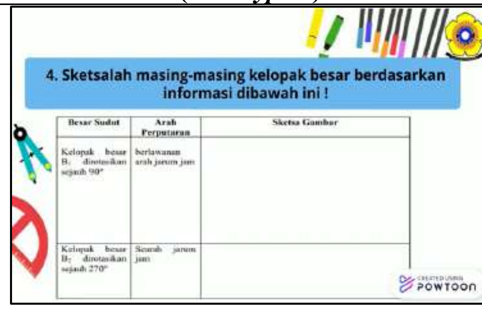
Before Revision	After Revision (*Prototype* 1)



5. Sketch each large petal based on the information from the picture above!

Large Angle	Rotation Direction	Sketch
Large petal B1 rotated by 90°	Counterclockwise produces B2	.....
Large petal B2 rotated by 180°	Counterclockwise results in B4	.....

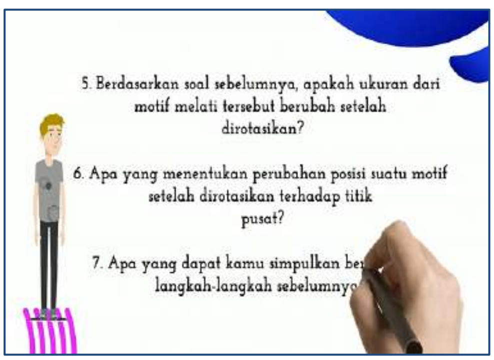
(k)



5. Sketch each large petal based on the information from the picture above!

Large Angle	Rotation Direction	Sketch
Large petal B1 rotated by 90°	Counterclockwise produces B2	.....
Large petal B2 rotated by 180°	Counterclockwise results in B4	.....

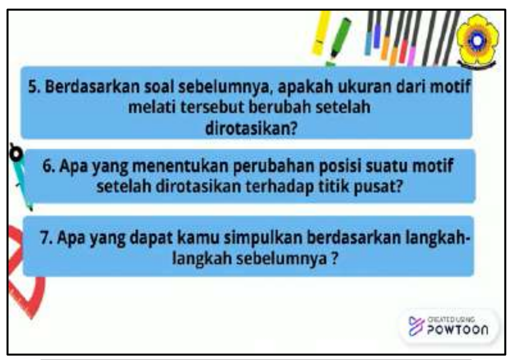
(l)



Translation

6.Based on the previous problem, does the size of the jasmine motif change after rotating?
7.What determines the change in position of a motif after it is rotated about the center point?
8.What can you conclude based on the previous steps related to the definition of rotation?

(m)



Translation

6.Based on the previous problem, does the size of the jasmine motif change after rotating?
7.What determines the change in position of a motif after it is rotated about the center point?
8.What can you conclude based on the previous steps related to the definition of rotation?

(n)

Before Revision	After Revision (*Prototype* 1)

Translation

Problem 2 (Jumping Task)

The picture is the basic material of the Palembang tanjak made of batik cloth with a cucumber seed motif. Determine the result of a 270° counterclockwise rotation! Next, write down the resulting generalized shape!

(o)

Translation

Problem 2 (Jumping Task)

(p)

Translation

Problem 2 (Jumping Task)

The picture is the basic material of the Palembang tanjak made of batik cloth with a cucumber seed motif. Determine the result of a 270° counterclockwise rotation! Next, write down the resulting generalized shape!

(q)

Translation

Problem 2 (Jumping Task)

The picture is the basic material of the Palembang tanjak made of batik cloth with a cucumber seed motif. Determine the result of a 270° counterclockwise rotation! Next, write down the resulting generalized shape!

(r)

- **Expert Review**

Researchers presented the learning videos developed to experts for validation. This study involved three validators, Based on content, construct, and language, the three validators made remarks and recommendations about the learning video on the validation sheet that was supplied. Suggestions and input from validators were used to revise the developed product. The three validators' feedback and recommendations regarding the created learning video are listed below, along with the findings of the researchers' edits, which are displayed in Table 2.

TABLE 2. Validator's Comments and Suggestions and Researcher's Revision Decision

Expert	Comments and Suggestions	Revision Decision
Dr. Refi Elfira Yuliani, S.Si., M.Pd.	• Expand the length of the instructional video. • Videos intended for instruction can incorporate the researcher's voice. • Before the problem portion of the problem, include a description of the PMRI stage's context.	• The researchers have added duration to the video. • The researchers have added the researcher's voice. • The researchers have added an explanation of the context of the Palembang *Tanjak.*
Dr. H. Muslimin Tendri, M.Pd.	• Make the prepositional sentences in the questions better written. • The video moves too quickly • Include the researcher's voice in the educational film.	• The researchers have improved the writing of prepositions in the questions. • The researchers have added video duration. • The researchers have added the researcher's voice
Nur Elisyah, S.Pd., M.Pd.	• The addition of sound would improve educational videos. • Include introductory videos that are pertinent to the situation. • The speed of the video has been lowered to make it simpler for students to read the instructions. • Improve the sentence on the question	• The researcher has added the researcher's voice • The researchers have added an explanation of the context of Palembang *Tanjak* • The researchers have added video duration • The researchers have improved the sentence of question number 2

- **One-to-one tryout**

Three students in the class IX Sumsel Jaya Palembang Junior High School tested the updated prototype 1 with heterogeneous student abilities. Through interviews, students also offered feedback and recommendations regarding the instructional video. Researchers used the information from the three students' interviews and observations to make revisions to the instructional video. The outcomes of the comments and recommendations made by students, along with the revision choices made by the researchers, are displayed in Table 3.

TABLE 3. Observation and Interview Results, and Researcher Decisions at the One-to-one tryout Stage

No.	Observation and Interview Results	Revision Decision
1.	The video is interesting, but the video is too fast.	The researchers have added the duration.
2.	The text in the video can be made slightly larger.	Researchers have increased the size of the text in the learning video.

The video was edited to produce a workable prototype 2, which is depicted in Figure 2, following a one-on-one tryout trial and validation at the expert review stage.

Translation

Problem 1 (Sharing Task)

Take a look at the illustration of one of the Jasmine flower batik motifs from the Palembang tanjak below:

Translation

The small petals (K1) illustrated are white and the large petals (K2) illustrated are brown.

Translation

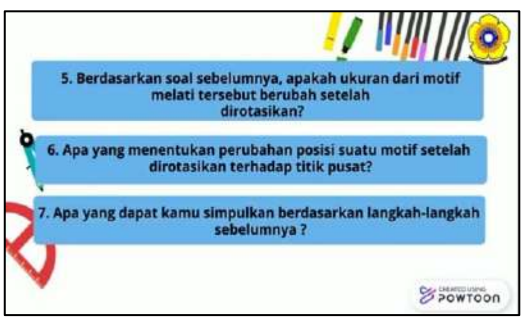
1.Observe what information is known related to the motifs and types of Palembang tanjak!

2.Complete the angle and direction of rotation of the small petals based on the picture below!

3.Based on the previous result, determine the angle and direction of rotation of the small petal!

5. Sketch each large petal based on the information from the picture above!

Large Angle	Rotation Direction	Sketch
Large petal B1 rotated by 90°	Counterclockwise produces B2	....
Large petal B2 rotated by 180°	Counterclockwise results in B4	....



Translation

6.Based on the previous problem, does the size of the jasmine motif change after rotating?
7.What determines the change in position of a motif after it is rotated about the center point?
8.What can you conclude based on the previous steps related to the definition of rotation?

Translation

Problem 2 (Jumping Task)

The picture is the basic material of the Palembang tanjak made of batik cloth with a cucumber seed motif. Determine the result of a 270° counterclockwise rotation! Next, write down the resulting generalized shape!

FIGURE 2. Prototype 2: Utilizing the Palembang *Tanjak* Context for Rotation Material

- **Small group tryout**

Six students from SMP Sumsel Jaya Palembang's class IX in a small group trial of the revised prototype 2. They were split into two groups, each with three pupils chosen from a range of skill levels and teacher recommendations. Through interviews, students also offered feedback and recommendations regarding the instructional video. Researchers used the information from the six students' observations and interviews to make revisions to the instructional video. The outcomes of the comments and recommendations made by students, along with the revision choices made by the researchers, are displayed in Table 4.

TABLE 4. Observation and Interview Results, and Researcher's Revision Decision at Small group tryout

No.	Observation and Interview Results	Revision Decision
1.	The learning video section still has a display that moves too quickly.	The researchers have increased the duration of learning video.
2.	The sound in the video needs to be increased.	The researchers have enlarged the sound in the video.
3.	The questions don't have any question writing on them.	Researchers have added duration to the video.
4.	The questions still contain some unclear sentences.	The researchers have improved the sentence in the first problem.

The learning video is revised to produce a viable and workable prototype 3 after being tested in small groups during the tryout phase. Figure 3 depicts Prototype 3 as follows.

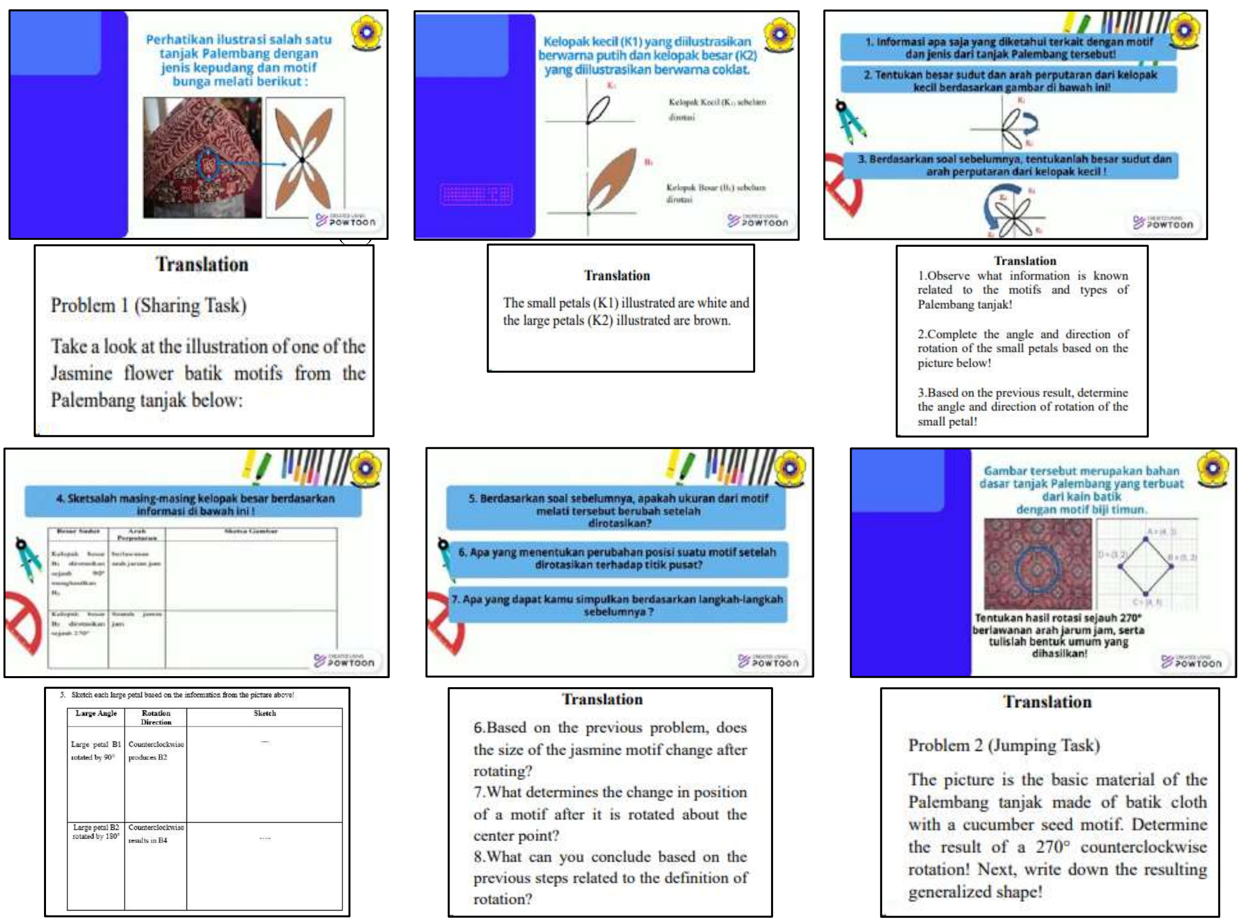


FIGURE 3. Prototype 3 on Rotation Material Using the Palembang *Tanjak* Context

The learning video created for this study includes a variety of elements, including sounds, graphics, and multiple animations used as illustrations Figure 3 [20]. One of the crucial subjects that is brought up in this study is rotation.

One significant kind of geometric transformation is rotation material, which can be applied to everyday objects [1]. In PMRI there are Five features include the use of student contributions, models, contextual problems, interaction, and integration with other subjects [11]. The PMRI technique can be tailored to the specific cultural circumstances and settings found in Indonesia [12]. There is a connection between mathematics and culture in that the former becomes a component of the latter through application and analysis of novel ideas [13]. Palembang *Tanjak* was selected as the research context because it is relevant to daily life, making learning more meaningful.

CONCLUSION

Based on findings from a one-to-one tryout study conducted at Sumsel Jaya Palembang Junior High School with representatives of three subjects with high, medium, and low abilities. Learning video was created was found to be valid based on the validation results at the expert review stage. Additionally, it was determined that the learning video was practical based on the findings of research conducted with six student participants in the small group tryout with two groups of students. The learning video that the researchers developed on rotation material using the Palembang *Tanjak* context is valid and practical, based on the description provided above. This information was gathered through observations made during the students' use of the instructional video and interviews.

ACKNOWLEDGMENTS

The learning videos in this study were validated by Dr. Refi Elfira Yuliani, S.Si., M.Pd., H. Muslimin Tendri, M.Pd., and Nur Elisyah, S.Pd., M.Pd., who provided comments and suggestions that allowed the learning videos to be used for research. For this, the author is grateful. The principal, SMP Sumsel Jaya Palembang's math teachers, and school operators who helped with this research are also appreciated by the authors.

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The Development of Learning Video on Reflection Material Using Palembang *Songket* Fabric Context

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Abstract. The type of research used is design research type development studies. The goal is to produce a learning video on reflection material using the context of Palembang *Songket* fabric that is valid and practical. This research uses PMRI approach and collaborative learning. This research was conducted because there were low factors in geometric transformation material, the lack of problems that related the material to everyday life and the availability of learning media that influenced students to be able to bring up their creative ideas. The context in this study used a cultural context, namely the context of Palembang *Songket* fabric. The subjects used were class IX (third grade) students in the odd semester at Sumsel Jaya Palembang Junior High School in the 2023/2024 school year. These students were identified to have heterogeneous abilities (high, medium and low). This research was conducted offline. The implementation procedure in this study uses two stages, namely preliminary stage (preparation, analysis and design) and formative evaluation stage (self-evaluation, expert review, one-to-one tryout and small group tryout). There were two methods used in collecting data, namely observation and interviews. The data analysis techniques used were observation data analysis and interview data analysis. The results of this study have shown that the learning video of reflection material using the context of Palembang *Songket* fabric is valid and practical. By using a learning video and a real context, namely Palembang *Songket* fabric, it can attract students' attention.

INTRODUCTION

Geometry transformation is one of the important materials for students to learn at the junior high school level. The definition of geometry transformation is a change that occurs such as a change in size, a change in shape in a geometric plane and a displacement of position. Transformation is divided into four parts, namely reflection (mirroring), dilation (magnification), rotation and translation (displacement) [1]. However, researchers only focus on the material that is reflection (mirroring). Moving a geometric figure or object with the same distance between the point of displacement and the mirror and the starting point and the mirror is known as reflection [2]. Geometry transformation is an important material because it contains a variety of cultures derived from everyday life [3]. However, the material is still fairly low because students still do not understand how to be reflected or mirrored from a building [4]. Students also face difficulties in choosing the right formula to solve the problem [5]. In addition, another problem is that the teaching method used is that the teacher is more active than students who only receive information [6]. Therefore, on the material of geometry transformation (reflection) should get the right way of learning.

One way to improve geometry transformation material is to relate it to more real examples [7]. This is in line with Indonesian Realistic Mathematics Education or better known as PMRI. PMRI is the name of "RME (Realistic Mathematic Education)" which has been adapted and adjusted in Indonesia [8]. Over several previous decades, realistic mathematics education (RME) has emerged as one of the major trends in mathematics education [9]. PMRI is a learning approach that uses real situations to help students solve problems and find their own answers [10]. Because PMRI uses real contexts or daily activities, learners can directly connect things they have experienced to mathematics. [11]. In PMRI teaching is built from the knowledge of learners [12]. In addition, one of the things that can be applied in schools so that students become active in learning mathematics is using PMRI [13]. By using PMRI,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040013-1–040013-10; https://doi.org/10.1063/5.0244868

this can help students in understanding learning materials [14]. The learning process will be more meaningful if it uses a context or involves things in everyday life [15].

One of the real activities in daily life can be motivated from a cultural context. [16] recommending cultural aspects allows students to learn and solve problems in mathematics in the context of everyday life at elementary school to college level learning. One of the cultures in Indonesia is *Songket* fabric. *Songket* fabric comes from South Sumatra, precisely in Palembang. Over time and the development of the times, *Songket* weaving crafts have been considered to be the cultural products of the Indonesian people, especially the Palembang area. The word *Songket* comes from the Malay language and the Indonesian language known as *sungkit*, which means "hooking" or "prying" [17].

There are four skills in the 21st century which are often known as 4C skills, namely, collaborative skills, critical thinking skills, communication skills, and creative thinking skills [18]. One of the important abilities in 21st century skills is collaborative skills. With a sense of togetherness and mutual collaboration, a sense of developing and solving solutions to problems in the group will automatically appear [19]. When learning in groups, students must ask questions in sharing task and jumping learning task using collaborative learning, which is important to learn in order to develop student potential [19]. Besides, when asking questions within the scope of Collaborative Learning, students are taught to say "Please Teach Me" [20].

Because learning media is needed in the 21st century, the solution used is to use learning videos. Student learning motivation will be proportional to the level of curiosity in a learning media prepared by the teacher [21], so the media prepared by the teacher must be interesting [22]. Learning media is a way to facilitate the teaching and learning process through a tool as an intermediary for delivery, so that teachers and students communicate effectively [23]. In learning, the media is expected to make the learning process more effective and efficient in accordance with learning objectives [24]. One of the learning media can be a video, because this can influence students to bring up their creative ideas [25]. A learning video is a type of media that conveys audio and visual messages that help students understand the subject matter and also in learning videos contain concepts, principles, techniques, and theories of knowledge applications [26]. Learning videos can be used as an effective learning resource, because they display concepts in a real and organized manner [27]. The relationship between PMRI and learning videos is in line with [26] who said that the results show that students are given freedom of thought by using learning videos made based on PMRI learning characteristics.

There is previous research on the learning design of reflection and translation in the context of the Sam Poo Kong Temple Semarang researched by [28], as well as interactive videos and E-LKPD to help improve understanding of geometry transformation material in the SAVI learning model researched by [29]. There is also previous research from [30] entitled Inductive reasoning ability of students using the Palembang *Songket* fabric context in rotational learning in grade IX. Then, the development of GeoGebra-assisted mathematics learning media on geometric transformation material studied by [31]. In addition, there is an effect of using video learning media on the learning outcomes of elementary school students [32]. One of the other previous studies was the development of teaching materials in the context of the La*skar Pelangi set with the Indonesian realistic mathematics education (PMRI) approach for class VII junior high school* [33]. From the explanation above, it can be seen that there is no research that combines learning video development, cultural context, namely Palembang *Songket* fabric, and reflection material.

Based on the explanation above, researchers conducted research on "Development of learning video on reflection material using Palembang *Songket* fabric context".

METHOD

The type of research used is design research type development studies. The goal is to produce a learning video on reflection material using the context of Palembang *Songket* fabric that is valid and practical. The subjects used were class IX students in the odd semester at Sumsel Jaya Palembang Junior High School in the 2023/2024 school year with heterogeneous abilities (high, medium and low). The implementation procedure in this study used two stages, namely preliminary stage and formative evaluation stage [34]. At the preliminary stage consists of preparation stage, analysis stage and design stage while at the formative evaluation stage are self-evaluation, expert review, one-to-one tryout and small group tryout. In preparation for initial research, researchers conducted observations of the research site, namely Sumsel Jaya Palembang Junior High School. Researchers asked permission from the principal of SMP Sumsel Jaya Palembang to conduct research. After that, the researcher discussed with the teacher about the students who would be used as research subjects, then discussed the right time for implementation. The results of the discussion obtained were that there were three ninth grade students who would be used in the one-to-one tryout trial and six ninth grade students in the small group tryout trial who had heterogeneous abilities. There are two ways used in collecting data, namely observation and interviews. Observation is used in the learning process to see the attitude or behavior of students. At the one-to-one tryout stage, observation was carried out to see the validity of the learning video, while at the small group tryout stage it was carried out to see the practicality of using the developed learning video. The interview at the one-to-one tryout stage aims to find out students' difficulties in solving problems in the learning video which is used to improve the developed learning video. The interview at the small group tryout stage aims to see the use of the developed learning video. The data analysis techniques used are observation data analysis and interview data analysis. The following Figure 1 is a flow chart of this research:

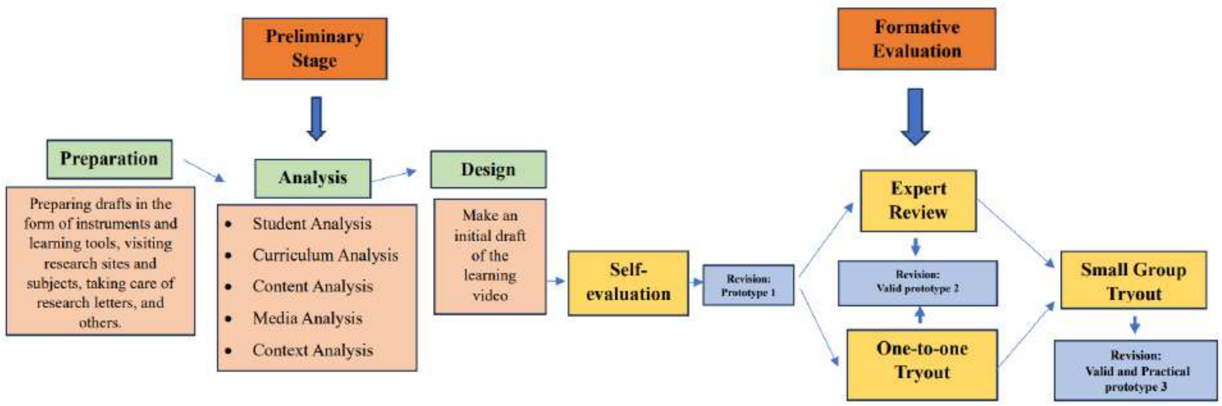


FIGURE 1. Research flowchart

Figure 1 shows that the flow chart of the research starts from the preliminary stage (preparation, analysis, and design) and the formative evaluation stage namely self-evaluation, expert review, one-to-one tryout and small group tryout.

RESULTS AND DISCUSSION

This research will produce a learning video of reflection material using the context of *Songket* fabric that is valid and practical. The instrument used in this research is a learning video. There are three stages in preliminary stage, namely preparation stage, analysis stage and design stage, the following is an explanation of these stages:

1. Preparation Stage

In preparation stage, researchers prepare drafts in the form of instruments and learning devices, visit research sites and subjects, take care of research letters, and others.

2. Analysis Stage

The analysis stage consists of 5 components, namely student analysis, curriculum analysis, content or topic analysis, media analysis and context analysis. At the student analysis stage, the researcher discussed with the math teacher about the students' abilities. At the curriculum analysis stage, the teacher provided information that the curriculum used at Sumsel Jaya Palembang Junior High School is the 2013 curriculum, this aims to determine the basic competencies and learning objectives to be achieved. Furthermore, in the content/topic analysis, researchers analyzed the material used in the learning video, namely geometric transformation material (reflection). Reflection material is found in class IX in the odd semester. This is used because reflection material is related to everyday life. The media analysis demonstrates that there is still a lack of Sumsel Jaya Palembang Junior High School teachers using learning media in the form of learning videos, so the learning media used by researchers is learning videos. Finally, the context analysis used a cultural context, namely the context of Palembang *Songket* fabric.

3. Design Stage

In the design stage, researchers designed a learning video on reflection material using the context of Palembang *Songket* fabric. The design results of the products that have been made are called prototypes which have three characteristics. These characteristics are content, construct and language. The Figure 2 below shows the initial prototype:

BASIC COMPETENCIES

3.5 Explaining geometry transformation (reflection) related to contextual problems
4.5 Solve contextual problems related to geometry transformation (reflection)

COMPETENCY ACHIEVEMENT INDICATORS

3.5.1 Determine geometric transformations (Reflection) associated with contextual problems
4.5.1 Solve problems related to geometry transformation (Reflection)

LEARNING OBJECTIVES

3.5.1 Using a learning video through problems using Palembang *Songket* Fabric Context, students can determine geometry transformation (Reflection) connected to contextual problems.
4.5.1 Students can solve problems related to geometric transformation (Reflection) using learning videos with problems using Palembang *Songket* Fabric Contexts

INSTRUCTION

1. Prepare paper and stationery
2. Make your identity such as name, class, attendance number and day group.
3. Work on these problems individually first
4. If there is still something you don't understand, then you have to ask for help from a group of friends and say "Please Teach Me". The friend who is asked for help is obliged to teach until he understands.

PROBLEM 1

One day, Nina went to a *Songket* fabric shop. then she tried one of the *Songket* fabrics. then she looked in the mirror. the *Songket* fabric motif used by Nina is the *Rumpak Songket* fabric motif.

1. What is the information in the question?
2. In the figure above, mirroring is shown with respect to which axis?
3. Draw it again and fill in the sketch by giving different letters to the triangles
4. How many pairs did you find?
5. What are the pairs of mirrored letters?
6. Is it obvious that there is "mirroring" material in this problem? If so, explain!

PROBLEM 2

Ms. Nanda went to a mall with her family. There was a fabric exhibition, one of which was *Songket*. Here is one of the illustrations of the *Songket* fabric motif that she saw

Then, determine (Reflection) on the y-axis, then continue with mirroring on y = 1 and draw a picture in cartesian coordinates

FIGURE 2. Initial Prototype of Reflection Video Learning Material Using the Context of Palembang *Songket* Fabric

Figure 2 above shows the learning video that was made for the first time before being tested on students and validated by expert review. After making the learning video, the next stage is the formative evaluation stage which consists of several stages.

In formative evaluation stage consists of self-evaluation, expert review, one-to-one tryout and small group tryout. he following is an explanation of the formative evaluation stages that have been carried out:

a. Self-evaluation

At this stage, the product that has been made and designed at the previous stage was checked or re-evaluated by the researchers to identify potential errors. Based on the evaluation results by researchers, there were several revisions, namely, (1) adding duration and (2) revising the video title. The following Table 1 includes the results of prototype 1:

TABLE 1. Results before and after revision at the self-evaluation stage

Before revision	After revision
	
	
REFLECTION (Mirroring) "*Songket*" Context Reflection Video	REFLECTION (Mirroring) Context reflection video of Palembang *Songket*

After the self-evaluation stage with revisions in Table 1. Next, researchers proceeded to the Expert review stage, where all learning tools were validated in order to become more valid.

b. Expert review

At the expert review stage, the learning videos were consulted to the validators. The validators in this study were Dr. Refi Elfira Yuliani, S.Si., M.Pd., Dr. H. Muslimin Tendri, M.Pd., and Nur Elisyah, S.Pd., M.Pd. Suggestions and comments from the three validators were used to revise the product developed by the researcher, namely the learning video of reflection material using the context of Palembang *Songket* fabric. The types of validity used by validators are content validity, construct validity, and language validity. The following Table 2 summarizes suggestions, comments from validators, and revision decisions from researchers regarding the learning videos.

TABLE 2. Suggestions, Comments from Validators and Revision Decision at Expert Review stage

Expert	Suggestions and Comments	Revision Decision
Dr. Refi Yuliani, S.Si., M.Pd.	1. Video can be added with researcher's voice	The researchers have added real voices to the learning video
	2. The video can be slowed down so that students are still reading but already on the next slide.	The researchers have revised by lengthening the duration of the video and

Expert	Suggestions and Comments	Revision Decision
		adjusted to the addition of the researcher's original voice.
Dr. H. Muslimin Tendri, M.Pd	1. Adding the researcher's real voice to the video	The researchers have added real voices to the learning video
	2. Some of the text in problem 2 can be enlarged	The researchers have improved/enlarged the writing on problem 2
	3. Adding source to photos in problem 1 and 2	The researchers have added sources to the photos in problems 1 and 2 but personal sources are not included
Nur Elisyah, S.Pd., M.Pd.	1. Showing a clearer picture of the context in problem 1	The researchers have clarified the picture on problem 1
	2. The sentence of point 4 in problem 1 needs to be clarified	The researchers have corrected the sentence in point 4 of problem 1.
	3. In problem 2, show the context image first	The researchers have added a context image to problem
	4. Customizing video time	The researchers have adjusted the video time to make it longer
	5. Adding sources to the photos in problems 1 and 2	The researchers have added sources to the photos in problems 1 and 2 but personal sources are not included.

Table 2 shows the validation results from Three Mathematics Education lecturers. The role of the three lecturers is very important and has provided suggestions to make the learning video better. From the results of the validation, the researchers revised all the suggestions and criticisms.

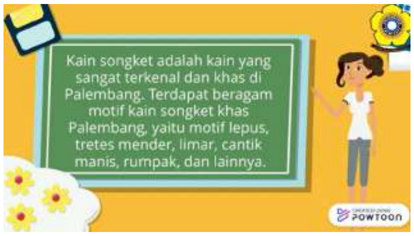
c. One-to-one tryout

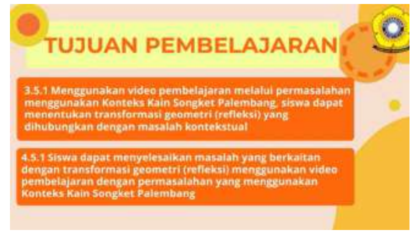
At the one-to-one tryout trial stage, there were three students with heterogeneous abilities who were recommended from the ninth-grade Mathematics teacher. Then, researchers conducted interviews to ask further about student responses, namely suggestions and comments on learning videos. The final results of the observation and interview served as a reference for the revision of the learning video. The following Table 3 includes the results of observations, interviews and revision decisions on one-to-one tryout:

TABLE 3. Observation, Interview and revision decision on One-to-one tryout

Observation and Interview Results	Revision Decision
The video is good and interesting, but students suggest that the writing can be enlarged so that it looks clearer.	The researchers have improved the video by splitting one slide into two slides to make the contents clearer in problem 2.
Students suggested slowing down the video because there were still some slides that had not been read before the video moved onto the next slide.	The researchers have revised by extending the duration of the video

After conducting the expert review and one-to-one tryout stages, the results of suggestions and comments were revised in Table 3 and the revised results were called prototype 2 which was valid in terms of content, construct and language. Figure 3 below shows the result of prototype 2:





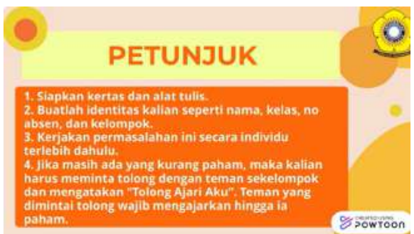
Songket fabric is a very famous and distinctive fabric in Palembang. There are various motifs of *Songket* fabric typical of Palembang, namely *lepus, tretes mender, limar, cantik manis, rumpak*, and others.

Here are some pictures of Palembang *Songket* motifs

Songket Lepus
Songket Tretes Mender
Songket Limar

LEARNING OBJECTIVES

3.5.1 Using a learning video through problems using Palembang *Songket* Fabric Context, students can determine geometry transformation (Reflection) connected to contextual problems.
4.5.1 Students can solve problems related to geometric transformation (Reflection) using learning videos with problems using Palembang *Songket* Fabric Contexts



INSTRUCTION

1. Prepare paper and stationery
2. Make your identity such as name, class, attendance number and day group.
3. Work on these problems individually first
4. If there is still something you don't understand, then you have to ask for help from a group of friends and say "Please Teach Me". The friend who is asked for help is obliged to teach until he understands.

One day, Nina went to a *Songket* fabric shop. then she tried one of the *Songket* fabrics. then she looked in the mirror. the *Songket* fabric motif used by Nina is the *Rumpak Songket* fabric motif.

1. What is the information in the question?
2. The following figure shows mirroring of what axis?
3. Draw it again and fill in the sketch by giving different letters to the triangles.
4. How many pairs of mirroring results are there?
5. What are the pairs of mirrored letters?
6. Is it clear that there is "Mirroring" in this problem? If so, explain!

Ms. Nanda went to a mall with her family. There was a fabric exhibition, one of which was *Songket*. Here is one of the illustrations of the *Songket* fabric motif that she saw.

Ms. Nanda went to a mall with her family. There was a fabric exhibition, one of which was *Songket*. Here is one of the illustrations of the *Songket* fabric motif that she saw

Then, determine (Reflection) on the y-axis, then continue with mirroring on y = 1 and draw a picture in cartesian coordinates

FIGURE 3. Prototype 2 of Learning Video on Reflection Using the Context of Palembang *Songket* Fabric

d. Small group tryout

The small group tryout stage invited groups of 6 students, namely 2 groups with each group consisting of 3 students. The 6 students who were used as subjects were discussed with the teacher. In each group contains heterogeneous students, namely high students, medium students, low students. There are 2 high students, 2 medium students and 2 low students with a total of 6 students. This was deemed sufficient to see the validity and practicality at the final stage, namely the small group tryout. Then, the researcher conducted interviews with students regarding students' responses and asked for suggestions and comments on the learning video that had been displayed. The results of the observations and interviews were used to revise for the learning video. The following Table 4 presents the results of observations, interviews and revision decisions in small group tryouts:

TABLE 4. Results of Observations, Interviews and revision decisions in small group tryout

Observation and Interview Results	Revision Decision
Students suggest improving the font color and background color.	The researchers have improved the writing color and background color in the context section.
Students suggest improving some of the sounds and lengthening the duration more.	The researchers have improved the learning video so that it is clearer and some sounds are slowed down.
Improving the picture of the problem in problem 1 to make it look more real.	The researchers have corrected the picture in problem 1

After conducting trials using learning videos at the small group tryout stage, there were suggestions and comments as a reference for revising learning videos and these results were proven valid and practical, which led to the prototype 3. The following Figure 4 displays the result of prototype 3:

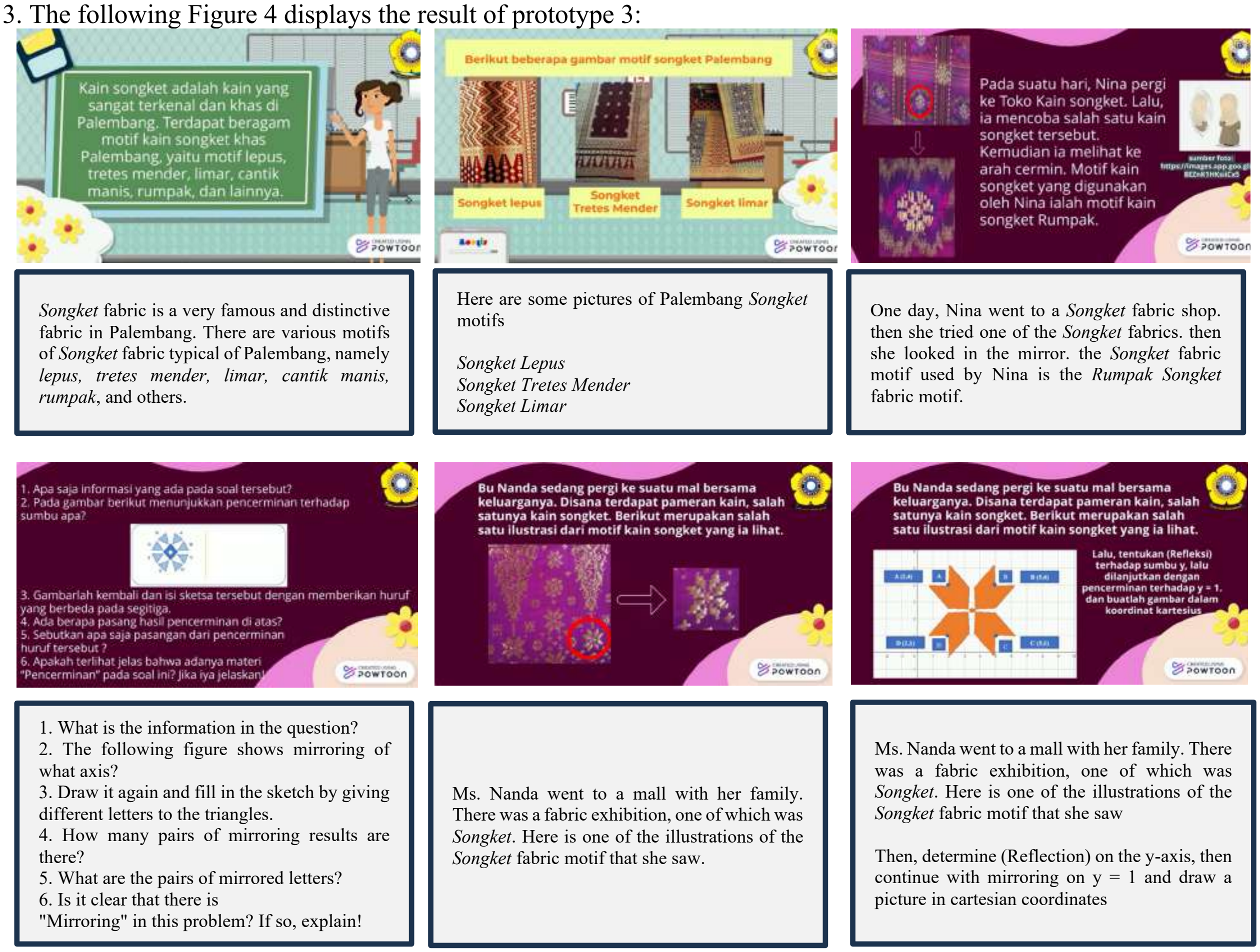


FIGURE 4. Prototype 3 Video Learning Reflection Using the Context of Palembang *Songket* Fabric

In Figure 4 is prototype 3 where this is a valid and practical prototype and can be used during learning. This research has developed a learning video about reflection material using the context of Palembang *Songket* fabric. One of the learning media can be a video, because this can influence students to bring up their creative ideas [25]. This research also uses PMRI and collaborative learning and has been adjusted to its principles and characteristics. One of the contents in the learning video displayed contains two real problems. Because it relates to real problems, this is related to PMRI. PMRI uses real context or real activities in everyday life so that students can directly connect the real things they have experienced into formal mathematics [11]. Two problems in the learning video used are sharing task and jumping task. When learning in groups, students must ask questions in sharing task and jumping task learning by using collaborative learning, this is important to learn in order to develop students' potential [19]. The content of the problem is related to the context used, namely the context of Palembang *Songket* fabric. The researchers have completed two stages in this research, namely preliminary (preparation stage, analysis stage and design stage) stage and formative evaluation stage (self-evaluation, expert review, one-to-one tryout and small group tryout). From the explanation above, the learning video of reflection material using the context of Palembang *Songket* fabric has been categorized as valid and practical.

CONCLUSION

From the results and discussions in the study, this learning video is proven interesting for students. Also, the study has concluded that the learning video on reflection material using the context of Palembang *Songket* fabric that has been developed has satisfied the valid and practical categories. With the characteristics of a learning video that has been valid and practical, there are sharing task and jumping task questions at the end of the video, audio contains the voice of the researcher and song accompaniment, and an explanation of the context of Palembang *Songket* fabric.

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ACKNOWLEDGMENTS

The author would like to thank Sumsel Jaya Palembang Junior High School for helping this research, especially the principal and grade IX Mathematics teacher. Also, the authors would like to thank the three validators who really helped this research by providing suggestions and comments on the learning video to make it better, namely Mrs. Dr. Refi Elfira Yuliani, S.Si., M.Pd., Mr. Dr. H. Muslimin Tendri, M.Pd., and Mrs. Nur Elisyah, S.Pd., M.Pd.

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Design Thinking as a Performance-Based Assessment in the Culture-Based Lessons in Geometry

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Abstract. In response to the challenges posed by the pandemic, this study aimed to enhance the learning experience of Grade 10 learners through the development of culture-based Self-Learning Modules (SLMs) and the integration of design thinking activities in the context of Mathematics education. The study utilized a nonequivalent group design and administered a 25-item van Hiele Test as both pretest and posttest to assess the geometric thinking levels of learners. The findings revealed a statistically significant improvement in geometric thinking among learners in the Culture-based Lesson with design thinking activities (CBLDT) group compared to those in the Culture-based Lesson (CBL) group. While specific quantitative data and examples from the van Hiele Test were not provided in this passage, the study demonstrated a meaningful impact of integrating design thinking activities. This suggests that such activities can be valuable tools for Mathematics teachers, enhancing students' geometric thinking abilities. It is imperative for educators to recognize the potential of design thinking activities as effective pedagogical tools. By incorporating these activities into Mathematics lessons, teachers can encourage students to think critically, problem-solve, and apply mathematical concepts in real-life scenarios. Furthermore, future research endeavors should delve deeper into the specifics of design thinking methodologies, providing comprehensive insights into their influence on various aspects of mathematical learning.

Keywords: Culture-based Lesson, Design Thinking Activity, Design Thinking, Performance-based Assessment, Self-Learning Module, van Hiele Test, and Level of Geometric Thinking.

INTRODUCTION

Geometry is a fundamental branch of mathematics and serves as a bridge between algebra and calculus. It introduces concepts like deductive reasoning, axiomatic systems, and theorems, which are essential in higher-level mathematics [24]. Learning geometry is important for its direct mathematical applications and its broader impact on cognitive development, problem-solving abilities, and relevance to a wide range of practical fields and everyday situations. [24, 37].

Nevertheless, within the context of the Philippines, the academic performance of Filipino students in the 2019 Trends in International Mathematics and Science Study (TIMSS) revealed a disheartening outcome, as they were positioned at the lowest tier among the 58 nations participating [38]. Specifically, the Philippines attained the lowest recorded scores, registering 297 in Mathematics and 249 in Science, figures that markedly lagged behind those of all other participating nations. This underscores the fact that many Filipino students exhibit suboptimal proficiency in recognizing standard geometric shapes primarily through visual means. Consequently, there exists a pressing imperative for Mathematics educators in the Philippines to embark on initiatives aimed at elevating the geometric reasoning abilities of Filipino students [28, 38].

Many researchers globally accept the notion that elevation of the van Hiele Level of geometric thinking is a promising solution to improve students' Geometry performance. Elevating students' geometric thinking levels in the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040014-1–040014-14; https://doi.org/10.1063/5.0241676

teaching and learning process is necessary because it is essential in many scientific, technical, and occupational fields such as engineering, technology, and inventions [39].

Several researchers did more quasi-experimental studies on enhancing the van Hiele level of geometric thinking. A few integrate technology and Video-based instruction since these let the learners explore geometric shapes and identify the properties of these figures. Some were maximizing another type of instruction. In addition, it was suggested that refining and applying hands-on learning activities to the extent furthers the learners' participation in Geometry class [38]. Moreover, Muslim mathematics teachers in Mindanao, one major part of the Philippines archipelago, applied culture-based lessons in their classrooms but suggested enhancing culture-based modules with activities and supplementing learning materials aligned to a hands-on approach reflecting the van Hiele-level theory [47].

Meanwhile, Design Thinking (DT), as a problem-solving approach in Mathematics, imparted a positive impact on Mathematics. It was determined that mathematical process standards and concepts were employed in DT in designing Minecraft. DT develops mathematical process standards. It was observed that prototyping implementation and the DT with Minecraft employed mathematical concepts [36]. Furthermore, Design thinking (DT) was utilized in logo-designing activities in mathematics classrooms [46]. Design thinking used as activities should be blended with geometric lessons can strengthen student learning and understanding of mathematical concepts in the context of the design process [36, 46]. By applying design thinking principles to geometry education, educators and instructional designers can create more engaging, effective, and learner-centered approaches to teaching geometric concepts. This approach not only helps students better understand geometry but also fosters creativity and innovation in the field of education itself [21].

To address the extension of the application of DT and the enhancement of the activities of the culture-based lesson in Geometry, the researcher found to develop culture-based lessons in the form of Self-Learning Modules with design thinking activities as performance-based activities in the SLMs in designing geometric transformations within the context of Maranao (Muslim Filipino) crafts. Therefore, the researcher would develop design thinking activities and SLMs, and investigate their effectiveness in the learners' van Hiele level of geometric thinking.

So, the fundamental goal of this study is to develop design thinking activities as a performance-based assessment in the culture-based SLMs. The sub-objectives are specifically the following:

1. Develop design thinking activities and culture-based SLMs;
2. Investigate the level of geometric thinking among learners by administering the result of the pre-tests and post-tests scores using 25-item van Hiele test
3. Compare the level of geometric thinking [Levels: Recognition (1), Order, Analysis (2), Deduction (3) and Rigor (4)] among learners with the SLMs and design thinking activities and those without design thinking activities and assess the level of improvement using Usiskin's Method [8]

Figure 1 shows the schematic diagram of the conceptual framework of this study. There are three significant variables in the conceptual framework, namely: 1.) Learner's Prior Level of Geometric thinking and prior skills in designing; 2.) The development of culture-based design thinking activities and Self-Learning Modules (SLMs); and 3.) The learners' improved level of geometric thinking with their developed skills in designing Maranao crafts. The learners' prior level of geometric thinking and design skills (input variable) influences how they engage with and benefit from the design thinking activities and culture-based SLMs (process). The effectiveness of the process (design thinking activities and SLMs) determines the extent of improvement in learners' geometric thinking and design skills (output). In connection, a strong process can potentially mitigate initial gaps in the learners' abilities, leading to a significant enhancement in their skills and level of geometric thinking. The researcher gave the pretest to learners to establish comparability of the two groups namely, Culture-based Lesson (CBL) group and the Culture-based Lesson with design thinking activities (CBLDT) group. The researcher then developed a culture-based lesson using SLMs and design thinking activities suitable to learners' capability. Learners used these activities to explore geometric concepts instilled in Maranao crafts. After doing all the activities, the researchers gave a post-test to testify to the improvement gained after the intervention. The performance of the said two groups in pretest and post-test was compared with appropriate statistical tools.

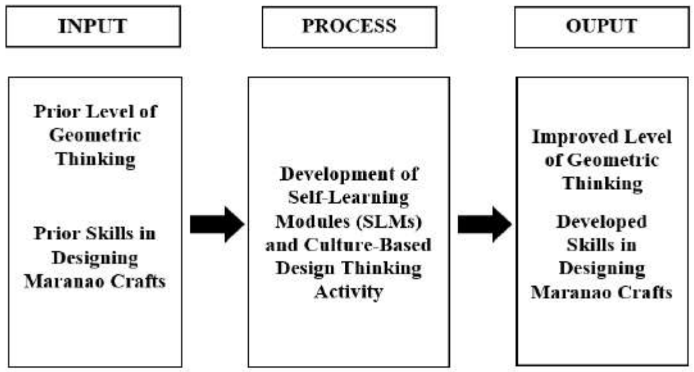


FIGURE 1. Conceptual Framework of the Study

METHODOLOGY

Research Design

This study employed a specific type of quasi-experimental design, the nonequivalent group design, to make inferences on the effectiveness of implementing culture-based SLMs and design thinking activity. In this design, the selection of the participants was not randomized. The selection was based on the latest grade in Math and their gender to sustain similarity between the two groups in avoidance of biases. These groups were named Culture-based Lesson Group (CBL Group) and Culture-based Lesson with design-thinking activities Group (CBLDT Group). Treatment of design-thinking activities was given to the participants belonging to the CBLDT Group, while no treatment was provided for the CBL Group. The developed design-thinking activities of the CBLDT group were attached to their Self-Learning Modules to serve as their performance-based- activities. The CBL group received the traditional types of SLMs and their activities. The time interval between the pretest and posttest was four weeks which was assumed to be sufficient to measure the participants' learning after the intervention. Furthermore, the difference in the participants' performance between the pretest and posttest served as the criterion for portraying the effectiveness of the intervention and identification of the level of geometric thinking. The researchers analyzed the results and performance of each group after data collection.]

Research Participants

The participants of this study were twenty (20) fourth-year high school students or Grade-10 students from Section 1 of the school during the school year 2021-2022. There were two groups in the study, the ten (10) learners that comprised the Culture-based Lesson Group (CBL Group) and the ten (10) learners that comprised the Culture-based Lesson with design thinking activity group (CBLDT group). Similar latest grades in Math, gender, and prior level of geometric thinking are the criteria that served as the basis for selecting participants. The participants were categorized based on their latest grades: High Achiever, Average, and Slow Learners concerning their gender. The introductory level of geometric thinking before the intervention was also considered. This was to ensure that the two groups' performances were equally the same. The researchers preferred these participants because based on the K to 12 Mathematics Curriculum Guide, and they were able to tackle more concepts about Algebra and Patterns, Geometrical shapes such as circles, triangles, parallelograms, and Trigonometry. The number of learners equals the number of target participants. Thus, these participants were chosen with a valid basis.

Data Collection

After the process was completed (development and validation of the developed design thinking activities and the SLMs by the panel of evaluators and the application for ethical approval before the conduct of the study), the researcher, with the thesis advisor's consent, sought permission from the Director of the school for the implementation of the activities to the selected Grade 10 learners. In addition, similar letters were sent to the principal of the school and cooperating teacher, explaining the purpose of the study.

Upon the approval from the school to conduct the study, parents' consent and learners' assent forms were then distributed, to finalize the list of learners willing to participate in the study. The release of parents' consent and assent forms was during the release of the first SLMs. Most of the parents signed the form within the day of release, and the rest gave back the forms after the day of distribution. This assured the parents' permission.

The researchers then implemented the developed design thinking activities for learners belonging to the experimental group with the help of the Grade-10 Mathematics teacher, who happened to be the adviser of the class also. The school's schedule for the distribution and submission of the SLMs was every Thursday. The gap in the releasing of SLMs and their submission was two weeks since it is the one of the protocols of the chosen school to submit their outputs every two weeks during modular learning. Two weeks of experimental study was sufficient in investigating the van Hiele geometric thinking level in the study of Tieng and Eu (2014) [51]. Thus, the submission of SLMs and two developed design thinking activities was sufficiently allotted for four weeks.

During the implementation, the researchers and the class advisor first distributed the SLMs with developed design thinking activities. After distribution, a pretest was conducted simultaneously for the two groups (CBL and CBLDT Group). The researchers clearly explained the instruction to the learners. The researchers monitored the learners through phone calls and direct messages online. After four (4) weeks of implementation, the learners retook the van Hiele test as their posttest.

The researchers created the SLMs, and design thinking activities implemented in this study. They were evaluated by a panel of evaluators composed of a School Head Coordinator, a Head Teacher who was also a Mathematics teacher, and an Associate Professor of a specific University Laboratory High School using the SLMs Evaluation Checklist and Design Thinking Validation Checklist. The researchers served as the mathematics teacher for four (4) weeks of implementation. The pretest and posttest were administered before and after the implementation. Design thinking activities were used as the performance-based assessment of the SLMs of the CBLDT group, while the CBL group received the traditional assessment activities in their SLMs. The learners' data were secured, and appropriate measures were taken to preserve anonymity of the learners.

Data Analysis

In interpreting the average ratings that the panel of evaluators gave for the SLMs and design thinking activities, the researcher used the SLMs Evaluation Checklist and Design Thinking Validation Checklist. The computation of the mean ranges assumed that the evaluator's average responses would fall within an interval following the critical points given in the evaluation tool.

Table 1 shows the mean ranges in the evaluation rating sheet and their corresponding interpretation used in this study for SLMs and design thinking activities.

TABLE 1. The Mean Ranges and Corresponding Descriptions Used in Interpreting the Ratings of the Panel of Evaluators on the Self-Learning Modules and Design Thinking Activities.

Mean ranges	Interpretation
2.35-3.00	Very Good (Passed)
1.68-2.34	Good (Passed)
1.00-1.67	Fair

For the quantitative data, the van Hiele test was administered before and after the implementation to determine the learners' level of geometric thinking. The results were recorded and analyzed to determine the learner's improvement in terms of the level of geometric thinking after the implementation of the design thinking activities for the CBLDT group. Likewise, the CBL group's result was recorded and analyzed. To determine the level of geometric thinking based on their performance in pretest and posttest, the learners' answers were evaluated using a method developed by Usiskin, known as the "*3 correct of 5*" method. This meant that when a learner answered at least 3 out of 5 items correctly in any of the subtests of the van Hiele Tests, the student was considered to have mastered the level. The following were the subsets of the van Hiele Tests: Level 0 (Recognition) – Item 1-5, Level 1 (Analysis) – Item 6-10, Level 2 (Order) - Item 11-15, Level 3 (Deduction) – Item 16-20, and Level 4 (Rigor) – Item 21-25. Scores were recorded according to the First Grading Method of Usiskin Method (2018). Each correct response to the 25-item multiple-choice test was assigned one point. Hence, the score of each learner from each of the two groups ranged from 0–25 marks.

Moreover, Table 2 shows learners' level of geometric thinking based on the Usiskin Method of Categorical Level of Improvement. It also shows the explanation of each progress used in interpreting the learners' scores before and after the implementation.

TABLE 2. Categorical Level of Improvement of Level of Geometric Thinking According to Usiskin Method [8]

Category	Explanation
Improvement between a level	The progression of van Hiele geometry cognitive development takes place in a sequential manner, exemplified by the transition from one level, such as L0, to a higher level, like L1, or from L1 to L2.
Skipping Phenomenon	Advancements in van Hiele geometry cognitive development do not adhere to a linear progression, as they do not consistently move from one level, such as L0, to a significantly higher level, like L2, or from L1 to L3.
Improvement within a level	There is no elevation in van Hiele geometry thinking levels, but there is a discernible augmentation in the scores reflecting the level of geometry thinking proficiency.
No Improvement	There is neither enhancement in the Van Hiele geometry thinking level nor any discernible change in the score representing the level of geometry thinking proficiency.

Coding of Qualitative Data

For easier data processing, participants or learners in each group were coded. Each participant was systematically assigned a corresponding three-letter consecutive code and number. The first letter of the code was based on their latest grade in Math. High Achiever Learners began their code as "H," Average Learner as "A," and Slow Learner as "S." The second letter of the code was based on their gender, "M" for Male and "F" for female. In the third letter and number, the participants in the CBL were coded using the letter C and a number corresponding to their consequential order. For instance, the first CBL group participant was coded C1, C2 for the second, and C3 for the third until C10. Likewise, the CBLDT was coded using the letter E and a corresponding number in sequential order. The first CBLDT group was coded E1, followed by E2 for the second participant, E3 for the third, E4, E5, E6 until E10. For example, a learner coded as HMC1 meant this learner was a Male High Achiever Learner and belonged to the CBL group. Likewise, the learner coded as AFE1 meant this learner was an Average Learner, Female, and belonged to the CBLDT group.

RESULTS AND DISCUSSION

Development of Culture-Based Self-Learning Modules (SLMs), Design Thinking Activities and Their Assessment Tools

The Backward Curriculum Design, a pedagogical framework introduced by Grant Wiggins and Jay McTighe in 1998, served as the foundational methodology for the creation of Student Learning Modules (SLMs) and the development of design thinking activities as performance-based assessments in this study. The fundamental premise underlying the Backward Curriculum Design departs from the conventional approach of designing lessons and then devising plans to attain educational objectives. Instead, it initiates the educational process by identifying the ultimate learning outcomes as the starting point. In this context, the learning objectives were meticulously developed, drawing upon the Most Essential Learning Competencies (MELCs) outlined in the K to 12 Mathematics Curriculum Guide, thus ensuring alignment with the broader educational objectives set forth by the Department of Education.

For the development of culture-based Self-Learning Modules (SLMs), after considering the preferred learning objectives from the K-12 Curriculum guide, the researchers developed two (2) SLMs and modified some of the activities by integrating cultural ideas as an illustrative example for geometric figures. These culture-based SLMs displayed the discussions of the selected topics in the MELCs. The topics in each module were quadrilateral, parallelograms, and circles and their parts. Each SLMs has four sub-parts. The first part of these SLMs stated the learning objectives. The second part was the pretest which was composed of five items only. The third part was Recap and Discussion, this section aims to reinforce the key concepts, lessons, or topics covered in the module. and the last part was Activities with Post-Test, consisting of five items. Figure 2 shows the processes of developing SLMs. First, the researcher prepared and considered the Most Essential Learning Competencies (MELCs) learning objectives. Afterwards, the Maranao cultural designs were incorporated as an illustrative example in geometric figure patterns. The researcher instilled the developed modules with the illustration of beautiful geometric shapes of Maranao Art textiles and crafts such as Okir, Landap, Baur and others. This process was followed by writing the activities in SLMs.

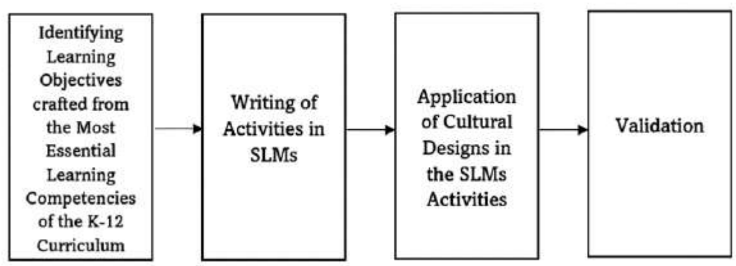


FIGURE 2. Diagram in Developing the Self-Learning Modules

Table 3 shows the summary of evaluation with the mean rating and percentage agreement results from the panel of evaluators in the SLMs. It earned a 2.94 total mean rating, with a percentage agreement reliability of 0.89 or 89.00%. In this evaluation results, the mean rating of 2.94 implied that the SLMs garnered the mark "*Passed*." It passed all these four factors: Instructional Design and Organization, Instructional Text and Visuals, Assessment, and Readability. Moreover, it had 0.89 reliability which meant the panel of evaluators agreed that all indicators or criteria were applied to the SLMs. Hence, based on the results, the crafted SLMs were qualified for implementation.

TABLE 3. Summary of Evaluation of the Culture-based SLMs

Criteria	Mean Rating	Percentage Agreement Reliability	Remarks
Factors:			
a.) Instructional Design and Organization	2.94	0.89/89.00%	Passed/Very Good
b.) Instructional Text and Visuals			
c.) Assessment			
d.) Readability			

After considering the preferred learning objectives from the K-12 Curriculum guide, the researcher developed two (2) design thinking activities that aimed to develop culture-based design thinking activities. These developed design thinking activities, which were culturally based, were composed of the five elements of the Design Thinking approach: Empathy, Defining the Problem, Ideation, Prototyping, and Testing. Figure 3 shows the processes of developing culture-based design thinking activities.

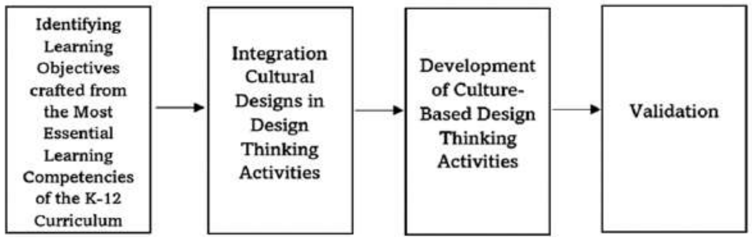


FIGURE 3. Diagram in Developing the Culture-Based Design Thinking Activities

Table 4 shows the evaluation with the mean rating and percentage agreement results from the panel of evaluators in the developed design thinking activities. It earned a 2.80 total mean rating with a percentage agreement reliability of 0.833 or 83.3300%. In this evaluation, the mean rating of 2.80 implied that the design thinking activities for the conduct were marked as "*Passed*." This meant that it passed all the characteristics and principles of the Design Thinking approach specified on the *Design Thinking Evaluation Checklist*. Moreover, it had 0.833 reliability which meant the panel of evaluators agreed that all the indicators or criteria were applied to the development and marked as "*Very Good*." Hence, based on the results, this development was proven aligned with the principles and characteristics of Design Thinking and qualified it for implementation.

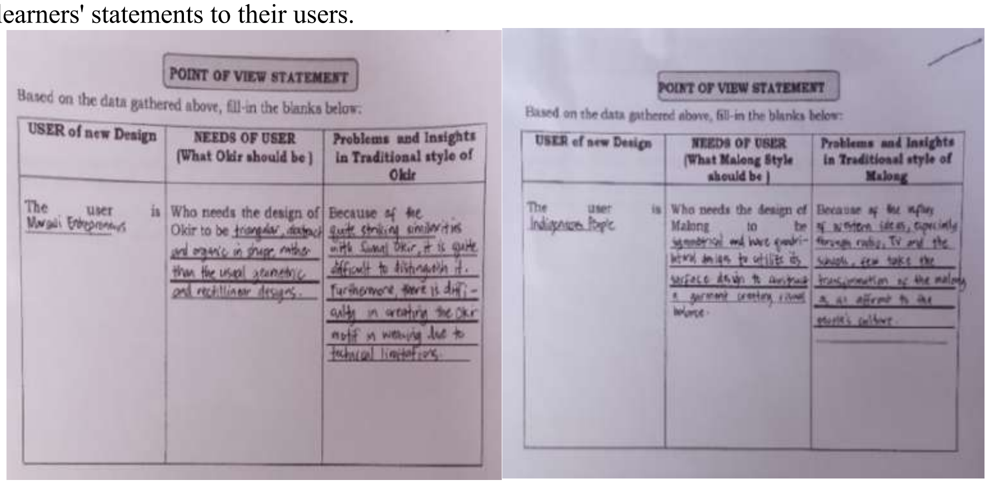
TABLE 4. Summary of Evaluation of the Developed Design Thinking Activities

Criteria	**Mean Rating**	**Percentage Agreement Reliability**	**Remarks**
Characteristics of Design thinking and its Principles	2.80	0.8333/83.33%	Passed/ Very Good

Doing Design Thinking Activities

Empathy entails the cognitive ability to adopt a perspective congruent with another individual's point of view and to deeply grasp their emotional state. This concept pertains to the discernment and actualization of the user's authentic desires within the context of product design [30,40]. In this step, learners used the Empathy map to outline the perspectives and feelings of their preferred users in the Maranao cultural designs.

The subsequent phase involves the formulation of problem definitions and an understanding of user requisites. Within the framework of design thinking (DT), an emphasis is placed on addressing user requirements. As part of this second stage, a strategy emerged, whereby students concentrated their efforts solely on a specific facet of the issue at hand. This culminated in the creation of a declarative statement referred to as a 'point of view statement' at the conclusion of this phase within the DT methodology. This led the student to develop various solutions, which ultimately helped them ideate and prototype [40]. Figure 4 shows the snapshots of the Point of View (POV) learners' statements to their users.



(a) (b)

FIGURE 4. (a) POV Statements of Participants about Okir (b) POV Statements of Participants about Malong

Third, Figure 4 that the most crucial process called ideation followed DT's second process. Ideation represents a creative endeavor wherein learners collectively engage in the generation of ideas during collaborative sessions. This collective effort is focused on optimizing the abundance of ideas available to address the issue articulated in the Point of View (POV) statement. Participants convene with open-mindedness, with the primary objective of generating a multitude of ideas, thereby guiding a problem statement toward a conducive, non-judgmental environment. Learners considered ways to integrate geometry in this process, as described by Caroll, M. etc. [21] in their work in discovering how to apply mathematics in Design thinking to create geometric transformation. They said that these high-level assignments released students from the constraints of solving problems. These allowed them to engage with and explore geometric shapes while exploring issue solution areas. Ideation was where the utilization of the learners applied their geometric thinking to their design, including visualizations, recognition of shapes, measurements, abstraction, and exploration [21, 30, 40].

The fourth step is prototyping. Prototyping constitutes a procedural approach by which design teams transmute conceptual abstractions into tangible manifestations, spanning the spectrum from ethereal ideas to palpable entities such as documents, digital renderings, and schematic representations in the realm of product design. This procedural initiative commences with the development of prototypes fashioned from readily available materials, including but not limited to paper, cardstock, and illustrative sketches. Learners can create multiple prototypes as a team [21, 30, 40].

FIGURE 5. Prototypes of the Learners

Figure 5 shows snapshots of the prototypes of the learners. The final process in DT is testing. Testing is a process of evaluating the prototypes by revisiting the demands of the learners' preferred users [21, 30, 40]. Learners used a checklist of the needs of their users to see if the things they wanted to see were applied to it.

Investigation of the Level of Geometric Thinking Among Learners and Its Comparison

TABLE 5. Level of Geometric Thinking of Learners Before the Intervention

CBL Group	Geometric Thinking Level	CBLDT Group	Geometric Thinking Level
HMC1	2 (Order)	HME1	2 (Order)
HFC2	1 (Analysis)	HFE2	1 (Analysis)
AFC3	0 (Recognition)	AFE3	0 (Recognition)
AFC4	1 (Analysis)	AFE4	1 (Analysis)
AFC5	0 (Recognition)	AFE5	0 (Recognition)

CBL Group	Geometric Thinking Level	CBLDT Group	Geometric Thinking Level
AMC6	0 (Recognition)	AME6	0 (Recognition)
AMC7	1 (Analysis)	AME7	0 (Analysis)
AMC8	1 (Analysis)	AME8	1 (Analysis)
SMC9	0 (Recognition)	SME9	1 (Recognition)
SFC10	0 (Recognition)	SFE10	0 (Recognition)

Table 5 displays the level of geometric thinking of the learners from both groups before the intervention. As shown, in the CBL group, only HMC1 reached Level 2 (Order), the highest level among the learners in this group. Four learners coded as HFC2, AFC4, AMC7, and AMC8 reached Level 1 (Analysis), and five learners, namely, AFC3, AFC5, AFC6, SMC9, and SFC10 were in Level 0 (Recognition).

In summary, learners in the CBL group had reached only Level 2, Level 1, and Level 0. Likewise, in the CBLDT group, only HME1 reached Level 2 (Order), the highest level among the learners. Four learners, coded as HFE2, AFE4, AME8, and SME9 reached Level 1 (Analysis), and five learners, namely, AFE3, AFE5, AME7, AFE6, and SFE10 were in Level 0 (Recognition). Summarily, learners in the CBLDT group had reached only Level 2, Level 1, and Level 0. This means that the pretest performance of the learners in the CBL group paired with the CBLDT group was largely similar except for AMC7 to AME7 and SMC9 to SME9.

TABLE 6. Comparison of Pretest Scores of Two Groups

	N	Mean Rank	Sum of Mean Ranks	U	Z- Score	P-Value
CBL Group	10	10.50	105.00	50.00	0.002	0.923
CBLDT Group	10	10.30	103.00			

Note: a=0.05 level of significance

The pretest was administered to establish the comparability of the two groups before conducting this study. Table 6 compares the pretest of two groups using the nonparametric test called the Mann-Whitney U Test. The result revealed no statistically significant difference in the geometric thinking level of the learners in the CBLDT and in the CBL groups before the intervention ($U=50.00$, $Z=0.002$, $p = 0.923 > 0.05$). This result shows that both groups were at the same level of geometric thinking before the start of the intervention. This means that the selection of the learners in the CBL and the CBLDT group was fair, and their levels of geometric thinking were similar.

TABLE 7. Level of Geometric Thinking of Learners After the Implementation

CBL Group	Geometric Thinking Level	CBLDT Group	Geometric Thinking Level
HMC1	2 (Order)	HME1	4 (Rigor)
HFC2	0 (Recognition)	HFE2	2 (Order)
AFC3	0 (Recognition)	AFE3	3 (Deduction)
AFC4	1 (Analysis)	AFE4	1 (Analysis)
AFC5	0 (Recognition)	AFE5	0 (Recognition)
AMC6	1 (Analysis)	AME6	1 (Analysis)
AMC7	0 (Recognition)	AME7	1 (Analysis)
AMC8	0 (Recognition)	AME8	2 (Order)
SMC9	0 (Recognition)	SME9	1 (Analysis)
SFC10	0 (Recognition)	SFE10	1 (Analysis)

Table 7 displays the level of geometric thinking of learners in both groups after the implementation (or based on their performance in the posttest). As shown, in the CBL group, only HMC1 reached Level 2 (Order), the highest level among the learners in this group. Seven learners coded as HFC2, AFC3, AFC5, AMC7, AMC8, SMC9, and SFC10 reached Level 0 (Recognition), and only two learners, AFC4 and AMC6, reached Level 1 (Analysis). HMC1, AFC3, AFC4, AFC5, AMC7, AMC8, SMC9, and SFC10 were the learners who were able to maintain their level despite the intervention. In the case of HFC2, AMC7, and AMC8, the learners were not able to improve their geometric thinking level. Instead, they fell one level below since they were from Level 1and went down to Level 0. However, in the case of AMC6, there was a one-step level of improvement observed coming from Level 0. The pretest went up to Level 1 in the posttest. In other words, only Analysis, Order, and Recognition Levels were reached even after the intervention in the CBL group. In summary, learners in the CBL group had reached only

Level 2, Level 1, and Level 0 again after the intervention. The similarity of the performance of this group before and after the intervention exemplified the acute effect of the SLMs and their traditional activities.

Meanwhile, more level of improvement was observed in the learners from the CBLDT group. The highest Van Hiele level of geometric thinking was reached by HME1 after the intervention. HME1 was from Level 2 (Order), but he improved his geometric level to the highest one, Level 4 (Rigor). Moreover, the same improvements in HFE2, AFE4, and AME8 were observed since they were from Level 1 (Analysis) and went up to Level 2 (Order). Another one-step improvement was observed in AME6, SME9, and SFE10 since they were from Level 0 (Recognition) and upgraded to Level 1 (Analysis). A two-step level of improvement was done by AFE3, only coming from Level 0 to Level 3 (Deduction). AFE5 and AME7 had no improvements at all, but they maintained their geometric thinking level before and after the intervention, as shown in Tables 5 and 7. In summary, learners in the CBLDT group completely reached the five van Hiele Levels of geometric thinking after the intervention. Most of the learners in this group who had received the SLMs and design thinking activities as performance-based activities improved their level of geometric thinking. This caused a positive effect on the geometric skills of the learners.

TABLE 8. Comparison of Posttest Scores of Two Groups

	N	Mean Rank	Sum of Mean Ranks	U	Z- Score	P-Value
CBL Group	10	7.10	71.00	16.00	-2.705	0.007
CBLDT Group	10	13.90	139.00			

Note: a=0.05 level of significance

Table 8 presents the results of comparing the posttest of two groups using the nonparametric test called the Mann-Whitney U Test. The results of this test revealed a statistically significant difference in the geometric thinking level of the learners in the CBLDT and the CBL groups after the intervention ($U=16.00$, $Z=-2.705$, $p = 0.007 < 0.05$). These results suggested that these groups were not at the same level of geometric thinking after the intervention. However, there was a significant difference in their levels. Hence, it is statistically shown that the development of culture-based design thinking activities as a performance-based activity improved the geometric thinking level of the learners in the CBLDT group. Therefore, its implementation was effective and is recommended to be used as a performance-based assessment to upgrade the geometric thinking level of the learners.

TABLE 9. Comparison of Pretest and Posttest Scores in CBL Group

	N	Mean	Std. Dev.	Mean Rank	Sum of Ranks	Z-Score	P-Value
Pretest	10	0.60	0.699	2.50	2.50	-1.000	0.317
Posttest	10	0.40	0.699	2.50	7.50		

Note: a=0.05 level of significance

Table 9 presents the results of comparing the pretest and posttest of the CBL group using the nonparametric tests called the Wilcoxon-Signed Ranks Test further to describe the performance of the learners in this group. The result of this test revealed no statistically significant difference in the geometric thinking levels of the learners of this group before and after the intervention ($Z=-1.000$, $p = 0.317 > 0.05$). This means that based on the same mean ranks, the geometric thinking level of the learners in the pretest was the same as their levels after the intervention or in the posttest. Therefore, the conduct of traditional SLMs did not affect the learners belonging to this group.

TABLE 10. Comparison of Pretest and Posttest Scores in CBLDT Group

	N	Mean	Std. Dev.	Mean Rank	Sum of Ranks	Z-Score	P-Value
Pretest	10	0.60	0.699	4.50	36.00	-2.636	0.008
Posttest	10	1.70	1.160	0.00	0.00		

Note: a=0.05 level of significance

Table 10 compares the pretest and posttest of the CBLDT group using the nonparametric test called the Wilcoxon-Signed Ranks Test to describe the learners' performance in this group. The result of this test further revealed a statistically significant difference in the geometric thinking level of the learners before and after the intervention ($Z= -2.636$, $p = 0.008 <0.05$). This result implies that based on the difference in mean ranks, the geometric thinking level of the learners in the pretest differed from their levels after the posttest. Therefore, the conduct of SLMs with the developed design thinking activities had a positive effect: the improved level of geometric thinking observed in the learners in this group.

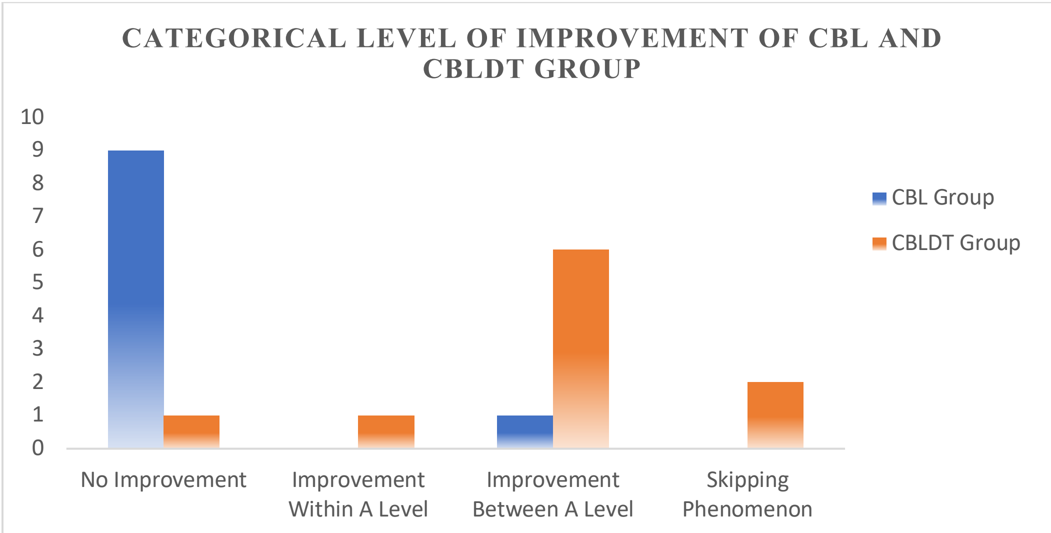


FIGURE 6. Categorical Level of Improvement of CBL and CBLDT Group

Figure 6 displays the bar graph of the learners' Usiskin's Method Categorical Level of Improvement in both groups. As shown, in the CBL group, nine (9) learners had no improvement before and after the intervention, and their performance was under the category of *No Improvement*. One (1) learner improved up one step, which was *Improvement between a level*. No one in this group was originally under the category of *Improvement within a level* and *Skipping Phenomenon*.

Meanwhile, in the CBLDT group, only one (1) learner was under *No Improvement* since there was no level of improvement observed. Also, there was another (1) learner whose improvement was under *Improvement within a level*. This category, according to Usiskin, was an improvement in which there was no step level of improvement, but the number of scores from pretest to posttest increased. Hence, this learner was able to increase his scores after the intervention. There were six (6) learners who were under this category of *Improvement between a level* since the improvements of these learners were all one step up (i.e., Level-0 to Level-1). Lastly, two learners were under the *Skipping Phenomenon*. This meant that these learners' improvement level was either two or three steps and did not occur in sequence. Summarily, many of the learners in the CBL group were under the *No Improvement* level, while the majority in the CBLDT group were under the category of *Improvement between a level* and *Skipping Phenomenon*. This abundance of improvement in the experimental group exemplified the positive effect of the design thinking activities in upgrading the geometric thinking of the learners.

Taking all of these accounts, it is clear that the implementation of design thinking activities had an affirmative effect on improving the level of geometric thinking among learners. Based on the series of *p-values calculated*, it was proven through the Mann-Whitney and the Wilcoxon Signed tests that there was a significant difference in the level of geometric thinking among learners who received SLMs with the design thinking activities, and those traditional activities. Learners in the CBLDT group had an even significant difference between their performance in pretest and posttest, while the learners in the CBL group had no significant difference in both tests. Moreover, based on the Usiskin's Categorical Level of Improvement, the level of improvement of the CBLDT group fell to *Improvement* levels while the CBL fell to the *No improvement* category.

CONCLUSION AND RECOMMENDATIONS

Following the *Backward Curriculum Design* in developing the SLMs and the design thinking activities, learners could reach learning goals with the help of these modules and the said activities; that is, culture-based as a performance-based assessment. Furthermore, implementing culture-based design thinking activities as a performance-based assessment in the SLMs positively impacts the learners' geometric thinking. In connection, after the processes that the learners in these activities have undergone, such as Empathy, Defining the Problem, Ideation, Prototyping, and Testing, it was proven that the activities that the learners did are aligned with the characteristics and principles of Design Thinking Approach. The prior level of geometric thinking of the learners in the CBL group before the treatment was the same in their post levels. At the same time, the learners in the CBLDT group showed more levels of improvement in the conduct of this study due to the integration of design thinking activities in their SLMs, as performance-based assessment. Therefore, the design thinking activities could be a catalyst for a math activity to improve the geometric thinking of the learners. It is found that through traditional methods of learning (specifically the use of Self-Learning Modules with its traditional activities for modular learning in Geometry) had an acute impact on the geometric thinking of the learners. This is so because it is statistically proven that there is no significant difference in the *level of geometric thinking* in the learners receiving SLMs with traditional activities in both pretest and posttest. However, if the learners are tasked to do a hands-on performance-based assessment along with SLMs such as the developed culture-based design thinking activities, this would potentially help to improve their performance in Geometry.

Based on the conclusions of the study, the following recommendations should be taken into consideration:

1. Mathematics teachers may develop and use design thinking activities as a performance-based assessment of SLMs since improvement has been shown. This pertains to the learners improving their van Hiele Level of geometric thinking through the implementation design thinking activities in this study.
2. Mathematics teachers (or any teacher) should try to make activities within the context of culture to ensure the learners' engagement in Mathematics (and other content areas), and for the learners to realize the real-life application of learning contents.
3. School administrators should require the teachers, specifically Math teachers, to extend their Self-Learning Modules with the hands-on learning activities such as a performance-based assessment like Design Thinking Activities. This is so because it has been proven that these have a positive impact on the mathematical thinking of the learners (as in geometric thinking).
4. Schools with Maranao students adapting Modular Learning may use these developed culture based- SLMs and developed design thinking activities to maximize learners' participation in the learning process even in the "New Normal" of schooling.
5. Further research must extend this study to include other topics in Mathematics or in Geometry in which researchers can integrate design thinking. They might also extensively apply design thinking in another discipline, and not just in Mathematics.

ACKNOWLEDGEMENT

The authors wish to convey their profound appreciation to the Department of Science and Technology, Science Education Institute (DOST-SEI), for the generous scholarship grant awarded through the Capacity Building Program in Science and Mathematics Education (CBPSME). Furthermore, they extend their heartfelt gratitude to the College of Education, DSME, MSU- Iligan Institute of Technology, situated in the city of Iligan.

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RICOSRE: Improving Students' Scientific Literacy Abilities in Environmental Change Material

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Abstract. The aim of this research is to find out how the RICOSRE learning model can influence the scientific literacy abilities of class X students on environmental change material. The research method was carried out through a quasi-experiment with a nonequivalent control group design. This study involved class X students in one of the high schools in the metropolitan city of Bekasi as the population. The sample for this research is X MIPA 1 as an experimental group using the RICOSRE learning model and X MIPA 5 as a control group using a direct learning model. The data collected is in the form of pre-test scores and post-test scores. The research results based on the Wilcoxon Signed Rank hypothesis test show that (1) there is an influence of the RICOSRE learning model with $\alpha = 0.00 < 0.05$ (2) the average N-Gain value of the RICOSRE learning model is greater than the direct learning model, namely equal to 64.38% compared to the direct learning model of i57.82%. So it can be concluded that the RICOSRE learning model has the potential to improve the scientific literacy skills of class X students at SMAN 6 Tambun on the subject of environmental change.

INTRODUCTION

Technological developments in the 21st Century require students to have more freedom in the learning process, both in speaking, expressing opinions and so on [1]. Students can solve problems independently and in groups so that there is socialization between students didik [2]. Educational institutions require 4C skills, namely creative thinking (creative thinking), critical thinking and problem solving (critical thinking and problem solving, communication and collaboration) focus on teachers (teacher center) must change to focus on students (student center) [3].These skills can of course help students to deal with social problems, scientific problems, and problems in an practically effective efektif [4]. Problem solving ability is a series of actions to solve problems using steps to produce the expected solution [5]. Learning that has been carried out by previous educators, namely by using the direct model in the form of a lecture limits students' freedom in solving problems and expressing opinions.

A learning model is a plan or pattern created to become the basis for teaching staff to provide teaching in class according to what has been prepared to make it easier for teaching staff in providing explanations of teaching materials to students [6] Limited and monotonous learning models or tools generally cause a reduction in students' interest in learning [7]. One learning model that can be used is the RICOSRE learning model. The RICORSE learning model was first developed by [4] which facilitates students to practice high-level thinking skills. The syntax of the RICORSE learning model is a development of the problem-solving-based learning model developed by several figures such as John Dewey (1933), Georga Polya (1988) and Stephen Krulick with Jesse Rudnick (1996) which consists of Reading, Identifying the Problem, Constructing the Solution, Solving the Problem, Reviewing the Problem Solving and Extending the Problem Solving. This change is based on the similarity of students' skills in working together, thinking at a higher level, having cultural literacy, being able to communicate, and being able to learn throughout life (long life learning).

Scientific literacy is defined as scientific knowledge and skills to identify questions, gain new knowledge, explain scientific phenomena, and draw conclusions based on facts. Developing scientific literacy for elementary school students is basically about attracting student involvement in the learning process and creating a pleasant learning atmosphere [8]. In categorizing students' abilities in scientific literacy, seven indicators are used to determine scientific literacy abilities. The seven indicators refer to indicators of scientific literacy abilities, namely (1) identifying valid scientific opinions (2) conducting effective literature searches (3) understanding the elements of research design and

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040015-1–040015-5; https://doi.org/10.1063/5.0241570
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

their impact on findings/conclusions (4) making appropriate graphs of data; (5) solve problems using quantitative skills, including basic statistics; (6) understand and interpret basic statistics; (7) make inferences, predictions and draw conclusions based on quantitative data [9].

There are many problems in the world of education, including the literacy of students who are still in the low category. Scientific literacy is one of the parameters in determining the human development index which is greatly influenced by the quality of education [10]. Scientific literacy encompasses many skills and can be described as the ability to critically transmit and understand scientific literature and apply this to a broader information context [11]. Based on data from PISA (International Student Assessment Program), students in Indonesia had a scientific literacy score in 2018 of 379 with a ranking of 71st. Indonesia's scientific literacy scores from 2000 to 2018 were 393, 395, 395 and 383, 379. [12]. Measurement of the level of scientific literacy is also carried out by TIMSS (Trend in International Mathematics Science Study) every four years with the aim of looking at the competition for achievements in Mathematics and Science among students in grades i4 and 8 in several countries that participated in the survey [13].

The results of pre-research on scientific literacy of students in one of the middle schools in a metropolitan city show that students' scientific literacy skills are still low, with indicators of understanding scientific phenomena 41.2%, finding scientific problems 47.3%, explaining phenomena scientifically 46.8 %, using scientific evidence 50%, and solving problems 52%. Meanwhile, student learning outcomes are still below the KKM. The KKM value is 76, while the average value is 61.12. Based on data from PISA and TIMSS as well as field observations, there is evidence that students are still in the very low category in scientific literacy and their learning outcomes [14]. The problem of low scientific literacy requires a creative and innovative learning model, namely the RICOSRE learning model [15].

The RICOSRE learning model can improve scientific literacy and cognitive learning outcomes [16]. There is an influence of the RICOSRE model on scientific literacy & students' self-esteem in Biology subjects [17]. Learning analytical skills [2] Problem solving skills in upper, middle and lower academic groups [18]. The lowest academic group achieved a remarkable increase in problem solving abilities (141.17%). In contrast to previous research, this research focused on measuring students' scientific literacy in environmental change material in high schools. Based on this background, researchers offer research entitled The Effect of the RICOSRE Learning Model to Improve the Scientific Literacy Abilities of Class X Participants on Environmental Change Material.

METHOD

The method in this research uses the one-equivalent control group design method, which is a quasi-experimental design that uses experimental groups and control groups [19]. In the experimental class the RICOSRE learning method will be given, while in the control class only Direct Instruction will be used. The population used was all students in class X MIPA 1 (experimental class) and X MIPA 5 (control class) totaling 77 people. Obtaining data to measure scientific literacy using the pre-test and post-test from the experimental class and control class which used a test instrument in the form of a description consisted of 15 questions. Data analysis uses analytical and descriptive statistics. The test results were processed using IBM SPSS Statistics 23 to measure the influence of the RICOSRE learning model in increasing the scientific literacy of class X students on environmental change material.

RESULT AND FINDINGS

The normality test is used to determine whether the data is normally distributed. In Table 1, it can be observed that the post-test group, experimental group, and pre-test control group showed sig results > 0.05, which means that the post-test scores for the experimental group and the pre-test control group had an abnormal distribution

TABLE 1. Normality Test

Group		Shapiro-Wilk		
		Statistic	**df**	**Sig.**
Pre test	Experimental Group	.938	37	.041
	Control Group	.964	35	.307
Post test	Experimental Group	.941	37	.055
	Control Group	.922	35	.016

Meanwhile, the significance of the Shapiro Wilk test in the experimental group pre-test and control group post-test showed sig < 0.05, which means that the data was not normally distributed. With data that is not normally distributed, the analysis will be carried out using the Wilcoxon Signed Rank test method to test paired data that is not normally distributed.

TABLE 2. Uji Wilcoxon

		N	Mean Rank	Sum of Ranks
*Post test*_XIPA1 - *Pre test*_XIPA1	*Negative Ranks*	0[a]	.00	.00
	Positive Ranks	37[b]	19.00	703.00
	Ties	0[c]		
	Total	37		
*Post test*_XMIPA5 - *Pre test*_XIPA5	*Negative Ranks*	0[d]	.00	.00
	Positive Ranks	35[e]	18.00	630.00
	Ties	0[f]		
	Total	35		

Based on the Wilcoxon test in Table 2, it was found that at a significant level of 0.05, the asmyp value was found. Sig (2 tailed) = 0.000 < 0.05 in both classes, namely X IPA 1 as the experimental group and X IPA 5 as the control group, so it can be interpreted that there is a significant difference between the pre-test and post-test. Based on further observations, it can be observed that all class members in X IPA 1, namely the experimental group, and in class XIPA 5, which is the control group, have experienced an increase. This can be observed in the first table, namely the N positive rank or the increase in X IPA 1 by 37 and in X IPA 5 by 35.

TABLE 3. N-Gain Test

	Group				Statistic	Std. Error
NGain	Experimental group	*Mean*			64.3887	3.82215
			Confidence Interval for Mean	*Lo er Bound*	56.6370	
				Upper Bound	72.1404	
	Control Group	*Mean*			57.8248	3.64391
			Confidence Interval for Mean	*Lo er Bound*	50.4195	
				Upper Bound	65.2302	

Based on the statistical values in Table 3, it was found that the n gain value in the experimental group, on average, was 64.3887%, which means that effectiveness was in the quite effective category, while in the control group it was also in the same category, namely in the quite effective category, namely an average of 57.8248%. When compared, it can be interpreted that the effectiveness of the experimental learning model is better than the effectiveness of the control group.

DISCUSSION

The research results show that there is a significant increase in scores on the post-test compared to the pre-test in the experimental class, so it can be interpreted that the RICOSRE learning model has an effect on increasing students' scientific literacy. In accordance with research conducted by _which states that the RICOSRE learning model is an efficient learning model in improving students' cognitive abilities, which in this research is directly proportional to the level of scientific literacy.

The reading syntax in this research is that students are motivated to think critically and creatively by constructing meaning from a text. Reading activities are very important and must be included in the core learning process [20].The syntax for identifying the problem is that students are trained to think critically by understanding the meaning of the problem and how to solve it. Formulating a problem not only involves finding the problem, but also conducting a thorough investigation to find out the reasons behind the problem [4]. The syntax of constructing the solution is that students are trained to think creatively by designing solution paths to solve problems [21]revealed that creative thinking is the main ability to find problems, make solutions in various dimensions flexible, and create new ideas. The problem solving syntax in this research trains students to think critically and creatively by implementing strategies to solve problems. Problem solving can be interpreted as developing ideas or creativity in building new knowledge [5]. The syntax of reviewing the problem solving and extending the problem solving aims to train students to think critically by analyzing the effectiveness and efficiency of the solution they have chosen and apply these solutions to similar problems (Mahanal & Zubaidah, 2019).

Based on the N-gain value, it can be seen that the efficiency of the RICOSRE learning model was found to be an average of 64.3887%, while the average efficiency of the direct learning model was found to be 57.8248%. When compared, it can be observed that with the RICOSRE learning model, higher effectiveness was found, namely better improvement compared to classes taught with the direct learning model. Based on this comparison, it was found to be in accordance with research conducted by [22]. These findings state that the learning model has an influence on the science literacy abilities of students, with it being found that the increase in the RICOSRE learning model is also higher than the direct learning model.

The RICOSRE learning model compared to the direct learning model has several advantages. The advantages of this learning model include that it is applicative [18]. The RICOSRE learning model directly connects the knowledge being studied with life as well as experiments and case studies, stimulating students to be able to connect this knowledge with problems that may be encountered. Apart from that, another advantage of the RICOSRE learning model is that it stimulates students' ability to think [21]. This increase in creative thinking abilities comes from the syntax of constructing the solution and solving the problem. Based on the advantages discussed previously, namely the formation of a relationship between students' knowledge and the problems they may encounter, this will encourage students to think creatively in solving problems that they have never encountered before with limited knowledge. With this encouragement, it is hoped that students' ability to solve problems will increase considerably.

CONCLUSION

The data collected and the results found from this research show that in the RICOSRE learning model, as well as in the direct learning model, there is an influence on scientific literacy skills, namely by obtaining an asmyp.sig score of $0.00 < 0.05$. Then, in the results of comparing the N-Gain values between the two learning models, it was found that there was an increase in the RICOSRE learning model which was greater than the increase in the direct learning model, namely 64.388% compared to the direct learning model of 57.828%, so it can be concluded that the RICOSRE learning model is more effectively used than in the direct learning model.

ACKNOWLEDGMENTS

We would like to thank Lemlitbang and FKIP Muhammadiyah University Prof. Dr. Hamka who has helped the smoothness and success of this research.

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Improving TPACK Competencies of Junior High School Mathematics Teachers Using GeoGebra Classroom

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Abstract. Technology plays an important role in the world of education. The rapid development of technology requires the world of education to also adapt to these changes. Technological Pedagogical Content Knowledge (TPACK) is important in educational research and technology. TPACK shows the relationship between technological knowledge (T), pedagogy (P), and content, (C) and how this knowledge should be integrated into teaching practice. One of the technologies that teachers can use in learning mathematics is the GeoGebra Classroom. GeoGebra Classroom is a technology-based mathematics learning tool to help teachers integrate technology into learning mathematics. In its use, it combines technology, pedagogy, and content in one learning platform. In this context, improving the TPACK competency of mathematics teachers is very important to improve the quality of learning mathematics. GeoGebra Classroom is a learning platform that allows mathematics teachers to teach interactively using GeoGebra software. By using GeoGebra Classroom, they can create interesting and challenging learning activities for students, as well as integrate technology with appropriate content and learning methods. To improve the TPACK competence of Junior High School Mathematics Teachers in Magetan, we conducted training on using GeoGebra Classroom. The training participants consisted of 16 teachers. The training materials provided include junior high school mathematics material, the use of technology in learning mathematics, and the application of GeoGebra Classroom in learning mathematics The results of the study showed (1) an increase in the TPACK competence of mathematics teachers using the GeoGebra Classroom, (2) the positive response of mathematics teachers to the training provided, and (3) mathematics teachers'ability to integrate TPACK using GeoGebra classroom in their mathematics learning designs

Keywords: TPACK, Junior High School Mathematics Teachers, GeoGebra Classroom

INTRODUCTION

Mathematics is a subject that is considered difficult and frightening by many students. They often find it difficult to learn mathematics because there are too many formulas to learn. This is based on the fact that junior high school students often experience difficulties in understanding mathematical concepts, especially because there are many formulas and complicated ways to calculate them. In addition, the use of appropriate and effective educational technology has not been fully utilized by teachers in schools.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040016-1–040016-9; https://doi.org/10.1063/5.0241861
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

One of the technologies that teachers can use in learning mathematics is the GeoGebra Classroom. It is a technology-based mathematics learning tool to help teachers integrate technology into learning mathematics. In its use, it combines technology (T), pedagogy (P), and content (C) in one learning platform. By using GeoGebra Classroom, teachers can design learning activities that are more interactive and interesting for students. In addition, it also allows teachers to provide real-time feedback to students and monitor their learning progress.

Technological Pedagogical and Content Knowledge (TPACK) is a model used to measure teachers' ability to integrate technology into learning. Teachers who have TPACK competence are considered capable of teaching effectively by using technology as a learning tool. This is to the results of research conducted by Herizal, Nuraina, Rohantizani, and Marhami [1] and research conducted by Sintawati and Indriani [2] which concluded that TPACK is an important ability for prospective teachers, as future teachers especially in the era of society 5.0 and also as demand for 21st-century learning.

Koehler and Mishra (2009) propose seven sub-domains under the TPACK framework: content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technology knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK). The elements comprising the TPACK framework encompass various dimensions. These include (a) content knowledge (CK), which pertains to the subject matter to be learned or taught; (b) pedagogical knowledge (PK), which encompasses the practices of teaching in relation to educational objectives; (c) pedagogical content knowledge (PCK), which involves an understanding of appropriate teaching methods specific to particular subject matters; (d) technological knowledge (TK), which denotes the proficiency in utilizing both conventional and advanced technologies; (e) technological content knowledge (TCK), which refers to the familiarity with the characteristics of technology relevant to specific subject matters; (f) technological pedagogical knowledge (TPK), which entails the awareness of the capabilities and components of technologies, as well as their effective utilization; and (g) TPACK, which encompasses the three core components of content, pedagogy, and technology, while also extending beyond them as distinct entities.

TPACK refers to the teacher's exhibited understanding of content-specific pedagogical strategies that effectively use the capabilities of technology technologies to facilitate students' acquisition of specific mathematical concepts. The scope of this topic includes the understanding and utilization of technology to represent mathematical concepts. Additionally, it involves the application of pedagogical strategies that leverage technology to address mathematical difficulties, such as misconceptions, effectively. Furthermore, it involves using technology to enhance and expand upon preexisting mathematical knowledge (Patahuddin et al., 2016). TPACK encompasses the specialized understanding of how technology can be effectively utilized to facilitate the teaching of specific material. This understanding includes knowledge of the specific technology (Koh et al., 2017).

The TPACK framework has been developed as a conceptual framework to guide teachers in efficiently integrating technology into their instructional practices based on their knowledge and understanding of content, pedagogy, and technology (Luo & Zou, 2022). The TPACK framework has garnered considerable attention from researchers worldwide due to its promise to enhance teaching and learning outcomes by facilitating the efficient integration of technology in educational settings (Valtonen et al., 2017).

In the content knowledge aspect, the *Merdeka* Curriculum emphasizes a more creative and innovative pedagogical approach to teaching. Teachers must be able to design pleasant and interesting learning for students. The TPACK concept can assist teachers in integrating appropriate technology, content, and learning strategies in the mathematics learning process. By integrating pedagogical technology, such as GeoGebra Classroom, teachers can make learning activities more interactive and support a pleasant learning experience for students. The connection between TPACK and the *Merdeka* Curriculum shows that the use of pedagogical technology, such as the GeoGebra Classroom, can be an effective means of achieving the goals of the *Merdeka* Curriculum. In addition, the TPACK concept can assist teachers in developing more creative and innovative pedagogical approaches to teaching mathematics.

In this context, improving the TPACK competency of mathematics teachers is very important to improve the quality of learning mathematics in schools. GeoGebra classroom is a learning platform that allows mathematics teachers to teach interactively using GeoGebra software. By using the GeoGebra classroom, they can create interesting and challenging learning activities for students, as well as integrate technology with appropriate content and learning methods. Thus, it is hoped that students can more easily understand mathematical concepts and improve their learning achievement. Therefore, increasing the TPACK competency of mathematics teachers with GeoGebra Classroom in junior high schools is an important step in improving the quality of mathematics learning and producing students who are more competent in mathematics.

Based on the situation above, the problem faced by mathematics junior high school teachers in Magetan is the lack of TPACK competence in learning mathematics. Understanding of the TPACK concept is still lacking in some mathematics teachers in Magetan. This makes it difficult for them to design and develop mathematics learning activities that use pedagogical technology, such as the GeoGebra classroom. In addition, mathematics teachers in Magetan have not received adequate training and assistance in developing their TPACK competencies. Thus, they still find it difficult to integrate educational technology into learning mathematics. This can be an obstacle to improving the quality of learning mathematics in junior high schools. Problems during the last pandemic can be used as momentum for teachers to try to strengthen the TPACK competencies needed in learning mathematics in the *Merdeka* curriculum.

Based on the problems above, the researchers are interested in conducting research with the title: “Improving TPACK Competencies of Junior High School Mathematics Teachers Using GeoGebra Classroom” which aims to describe (1) how the Junior high School teachers in Magetan increase their TPACK competence using the GeoGebra classroom (2) how the teachers respond to the training of improving their TPACK competence using the GeoGebra classroom, (3) how the teachers design their mathematics learning in using the GeoGebra classroom.

Based on the problems described, the given solution to solve this problem is to implement TPACK Mathematics Teacher mentoring and training using GeoGebra Classroom to assist teachers in using technology in learning mathematics. The activity begins with a presentation of material related to TPACK which consists of 7 components that must be possessed by teachers, namely Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and TPACK. The next activity is teacher practice related to learning using GeoGebra Classroom.

Much research has also been done on TPACK, such as research conducted by Restiana [3] with the title TPACK profile evaluation for junior high school mathematics teachers in Banten which shows that teachers only master one component of TPACK, namely content knowledge, which means that teachers still do not master other components in TPACK, especially those related to learning technology components. research conducted by Yurinda and Widyasari [4] entitled Analysis of Technological Pedagogical Content Knowledge (TPACK) of Professional Teachers in Learning Mathematics in Elementary Schools shows that teachers are accustomed to using technology in learning mathematics, especially during the demands of a pandemic. Based on the results of this study it can be concluded that teachers need to know, understand, and apply learning with the help of technology.

METHOD

This is descriptive research, with one group pretest and posttest design. The research subjects consisted of sixteen junior high school mathematics teachers in Magetan City. The research instruments are (1) pretest and posttest sheets, (2) teacher's response questionnaire sheet, and (3) learning instrument assessment sheet. The training materials used in this research are (1) the GeoGebra classroom module, (2) the Circle Concept and its Application, and (3) Technology in Mathematics learning.

In general, the activities of training that will be carried out can be described as follows: (1) Giving a Pretest, (2) Presentation of material of the circle concept and its Application, (3) Presentation of material of technology in Mathematics learning, (4) Introducing GeoGebra classroom content, (5) Workshop on using GeoGebra Classroom in designing learning instruments (6) Giving Posttest and response questionnaire, and (6) Giving homework to design learning instruments that use GeoGebra Classroom (7) Presenting the results of homework developed by the teachers in groups.

The data collection method used in this research is the test and the questionnaire methods. To analyze the test results, the t-test was used to see whether there was a significant increase between the pretest and post-test results. If there is an increase, then it is determined how much the increase is in the pretest to the posttest. Besides that, the results of the research were also analyzed using the N-gain. The increase in test results is said to be successful if the N-gain is greater than or equal to 0.3. To analyze the results of the questionnaire, quantitative descriptive analysis was used by calculating how much the teachers responded positively to this training. To analyze the results of homework, we pay attention to whether or not it involves the use of GeoGebra Classroom in the learning instrument, as well as whether the use of GeoGebra Classroom with the learning design developed.

RESEARCH RESULTS AND DATA ANALYSIS

TPACK Training for Junior High School Mathematics Teachers

There were 3 parts of training given to junior high school mathematics teachers, including content reinforcement related to the concept of circle and its application, technology in learning and the use of GeoGebra Classroom in teaching mathematical concepts. It not only enriched their knowledge but also provided new ways to explain the material to students in a more practical way. Furthermore, training on using technology in learning provided insights into how technology can improve teaching effectiveness. Teachers learned to integrate digital tools into their curriculum, facilitating better understanding and student engagement in math learning. Finally, using the GeoGebra Classroom in teaching mathematical concepts provided an opportunity to create an interactive learning environment. With this platform, teachers can present math concepts engagingly and interactively, allowing students deeper exploration and understanding. The training provides a solid foundation for junior high school math teachers to improve their teaching quality and provide students with a more meaningful learning experience. An example of a practice problem is shown in Figure 1.

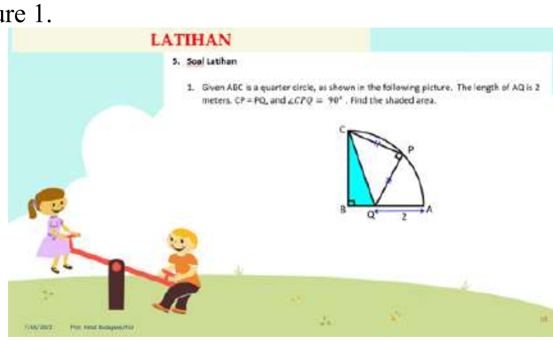

FIGURE 1. Circle Content Practice Problem

The first material aims to strengthen the understanding of mathematics content within the TPACK framework, primarily related to the circle concept and its application. Junior high school math teachers will be given a series of Olympic Exercise problems related to the circle material and discussion. The purpose of giving these questions is not only as a test but also as a pretest to evaluate the extent of the teacher's mastery of the circle material before following the module and further training. This approach is expected to create a deep understanding and applicative solid skills on the concept of circles in teaching mathematics at the junior high school level. Math learning technology is shown in Figure 2.

FIGURE 2. Math Learning Technology

Mathematics learning technology is a crucial foundation for middle school mathematics teachers in creating engaging and challenging learning experiences for learners. This second talk discusses two innovative technologies that significantly help improve the quality of math teaching in the classroom. First, ChatGPT is an indispensable tool for crafting engaging learning scenarios, enabling teachers to create immersive interactive experiences to understand mathematical concepts. The advantage of ChatGPT lies not only in its ability to design learning scenarios but also in its ability to respond dynamically to students' questions, creating a deep and personalized dialogue. Meanwhile, the second technology, Photomath, is a tool that supports learners in understanding the procedure of working on math problems. Using a mobile phone camera, Photomath allows students to take photos of math problems and presents step-by-step solutions instantly. The combination of these two technologies not only provides a more colorful learning experience but also helps to create a responsive and open learning environment for mathematical exploration. The iterface of GeoGebra Classroom is shown in Figure 3.

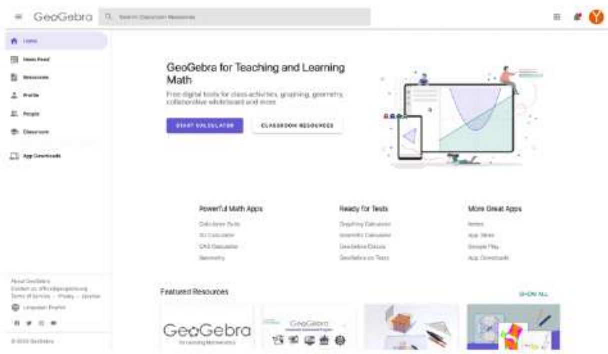

FIGURE 3. Interface of GeoGebra Classroom

The third course provided an in-depth introduction to GeoGebra Classroom as an effective technology tool for teaching math content. GeoGebra Classroom is a virtual platform that serves a similar purpose to its native application, GeoGebra, but with distinguishing advantages: its accessibility through a website and its ability to provide interactive tasks that are more engaging for students (Amiudi et al., 2021). More than just using the GeoGebra application, a proper understanding of mathematical concepts is also critical in influencing students' understanding of the material. This material provides math teachers with an understanding of how to create math formative content and assessments integrated with GeoGebra Classroom. Then, teachers are invited to create a mathematics lesson integrated with GeoGebra Classroom, aiming to measure the extent of their mastery of using this technology in mathematics learning. This step is expected to illustrate teachers' understanding of the usefulness of GeoGebra Classroom in helping to improve the quality of mathematics learning for students.

Pretest and Posttest Result

The Pretest and Posttest Results of Junior High School Math Teachers are summarized in Table 1 as follows.

TABLE 1. Pretest and Posttest Results of Junior High School Math Teachers

No.	**Initial**	**Pretest Score (= X_1)**	**Posttest Score) (= X_2)**	**$X_2 - X_1$ (= d)**	**d^2**
1	DMD	64	75	11	121
2	SMN	52	80	28	784
3	TYK	65	85	20	400
4	FMY	47	77	30	900
5	PMD	55	72	17	289
6	NDN	72	80	8	64
7	RDA	60	74	14	196
8	HUP	53	89	36	1296
9	WMR	75	90	15	225
10	JYT	50	70	20	400
11	PMB	65	85	20	400
12	UYY	45	95	50	2500
13	RSW	70	85	15	225
14	TSW	60	75	15	225
15	TEV	50	98	48	2304
16	YDK	70	90	20	400
Total		953	1320	367	10729
Mean		59.5625	82.5	22.9375	

Based on the data above, a standard deviation value of SD = 12.50 can be obtained. Furthermore, by assuming the research data is normally distributed, the t value can be calculated as follows.

$$t = \frac{\bar{d}}{\frac{s_d}{\sqrt{n}}} = \frac{\mathbf{22.9375}}{\frac{12.50}{4}} = 7.34, \text{ whereas } t_{(0{,}01,\ 15)} = 2.946713$$

Because $t_{(0{,}01,\ 15)}$ is greater than the t value, it can be stated that there is an increase in the TPACK competence of junior high school Mathematics teachers in Magetan City using the GeoGebra classroom.

The N-gain value is calculated as follows. N-gain = $\frac{(X_{posttest} - X_{pretes}t)}{(X_{ideal} - X_{pretest})} = \frac{(81.8125 - 62.625)}{(100 - 62.625} = 0.513378$

Since 0.3 ≤ N-gain ≤ 0.7, it means that the increase in TPACK competency of junior high school in Magetan is in the moderate category.

Teacher Response Questionnaire Results

The results of the teacher's response questionnaire were analyzed by giving an assessment score to each student teacher's response to each questionnaire item given. Based on the results of the questionnaire, it was determined whether the teacher's response included a positive or negative response. In addition, the researcher also described the impressions and suggestions given by the teachers participating in the training.

The results of the teacher's response questionnaire to the implementation of the training "Strengthening the competence of TPACK teachers using GeoGebra Classroom" can be presented in the following Table 2.

TABLE 2. Percentage of the Mathematics Teachers' Response

	Teacher response questionnaire statements	**TDA**	**DA**	**A**	**SA**	**Response categories**
1.	Instructors master the training material.	0	0	0	100	positive
2.	The training atmosphere is boring	50	50	0	0	positive
3.	The training material is presented clearly.	0	0	30	70	positive
4.	Interesting training material to be used in the process of learning mathematics.	0	0	0	100	positive
5.	This training does NOT increase my math knowledge.	40	60	0	0	positive
6.	Resource instructors LESS responding to participant questions well.	40	60	0	0	positive
7.	This training improves my understanding of using technology.	0	0	20	80	positive
8.	Presentation of learning technology material is difficult to understand	30	70	0	0	positive
9.	Using GeoGebra Classroom makes it easier for me to plan lessons.	0	0	40	60	positive
10.	The delivery time for training materials is too short.	0	0	80	20	positive
11.	I am NOT interested in taking up this kind of training again.	40	60	0	0	positive

Note: TDA: Totally Disagree, DA: Disagree, A: Agree, SA: Strongly Agree

The teachers' impression of the training that has been carried out is as follows.

1 The training is very interesting and adds motivation to continue learning
2 This training refreshed my memories regarding geometry and GeoGebra, and I understood more
3 The training is very interesting and inspires me to learn more so that I can make and plan lessons for children
4 This training is very useful because it adds to my knowledge of mathematics learning technology.
5 I am very happy to ask for more training in the geometry and GeoGebra chapters, more time.
6 It is very interesting and this training can be further developed in learning
7 Alhamdulillah very inspiring spirit and provides insight. The source is very interesting

8 Training is Great Fun
9 The resource person is fun, enjoys participating in the training
10 GeoGebra Classroom material is interesting to learn and try on students

Teacher criticism/suggestions for the training that has been carried out, can be stated as follows.

1. The duration of the study needs to be extended
2. Please extend the training time, so that you can absorb more knowledge from the resource person/speaker.
3. Hold another training
4. Time is a very short time and it should be added

Results of Teacher Performance in Designing Learning

Based on the results of the teacher's performance in designing group learning which they uploaded on the given Google Drive, 100% of teachers can use GeoGebra Classroom in the learning tools that are made, and the use of GeoGebra Classroom is the learning design provided. Figure 4 shows an examples of teacher performance results in designing learning instrument components using GeoGebra Classroom.

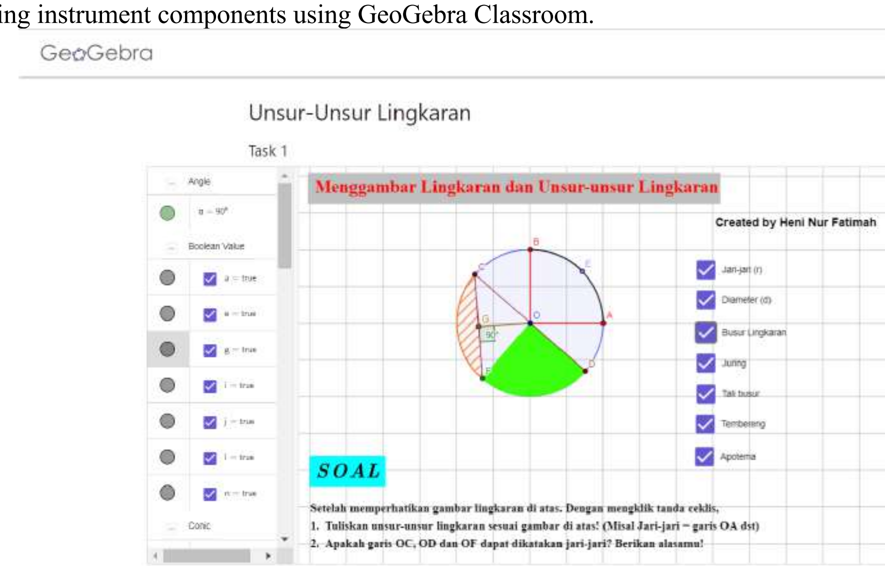

FIGURE 4. By using the learning media on the side, students can learn for themselves about the elements of circles and their respective images, then it is hoped that students will be able to define each element of the circle.

Based on all the results of data analysis, it can be stated that training on TPACK competence of junior high school Mathematics teachers using GeoGebra Classroom has a positive impact on increasing teacher TPACK competence in teaching mathematics. The teachers involved in this training have better knowledge and skills in integrating technology effectively in teaching, which in turn is expected to improve student learning outcomes. This research provides empirical support for the importance of proper TPACK training in the context of using educational technology such as the GeoGebra Classroom.

RESEARCH RESULTS AND DATA ANALYSIS

The results of this research are in line with the results of research conducted by Cerenus Pfeiffer [5] with the title "A Study of the Development of Mathematical Knowledge in A GeoGebra-Focused Learning Environment" and demonstrated that teachers had more motivation on how GeoGebra could be used as a pedagogical tool. The qualitative and quantitative results also revealed that GeoGebra allowed teachers to better teach and learn functions, circle geometry, and general solutions of trigonometric equations. The qualitative content analysis of pre-and post-tests for both transformations of functions and circle geometry showed that teachers moved to better competence

This is also in line with the research on the effects of training using the GeoGebra Classroom on teachers' TPACK competence in teaching mathematics. In the study, he compared the knowledge and skills of TPACK teachers before and after training. The results showed that there was a significant increase in teachers' TPACK competence after attending training with GeoGebra Classroom. Before the training, the majority of teachers experienced challenges in integrating technology into mathematics learning and felt a lack of confidence in using digital tools. However, after attending the training, the teachers better understood how to integrate GeoGebra Classroom into their learning. The competency of TPACK teachers is increasing in several key aspects, including:

1. Content Knowledge (CK): Teachers demonstrated a deeper understanding of the math concepts being taught and were able to identify the most appropriate concepts to illustrate through the GeoGebra Classroom tool.
2. Pedagogical Knowledge (PK): After the training, teachers become more skilled at designing engaging and interactive learning activities using GeoGebra Classroom, which encourages student participation and critical thinking.
3. Technology Knowledge (TK): Teachers gain an understanding of how to use GeoGebra Classroom features and tools to support mathematics teaching and create effective visual models.
4. Technology Pedagogy and Content Knowledge (TPACK): Teachers improve their skills in integrating knowledge, pedagogical, and technological content to create more in-depth and meaningful mathematics learning experiences.

The results of this study are also in line with research conducted by Bhagat, Chang, and Huang [6], with the title Integrating GeoGebra with TPACK in Improving Pre-Service Mathematics Teachers' Professional Development, and obtained research results that there were changes in teachers' TPACK after undergoing the GeoGebra workshop. Practical implications are discussed regarding how to enhance teachers' pre-service TPACK using GeoGebra in mathematics teaching.

CONCLUSION

Based on the results of the data analysis that has been done, it can be concluded that:

1. The TPACK competency of junior high school teachers in Magetan using the GeoGebra class has improved, reaching a moderate category
2. The teachers' response to the training of improving their TPACK competence using the GeoGebra classroom is positive.
3. All mathematics teachers can use GeoGebra Classroom in designing mathematics learning tools.

RECOMMENDATION

For Researchers who will carry out further research which:

1. Use more sophisticated performance measurement methods to assess the improvement in TPACK competency of Junior High School Mathematics teachers after training. For example, involving more intensive classroom observation and valid assessment tools.
2. Conduct in-depth case studies on teachers who have effectively integrated GeoGebra Classroom in their classrooms. This can provide more detailed insight into how the training impacts students' learning and understanding of mathematics.
3. As well as looking at improving teacher TPACK competence, research has also focused on the impact of using GeoGebra Classroom on student learning outcomes, such as increased academic achievement and interest in mathematics.
4. Should examine the inhibiting factors that teachers may face in integrating GeoGebra Classroom in mathematics learning, this is done to help design more effective training.
5. Conduct research for a longer period to observe the sustainability of improving teacher TPACK competencies and their impact on sustainable teaching practices.
6. It should investigate the comparison of the effectiveness of training using GeoGebra Classroom with other training methods in increasing the TPACK competence of Middle School Mathematics teachers.

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Analysis of the Validity of E-Comic Video Media on the Basic Isometry Theorem Material With A Realistic Approach to Educational Mathematics

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Abstract. The basic isometry theorem material is one of the materials that is considered difficult for students because it requires an understanding of concepts that are more easily understood by online tutorial students. Based on the results of the evaluation that was carried out in the transformation geometry course, it was suggested that one of the basic isometry theorem materials was difficult to understand. The reason of this research is to deliver a item within the frame of video-based e-comic media with a realistic mathematics education approach on isometric fundamental hypothesis material that can be utilized in online instructional exercises for understudies of the 4th semester Science Instruction ponder program at the Universitas Terbuka. This consider utilized the Dick & Carey design model with 5 stages, namely Dick & Carey are 1) distinguishing directions targets, 2) conducting guidelines examination, 3) analyzing understudy characteristics and setting, 4) defining particular directions goals, 5) creating evaluation disobedient, 6) creating guidelines techniques, 7) creating and selecting suitable directions materials. The yield that has been accomplished in this think about is the generation of video-based e-comic items with a practical science instruction approach that's substantial based on legitimacy tests from fabric specialists and media specialists. Based on the comes about of the normal evaluation gotten from material specialists that's rise to to 89.14% and the normal rating of media specialists is break even with to 90.86%. From the comes about of the two validators, a add up to normal of 90% was gotten, so it can be concluded that video-based e-comic item media with a realistic mathematics education approach on isometric essential hypothesis fabric is appropriate for utilize by Universitas Terbuka students.

Keywords: e-comic, realistic mathematics education, basic isometry theorem

INTRODUCTION

Within the current period of society 5.0, it is obligatory for speakers to be able to create understudies who are competent of confronting worldwide challenges, in agreement with the Universitas Terbuka Vital Arrange which states that lecturers must be able to make curiously ICT based learning, subsequently it is required for speakers to form inquire about ponders. IT-based, namely innovation to educate and learn science. With respect to the number of media utilized within the learning prepare, it must be balanced to the student's character and the characteristics of the subjects being considered. One of the subjects that Universitas Terbuka arithmetic instruction consider program understudies discover it

Realistic Mathematics Education (RME) may be a human action and must be connected to reality. RME has characteristics, among others, that within the learning prepare understudies must be given the opportunity to reevaluate mathematics through educator direction which the rehash of numerical thoughts and ideas must begin from investigating different circumstances and “real world” issues [1],[11].

Japanese comics such as manga have overpowered Indonesian fans centering on youths since the 1990s. The comes approximately of a consider conducted by Kompas explore and change made data illustrating that the bigger portion of manga aficionados were young people matured less than 25 a long time [2]. Comics, which are deciphered as cartoon pictures with substance, are able to communicate a message in a light and fun design. Grasping a comedian media design with video-based computerized bundling to communicate learning messages is an elective for making learning media.

Regarding the number of media used in the learning process, it must be adjusted to the student's character and the characteristics of the subjects being studied. One of the transformation geometry courses that students at the Universitas Terbuka mathematics education study program find difficult to understand is the basic theorem of isometry. Therefore, the researchers have developed media that can attract students' interest in reading, one of which is video-based e-comic media using the RME approach [12], [13].

Based on the description of the background of the problem, this article will raise the problem formulation, namely the validation results of video-based e-comic media using the RME approach on basic theorem of isometry.

LITERATURE REVIEW

Comics can be characterized as a cartoon that communicates characters and actualizes a story in a grouping that's closely related to pictures outlined to engage the readers. Comics incorporates a storyline that communicates an creative ability and tells stories in an interrelated arrangement, by combining pictures and composing outlined to supply amusement to perusers. Comics has an guidelines part in raising student's intrigued. The utilize of comics can offer assistance understudies capture unique things or equations.

A few individuals have created comics as a medium of teaching for diverse subjects, levels of instruction, and instructive goals [3], [14]. Comics utilized within the instructing and learning prepare can increment inspiration and incitement of learning exercises, and it encompasses a mental impact on understudies [4], [15]. Other than, comics can moreover increment understudy inspiration and intrigued and creates fun learning [5], [16]. The utilize of cartoons can help to diminish uneasiness in learning arithmetic [6]. The utilize of cartoons in educating empowers understudies to precise issues experienced and makes understudies realize that science instruction isn't as it were approximately giving "brief redress answers" but too includes wealthy discoursed. Their creative ability and imagination are set free. Hence, e-comics are required to attain learning destinations and make learning more interesting's so that understudies are more dynamic and propelled in learning.

Meanwhile, based on several studies on realistic mathematics education in the transformation geometry course the research results show that this learning trajectory can support students to understand the concept of Transformation Geometry [7]. As for research from [8] that the application of GeoGebra assisted PMRI using the context of line up rules can grow and improve students' understanding of the concept of geometric transformation. This can be in line with [8] claiming that the application of ethnomathematical based worksheets on geometric change materials can move forward understudy learning results. As for [9] The discoveries of the ponder appeared that this directions plan seem invigorate understudies to supply reflection characteristics and other transformation geometry casually, to classify them within the change isometry within the moment level, and to discover the reflection supporting line within the more formal level.

METHODOLOGY

This research has a place to the sort of R & D (research and development) specifically creating a learning media item. The investigate show employments the improvement of the Dick & Carey. The steps of this investigate and advancement show are 1) recognizing directions targets, 2) conducting guidelines investigation, 3) analyzing understudy characteristics and setting, 4) defining particular guidelines targets, 5) creating appraisal rebellious, 6) creating directions procedures, 7) creating and selecting fitting directions materials. The taking after is flowchart of the employments the improvement of the Dick & Carey demonstrate as takes after:

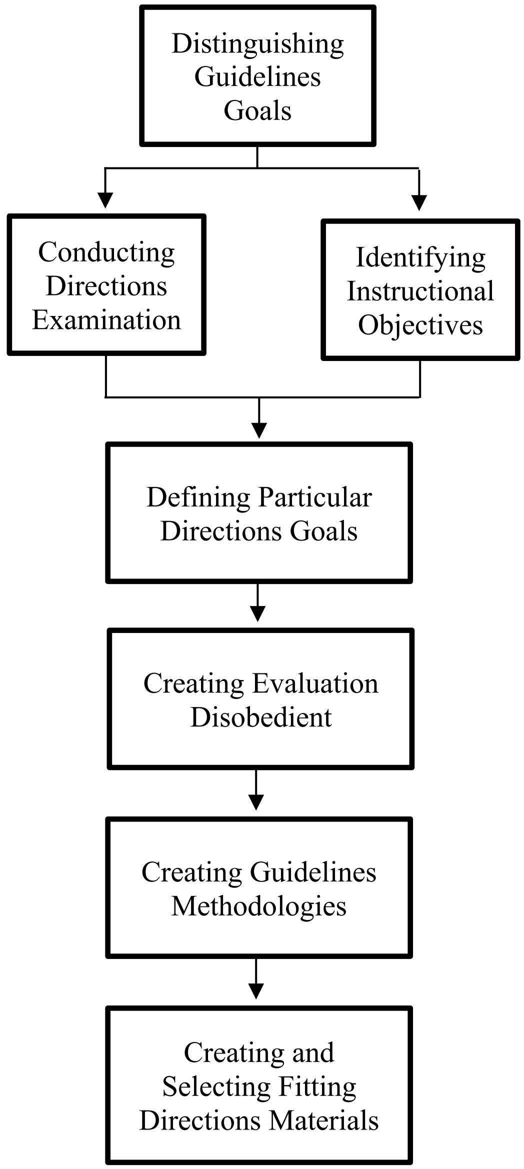

FIGURE 1. Flow Chart Dick and Carry Research Model

This think about enlisted all understudies of the mathematics education ponder program at an Universitas Terbuka whereas the subject of this consider is the 4th semester understudy of the Arithmetic Instruction Think about Program. In this think about a draft of e-comic media with a practical approach to science instruction video was created within the change geometry course. This consider utilized information collection strategies, specifically by disseminating surveys to media specialists and material specialists as evaluation materials to get an assessment, then the data collected, namely the results of the material expert and media expert questionnaires were analyzed and then presented in the form of a stem diagram and pie chart.

RESULT

The first activity of this research is collecting and identifying problems that occur in learning activities in the transformation geometry course, especially in the basic isometry theory materials. In the basic theorem of isometry material, many students find it difficult to understand the material and many students learning outcomes are still below the minimum completeness criteria. Next, the researcher carried out an instructional analysis, namely identifying the competencies that students must master by breaking down general behavior into specific behavior that is arranged logically and systematically. Then determine the instructional objectives of the basic theorem of isometry material so that students must have improved learning outcomes and this will be visible after learning. The next step for researchers to formulate specific instructional objectives is to develop learning media so that student learning outcomes can be seen before and after using learning media. Then the researchers developed an assessment instrument to measure student learning outcomes after using learning media. Then the next step is to develop an instructional strategy by organizing the material on the basic theorem of isometry and students, equipment and materials, as well as the time used in the instructional process to achieve the predetermined instructional goals. Then the final step is that the researcher develops and selects teaching materials that suit students' needs, in this case the media developed is a video-based e-comic with a realistic approach to mathematics.

The result of this research is that a product e-comic video media on the basic isometry theorem material. The e-comic video media on the basic isometry theorem material as shown in Figure 2, Figure 3, and Figure 4. Follow are some displays of e-comic video media on the basic isometry theorem material.

FIGURE 2. e-comic video media cover product with basic isometry theorem material

Based figure 2 appear beginning from media with e-comic with approach practical arithmetic instruction video illustrate and can be gotten to at https://online.fliphtml5.com/znhwi/stjm/. Other than, on the cover there's the identity of the maker and there are a couple of buttons that can be worked to see the substance of the e-comic.

FIGURE 3. Display of e-comic contents

Figure 3 shows e-comic substance with six characters who each have a story telling part to create the storyline contained within the e-comic.

FIGURE 4. Show of e-comic with practical science instruction video

Based figure 4 appear of e-comic with practical arithmetic instruction video. There are two recordings inside the e-comic that can move forward the understanding of commonsense practical scientific fabric. The first video is concerned with basic isometry theorem material with realistic mathematics, and the second video shows the similarity and isometric equality material with realistic mathematics.

DISCUSSION

The research has shown that an e-comic video media on the basic isometry theorem material has been produced and validated by media experts and material experts. Validation is done by using questionnaire form. From the questionnaire responses from media experts and material experts were obtained two results. The percentage of assessment are presented in Figure 5, Figure 6, Figure 7, Figure 8 which show the form stem diagram and pie chart below.:

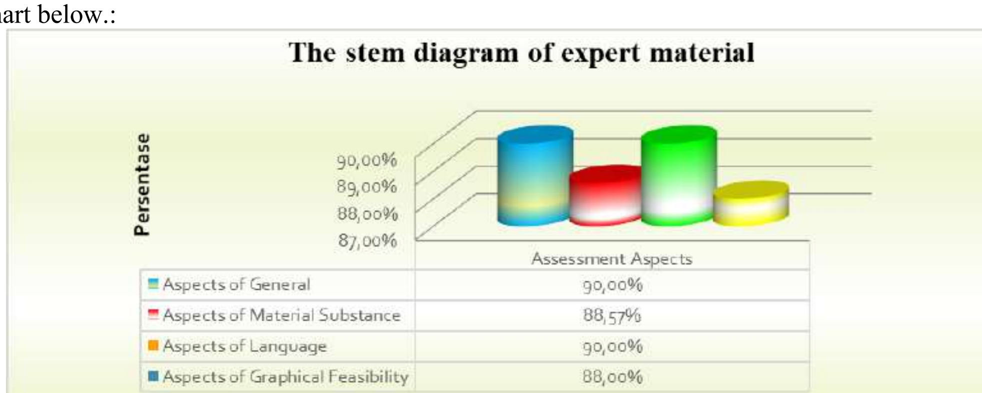

FIGURE 5. The stem diagram of expert material

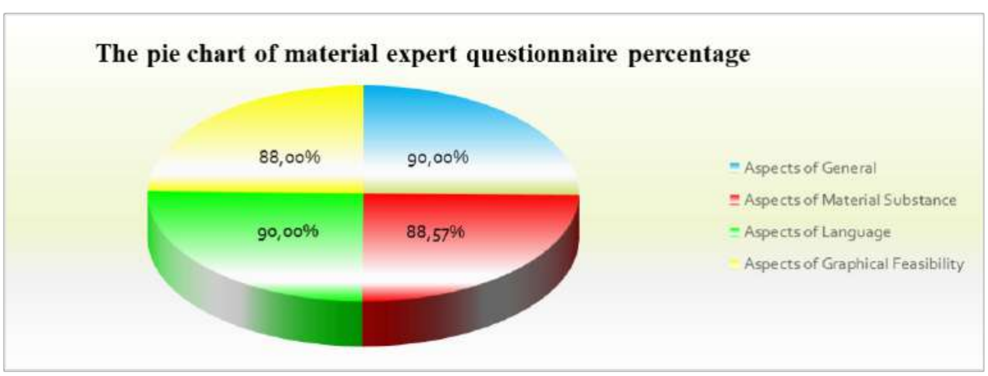

FIGURE 6. The pie chart of expert material

From the diagram above, it can be seen that based on the results of the material expert questionnaire on general aspects it was 90,00%, which means that the material in video-based e-comic media is quite easy to understand and can foster critical, creative and innovative thinking and is easy to use. Furthermore, the material substance aspect is 88,57%, meaning that the basic theorem of isometry material is very related to the phenomena around them and students can follow the learning stages on video-based e-comic media. Then the language appropriateness aspect is 90,00%, meaning that the video-based e-comic material uses good, effective language and is easy to understand. And finally, the graphic feasibility aspect is 88,00%, which means the color composition is good and the appearance of video-based e-comic media for learning is quite harmonious. From the four aspects of video-based e-comic media, an average of 89,14% was obtained, which means that in terms of video-based e-comic material, it is suitable to be tested on students.

Meanwhile, based on comments and suggestions from material experts, namely:

1. The material in e-comic video media contains clear and straightforward material.
2. E-comic videos can help students better understand geometry material transformation.
3. In the e-comic video material there are practice questions so you can measure your student abilities.
4. The material needs to be added with realistic mathematical explanations

Furthermore, the following is results of the expert media questionnaire. The grading percentages are presented in the form stem diagram below:

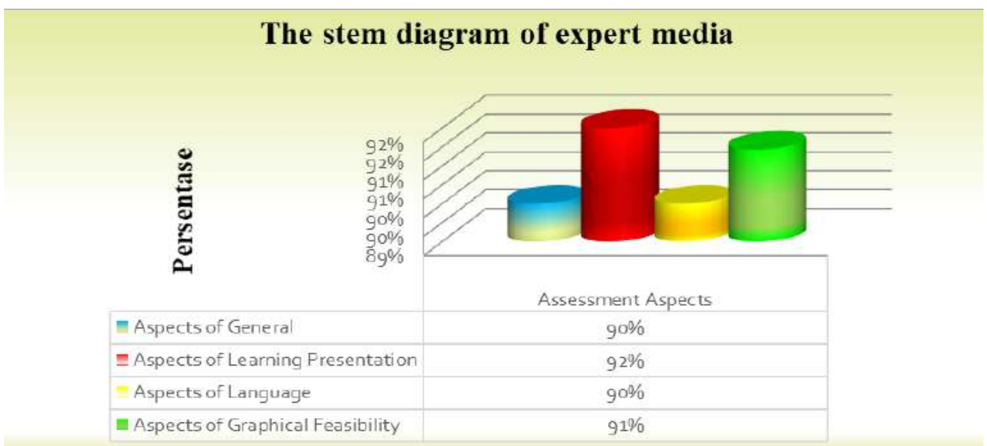

FIGURE 7. The stem diagram of expert media

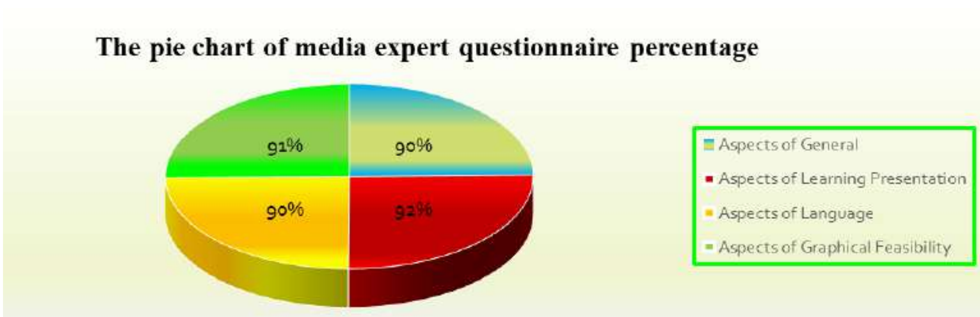

FIGURE 8. The pie chart of expert media

From the diagram above, it can be seen that based on the results of the media expert questionnaire on general aspects it was 90,00%, which means that video-based e-comic media has advantages over other learning media or conventional methods. Furthermore, the learning presentation aspect is 90,00%, meaning that e-comic video media with the RME approach activates students. Then the language appropriateness aspect is 90,00%, meaning that the use of language in e-comic videos using the RME approach is in accordance with the student's level of intellectual development. And finally, the graphic feasibility aspect is 91.43%, which means that video-

based e-comic media using the RME approach has elements that are located in a harmonious, harmonious, unified and consistent manner. From the four aspects of video-based e-comic media, an average of 90,86% was obtained, which means that based on the aspect of video-based e-comic media, it is suitable to be tested on students. Meanwhile, based on comments and suggestions from media experts, namely:
1. The appearance of e-comic video media is very interesting and looks new compared to e-books.
2. The combination of characters and background is in harmony and easy to read.
3. E-comic video media can be used on cellphones or laptops so it is more flexible.
4. There should be additional animation in the comic so that it can be more interactive.
5. There should be instrumental music in the e-comic section.

The average result of assessment e-comic video media on the basic isometry theorem material by media experts is 90,86%. Meanwhile, the average of assessment e-comic video media on the basic isometry theorem material by material experts is 89,14%. It can be concluded that the average assessment result of e-comic video media on the basic isometry theorem material for material experts and media experts is valid, which is 90%. Meanwhile, based on the results of the interview, there needs to be a slight revision related to the size of the letters but overall, it is suitable for use by students. It can be concluded e-comic video media on the basic isometry theorem material is valid and feasible to be tested students.

Based media video-based e-comic using the RME approach responses by questionnaire students, the stem diagrams and pie charts are obtained as below in Figure 9 and Figure 10:

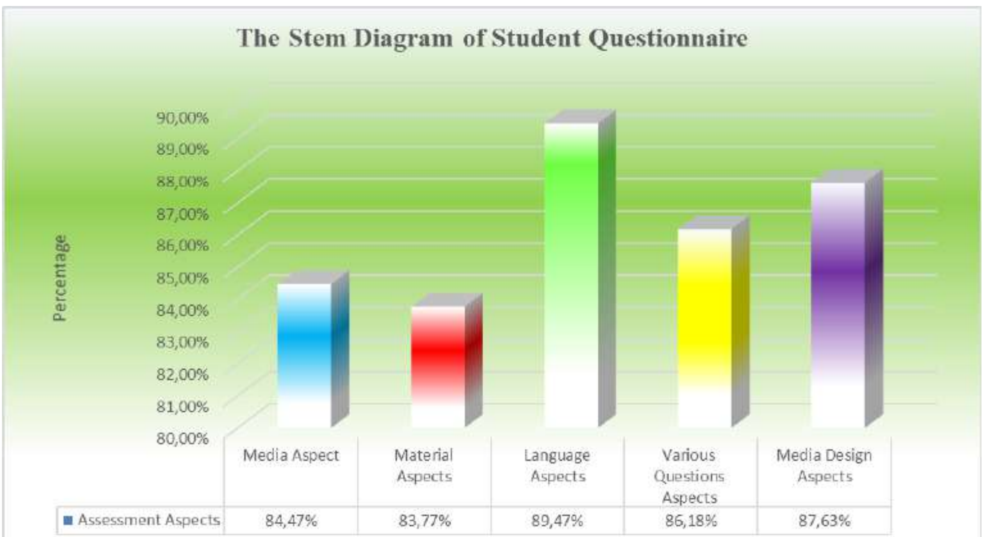

FIGURE 9. The stem diagram of student questionnaire

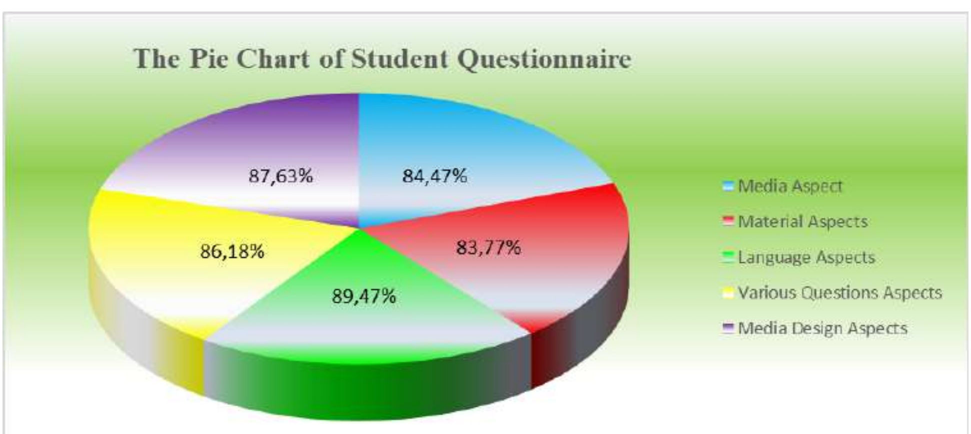

FIGURE 10. The pie chart of student questionnaire

From the diagram above, it can be seen that based on the results of student questionnaire on media aspects it was 84,47%, which means that video-based e-comic media using the RME approach has easy to understand and can develop critical, creative and innovative thinking. Furthermore, material aspect is 83,77%, meaning that the geometric material in this video-based e-comic media using the RME approach is adapted to the phenomena around us. Then the language aspects is 89,47%, meaning that the language or sentences used are easy to understand by students. And next is various questions aspects is 86,18%, meaning that there are exercises that enable students to understand the expected competencies. finally, the media design aspects is 87.63%, which means that good color composition and video-based e-comic media using the RME approach media display for interesting learning. From the five aspects of video-based e-comic media using the RME approach an average of 86,31% was obtained, which means that students can motivated and interesting with video-based e-comic media.

Meanwhile, based on comments and suggestions from student questionnaire, namely:

1. In my opinion, with the existence of e-comic media, students who don't study enough will become interested in studying because learning becomes more fun and in my opinion it would be better to develop more images so that they don't seem monotonous because that's all, or in other words, give more interesting images so that readers are more interested.
2. It would be better if the images could be developed further so that they can be more interesting to readers and don't get bored with just the same images.
3. It Interesting, understandable and easy can be read.

CONCLUSION

Based on the inquire about comes about and talk of the issue, it can be concluded that a video-based e-comic media item was delivered utilizing the RME approach on the fundamental hypothesis of isometry with an open interface (https://online.fliphtml5.com/znhwi/stjm/).

The comes about of the survey by fabric specialists and media specialists obtained an normal of 90%, which suggests that video-based e-comic media items with the RME approach to the fundamental hypothesis of isometry fabric are reasonable for utilize as learning media for understudies. Video-based e-comic media products with the RME approach are expected to increase student learning motivation
due to innovation in learning media.

The results of the questionnaire by students from the five aspects of video-based e-comic media using the RME approach an average of 86,31% was obtained, which means that students can motivated and interesting with video-based e-comic media.

SUGGESTION

Thank you for all sources of research grant funding under the Scheme Innovation Research PTJJ 2023 by LPPM UT.

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Difference in Results: High School Students' Mathematical Reflective Thinking of Science and Social Studies

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Abstract. A growing body of literature has showed that mathematical reflective thinking ability plays a crucial role in the learning process. Nevertheless, students' mathematical reflective thinking ability are not always in a good condition. Therefor The overarching objective of this qualitative study sought to explore the mathematical reflective thinking abilities of senior high school students in the science and social studies specialization program. A total of ten senior high school students in west java participated in the study. The data collecting used were observation, tests, and interviews. Triangulation strategy used to develop a comprehensive understanding of phenomena. The results showed that senior high school on science program were unable to fulfil all the indicators in each phase of reflective thinking. The phase that was mastered by students is the reacting phase, the phase that is sufficiently mastered by students is the elaborating/comparing phase, while the contemplating phase for students is still diverse. conversely the average subject on social program were only mastered the comparing phase where the subject could explain the answers obtained and could relate the problems asked to the problems they had faced. Furthermore, the reacting and contemplating phases were still not optimal because there were still subjects who did not write down and state what was asked and known and did not make final conclusions correctly.

INTRODUCTION

The COVID-19 pandemic has influenced all sectors globally, including the education sector, to utilize digital technology in their daily lives. The optimal use of digital technology is one of the characteristics of the 4.0 Industrial Revolution[1]. Dealing with the 4.0 Industrial Revolution requires high adaptation and consistency so that careful preparation is a must[2]. One of the important elements to consider is preparing and improving the competence of graduates who have 21st-century skills (Learning and Innovations Skills).

The 21st-century skills have five main domains; one of them is the thinking skill. In addition, the thinking skill is also an aspect of life skills that need to be developed through the educational process[3]–[6]. Through thinking skills, a person can observe and solve all life problems, including mathematics. When a person does mathematics, whether it is only to understand mathematical concepts, use them in solving mathematical problems, or use mathematics in everyday life, of course, must be accompanied by thinking skills. Therefore, thinking skill is essential that for every student at every level of education.

One of the thinking skills included in the Higher Order Thinking Skill (HOTS) is the ability to think reflectively [7]. The reflective thinking ability is called "the capacity of human minds and brains in understanding and creating knowledge" [8]. In comparison, [9] defined the reflective thinking skill as a process of interpreting one experience to the next one by making a deeper understanding of the relationship and connecting other experiences or ideas. Furthermore, it is stated that reflective thinking ability will certainly be critical in solving mathematical problems, called mathematics reflective thinking ability [10]–[12].

The previous research mentioned above has not captured students' mathematical reflective thinking abilities for science and social studies classes, so this research will fill this gap. This research aims to photograph and examine in depth the mathematical reflective thinking abilities of high school students majoring in science and social studies.

METHODS

This study used qualitative research methods. The qualitative research method is one of the methods that can be used to solve a research problem by using these data, such as narratives derived from interviews, observations, analysis of other supporting documents [13].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040018-1–040018-10; https://doi.org/10.1063/5.0242745
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This research interprets the qualitative data and describes it in order to get an in-depth picture of the description of the reflective thinking abilities of high school students in trigonometry both Science and Social Studies. This research was carried out at one of the high schools in Indonesia and the participants were 5 students in both class X science and social studies.

Data collection techniques in this study were using written test techniques, interviews, and observations. In the written test technique, the researcher gave two types of written tests, namely the initial mathematical ability test and the mathematical reflective thinking ability test. The mathematical reflective thinking ability test consists of 6 questions which contain material on the sine rule, cosine rule and the area of an arbitrary triangle. This test is then strengthened through interviews. The interview guide consists of 13 questions arranged according to indicators of reflective thinking.

This study uses the reflective thinking phase [14]**,**where there are 3 phases, namely: reacting, elaborating/comparing, and contemplating. The following is a table explaining the indicators of mathematical reflective thinking ability according to [15]:

TABLE 1. Indicators of Mathematical Reflective Thinking Ability

No	Phase	Indicator
1.	*Reacting*	a. State what is being asked. b. State what is known. c. Mention the relationship between what is asked and what is known. d. Being able to explain what is known is enough to answer what is asked.
2.	*Elaborating/Comparing*	a. Explain the answers or solutions that have been obtained. b. Relate the problems asked to the problems that have been encountered.
3.	*Contemplating*	a. Determine the intent of the problem. b. Detect errors in answers. c. Correct and explain if an error occurs in the answer. d. Make the right conclusions.

In this study, the ability to think mathematically reflectively was grouped into 3 categories, namely: reflective, less reflective and non-reflective. Students are said to be reflective if students can do all phases of reflective thinking well; students are said to be quite reflective if students are unable to go through a phase of reflective thinking; and students are said to be less reflective if students are unable to go through one/two phases of reflective thinking and cannot go through one/two phases of reflective thinking [16].

RESULTS AND DISCUSSION

The results section of this research will present the results of research on students majoring in science, then continued with the results of research on social studies students. Five subjects from each department were selected based on several aspects including the results of discussions with mathematics teachers, students' ability to communicate well, and students' willingness to be subjects in this research. analysis of several research findings obtained from answers and interviews conducted with research participants regarding trigonometry comparison material.The results for participants from the science group will be presented first as follows. One of the answers from IPA-1 Participants is as shown in Figure 1 below:

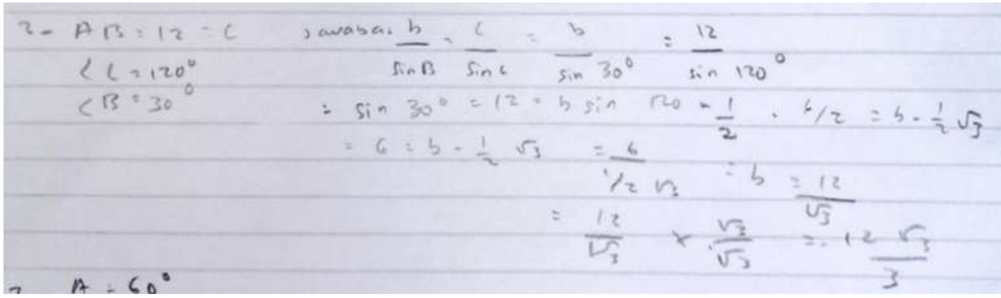


FIGURE 1. IPA-1 work results

Then interviews were conducted with IPA-1 participants as in table 1 below:

TABLE 2. IPA-1 Participant Interview Results

R	: In your answer, number 2 didn't you write down what was asked, right? Can you please state what is being asked and what is known from number 2?
IPA-1	:Known = Angle C 120°, Angle B 30°, Side AB 12cm
R	: Do you think there is a connection between what is asked and what is known?
IPA-1	: Asked? = AC side = b
R	:Then do you think the existing information is enough to answer the question?
IPA-1	:That's enough bro, that's enough

In the reaction phase, in Figure 1, the IPA-1 subject was only able to write down what he knew. However, when the IPA-1 subject was interviewed, he was able to state what was known and what was asked. In the interview excerpt above, it can also be seen that the IPA-1 subject stated that there was a relationship between what was known and what was asked. Furthermore, the IPA-1 subject stated that the information provided in the questions was sufficient to answer the questions given.

In the elaborating/comparing phase, the IPA-1 subject was able to describe the solution process obtained from beginning to end according to Figure 1. RP subject stated that he had never faced a similar problem before.

In the contemplating phase, based on the results of the interview, the IPA-1 subject revealed that he had little understanding of the meaning of the questions given. There are deficiencies in the results of the IPA-1 subject (figure 1), but the IPA-1 subject can detect where the deficiencies or errors are in the answers and is able to correct the errors. Furthermore, the IPA-1 subject was able to make conclusions from the answers even though the conclusions given were not correct.

Based on the analysis above, IPA-1 subjects can go through all the reacting phase indicators, can go through all the elaborating/comparing phase indicators, and can go through all the contemplating phase indicators. From this analysis, the IPA-1 subject can be said to be reflective in its mathematical reflective thinking abilities.

Furthermore, the results of the answers from IPA-2 are as shown in Figure 2 below:

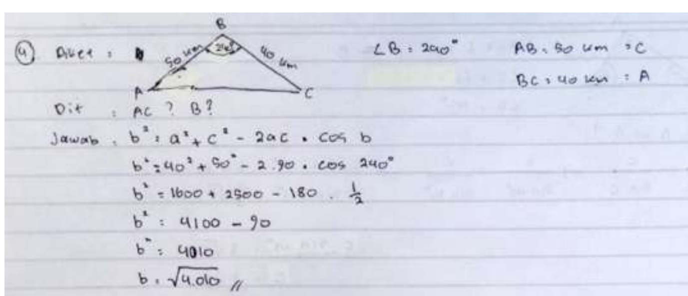


FIGURE 2. Results of IPA-2 work

In the reaction phase, the IPA-2 subject can state what is known and what is asked according to the information in the question. Furthermore, from the results of the interview, the IPA-2 subject said that there was a relationship between what was known and what was asked and the IPA-2 subject stated that the existing information was sufficient to answer the questions given.

In the elaborating/comparing phase, the IPA-2 subject is able to describe the solution process obtained from start to finish according to Figure 2 and believes the solution is correct. Furthermore, the IPA-2 subject stated that he had never faced a similar problem before.

In the contemplation phase, the IPA-2 subject stated that he understood the questions given. Furthermore, it was shown that the IPA-2 subjects were unable to detect exactly where the error was in their work, but when they were told the location of the error, the IPA-2 subjects were able to correct the error. Based on the results of their work, the IPA-2 subjects did not make conclusions, but when interviewed, the IPA-2 subjects were able to explain the conclusions obtained from their work. The results of interviews conducted with IPA-2 are shown in table 2 below:

TABLE 3. IPA-2 Participant Interview Results

R	: Well, the answer is correct. What is the conclusion of the problem?
IPA-2	: So, the distance from a to c is 10 root 61 km.

Based on the analysis above, the IPA-2 subject can go through all the reacting phase indicators, can go through all the elaborating/comparing phase indicators, and can only go through some of the contemplating phase indicators. From this analysis, the IPA-2 subject can be said to be less reflective in his mathematical reflective thinking abilities.

The results of the answers obtained from IPA-3 research participants are as shown in Figure 3 below:

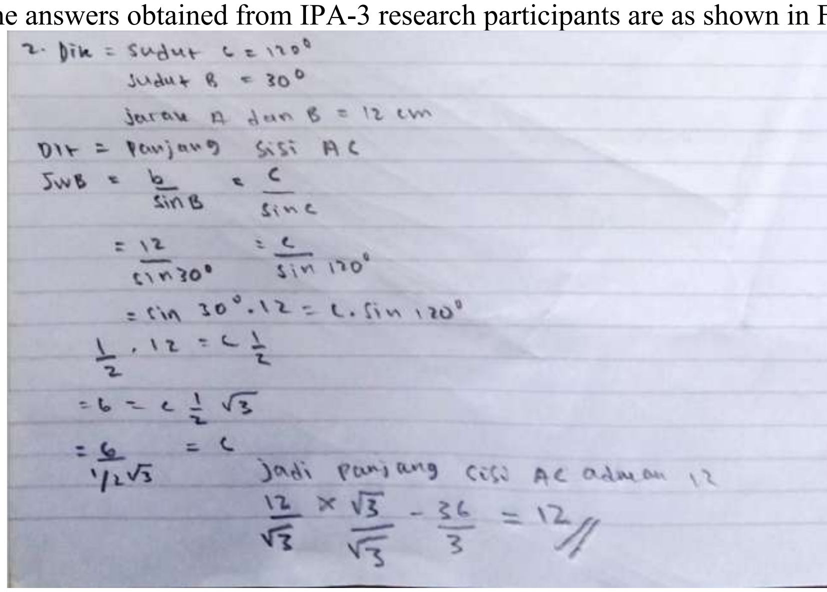


FIGURE 3. Results of IPA-3 work

TABLE 4. IPA-3 Participant Interview Results

R	: So, do you think there is a connection between what is known and what is asked?
IPA-3	: There is
R	:Okay. So do you think the existing information is sufficient to answer this question?
IPA-3	: Already

In the reaction phase, as seen from Figure 3, the IPA-3 subject was able to state what was known and what was asked. During the interview, the IPA-3 subject stated that there was a relationship between what was known and what was asked. Furthermore, the IPA-3 subject stated that the available information was sufficient to answer the questions.

In the elaborating/comparing phase, the IPA-3 subject is able to describe the solution process obtained from start to finish according to Figure 3 and believes the solution is correct. However, the IPA-3 subject stated that he had never faced a similar problem before.

In the contemplating phase, from the results of the interview, the IPA-3 subject stated that he understood the meaning of the questions given. The IPA-3 subject was confident in the answers he had worked on and said that he had checked his answers again. In Figure 3 there are slight errors in the results of the IPA-3 work, but IPA-3 cannot detect the location of the error in the answer and also cannot correct the error. Furthermore, the IPA-3 subjects were able to make correct conclusions. The following is an excerpt from the interview:

TABLE 5. IPA-3 Participant Interview Results

R	: For number 1, do you understand what the question means? What is being asked?
IPA-3	: Distance between city A and city B
R	: Then for number 2, have you checked the answer yet?
IPA-3	: Already
R	: Are you sure that this answer is correct? Is there something wrong or not?
IPA-3	: I don't think so
R	: In number 2, you made a mistake in the final answer, in the part about rationalizing fractions. Do you think you can fix that?
IPA-3	: The result is 12 roots 3 over 3 ka
R	: Can you simplify the fractions further?
IPA-3	: You can't do it

Based on the analysis above, the IPA-3 subject can go through all the reacting phase indicators, can go through all the elaborating/comparing phase indicators, and can only go through some of the contemplating phase indicators. From this analysis, the science-3 subject can be said to be less reflective in his mathematical reflective thinking abilities

Then for the science subject-4. The results of the answer can be seen in Figure 4 below:

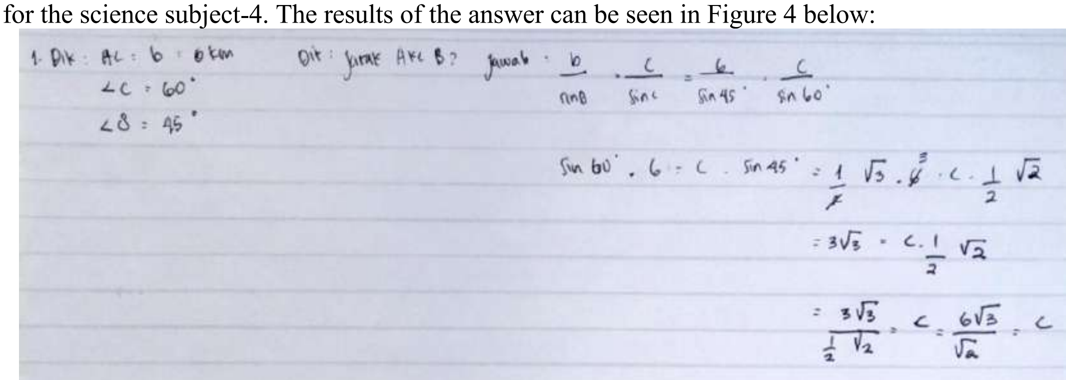


FIGURE 4. IPA-4 work results

In the reaction phase, in Figure 4, the Science-4 subject was able to state what was known and what was asked on the answer sheet. From the interview results, it can be seen that the IPA-4 subjects revealed that there was a relationship between what was known and what was asked. Furthermore, the IPA-4 subject stated that the information provided in the questions was sufficient to answer the questions given.

In the elaborating/comparing phase, the IPA-4 subject is able to describe the solution process obtained from start to finish according to Figure 4 and believes the solution is correct. The IPA-4 subject stated that he had never faced a similar problem before.

In the contemplating phase, the IPA-4 subject stated that he understood a little about the meaning of the questions. Then, there were some shortcomings in the results of his work or it could be said that the answer he gave was not correct. The IPA-4 subject can mention the shortcomings of his work, but he cannot correct his answer. In the results of his work, the IPA-4 subject did not write conclusions in all his answers, but during the interview the IPA-4 subject was able to draw appropriate conclusions from the answers he gave and was confident in his conclusions.

TABLE 6. IPA-4 Participant Interview Results

R	: Then for number 1, can you try to explain the answer you gave?
IPA-4	: here I can explain that this was well explained by given answers.
R	

IPA-4	: This means that for number 1, you are still not rational enough for the final result, right?
	: Yes, because as I see that here.
R	: But if for example, I told you to rationalize the end result, could you? How do you rationalize it, you know?
IPA-4	: No, sir.

Based on the analysis above, the IPA-4 subject can go through all the reacting phase indicators, can go through all the elaborating/comparing phase indicators, and can only go through some of the contemplating phase indicators. From this analysis, the science-4 subject can be said to be less reflective in his mathematical reflective thinking abilities.

And for the final participant from the science department, namely IPA-5. The results can be seen in the table below:

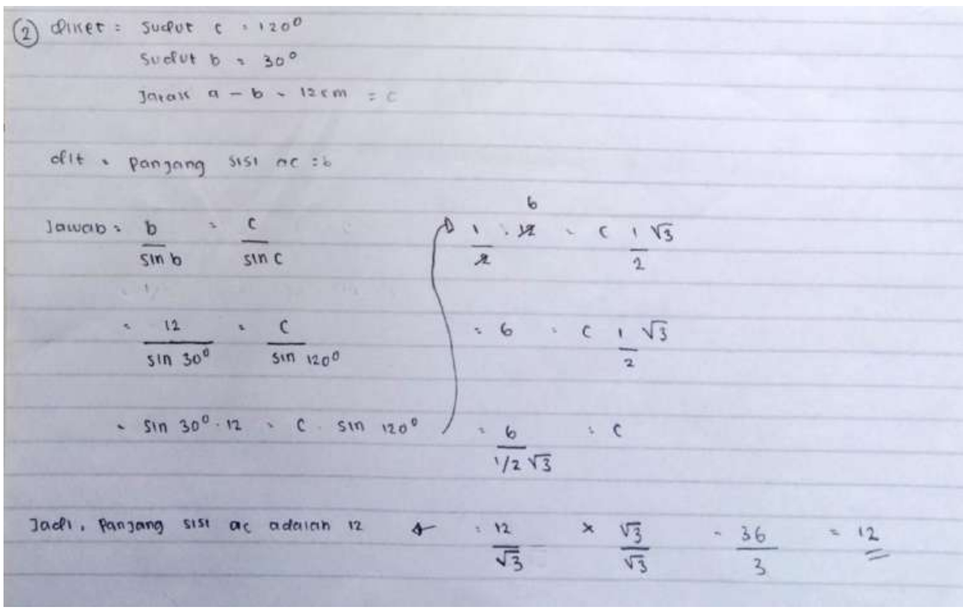


FIGURE 5. IPA-5 work results

Based on the results of the work above, IPA-5 shows a reaction phase, namely being able to write down what is known and what is asked according to the information available on the problem given. The IPA-5 subject revealed that there was a relationship between what was known and what was asked. The interview results showed that the IPA-5 subjects felt that the existing information was sufficient to solve the problems in the questions.

In the elaborating/comparing phase, the IPA-5 subject is able to describe the solution process obtained from start to finish according to Figure 5 and believes the solution is correct. Furthermore, the IPA-5 subject stated that he had never faced a similar problem before.

In the contemplating phase, based on the results of the interview with the IPA-5 subject, he said that he understood the meaning of the questions. Based on the results of the work on the IPA-5 subject above, a few errors were found in the answers. However, IPA-5 cannot detect where the error is in the answer. IPA-5 subjects cannot correct errors in their work. Based on the results of the IPA-5 written test, you can draw conclusions from existing problems correctly and precisely. The following is an excerpt from the interview:

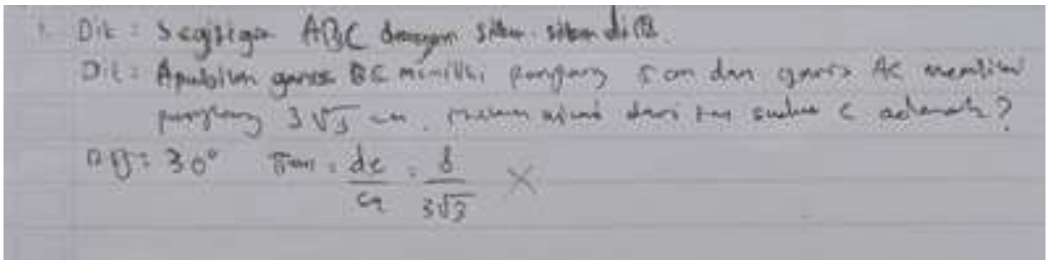
TABLE 7. IPA-5 Participant Interview Results

R	: I want to ask again, do you think your answer number 2 is correct or not?
IPA-5	: Wait a minute, bro
R	: OK
IPA-5	: This one is wrong, right? (while showing the answer) it should be 6=1√3, right?
R	: No, that's correct

IPA-5	: Ohh, I thought I was wrong
R	: So you think your answer is correct, right?
IPA-5	: That's right bro, is it really wrong, bro?

Based on the analysis above, the IPA-5 subject can go through all the reacting phase indicators, can go through all the elaborating/comparing phase indicators, and can only go through some of the contemplating phase indicators. From this analysis, the IPA-5 subject can be said to be less reflective in his mathematical reflective thinking abilities.

The next presentation of the results is for social studies students. For the social studies subject-1, of the five questions given, they only worked on two questions, namely numbers 1 and 2, which can be seen in Figure 1 below:



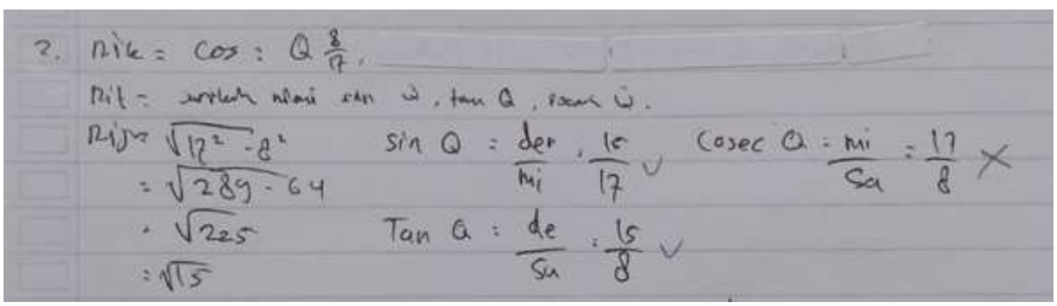
Answer to question number 1 from Subject IPS-1

Translation

Given: Triangle ABC with a right angle at B.

Asked: If line segment BC is 5 cm long and line segment AC $3\sqrt{3}$ cm long, what is the value of tan C?

(a)



Answer to question number 2 from Subject IPS-1

Translation

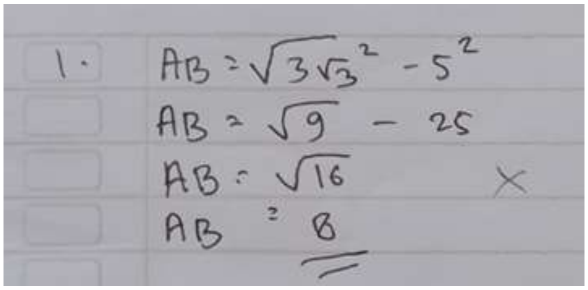
Given: $Cos = Q\,\frac{8}{17}$

Asked: Value of $Sin\ Q$, tan Q, $cosec\ Q$

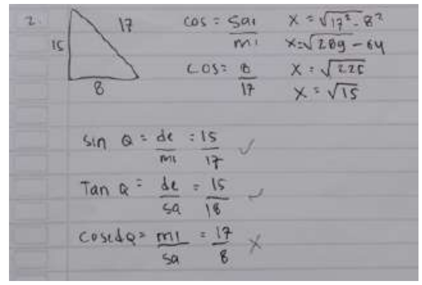
FIGURE 6. IPS-1 Subject Answers

Based on Figure 1, IPS-1 subjects were unable to fulfill the indicators of reflective thinking in the reaction phase. This is because IPS-1 is less able to express correctly what is known and asked in the question clearly, knowing that there is a relationship between what is being asked and what is known but cannot be stated. IPS-1 also confirms that what is known is sufficient to answer what is asked. In the IPS-1 comparing phase, we were unable to explain the answers to the IPS-2 questions obtained. IPS-1 can relate the IPS-2 question being asked to the IPS-2 period they have encountered by mentioning the material, but the similarities are not mentioned in detail. Then IPS-1 does not go through the contemplating phase because it cannot determine mIPS-3ud from permasaIPS-2an, let alone detect saIPS-2an errors in the answers and cannot correct answers when saIPS-2an errors occur. Apart from that, IPS-1 subjects were also unable to make correct conclusions. Based on this analysis, it can be concluded that the IPS-1 subjects did not fulfill the reacting, comparing and contemplating phases. Thus, the IPS-1 subject's mathematical reflective thinking is still very lacking.

The IPS-2 subject was also only able to answer two of the five questions which can be seen in Figure 2 below:



Answer to question number 1 from Subject IPS-2

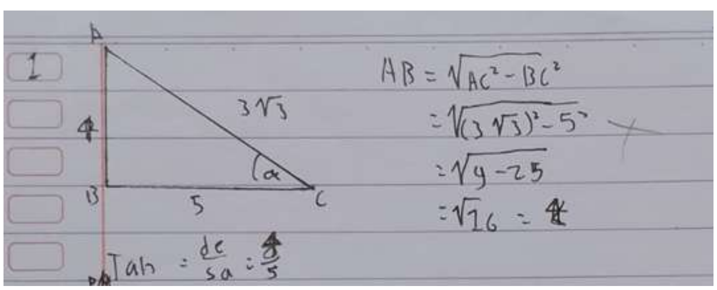


Answer to question number 2 from Subject IPS-2

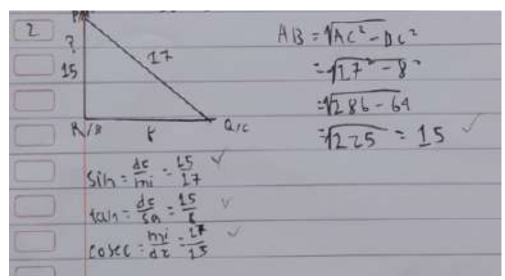
FIGURE 7. IPS-2 Subject Answers

Based on Figure 2, in the reaction phase IPS-2 does not write down what is known and asked in the questions, but during the interview IPS-2 can mention it. IPS-2 knows that there is a relationship between what is asked and what is known but cannot explain it, IPS-2 also emphasizes that what is known is sufficient to answer what is asked. Furthermore, in the comparing phase, IPS-2 was less able to explain the answers to the IPS-2 questions obtained. IPS-2 can relate the IPS-2 period being asked to the IPS-2 period that has been encountered by mentioning the material, but the similarities are not mentioned in detail. In the contemplating phase, for number 1 IPS-2 could not determine mIPS-3ud from problemIPS-2an well, but for number 2 IPS-2 was able to determine mIPS-3ud from problem. Apart from that, IPS-2 subjects cannot detect errors in answers and cannot correct answers when an error occurs. IPS-2 also cannot draw conclusions correctly.

The IPS-3 subject also only answered two of the five questions which can be seen in Figure 3 below:



Answer to question number 1 from Subject IPS-3



Answer to question number 2 from Subject IPS-3

FIGURE 8. IPS-3 Subject Answers

Based on Figure 3, in the reaction phase IPS-3 did not write down what was known and asked in the questions, but when interviewed IPS-3 was able to mention it. Knowing that there is a relationship between what is asked and what is known but cannot explain it, IPS-3 also emphasizes that what is known is sufficient to answer what is asked. In the comparing phase, number 1 IPS-3 was unable to explain the answers to the problems obtained, while number 2 IPS-3 was able to explain the answers obtained correctly. IPS-3 can relate the problem being asked to problems that have been faced by mentioning the material, but the similarities are not mentioned in detail. In the contemplating phase, IPS-3 can determine mIPS-3ud from the problem well, but IPS-3 subjects cannot detect errors in answers and cannot correct answers when errors occur. Then, the IPS-3 subjects were also unable to draw conclusions correctly for number 1, while number 2 IPS-3 was able to draw conclusions correctly.

For the IPS-4 subject, you are able to do one of the five questions available. The answer can be seen in Figure 4 below:

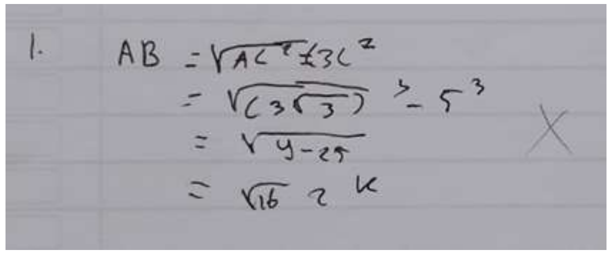


FIGURE 9. IPS-4 Subject Answers

Based on Figure 4, in the reaction phase IPS-4 did not write down what was known and asked in the questions and when interviewed was also unable to mention it. Knowing that there is a relationship between what is asked and what is known but cannot explain it, IPS-4 also emphasizes that what is known is sufficient to answer what is asked. IPS-4 does not go through the comparison phase, because it cannot explain the answers to the problems obtained, it cannot relate the problems asked to those that have been faced. IPS-4 also does not go through the contemplating phase because IPS-4 cannot determine the meaning of the problem, let alone detect errors in answers, and cannot correct errors in answers. Apart from that, IPS-4 also cannot make conclusions correctly because it does not complete the answer correctly.

For the IPS-5 subject, they only do one of the five questions given as in Figure 10 below:

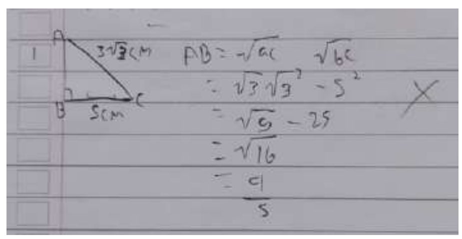


FIGURE 10. IPS-5 Subject Answers

Based on Figure 8, in the reaction phase IPS-5 cannot write down what is known and asked in the questions. Knowing that there is a relationship between what is asked and what is known but cannot explain it, IPS-5 also emphasizes that what is known is sufficient to answer what is asked. In the comparing phase IPS-5 cannot explain the answers to the problems obtained, it can relate the problem being asked to problems that have been faced by mentioning the material, but the similarities are not mentioned in detail. IPS-5 does not go through the contemplating phase because IPS-5 cannot determine the meaning of the problem, let alone detect errors in answers and cannot correct errors in answers. Apart from that, IPS-5 also cannot draw conclusions correctly because it does not solve the questions correctly.

From the research discussion regarding students' mathematical reflective thinking abilities in terms of low prior knowledge, it can be concluded that students' mathematical reflective thinking abilities are still low.

CONCLUSION

Based on the results and discussion in this study, the conclusion of this study are The results showed that senior high school on science program were unable to fulfil all the indicators in each phase of reflective thinking. The phase that was mastered by students is the reacting phase, the phase that is sufficiently mastered by students is the elaborating/comparing phase, while the contemplating phase for students is still diverse. conversely the average subject on social program were only mastered the comparing phase where the subject could explain the answers obtained and could relate the problems asked to the problems they had faced. Furthermore, the reacting and contemplating phases were still not optimal because there were still subjects who did not write down and state what was asked and known and did not make final conclusions correctly.

ACKNOWLEDGMENTS

We would like to thank the Research Institution (Lemlit) of Uhamka for funding this research.

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The Analysis of Mathematical Literacy Skills of Junior High School Students in Solving PISA Problems in Terms of Learning Styles in the New Normal Era

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Abstract. In the new normal era, many students experience learning difficulties and their motivation to learn decreases. This affects math learning because most students find it difficult, The difficulties that students usually face are usually caused by a lack of mathematical literacy skills. Students' mathematical literacy skills are important for the government in improving the quality of education. One of the programs that can be used to measure students' literacy skills is the Program for International Students Assessment (PISA). One of the factors that influence mathematical literacy skills is students' learning style. The purpose of this study is to describe how students' mathematical literacy skills when working on PISA model questions based on students' learning styles. The method used in the research is descriptive qualitative. The research subjects consisted of 3 students of class VII D at SMPN (Public Junior High School) 1 Kebonsari with visual, auditory and kinesthetic learning styles. The instruments used in the study were learning style questionnaire, math literacy test and interview. The results showed that: (1) students with visual learning styles solved PISA problems up to level 4 fulfill the indicators of formulating, employing, and interpreting. (2) students with auditorial learning style solved PISA problems up to level 2 fulfill the indicators of formulating, employing, and interpreting and at level 3 only fulfill the formulating indicator. (3) students with kinesthetic learning style in solved PISA questions up to level 3 fulfill the indicators of formulating, employing, and interpreting.

INTRODUCTION

Learning is experiencing obstacles due to a dangerous pandemic outbreak, namely Covid-19. This situation forces learning to be carried out online in order to organize learning during the adaptation of new normal (Samarenna, 2020). This affects student learning, especially in math learning because most students find math learning difficult, the difficulties that students usually face are usually caused by a lack of mathematical literacy skills so that students are expected to be able to master numeracy literacy. One of the abilities that must be possessed by students is mathematical literacy. According to Genc & Erbas (Edimuslim, Edriati, & Mardiyah, 2019) Mathematical literacy skills can help students understand and implement mathematical concepts in the real world by using efficient techniques to solve problems. The standard for measuring students' mathematical literacy skills through PISA is based on the level 1 of general and basic problems that students already know, level-2 problems are done using basic algorithms, formulas, and routine implementation of procedures, level-3 problems can be solved by choosing techniques in solving simple problems and requiring sequential solution procedures, level-4 problems that contain concrete but complex situations and problems that require the conversion of real-world problems into mathematical forms, level-5 problems that contain topics that include complex situations with various obstacles that exist in it so that conjectures arise in the solution, and level-6 problems that require conceptualization and generalization using data derived from modeling and examining complex situations (OECD, 2019).

Students' mathematical literacy skills are important for the government in improving the quality of education in Indonesia today, One of the programs that can be used in measuring students' literacy skills is the Program for International Students Assessment (PISA) which is usually carried out every three years. PISA (Programme for International Student Assessment) is an international program organized by OECD (Organization for Economic Cooperation and Development) to determine the extent to which students who have an age range of 15 years in the process of thinking in applying their knowledge in the context of life. Some of the things that are assessed include math literacy, reading literacy, and science literacy(Anggrieni & Putri, 2018). Based on the results of research conducted by the Program for International Student Assessment (PISA) which was carried out in 2018, the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040019-1–040019-8; https://doi.org/10.1063/5.0244675

mathematical literacy skills of Indonesian students are still low. There are other studies that examine the low mathematical literacy skills of students. As research conducted by (Fitriana & Lestari, 2022) shows that in general the initial spatial ability and mathematical literacy of students are still very low. Research that supports the low mathematical literacy skills of students is research conducted by (Salsabilla & Hidayati, 2021).

One of the factors that influence mathematical literacy is students' learning style. Students will find it helpful to absorb information through the learning style they use, which will facilitate them in the learning process and interaction. Each student has their own learning style and cannot be applied to use the same learning style.(Edriati, Hamdunah, & Astuti, 2016; Nariyati, 2016; Wulandari, 2022). Learning styles are divided into 3 types, namely Visual, Auditorial and Kinesthetic. Based on the explanation above, students' literacy skills in mathematics are very important in the context of education, therefore, researchers must conduct an analysis to determine students' literacy skills. this research focuses on analyzing the mathematical literacy skills of SMPN 1 Kebonsari students with visual, auditorial, and kinesthetic learning styles in solving PISA problems in the new normal era along with influencing factors. this research is expected to obtain accurate results, so as to provide an accurate description of mathematical literacy skills.

RESEARCH METHOD

This research uses descriptive research with a qualitative approach. This research was conducted on seventh-grade students of SMPN 1 Kebonsari. The study recruited 3 students from class VII D with visual auditorial and kinesthetic learning styles. The subjects were chosen based on the distribution of the learning style questionnaire that had been given.

The technique used in taking the subject of this research uses purposive sampling technique, which is a data source sampling technique with certain considerations (Sugiyono, 2019). Data collection techniques in this study used learning style questionnaires, mathematical literacy tests and interviews. Data analysis techniques in this study are test and interview data reduction, presentation of test and interview data and conclusion drawing. The test results will then be analyzed using triangulation of techniques and time based on 3 indicators of mathematical literacy skills.

TABLE 1. indicator of Mathematical Literacy

Indicator	Aspects
formulating	Identify aspects/components in math problems.
	Translate or convert problems into representations using mathematical symbols
employing	Develop plans and steps to find the right solution
	Use mathematical concepts in the process of finding solutions to problems
interpreting	Reinterpret the results obtained in the context of everyday life
	Explains the reason for the result according to the context of the problem

(Adam, Dwijayanti, & Endahwuri, 2022; Apriandi, Murtafiah, Ayuningtyas, & Rudyanto, 2020)

The first step taken in this study was to distribute learning style questionnaires to 35 students of class VII D. Based on the results of the learning style questionnaire and consideration from the math subject teacher. After that, the second step is giving math literacy test questions. After the students answered the test in writing, the researcher continued by conducting semiformal interviews to get a deeper understanding of the answers the subjects did.

RESULT AND DISCUSSION

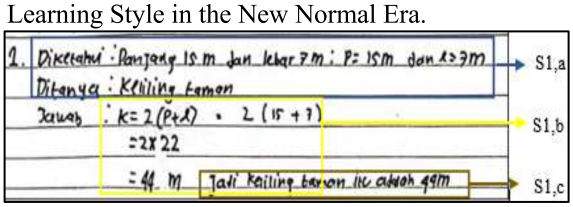
The results of the learning style questionnaire test show that students have diverse learning styles. The dominant learning styles in the class are visual, auditorial and kinesthetic. The results of the learning style questionnaire test can be seen in Table 1 below.

TABLE 2. Learning Style Questionnaire Results

Learning Style	Total
Visual	24
Auditory	9
Kinaesthetic	2
Total	**35**

Based on the learning style questionnaire that has been distributed to students, 3 subjects were selected based on the student's answers and the results of the student learning style questionnaire in this study, namely subject JDD (visual learning style), CC (auditorial learning style), DSP (kinesthetic learning style). This section discusses the results of research that describes the mathematical literacy skills of students in solving PISA problems based on learning styles in the new normal era.

1. Mathematical Literacy skills of Junior High School Students in Solving PISA Problems Based on Visual Learning Style in the New Normal Era.



Translation:
Given: length 15 m and width 7m
Asked: circumference of garden?
Answer:

$$K = 2(p + l) = 2(15 + 7)$$
$$= 2 \times 22$$
$$= 44\,m$$

So, circumference of garden is 44 m

a. Formulating

Students with visual learning styles on level 1, 2, 3 and 4 questions can understand the test questions well, identify mathematical aspects, express information in the problem by explaining, and describe what is known and what is asked according to the problem and converting problems into representations using mathematical symbols. This is in line with research (Rismen, Putri, & Jufri, 2022) that students with visual learning styles are able to understand the problem according to the problem and can identify mathematical aspects. During the pandemic, students with visual learning styles are able to fulfill the indicators of formulating this is in line with research conducted by (Pardede, Ahmad, & Harahap, 2021) showing that during online learning students are able to understand the material provided.

Students with visual learning styles about level 5 and 6 have not been able to understand test questions, identify mathematical aspects, or write down the information in the problem by describing what is known and what is asked according to the problem and have not been able to translate the problem into representation. This is in line with research (Amaliya & Fathurohman, 2022) claiming that students with visual learning styles have difficulty in translating problems and choosing the right words.

b. Employing

Students with visual learning styles on level 1, 2, 3 & 4 questions are able to explain mathematical concepts and how to design strategies by determining the formula used in solving problems to find mathematical solutions. It can be seen that students can explain the steps of the work appropriately according to the formula. During the pandemic, students with visual learning styles are able to fulfill the indicators of applying relevant research(Al-Hamzah & Awalludin, 2021) that students are able to operate with formulas and complete steps according to the problem.

Students with visual learning styles on level 5 and 6 questions have not been able to explain mathematical concepts and how to design strategies appropriately, therefore students cannot work on these problems. In this indicator, students are unable to understand the problem so that students do not know what formulas and steps can be used to solve the problem. This is in line with research (Nariyati, 2016) reporting that students with visual learning styles cannot design strategies, so they do not understand what steps should be done next in the problem.

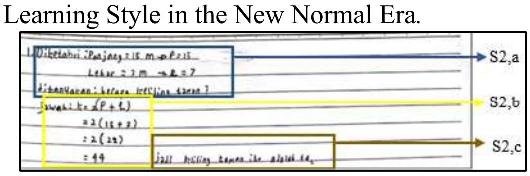
c. Interpreting

Students with visual learning styles on level 1, 2, 3 and 4 questions are able to provide explanations of the causes underlying the results according to the context of the problem and reinterpret the results obtained in the context of the real world by writing the final answer and drawing conclusions from the problem in the context of the real world. In addition, students also re-examine the results that have been done. This is in line with research (Edimuslim et al., 2019) claiming that students with visual learning styles can re-present an object from information in the real world completely. Research conducted by (Al-Hamzah & Awalludin, 2021) students with a visual learning style did not fulfill the interpretation indicator, because they focused on solving the problem so they forgot to conclude the problem.

Mathematical literacy skills in solving PISA problems in the new normal era students with visual learning styles on level 5 and 6 questions have not provided an explanation of the causes underlying the results according to the context of the or attempted to reinterpret the results obtained in the context of the real world by writing the final answer and drawing conclusions.

Students with visual learning styles can solve level 1, 2, 3, and 4 problems correctly and meet all indicators because problems at levels 1 and 2 are problems with clear questions and contexts. Problems with levels 3 and 4 are problems that require sequential solution procedures and can be solved by applying simple problem-solving strategies and working effectively with models for concrete but complex situations. This is supported by research (Edimuslim et al., 2019) showing that students with visual learning styles are able to achieve problem levels 1, 2, 3 and 4. Research (Atiyah & Priatna, 2023) said that in level 2 problems students still find it difficult to design a solution strategy and make mistakes in calculating algebraic material. The difference in this study is because the ability of each student is different and the material used is different. The research (Atiyah & Priatna, 2023) was conducted during the covid-19 pandemic while this study was conducted in the new normal era. Meanwhile, the level 5 and 6 questions did not fulfill all indicators because they could not translate the problem. It can be seen that students with visual learning styles with levels 5 and 6 have difficulty in understanding, interpreting, designing strategies. Drawing conclusions on problems that use models with complex situations and applying strategies in solving complex problems. Relevant research conducted by (Firdaus & Rustina, 2019) at level 5 with a visual learning style category cannot translate problems, have difficulty interpreting the situation, have difficulty applying strategies in solving complex problems. One of the characteristics of the visual learning style is to rely on learning activities on the subject matter they see (Hartati, 2015). This can be the cause of students with visual learning styles only being able to be at level 4 questions, because the questions tested are new questions for students.

2. Mathematical Literacy skills of Junior High School Students in Solving PISA Problems in View of Auditorial Learning Style in the New Normal Era.



Translation:
Given: length 15 m and width 7m
Asked: circumference of garden?
Answer:

$$K = 2(p + l) = 2(15 + 7)$$
$$= 2 \times 22$$
$$= 44\ m$$

So, circumference of garden is 44 m

a. Formulating

Students with an auditorial learning style on level 1, 2, and 3 questions can understand the test questions well and identify mathematical aspects. Moreover the subject is can express information in the problem by explaining and describing what is known and what is asked according to the problem. This is in line with research (Indrahapsari, Sujatmiko, & Chrisnawati, 2018) showing that students who have an auditorial learning style are able to identify the elements asked in the information presented and convert problems into representations using mathematical symbols. The other with research conducted by (Widyanti, Abidin, & Walida, 2021) students do not write complete information without defining what is known and asked. Another case is the research conducted by (Widyanti et al., 2021) students do not write down the information completely without defining what is known and asked.

Students with auditorial learning styles on level 4, 5 and 6 questions are unable to understand test questions. Students are unable to identify mathematical aspects or write information from the problem, translate the problems, or write what is known and asked in the problem according to the problem.

b. Employing

Students with auditorial learning styles on level 1 and 2 questions can explain mathematical concepts and plan strategies by identifying formulas used to solve problems to find mathematical solutions. It can be seen that students can correctly explain the steps of work according to the formula. This is in line with students (Trisnaningtyas & Khotimah, 2022)with an auditorial learning style can explain the steps of solving the problem. Mathematical literacy skills in solving PISA problems in the new normal era students with auditorial learning styles on level 3 questions can plan strategies by identifying formulas used to solve problems in finding mathematical solutions. At this level students are not able to solve the problem correctly because students do not understand mathematical concepts in operating numbers so they have yet to answer the questions accurately. This is in line with research (Khoirunnisa & Soro, 2021) who demonstrate that students have difficulty in understanding concepts in operating answers.

Students with auditorial learning styles about level 4, 5 and 6 Students cannot explain mathematical concepts and strategies correctly, making students unable to work on these problems. With this indicator, students are less able to understand the problem, so they do not know what formulas and steps can be used to solve the problem. This is in line with research (Nariyati, 2016) students at the auditorial learning style at this level cannot work on problems do not understand what strategies will be used in solving the problem.

c. Interpreting

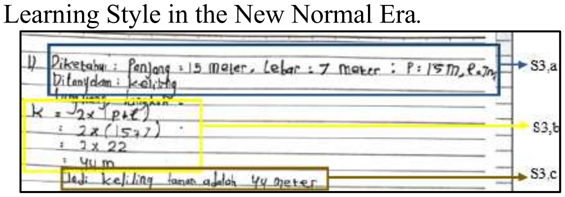
Students with auditorial learning styles on level 1,2 questions can explain the reasons for the results according to the context of the problem and interpret the results obtained in the real context, record the final answer and draw conclusions about problems in the real context. In addition, students also check the results. This is in line with research (Wulandari, 2022) that students with an auditorial learning style can fulfill indicators, such as the subject can re-evaluate the answer by checking back before collecting, re-concluding the answer, and providing reinforcement regarding the answer conclusion. In contrast to research conducted (Widyanti et al., 2021) students with an auditorial learning style tend not to write conclusions at the end of the working process.

Students with auditorial learning styles on level 3, 4, 5 and 6 questions have not been able to provide explanations of the causes underlying the results in accordance with the context of the problem and have not been able to reinterpret the results obtained in the context of the real world by writing the final answer and drawing conclusions. the subject did not re-examine the results done. In line with research (Anggraini, Hendroanto, & Hendroanto, 2021) that students with an auditorial learning style solve problems less precisely so that the writing of conclusions is also less precise.

Students with an auditorial learning style can solve level 1 and 2 problems correctly and meet all indicators because the problems at level 1 and 2 are problems with familiar questions and contexts. In research (Saputri, 2021) has not been able to fulfill the indicators of formulating saying that students have not been able to write what is known and what is asked in the problem. The difference in this study is due to the different materials used and the different abilities of each student. In level 3 problems, the students only fulfill one indicator of mathematical literacy. However, they are unable to solve problems at level-3, because level 3 problems require sequential solution procedures. This is supported by research (Rismen et al., 2022) showing that students with auditory learning styles are only able to reach levels 1 and 2.

Students cannot solve problem at levels 4, 5, and 6 because they could not translate the problem. It can be seen that students with auditorial learning style at levels 4,5 and 6 have difficulty in understanding, interpreting, designing strategies and drawing conclusions on problems that use models with complex situations. Students who use the auditorial learning style have difficulty in writing and learn by listening and remembering what is discussed. (De Porter, B., & Hernacki, 2002) This may be the cause of students with an auditorial learning style not being able to reach levels 4, 5, and 6.

3. Mathematical Literacy skills of Junior High School Students in Solving PISA Problems in View of Kinesthetic Learning Style in the New Normal Era.



Translation:
Given: length 15 m and width 7m
Asked: circumference of garden?
Answer:

$$K = 2(p + l) = 2(15 + 7) = 2 \times 22 = 44\,m$$

So, circumference of garden is 44 m

a. Formulating

Students with visual learning styles on level 1, 2, and 3 questions have mathematical literacy skills that include the ability to recognize various aspects of mathematics, a good understanding of test questions, and the ability to write complete information about what is known and what is asked in the context of the problem. In line with research (Indrahapsari et al., 2018) that students with kinesthetic learning styles are able to identify the known and questionable elements in the information presented.

Students with kinesthetic learning styles on level 4, 5 and 6 questions have limitations in mathematical literacy skills, where they have not been able to fully understand the test questions, identify relevant mathematical aspects, and write descriptive information about what is known and what is asked according to the context of the problem. A previous research (Wulandari, 2022) shows that students with kinesthetic learning styles have not been able to clearly write down the known and questionable variables in the problem. In addition, they also have not been able to transform the problem into the right mathematical representation.

b. Employing

Students with kinesthetic learning styles on questions level 1, 2 and 3 have good mathematical literacy skills. students can explain mathematical concepts well and design strategies in solving problems by determining the right formula. students are able to explain the steps of the work appropriately in accordance with the formula used.

Mathematical literacy skills in solving PISA problems in the new normal era students with kinesthetic learning styles on level 4, 5 and 6 questions have not been able to explain mathematical concepts well and design appropriate strategies to solve these problems. Due to a lack of understanding of the problem, students are not familiar with the formulas and steps that can be used to solve these math problems. Therefore students have difficulty working on these problems. This is in line with research (Khoirunnisa & Soro, 2021) showing students with kinesthetic learning styles still face obstacles in presenting mathematical concepts in the form of appropriate representations. They still have limitations in understanding mathematical concepts thoroughly.

c. Interpreting

Students with kinesthetic learning styles on level 1, 2, and 3 questions have good mathematical literacy skills. They can provide explanations of the causes underlying the results according to the context of the problem and interpret the results obtained in the real context. In addition, they can record the final answer and draw relevant conclusions about the problem in the real context. In addition, they can also carry out an important step to re-examine the results they have done. In accordance with research conducted by (Anggraini et al., 2021) which report that students who have a kinesthetic learning style are able to identify the elements known and asked in the answer sheet according to their own understanding.

Students with kinesthetic learning styles on level 4, 5, and 6 questions still have difficulty in explaining the reasons for the results in accordance with the context of the problem in the problem. They also have not been able to reinterpret the results obtained in the context of the real world by writing the final answer and drawing conclusions. In addition, students do not re-examine the results they have done. This is in line with research (Anggraini et al., 2021) which report that students who have a kinesthetic learning style cannot solve problems well, so they are unable to write relevant conclusions in a real-world context. In addition, the subject also did not carry out the stage of rechecking the results that had been done.

Students with kinesthetic learning styles can solve level 1, 2 and 3 problems correctly and fulfill all indicators. Problem levels 4, 5, and 6 do not fulfill all indicators because they cannot write answers, or have difficulty explain the first step in the problem. It can be seen that students with kinesthetic learning styles level 4, 5, and 6 have difficulty in understanding, interpreting, designing strategies and difficulty in drawing conclusions on problems that use models with complex situations and applying strategies in solving complex problems. The characteristics of students with kinesthetic learning styles are always physically oriented and learn through practice (DePorter & Hernacki, 2001). because of students with kinesthetic learning styles cannot created.

CONCLUSION

Based on the results of the research and discussion that has been described, the study: First, students with visual learning styles in solving PISA problems up to level 4 fulfill the indicators of formulating, employing, and interpreting. Second, the students with auditorial learning style can solve PISA up to level 2 which requires the mastery in formulating, employing, and interpreting Level 3 only fulfill the formulating indicator. (3) students with kinesthetic learning style in solving PISA questions up to level 3 fulfill the indicators of formulating, employing, and interpreting. It is expected that students try to improve their mathematical literacy skills by getting used to working on mathematical literacy type problems. It is recommended for teachers to develop more effective learning strategies. By understanding students' learning styles, teachers can organize teaching that suits students' individual needs.

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Logical Intuition of Gifted Students in Solving Mathematics roblems

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Abstract. A person can reason quickly and automatically to produce the correct answer. This is an important aspect for someone in making decisions when solving problems. This study examined the forms of logical intuition in gifted students' mathematical problem-solving. This research uses a qualitative approach with a case study type. The case study in this research is a multiple case study. The research instrument consisted of the researcher as the main instrument, logical intuition indicator rubrics, mathematics problems, semi-structured interview guides, audio-visual recording tools, and researcher notes. This research was conducted in Banyuwangi Regency, East Java Province, Indonesia. The subjects of this study were three mathematically gifted students at the junior high school level. The research data consisted of the subject's written answers, interview recordings, and the researcher's notes. The data analysis technique is an interactive data analysis technique consisting of data collection, reduction, data presentation, and conclusion. This study's results indicate three forms of modus ponen (MP) logical intuition, namely MP1, MP2, and MP3. The dominant characteristic of MP 1 is the use of formulas. The characteristic of MP2 is the use of proportion. The dominant characteristic of the MP3 is the use of memorized steps. The different forms of logical intuition are due to the different learning experiences of each subject. This research is limited to the reasoning cases of high-achieving junior high school students only. The implication of the results of this research is that teachers are advised to provide mathematical problem-solving training to all their students so that they have logical intuition.

INTRODUCTION

Recent research in the field of reasoning and decision-making shows that a person can produce a response to information correctly automatically or intuitively [1]–[4]. This event is referred to as logical intuition or intuitive logic. However, the concept of logical intuition contradicts the general theory of reasoning. Reasoning in general describes that intuition is a form of someone's hunch and has no correlation with logic, the law of causation, and the concept of probability of occurrence [5]–[7]. Logical intuition can occur because one's learning experience exploits the structure of problems that correlate with mathematical concepts and the validity of arguments so that they are internalized in memory [8]–[10]. Someone who experiences logical intuition tends not to do mathematical calculations and instead analyzes the correlation between the structure of the problem and their learning experience [11]. Once the correlation is generated, a spontaneous or automatic response occurs. In this study, the logical intuition that occurs when the process of correlating the structure of mathematical problems with learning experiences is examined in depth.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040020-1–040020-12; https://doi.org/10.1063/5.0241742
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Intuition in the view of dual process theory is system 1 which is indicated by the occurrence of automatic processes, subjective-empirical processes, and processes without realizing it. An automatic process is a mental process in generates a response spontaneously based on information that has been internalized. One representative form of internalized information is memorized information. The subjective-empirical process is a mental process in producing answers based on audio-visual impressions of information. Furthermore, the process without realizing it is a mental process in producing answers without going through matching the characteristics of an information with learning experience or other information.

In logical intuition, system 1 is not activated when one generates a response. When logical intuition occurs, system 2 is an active mental activity that precedes system 1. System 2 is active when there is scrutiny and correlation of problem structures with learning experiences [3], [12], [13]. The results of the observation and correlation trigger the activation of system 1 so that a response is generated automatically.

Logical intuition can only occur in someone who has learning experience and high-order thinking skills [1], [14]. This is because the repetition of learning information will be internalized in memory. Internalization of information occurs after it has been abstracted through higher-order thinking. Abstraction of information through higher-order thinking produces core concepts that are not attached to contextual traits [15], [16]. Thus, logical intuition can be studied through the thinking of someone who has undergone training and has higher-order thinking skills. Such conditions occur in students who take part in Mathematics Olympiad training. Furthermore, the study is more appropriate for gifted students who have achievements in competitions. In this study, a study was conducted on the thinking of junior high school students who had achievements in math competitions.

Meanwhile, math problems are used as a trigger for students' thinking. The mathematical problems used in this research are story problems. Story problems are used because of their complexity. This complexity can trigger the activation of system 2 and system 1 so that logical intuition occurs [10], [17], [18]. Solving story problems requires analysis which is the realm of system 2 activation. The results of this analysis have the potential to activate system 1 because students already have sufficient learning experience so that automatic processes can occur. The following is presented in Table 1 which summarizes the position of this research when compared to previous studies.

TABLE 1. Research Position & Novelty

Researcher ear	**sub ect**	**Novelty Findings**
[11] Howarth et al., 2022	adults	Logical intuition process
[4] Trippas et al., 2016	adults	Intuition
[19] Lem et al., 2015	student	Characterization of intuition in solving large number problems
[12] Reyna et al., 2015	student	Decision making using intuition
Nugroho et al., 2023 This research	Middle school students	Forms of logical intuition

Based on Table 1, the difference between this research and the research of Howarth et al., 2022 [11] lies in the process and formulation of logical intuition. Howarth et al.'s 2022 research examines the process of logical intuition, while this research examines categories or forms of logical intuition. Furthermore, the difference between this research and the research of Trippas et al., 2016 [4] lies in the type of intuition. Trippas et al.'s 2016 research examined intuition in general which has the potential to produce wrong or right answers. Meanwhile, this research examines the logical intuition that produces the correct answer. Compared with the research of Lem et al., 2015 [19], this study has differences in its intuitive characterization. Lem et al's research in 2015 examined general intuition in routine problems involving large numbers, while this research characterizes the form of intuition in solving problems in the form of stories. Furthermore, when compared with research by Reyna et al., 2015 [12], the difference lies in the type of response produced by intuition. Reyna et al.'s research in 2015 focused on decision making, while this research focuses on forms of logical intuition.

The novelty of this research when compared with previous studies is the forms of logical intuition that are characterized. In other words, the aim of this research is to answer the problem formulation regarding the characteristics of logical intuition forms of mathematically gifted junior high school students in problem-solving.

METHOD

This section describes the research design, subjects, procedures, instruments, data, and analysis techniques.

Research Design and Research Sub ects

This research is a qualitative-research with a case study type. The case study in this research is a multiple case study. Multiple case studies are case studies that examine more than one unit of analysis (Darmawan & Yusuf, 2022) . The unit of analysis in this research is the thinking of three gifted mathematics students. The characteristics of students who are potential subjects of this study are as follows.

1. junior high school students.
2. students who pass the selection of coaching in Mathematics Olympiads in schools.
3. students who have at least district or city level achievements in the field of Mathematics Olympiads.

This research was conducted at Bustanul Makmur Genteng Junior High School, Banyuwangi, East Java, Indonesia. There were as many as five students who became prospective subjects because there were only 5 students who met the requirements as potential subjects at the research location. One student won the highest gold medal in the kangaroo mathematics contest in 2023 and the gold medal in the KSN (National Science Competition) in Mathematics in 2022 at the national level. One student won the highest KSN 2022 gold medal at the national level. One student achieved the highest achievement in passing the 2022 KSN selection at the provincial level. One student won the highest achievement as first place in KSN 2023 at the district level. One student won the highest achievement in the 2023 KSM (Madrasa Science Competition) at the district level.

Research rocedure

Researchers collected prospective subjects at one of the schools in Banyuwangi, East Java. Each prospective subject was given a math problem to solve individually with unlimited duration. Prospective subjects were allowed to solve problems until they felt satisfied with their progress. After feeling complete, students were asked to submit their answers to the researcher. Furthermore, these prospective subjects were not allowed to use other media to write other than the answer sheet provided by the researcher. This was done so that all of the subject's thinking can be detected through written answers.

Research Instruments

The research instrument consisted of main instruments and supporting instruments. The main instrument was the researcher as a determinant and decision maker on research results. Meanwhile, the supporting instruments consisted of logical intuition indicator rubrics, mathematical problems, semi-structured interview guidelines, researcher notes, instrument validation sheets and audio-visual recording tools. In the following, each presentation of the instrument is presented.

1. Mathematics Problem

The following presents the mathematics problems used in this study.

30 tukang dapat menyelesaikan pekerjaan dalam waktu 24 hari. Setelah 10 hari bekerja, pekerjaan terhenti selama empat hari karena cuaca buruk. Jika ingin menyelesaikan pekerjaan tepat waktu, maka harus menambah berapa tukang?

Translation
30workers can complete a job in 24 days. After 10 days of work, work was stopped for four days due to bad weather. How many workers should you add if you want to finish the job on time?

The problem used has characteristics that can trigger the activation of system 1 and system 2 because it is in the form of a story problem. The information used to trigger system 1 activation is the number of workers, the time to complete the work, and the number of workers that must be added to complete the work. These three pieces of information have the potential to activate automatic processes if the subject has learning experience using internalized formulas or steps to solve them. However, system 1 is active after the analysis through system 2 is carried out by the subject in such a way that the logical intuition occurs.

2. Logical Intuition Indicator Rubric

The following presents the logical intuition indicator rubric used in this study.

TABLE 2. Logical Intuition Indicator Rubric

Forms of Logical Intuition	System 2	System 1
Modus Ponens Type 1 (MP1) Premise 1: If p then q Premise 2: p Conclusion: q p is information regarding the ratio of the number of workers and the time to complete the work q represents the decision to use the concept of proportion	Concious Process: Matching the characteristics of information on math problems with learning experiences	Automatic process: generating patterns to solve problems spontaneously because
Modus Ponens Type 2(MP2) Premise 1: If p then q Premise 2: p Conclusion: q p is information about the number of workers and the time to complete the job q represents the decision to use the formula	Concious Process: Matching the characteristics of information on math problems with learning experiences	Automatic process: using memorized formulas to solve problems spontaneously.
Modus Ponens Type 3(MP3) Premise 1: If p then q Premise 2: p Conclusion: q p is information regarding the ratio of the number of workers and the time to complete the work q is the decision to use memorized steps	Concious Process: Matching the characteristics of information on math problems with learning experiences	Automatic process: using memorized steps to solve problems spontaneously

Based on Table 2, logical intuition in the form of modus ponens is categorized into three, namely MP1, MP2, and MP3. Logical intuition occurs because of premise 1, premise 2, and conclusion. Premise 1 and premise 2 are signs that system 2 is active. Meanwhile, conclusions are generated through system 1. So, drawing conclusions based on premise 1 and premise 2 is a process of logical intuition. The modus ponens form of logical intuition involves both conscious and automatic processes.

In MP1's logical intuition, the statement is information about the ratio of the number of workers and the time to complete the work. The statement is a decision that uses the concept of proportion. In the MP2 logical intuition, is information about the number of workers and job completion time and is the decision using the formula. Furthermore, in MP3's logical intuition, is information regarding the ratio of the number of workers and job completion time and is the decision to use memorized steps.

3. Semi-Structured Interview Guidelines

Interview guidelines in this study were prepared in a semi-structured manner. The essence of the questions for each subject was the same, but deep digging into the subject's thinking uses questions that were flexible according to the conditions of each subject. The following presents the semi-structured interview guidelines used.

4. Instrument Validation Sheet

The instrument validation sheet is used to measure the validity of this research instrument. The instruments that were validated were logical intuition indicator rubrics, mathematical problems, and semi-structured interview guidelines. The validator of this study was an expert in the field of mathematics education, a graduate of a master's program with more than years of teaching experience.

5. Data and Research Data Sources

The research data is in the form of the subject's written answers and the interview recordings. The data source for this research was junior high school students who were selected as research subjects.

6. Data analysis technique

The data analysis technique used in this study is an interactive data analysis technique. This data analysis technique, namely data collection, data reduction, data presentation, and drawing conclusions. At the time of data collection, an analysis was carried out on the subject's written answers to map students who were potential subjects. Then, the answers from the subjects were reduced before being presented. Reduction was carried out on data that was out of sync in the subject's written answers with the interview results. Furthermore, the conclusion of this study regarding logical intuition is based on the results of an analysis of the subject's mental processes in solving mathematical problems until the data is saturated. The following data analysis techniques are presented in the chart.

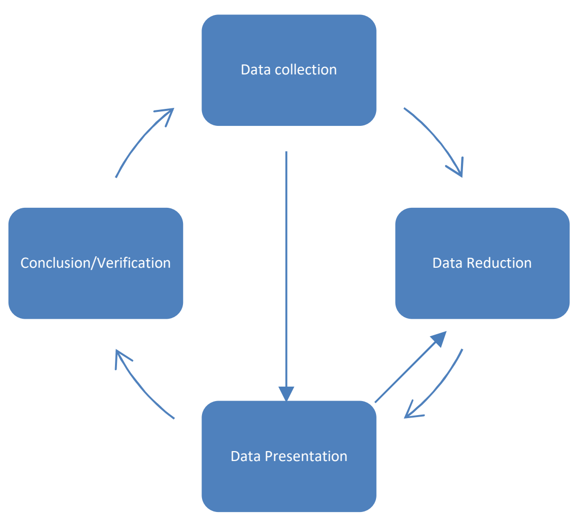
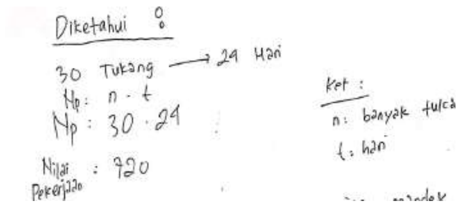


FIGURE 1. Interactive data analysis techniques

RESULTS

Sub ect 1 Logical Intuition M 2

Subject 1 is a subject that produces answers through logical intuition with the MP2 form. In Figure 2 below, subject 1 is indicated using a mathematical formula to generate answers. The figure below is divided into three parts based on the stages of subject 1's thinking process in generating answers.

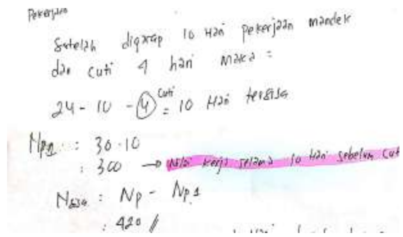


Translation
Is known:
workers work days

Worker value

art 1

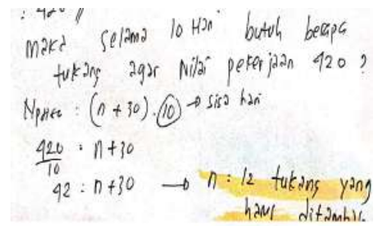
(a)



Translation
After working 10 days, workers go on leave for 4 days, so:

art 2

(b)



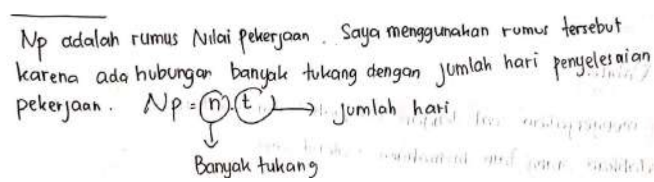
Translation
Therefore, in 10 days how many workers will it take to get the value of the work to be 420?

art 3

(c)

FIGURE 2. Subject's 1 Written Answers

Part 1 in Figure 2 above is evidence of the occurrence of logical intuition in the MP2 form. Subject 1 uses a formula with information and Based on the results of interviews and the following research notes, subject 1 uses the formula on the structure of the problem that has been internalized.



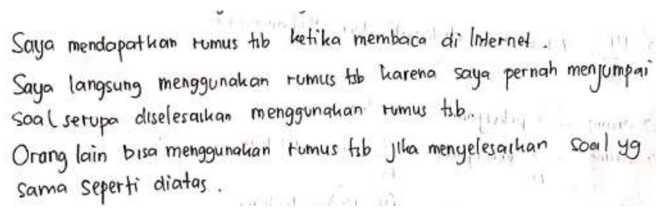
Translation:
is the job value formula. I use this formula because there is a relationship between the number of workers and the number of days to complete the work.

FIGURE 3. Researcher Notes for Subject 1

Based on Figure 3, subject uses this formula because there is a relationship between the number of workers or workers and the number of days needed to complete the work. Thus, logical intuition in the form of MP2 occurs because the result of system 2 triggers the activation of system 1.

System 2 subject 1 is active when a conscious process occurs. The process of realizing this occurs when subject 1 analyzes the structure of the problem and matches it with learning experiences. Based on part 1 and part 2 Figure and researcher's notes, Subject 1 broke down the structure of the problem into several parts, namely, the number of workers, the number of working days, the number of days off, and the number of additional workers needed. Then, subject 1 synthesizes the information. The result of this synthesis triggers the activation of system 1 which is marked by the occurrence of an automatic process.

The automatic process of subject 1 occurs when a mathematical formula is generated spontaneously. This happened because subject 1 memorized the formula. The following is the researcher's notes based on the results of interviews with subject 1.



Translation:
I learned the formula from the internet.
I immediately used this formula to answer this question because I had previously worked on a similar question.Other people can use this formula if they face questions that are similar to the questions given by the teacher.

FIGURE . Subject Automatic Process 1

Based on Figure 4, subject 1 uses a formula when solving a problem with the characteristics of a problem structure that relates information about the number of workers, the number of working days, the number of days off, and the number of additional workers needed. The mental process that occurs in subject 1 since analyzing the structure of the problem to producing the formula is a logical intuition in the form of MP2.

Logical intuition in MP2 form consists of premise 1, premise 2, and conclusion. Premise 1 is a statement if there is a problem containing information about the number of workers, the number of working days, the number of days off, and the number of additional workers needed, the formula is used. Premise 2 is a statement that there is a problem which contains information about the number of workers, the number of working days, the number of days off, and the number of additional workers needed. Furthermore, the conclusion from the MP is the formula .

Sub ect 2 Logical Intuition M 1

Subject 2 is a subject that produces answers through logical intuition with the MP1 form. Subject 2 uses the concept of reverse value proportion in solving problems. The following is presented Figure 5 which is the written answer of subject 2.

Translation:

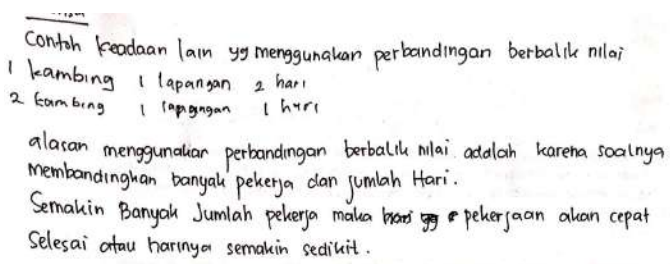
Workers Lots of all the workers	Days	Job
	14	job that has not been completed after 10 days of work

Workers	Days	
		30 workers can do the remaining job in days. Because there are days of leave, the remaining days are days. The fewer days given, the more workers are needed.

The number of additional workers is

FIGURE . Subject's 2 Written Answers

Figure 5 shows that subject 2 makes a number arrangement that represents the inverse proportion of these values. Explanation of subject 2 in the interview was recorded by the researcher as follows.


Contoh keadaan lain yg menggunakan perbandingan berbalik nilai
1 kambing 1 lapangan 2 hari
2 kambing 1 lapangan 1 hari
alasan menggunakan perbandingan berbalik nilai adalah karena soalnya membandingkan banyak pekerja dan jumlah Hari.
Semakin Banyak Jumlah pekerja maka ~~hari yg~~ pekerjaan akan cepat Selesai atau harinya semakin sedikit.

Translation:
Examples of other situations that use inverse value comparisons.
1 goat eats 1 patch of grass in 1 day
2 goats eat the grass of 1 field in 2 days
inverse proportions are used because problems are comparing the number of workers and the number of days.
The more workers there are, the faster the work will be completed. In other words, fewer days are required.

Figure . Subject Interview Result Notes 2

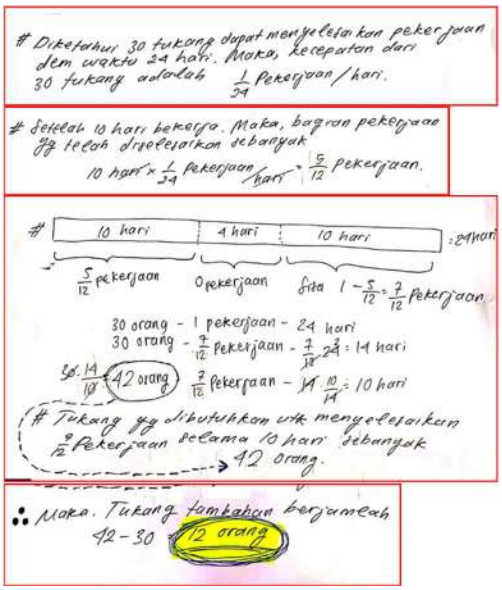
Based on Figure 6, subject 2 explains the condition that the concept of reverse value proportion can be used, that is, the more workers, the faster the work will be completed. In fact, subject 2 gave a case as an example, if one goat can eat one field of grass in two days then two goats can eat one field of grass in one day. This is evidence of the occurrence of logical intuition in solving subject 2 problems.

The logical intuition experienced by subject 2 is in the form of MP1. The MP1 consists of premise 1, that is, if in the problem there is information that compares the number of workers and the number of days with each other the value reduces or increases, then the concept of reverse value proportion is used to produce a solution. Premise 2 is that in the problem there is information that compares the number of workers and the number of days with one another the effect of reducing or enlarging the value. Thus, subject 2 concludes to use the reverse value proportion concept.

In subject 2's logical intuition, system 1 and system 2 are active. System 2 is active on premise 1 and premise 2, while system 1 is active on conclusion. The activation of system 2 is marked by the realization process. The process of realizing is active when subject 2 analyzes the structure of the problem. Subject 2 breaks down the information on the problem into several parts, namely the number of existing workers, the number of days off, and the number of additional workers. Then, subject 2 synthesizes the information in such a way as to produce a problem structure with interconnected information. The synthesis result also includes information about the days remaining to complete the work. Furthermore, the results of this analysis are the result of a conscious process. The results of the realizing process trigger the activation of system 1. An active system 1 is marked by the conclusion of subject 2 through an automatic process. The automatic process occurs when subject 2 spontaneously uses the concept of inverse proportion because the structure of the problem is considered the same as the learning experience.

Sub ect 3 Logical Intuition M 3

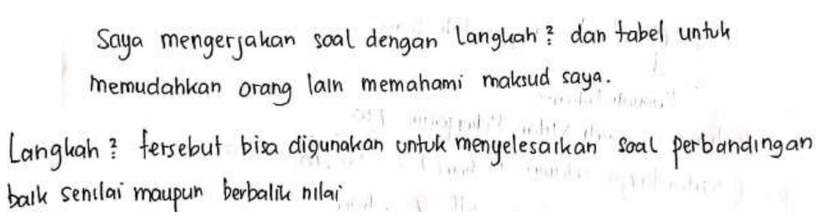
Subject 3 produces answers through 5 steps. Step 1 to step 3 is a process towards a conclusion in step 4. The following is the answer from subject 3.



Step 1	It is known that 30 workers can complete the work within 24 days. Then the speed of 30 workers is — jobs/day
Step 2	After 10 days of work the work that has been completed is — —
Step 3	10 days —work, 4 days 0 work, 10 days — — 30 workers – 1 work – 24 days 30 workers - —work – 14 days — - —work - — The number of workers needed to complete a job in 10 days is 42 workers
Step	Then the number of workers must be increased by

FIGURE . Subject's 3 Written Answer

Based on the Figure 7 and the researcher's notes, the sign represents a stage or step carried out by subject 3. While the sign represents the conclusion produced by subject 3. Each step marked with is marked again by the researcher with step 1, step 2, and step 3. Meanwhile the conclusions that are marked marked by the researcher with step 4. Steps 1 to step 4 carried out by subject 3 are the result of system 2, but the decision to carry out these steps is the result of system 1. The following is the researcher's notes on the results of interviews with subject 3 which show that matter.



Translation:
I solve problems with steps and tables to make it easier for other people to understand the solutions I produce. These steps can be used to solve equal and reverse proportion problems

FIGURE . Notes on Subject 3

Based on Figure 8, subject 3 uses these steps to solve the problem of proportion of values and returns of value. Furthermore, subject 3 uses tables in problem solving to make it easier for others to understand the answers produced. The researcher's note shows the occurrence of logical intuition in the form of MP experienced by subject 3. The MP consists of premise 1, premise 2, and conclusion. Premise 1 is if there is a problem that contains information about the number of workers compared to the completion time, the solution can be generated through four steps: Step 1, namely determining the work ability of one mason in a day; Step 2, namely, determine the work that has been completed for several days; Step 3, namely, determine the remaining days to complete the work; and Step 4, which concludes the number of additional workers needed based on step 1 to step 3.

DISCUSSION

The logical intuition that occurs in the subject is divided into three forms, namely MP1, MP2, and MP3. MP1 and MP3 are more flexible than MP2. In MP1 and MP3, the subject thinks according to the condition and context of the problem. Subjects who experience MP1 see conditions that are in accordance with the concept of value proportion and the concept of value proportion in problem solving. In other words, logical intuition in the form of MP1 has two channels. The first channel is towards the use of the value proportion concept and the second channel is towards the use of the reverse value of proportion concept. Two channels can be formed based on the subject's learning experiences that experience intensive repetition of similar problems and have different core information [21]–[23].

Meanwhile, MP3 is flexible in its steps. Each step can be modified by the subject according to the context of the problem. In other words, in MP3, multiple channels are formed, each of which leads to certain decisions that are correlated with internalized learning experiences. This multi-channel can be formed due to the subject's repetitions on various problems. Another possibility that forms this multi-channel is that the subject limits the internalization of the learning experience to only certain information globally [4], [24], [25]. The details of the elaboration of this information are not internalized by the subject with the aim of avoiding deadlock in problem solving. A deadlock may occur if the subject only has a single channel.

In this study a single channel occurs in MP2 because the subject only knows one formula for problem solving. After analyzing through system 2, a decision is made using a formula that has been internalized. The process of generating the formula is through system 1. In MP2 the subject does not have other channels so that there is more potential for deadlock in problem solving. This can happen if the context of the problem is different from the subject's learning experience but the subject is not aware of these differences [26]–[28].

The logical intuition of gifted students in this study has similarities and differences. The same thing happens in system 2, namely the activation of conscious processes. Gifted students activate system 2, which is characterized by conscious processing. This shows that the mental activity of gifted students begins with information analysis. Meanwhile, the difference with logical intuition occurs in the processes included in system 1. System 1 is active because it is triggered by a response produced through a conscious process. Different learning experiences lead to different active operations in system 1.

CONCLUSION

The conclusion of this study is that logical intuition occurs in three forms, namely MP1, MP2, and MP3. The main characteristic of the MP1 is its use of the concept of proportion. The main characteristic of MP2 is the use of formulas. The main characteristic of MP3 is the use of memorized steps. Logical intuition occurs in different forms due to the different learning experiences of each subject. Suggestions for further research are to examine other forms involving mental processes that have not been revealed in this research. The mental processes that have not been revealed from the system category 1 are unconscious processes and subjective-empirical processes. Meanwhile, the mental process of system category 2 that has not been revealed is the process of empirical accuracy. Based on the conclusions of this research, recommendations for future research are to examine logical intuition in students who are not categorized as gifted students. In addition, researchers recommend that teachers familiarize their students with solving non-routine problems to improve their logical and intuitive thinking abilities.

ACKNOWLEDGMENT

The researcher would like to thank Laras Shita Prastiwi, M.Pd. who assisted in this research at the Bustanul Makmur Middle School institution, Genteng, Banyuwangi as the location for data collection.

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Implementation of Entrepreneurship Learning in Senior High School

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Abstract. Schools have their own ways to support their students to be creative and innovative to face life in society. This is because not all high school graduates continue their education to a higher level of education. The purpose of of this research is to identify the entrepreneurship learning model and the implementation of entrepreneurship learning at the upper secondary education level. This research uses a descriptive qualitative approach with a literature study approach where the main source of this research is previous scientific works that are closely related to the focus to be discussed, for example: (1) textbooks, (2) international journals, and (3) internet articles of formal institutions. The results showed that the implementation of entrepreneurship learning greatly trains and builds students' soft skills, especially by using a project-based learning model. Based on the results it can be concluded that the implementation of entrepreneurship learning is very attractive to students, especially with learning that is applicative and interesting, by being trained in how to solve real problems that exist in the field and coupled with direct practice. This form can shape the character of children to be more responsible and dare to take steps in achieving their future goals. Entrepreneurship education can be carried out intraculicularly, co-curricular and extracurricular in accordance with the learning independence curriculum currently implemented at school.

INTRODUCTION

Indonesia has a large population, the population has strategic potential if viewed as a potential market share for industrial development. [1] stated that since 2012 until 2035 it is estimated that Indonesia will enter a demographic bonus period with the peak demographic period is between 2020-2030. This phenomenon is characterized by the number of productive age population that reaches twice the number of age population children and elderly. In Indonesia itself, the number of productive age is 187.2 million, this magnitude has tripled from the previous year. Demographic bonus It cannot be released to the millennial generation, because of the contribution of the millennial generation in building a structure the number of productive age population is quite high [2]. This demographic bonus can be a boomerang if it is not taken seriously one of which is unemployment that occurs in the majority of productive age with range of 15-64 years.

TABLE 1. Open Unemployment Level 2020 - 2022

Education Level 2	Open unemployment rate based on education level		
	2 2	2 21	2 22
Never been to school/Not yet Graduated & Completed Elementary School	3.61	3.61	3.59
Middle School (SMP)	6.46	6.45	5.95
High School (SMA)	9.86	9.09	8.57
Vocational School (SMK)	13.55	11.13	9.42
Diploma I/II/III	8.08	5.87	4.59
Scholar	7.35	5.98	4.80

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040021-1–040021-4; https://doi.org/10.1063/5.0241883
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Based on table 1. The highest level of unemployment is experienced by high school and vocational education levels. This is very unfortunate if the investment in educated human capital cannot be utilized optimally. Based on data from the Central Statistics Agency (BPS), the ratio of entrepreneurs in Indonesia is still 3.47% or only about 9 million people from the total population of Indonesia, although this has increased compared to 2016 which only amounted to 3.3%. The National Labor Force Survey shows that graduates of high school accounted for the highest number of open unemployment after vocational school. School learning is very influential on the final results of students taking high school education in particular, one of which is through learning entrepreneurship, according to [3] printing a skilled young generation with an entrepreneurial spirit is by implementing entrepreneurship learning is one of the steps to face the demographic bonus era and reduce educated unemployment in Indonesia.

Entrepreneurship education is one of the means of training learning and increase children's creativity in awakening the entrepreneurial spirit and choosing to be an entrepreneur rather than being a worker, aligns with [4] that entrepreneurship education is a field that have the ability and skills in managing a job complexity. The learning process carried out can use various approaches, models, strategies, and methods that refer to inspiring characteristics and interactive, challenging, fun and motivating learners to participate actively, collaboratively and contextually, providing great opportunities to be creative and self-actualize for the independence of students and accordance with the talents, interests, physical and psychological development of learners.

To hone the creativity of students, a model learning is needed that can be realized in the form of tangible results. Where the implementation of learning is not only theoretically capable but they can develop knowledge that has been learned so far can implemented in the form of real skills in creating products. Schools have an important role in helping students hone soft skills that students have and motivate students in developing creative ideas owned.

The learning process carried out today is more about learning project-based or Project Based Learning (PBL) that is collaborated to adjust to the Strengthening Pancasil Student Profile (P5) project accordance with independent learning curriculum promoted by the Ministry of Education of the Republic Indonesian. Entrepreneurship learning in high school is implemented in craft and entrepreneurship learning that has aim to introduce the concept of entrepreneurship, initial training to develop a business, gaining practical experience in entrepreneurship fosters entrepreneurial interest and develop entrepreneurial potential.

The entrepreneurship education program is a program for increase the creativity and become a person who is able to solve problems, accordance said by [5] that entrepreneurship education is very important for the students both at the level basic and upper to prepare to cope with a job which is increasingly modern with a high level of competition. There fore this program should be an alternative in preparing capable graduates implement and manage business opportunities and be able to adjust to succeed in community life and be able to face global competition.

Entrepreneurship education will be one solution in pressing high unemployment rate especially for high school graduates in Jakarta, given the still high rate of open unemployment among the educated, including high school graduates, the provision of entrepreneurship education is considered it is very important to instill an entrepreneurial spirit in students. This is in line with research [6] showing that according to student perception, entrepreneurship education is felt positively in all dimensions and shows a strong positive relationship between perception and intention entrepreneurship. Building a positive perception of entrepreneurship education in among students is the basis for achieving its main goal. Education entrepreneurship is considered very important to provide opportunities for students become an innovative, creative, independent, and a leader able to face challenges. Therefore, entrepreneurship education is an effort to prepare graduates to become entrepreneurs so that able to contribute to economic development.

Proper implementation of entrepreneurial learning in the process learning both the model and the learning approach used will be produce learning objectives that are appropriate and beneficial in the community. Entrepreneurship education is not solely for the benefit of the business world, but every job that has a spirit, mindset, and entrepreneurial character will make a difference, change, and growth positive in their profession and work outside the field of the business world. Soul entrepreneurship will have creative and innovative power, look for opportunities and dare to take risks. Entrepreneur education will give the character of the students with strong mental and moral strength, a spirit of independence, and tenacious attitude, knowledge and skills, and able to face global competition.

Entrepreneurship education that can foster interest is simulated learning with various learning models that leads to thinking skills and creativity. Efforts to improve quality entrepreneurship learning in schools can be done through activities intracurricular, co- curricular and extracurricular. The approach that the teacher chooses It should stimulate students to think creatively. Learning can be carried out by applying project learning by utilizing and develop local potential in the area. Other learnings that can be applied in a design thinking model that presents a solution approach to solve the problem. Learning begins with identifying desires or tastes of consumers, formulating problems and solving solutions problems, the process of gathering ideas through brainstorming, prototyping and test it for basic prototype repairs.

Entrepreneurship in addition to being taught through compulsory subjects, can also carried out through co-curricular projects. Entrepreneurial projects are carried out with collaborate on basic competencies or learning outcomes from various subject. With collaboration between subjects, students can learn and deepen competence from different points of view. Shape of co-curricular projects can train students how to work together, appreciate opinion of friends, finding creative ideas for solving problems, utilizing technology to support their projects. Entrepreneurship in schools can also be developed through extracurricular activities that tailored to the needs, potentials, talents, and interests of the students being guided by educators or education personnel appointed by the school.

Currently, the government is encouraging various activities or activities entrepreneurship. It is expected that entrepreneurship education will be held on primary to upper education levels can produce quality output, creative and innovative. This is actually an obligation for educational institutions Indonesia to apply entrepreneurial activities to students.

METHOD

This research uses qualitative descriptive method with approach literature study, where the collection of information is sourced from research that related to literature review that is bibliographical. This primary research is an earlier scientific work closely related to the focus that will be discussed, for example: (1) textbooks, (2) international journals, and (3) articles internet formal institutions. Data is presented in the form of tables and words systematically in its preparation, but in this paper, it is not done empirical test of the data obtained. The purpose of this study is to find out learning models that are suitable for entrepreneurial learning at the level of high school in Jakarta.

RESULTS AND DISCUSSION

In implementing entrepreneurship education in school the upper middle must go through several stages: 1) the appropriate planning stages with the vision, mission, and curriculum of an institution; 2) planning on activities; learning 3) planning teaching and learning activities and application to in practice [7]. The results of the research revealed above are also in line with the results of research [8] That there are three stages in implementing entrepreneurship education, namely (1) Planning stage, includes: formulation of program objectives, vision and mission of educational programs entrepreneurship, determine the subject matter then enter values entrepreneurship education to be developed in the implementation plan learning; (2) Implementation stage, including: classes, subjects entrepreneurship, integrated with subjects, self-development activities, school culture; and (3) Evaluation stage, including educational assessment activities entrepreneurship that is based on entrepreneurial values that have been internalized and implemented in behaviors seen in activities learners at school.

In the implementation process, entrepreneurship education can be in implement through several activities according to[9] The implementation of entrepreneurship can be carried out through intracurricular activities, co-curricular and extracurricular. On Educational intracurricular activities entrepreneurship is applied through entrepreneurship and craft subjects, a suitable learning approach in this subject is with a project based learning (PJBL), according to [10] learning model project- based is proven to be able to increase the spirit of entrepreneurship and achievement student.

Co-curricular activities can be carried out jointly or individually and this co-curricular activity can be carried out side by side with other subjects. Furthermore, extracurricular activities which are activities outside of hours learning, extracurricular activities related to education entrepreneurship like, extra entrepreneurship etc.

In research conducted by [11] resulted in that the application of entrepreneurial activities at SMAN 1 Sumberlawang is more through co-curricular activities. This entrepreneurial co-curricular goal is for students able to identify economic potential at the local level and existing problems in the development of this potential, as well as its relation to the environment, social, and community welfare.

Based on above literature, a common thread can be drawn that Implementation of entrepreneurship education must be thoroughly prepared carefully with several stages such as planning stages that must be aligned with the vision, mission and curriculum of the school, the implementation stage that can be done through intracurricular, co-curricular and extracurricular activities to hone student ability as well as cultivating the spirit of entrepreneurship and stages evaluate, assess the advantages and disadvantages of the learning process implemented. In the learning process, a suitable model is used to entrepreneurship education is project-based learning where students or students asked to practice directly related to entrepreneurship material, It hones creativity as well as a better mindset in the future.

CONCLUSSION

the implementation of entrepreneurship learning greatly trains and builds students' soft skills, especially by using a project-based learning model. Based on the results it can be concluded that the implementation of entrepreneurship learning is very attractive to students, especially with learning that is applicative and interesting, by being trained in how to solve real problems that exist in the field and coupled with direct practice. This form can shape the character of children to be more responsible and dare to take steps in achieving their future goals. Entrepreneurship education can be carried out intraculicularly, co-curricular and extracurricular in accordance with the learning independence curriculum currently implemented at school. , a common thread can be drawn that Implementation of entrepreneurship education must be thoroughly prepared carefully with several stages such as planning stages that must be aligned with the vision, mission and curriculum of the school, the implementation stage that can be done through intracurricular, co-curricular and extracurricular activities to hone student ability as well as cultivating the spirit of entrepreneurship and stages evaluate, assess the advantages and disadvantages of the learning process implemented.

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Fractional Learning Design Using the Kayuagung Tourism Context to Construct the Argumentation Skills of Fifth-Grade Students

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Abstract. Fraction is one of the most important topics in mathematics. However, many students still learn fractions only by memorizing procedures without understanding the meaning. The purposes of this research is to produce a fraction learning trajectory using the Kayuagung tourism context and find out whether the fraction learning design uses fraction using the Kayuagung tourism context can construct the argumentation skill of fifth-grade students. The subject of the research was fifth-grade students of SDIT Bina Insani Kayuagung. The research method is design research, validation studies type that contained 3 stages : designing learning activities (preliminary design), implementing learning (teaching experiment) and conducting retrospective analysis (retrospective analysis) to contribute to theory local learning (Local Instructional Theory) to construct students' argumentation abilities in learning fractions. Hypothetical Learning Trajectory was developed from a learning activity using the context of Kayuagung tourism in understanding equivalent fractions through the activity of determining the measurements of the *sepulut* cake ingredients. Data collection was carried out through test, documentation, and interview. Hypothetical Learning Trajectory (HLT) which has been designed and then compared with the actual learning trajectory during the implementation of learning. The result shows that the use of the Kayuagung tourism context can construct the argumentation skills of fifth grade students in indicator data, claim, evidence, reasoning, and rebuttal.

INTRODUCTION

Fraction materials are essential for understanding the concept of proportional reasoning, which is necessary not only for a deeper understanding of mathematics but also to support daily activities [1]. Understanding the concept of fractions is indispensable for learning algebra, geometry, and other higher-level aspects of mathematics [2]. Fraction concepts have been known by students in Indonesia informally through their daily activities and have also been introduced formally in elementary and junior high schools [3].

But in reality, there are still many students who think that fractions are complicated and unpleasant material. Fraction material is also seen by students as difficult to understand as can be seen in research that shows this [4]. Many students view fractions as meaningless symbols or see the numerator and denominator of fractions as separate numbers rather than a unified whole [2].

One of the main causes of students' difficulties in learning fractions is that they only memorize formulas and algorithms, do not understand fractions, and consider the denominator and numerator of fractions as two separate integers [5]. Students are rarely allowed by teachers to understand the rationale behind the algorithms taught to them so the knowledge gained becomes less meaningful and quickly forgotten [6].

Critical thinking skills are one of the important skills mastered by students in the 21st century. One of the abilities that cannot be separated from critical thinking skills is the ability that has an important role in developing

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040022-1–040022-8; https://doi.org/10.1063/5.0241841

students' critical thinking patterns and increasing students' understanding of an idea or idea. Argumentation plays a significant role in developing critical thinking skills and the ability to understand ideas [7]. Argumentation ability is a person's ability to provide answers and reasons for a problem accompanied by evidence in the form of sufficient and appropriate data and theory [8]. Argumentation skills in mathematics learning can strengthen students' understanding of mathematical concepts, obtain new ideas to expand the knowledge they already have, and eliminate misconceptions about a material [9].

To train students to develop their argumentation skills, a learning design that can construct argumentation skills is needed. As a first step, the researchers develop a hypothetical learning trajectory (HLT). HLT is a description of an alleged activity carried out by students from the beginning of learning until the learning objectives are achieved [10]. In this research, the HLT will be developed using the context of Kayuagung tourism. The learning approach that matches this characteristic is the Indonesian Realistic Mathematics Education (PMRI) approach. One of the characteristics of PMRI is the use of context. Wijaya [11] mentioned that in realistic mathematics learning, context is used as the starting point of learning. The context referred to in this case is not only in the form of problems that exist in the real world, but may also be in the form of games, props, or other situations that can be imagined by students. In addition, according to Treffers and Van den Heuvel Panhuizen, one of the other characteristics of PMRI is interactivity. The learning process will be meaningful when students communicate their ideas with each other. Through interaction, students can develop cognitive and affective abilities simultaneously. It is at this time that students are expected to develop their argumentation skills [11].

Several studies that show the success of the PMRI approach in overcoming students' difficulties in understanding fraction material. Among them are research conducted by Warsito, Nuraini, and Sukirwan [12] on fraction learning design with a realistic approach in fifth-grade which shows that a series of learning activities with PMRI can bring students from concrete situations to more formal situations and students can work on fractions from contextual forms with reasons. In addition, there is also research conducted by Zaini and Marsigit [13] which shows that mathematics learning with a realistic mathematics approach is better than conventional learning in terms of mathematical reasoning and communication skills in students, where mathematical reasoning and communication skills are the basis for argumentation skills. However, there are not many mathematics education studies that use the context of Kayuagung tourism as a starting point for teaching. Therefore, the researcher is interested in conducting a study with the title " Fractional Learning Design Using the Kayuagung Tourism Context to Construct the Argumentation Skills of Fifth-Grade Students ".

METHOD

Research Design

This research was conducted at SDIT Bina Insani Kayuagung with the research focus producing learning trajectory by making HLT of fraction material using the context of Kayuagung tourism to construct students' argumentation ability. The type of research in this study employed qualitative, using design research method, with the research procedure involving validation studies. According to Gravemeijer & Eerde [14] validation studies require researchers to carry out experimental preparation (preliminary), design experiments consisting of pilot experiments and teaching experiments, and retrospective analysis.

The Research Procedure

In the first stage of the research, the researchers conducted an initial test to see the initial ability of students on fraction material. Furthermore, the researcher compiled learning tools for Student Worksheets (LKPD), designed HLT, made question cards and Lesson Plans (RPP) on fraction material using the context of Kayuagung tourism. HLT was made in the form of learning activities that would be implemented. The HLT contains learning objectives, learning descriptions, and predictions of student responses to learning activities. This HLT is flexible so that it can be adjusted to students' reactions to learning and revised again during the teaching experiment stage.

The second stage of the research, the design experiment, consisted of a pilot teaching and teaching experiment. During the pilot teaching, the researcher tested and improved the HLT that had been made to develop an understanding of how the HLT worked in the learning process. The pilot test was conducted on six students of Istambul fifth-grade SDIT (Islamic Elementary School) of Bina Insani Kayuagung. The pilot experiment was also conducted to adjust the content and sequence of activities that had been made and could be developed to be better in preparation for the next stage, the teaching experiment.

The learning objective in the activity is to understand the meaning of equivalent fractions. In this activity, a problem is presented about the amount of sweetened condensed milk needed to make a typical Kayuagung *sepulut* cake. The measure of sweetened condensed milk needed and the measure of sweetened condensed milk available contain fractions with different numerators and denominators. Students use cans and sand to make the required sweetened condensed milk measure and compare it with the available sweetened condensed milk measure. If the amount of sand in the can that represents the two fractions is equal, then the two fractions are equal even though the numerators and denominators are different. The predictions of students' thinking in this second activity are: (1) students identify the information in the contextual problem, (2) students make measurements of sand as much as $\frac{2}{3}$ and $\frac{4}{6}$ cans, (3) students compare the amount of sand in the two cans to find the meaning of equivalent fractions, and (4) students conclude that equivalent fractions are fractions whose values are the same even though the numerators and denominators are different.

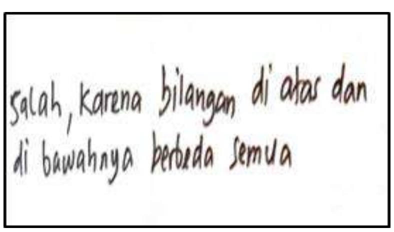
There are several argumentation patterns developed as a tool to analyze students' argumentation including Toulmin's argumentation pattern and Mc. Neill & Karajick. Argumentation indicators according to Toulmin consist of six elements, namely claim, data, warrant, qualifier, rebuttal, and backing [15]. Data is that students can to identify information, claim is that students can to state which steps are correct and which steps are wrong, warrant is that students can to provide reasons for claims issued by students, backing is that students can to provide evidence to support warrant, qualifier is that students can to show the level of confidence in the claims given, and rebuttal is that students can reject the statement and explain the conditions under which the statement does not apply.

Meanwhile, according to Mc. Neill & Krajick [16], the indicators of argumentation ability consist of 3 aspects, namely (1) claim: students can to state which steps are correct and which steps are wrong, (2) evidence: students can to show capable data, supporting the statements put forward, (3) reasoning: students can to provide reasons as justification for the statements given. This research combines the argumentation pattern developed by Toulmin and the argumentation pattern of Mc. Neill & Karajick's argumentation pattern. Some of these aspects were chosen based on considerations to get in detail what the pattern of students arguing in solving a problem looks like. The aspects of warrant, backing and qualifier in Toulmin's indicators were not used in this study because they were represented by the aspects of evidence and reasoning [17]. So that the indicators of argumentation skills used in this study are claim, data, evidence, reasoning, and rebuttal.

RESULTS AND DISCUSSION

Preliminary

Before designing HLT and implementing learning, the researcher conducted an initial test to see the students' initial ability on fraction material. The pre-test results showed that there were still misconceptions about the equivalent fraction. Students were asked to answer whether $\frac{1}{3} = \frac{2}{6}$. Students were also asked to give reasons for their answers to see students' understanding and argumentation skills. Some student answers can be seen as follows:



TRANSLATION

Wrong, because the numbers above and below are all different

FIGURE 1. Some student's Answer for Pre-test Question Number 2

Based on figure 1, students do not yet understand about equivalent fractions. Student has not understood that the value of a fraction is fixed or does not change if the numerator and denominator are multiplied by the same (non-zero) number. The misunderstanding that occurs is that students assume that a fraction is only worth the same if the number in the numerator and the number in the denominator are the same.

Pilot Teaching

Based on the results of the initial test above, the researcher compiled the HLT for fraction learning using the tourism context and designed a learning activity that would be used in the pilot teaching stage. A total of six Istambul fifth grade students with heterogeneous abilities participated in the pilot teaching stage. In the pilot teaching stage, the researchers acted as a model teacher who taught, while the class teacher acted as an observer during learning.

Learning activities lasted for 70 minutes with the learning objective for students to understand the meaning of equivalent fractions. At the beginning of the learning activity, the researcher as the model teacher started the learning by checking students' readiness to participate in learning activities. Then the teacher delivered an apperception about fractions that students had learned in grade 3 and asked students some questions about the context of *sepulut* cake. Six students were divided into two groups and each group was asked to discuss to answer the questions in the LKPD. The problem presented in LKPD is about the recipe for *sepulut* cake which is one of typical Kayuagung culinary. In this second activity students are still asked to discuss in groups to solve the problems the LKPD. The problems in the second activity are as follows:


Topik: Pecahan Senilai

AKTIVITAS 2

PERMASALAHAN 1

MEMBUAT BOLU SEPULUT

Salah satu hidangan khas Kayuagung adalah bolu sepulut. Bolu yang terbuat dari telur, gula, tepung ketan, dan susu kental manis ini sering dijadikan oleh-oleh khas Kayuagung. Untuk memasak seloyang bolu sepulut ukuran standar, biasanya diperlukan sekaleng susu kental manis.

Bu Rahma ingin membuat bolu sepulut, karena tidak terlalu menyukai rasa manis, Bu Rahma ingin mengurangi takaran penggunaan susu menjadi hanya $\frac{2}{3}$ kaleng saja.
Bu Rahma menyuruh anaknya mengecek stok susu yang ada di dalam kulkas. Anaknya mengatakan susu kental manis yang tersedia adalah $\frac{4}{6}$ kaleng. Apakah susu yang tersedia di kulkas cukup untuk membuat bolu sepulut sesuai keinginan Bu Rahma?

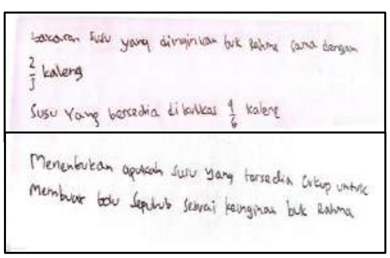
TRANSLATION

Making *Sepulut* Cake

One of Kayuagung's typical food is bolu sepulut. This dish is often used as a souvenir of Kayuagung. To cook a standard-sized pan of bolu sepulut, it usually requires a can of sweetened condensed milk. a can of sweetened condensed milk is required.
Bu Rahma wanted to make sponge cake, because she doesn't really sweetness, Bu Rahma wanted to reduce the amount of milk to milk to only 2/3 of a can. Bu Rahma told her son to check the milk stock in the refrigerator. Her son said that there was only 4/6 cans only. Is the milk available in the refrigerator enough to make the sponge cake as Mrs. Rahma wanted?

FIGURE 2. The Problem in LKPD

In the second activity LKPD, the problem of the amount of sweetened condensed milk needed to make sepulut cake is presented. Students are asked to compare the measure of milk needed with the amount of milk available. Through this activity students will be invited to understand the meaning of equivalent fractions. The students' answers to this problem are as follows:


takaran susu yang diinginkan buk Rahma sama dengan $\frac{2}{3}$ kaleng

Susu yang tersedia di kulkas $\frac{4}{6}$ kaleng

Menentukan apakah susu yang tersedia cukup untuk membuat bolu sepulut sesuai keinginan buk Rahma

TRANSLATION

The amount of milk that Mrs. Rahma wants is 2/3 cans
Milk available in the refrigerator is 4/6 cans

Determining whether there is enough milk to make the sepulut cake as Mrs. Rahma wants

FIGURE 3 . Students's Answer in LKPD Using Data Argumentation Pattern

Based on the figure 3, it can be seen that the argumentation pattern used is data. Students have written down important information that can be used to solve problems on activity 2 of LKPD such as how many measures of milk are available and how many measures of milk are needed to make sponge cake. Students have also been able to identify how they will solve the problem.

In the next question, students were asked to use cans and sand to make $\frac{2}{3}$ cans and $\frac{4}{6}$ cans respectively. Then students are asked to observe the condition of the sand in the two cans and then conclude whether the amount of milk available is sufficient to make the sponge cake according to Mrs. Rahma's wishes. The students' answers are as follows:

TRANSLATION

The milk available in the can is enough to make the sponge cake that Bu Rahma wants because it turns out that $\frac{2}{3}$ of the can is as much as $\frac{4}{6}$ cans.

FIGURE 4. Student's Answer in LKPD Using Evidence and Reasoning Argumentation Pattern

The argumentation patterns used by students in this problem are evidence and reasoning. The evidence argumentation pattern can be seen when students have been able to provide data to support the answer by providing a picture showing that $\frac{2}{3}$ cans are as many as $\frac{4}{6}$ cans. While the reasoning argumentation pattern can be seen when students have been able to provide reasons as justification for the statements given.

From this activity students can conclude the meaning of equivalent fractions, that although two fractions have different numerators and denominators, they can be equal. Equivalence here can be seen by students when doing sand measuring activities. Students see the similarity of the value from the similarity of the amount of sand in the can which represents fractions $\frac{2}{3}$ and $\frac{4}{6}$.

At the end of activity two, the researcher conducted a reflection with the model teacher to evaluate the learning that had been done. Based on the activities carried out at the pilot teaching stage, it can be seen that two patterns of argumentation have not appeared, namely claim and rebuttal. After conducting a retrospective analysis of why these two argumentation patterns did not appear in the learning, it was concluded the cause was that the questions in the LKPD had not been able to stimulate students to use the claim and rebuttal argumentation patterns. In addition, from the discussion with the model teacher, additional questions were also needed in the LKPD that provided opportunities for students to see the relationship between the numerator and denominator of fractions so that students could determine other equivalent fractions. The researcher made revisions to the HLT and LKPD based on the results of this retrospective analysis and then used them in the next stage, namely the teaching experiment.

Teaching Experiment

Twenty students of class V Islamabad were divided into four groups at the teaching experiment stage. the problem presented is about the amount of milk in the *sepulut* cake recipe. Based on the HLT, in the first question students will identify the information in the contextual problem. All student groups were able to answer this question correctly. The argumentation pattern used by students at this stage is data.

In the next problem, students will investigate whether the available sweetened condensed milk is enough to make the sponge cake as desired. To solve this problem, students will use the help of transparent cans and sand to represent the milk and cans. Based on the HLT, at this stage students will make the size of sand as much as $\frac{2}{3}$ and $\frac{4}{6}$ cans, compare the amount of sand in both cans to find the meaning of equivalent fractions, and will conclude that equivalent fractions are fractions whose values are the same even though the numerators and denominators are different. The argumentation pattern used by students is evidence and reasoning. All groups were able to answer this question correctly.

The next problem was to further examine students' understanding of equivalent fractions. A problem about cutting *sepulut* cake was presented as follows:


Alya dan Dinda masing-masing membeli 1 loyang bolu sepulut berukuran sama. Bolu sepulut Alya dipotong menjadi empat bagian sama besar, sementara bolu sepulut Dinda dipotong menjadi enam bagian sama besar. Alya dan Dinda sama-sama ingin memberi bolu sepulut kepada Ani, salah satu teman mereka. Mereka akan memberikan bolu dengan besar yang sama.

Selidikilah apakah pernyataan di bawah ini bernilai benar atau salah, berikanlah alasan dengan membuat gambar yang melambangkan potongan kue milik Alya dan Dinda yang diberikan kepada Ani.

TRANSLATION

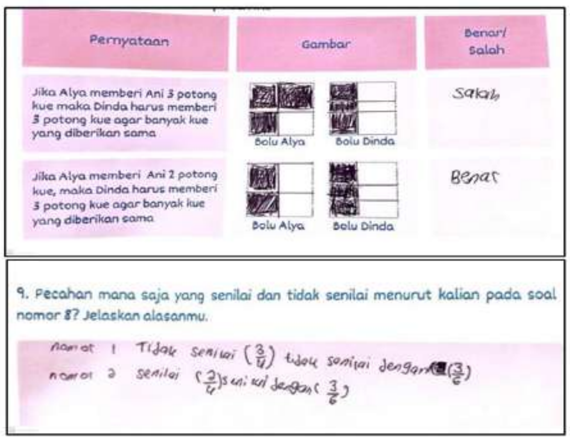
Alya and Dinda bought 1 pan of equal-sized sepulut cake. Alya's sepulut cake is cut into four equal pieces, while Dinda's sepulut cake is cut into six equal pieces. Alya and Dinda both want to give the sepulut cake to Ani, one of their friends. They will give the sponge cake with the same size.
Investigate whether the statements below are true or false, give your reasons by drawing a picture that symbolizes Alya's and Dinda's slices of cake given to Ani.

FIGURE 5. The Problem in Revised LKPD

In the problem that how in figure 7, students are asked to investigate the equivalence of two fractions by drawing a representation of the cake cutting illustration presented in the problem. Students are asked to determine the truth value of the given statement. The answer of one group of students from the problem above is as follows:

If Alya gives Ani 3 pieces of cake then Dinda must give 3 pieces of cake so that the number of cakes given are

If Alya gives Ani 2 pieces of cake then Dinda must give 3 pieces of cake so that the number of cakes given are


Pernyataan	Gambar	Benar/ Salah
Jika Alya memberi Ani 3 potong kue maka Dinda harus memberi 3 potong kue agar banyak kue yang diberikan sama	Bolu Alya Bolu Dinda	Salah
Jika Alya memberi Ani 2 potong kue, maka Dinda harus memberi 3 potong kue agar banyak kue yang diberikan sama	Bolu Alya Bolu Dinda	Benar

9. Pecahan mana saja yang senilai dan tidak senilai menurut kalian pada soal nomor 8? Jelaskan alasanmu.

nomor 1 Tidak senilai $(\frac{3}{4})$ tidak senilai dengan $(\frac{3}{6})$
nomor 2 senilai $(\frac{2}{4})$ senilai dengan $(\frac{3}{6})$

Wrong

Correct

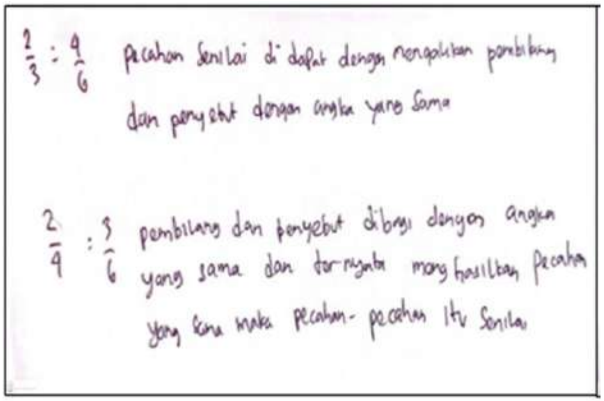
Number 1
$\frac{3}{4}$ not equivalent to $\frac{3}{6}$

Number 2
$\frac{2}{4}$ not equivalent to $\frac{3}{6}$

FIGURE 6. Students' Answer Using Claim and Rebuttal Argumentation Pattern

Based on the students' in figure 8, the argumentation patterns used are claim and rebuttal patterns. The claim pattern appears when students reject/accept statements regarding the number of pieces of Alya and Dinda's cake. The rebuttal argumentation pattern appears when students explain the reason why the statement applies/not applicable, in this case the reason is given in the form of a picture. From the picture, students can see that two fractions will be equal if the shaded areas are the same. However, if the shaded areas are not the same then the fractions are not equal.

At the end of activity, students are asked to pay attention to the relationship between the numerator and denominator of the two equivalent fractions obtained in activity 2 and then conclude how to find equivalent fractions. All groups were able to make conclusions as seen from the examples of answers of some groups as follows:



TRANSLATION

$\frac{2}{3} = \frac{4}{6}$
Equivalent fractions are obtained by multiplying the numerator and denominator by the same number

$\frac{2}{4} = \frac{4}{6}$
(If) the numerator and denominator are divided by the same number and produce the same fraction then the fractions are equal.

FIGURE 7. Students Summarize the Meaning of Equivalent Fractions

Based on the results above, it can be seen that the learning activities that have been carried out at the teaching experiment stage can help students understand the meaning of fractions worth as well as develop their argumentation skills. This is inline with Zaini and Marsigit [13] who mentioned that mathematics learning with a realistic mathematics approach is better than conventional learning in terms of mathematical reasoning and communication skills in students, where mathematical reasoning and communication skills are the basis for argumentation skills.

The context of Kayuagung traditional cake used in learning has been able to lead students in finding the meaning of fractions worth. Student discussion activities when they measured ingredients of sepulut cake using cans and sand, and shading pieces of sponge cake have been able to guide students to argue using the pattern of data, claim, evidence, reasoning, and rebuttal. Through interaction, students can develop cognitive and affective abilities simultaneously. It is at this time that students are expected to develop their argumentation skills [11].

CONCLUSION

Based on the research results, it can be concluded that learning trajectory of fraction material using the context of Kayuagung tourism can be used to construct students' argumentation skills. The result shows that the use of the Kayuagung tourism context can construct the argumentation skills of fifth-grade students in the argumentation pattern: data, claim, evidence, reasoning, and rebuttal. Students have been able to understand the meaning of equivalent fractions through the activities they have done in learning.

ACKNOWLEDGMENTS

This research was supported by Direktorat Jenderal Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia based on SK Rektor Universitas Sriwijaya No. 0187/UN9.3.1/SK/2023. Thanks to Universitas Sriwijaya for the opportunity to join this research team.

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Designing Hypothetical Learning Trajectory for Geometry Transformation using Realistic Mathematics Education

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Abstract.
The purpose of this study was to create a learning trajectory that would encourage students to learn and aid in their compr ehension of geometric transformation content. the *Tedhak Siten* tradition serves as a foundation for this study and a source of knowledge. The method used was research and development by Gravemeijer & Cobb with three main activities: preliminary design, design experiment (pilot experiment and teaching experiment), and retrospective analysis. This research involved grade 9th students at SMP Negeri 6 Semarang who carried out learning activities using the RME approach. The learning trajectory using the context of the *Tedhak Siten* tradition in geometric transformation material consists of 6 activities, namely: 1) find the definition and properties of geometric transformation; 2) find the formulas and reflection results; 3) find formulas and translation results; 4) find formulas and rotation results; 5) find the formulas and dilation results; and 6) solving contextual problems related to geometric transformations. This article presents the preliminary design stage of the design research, providing a detailed explanation of the initial stage and preparing it for testing in the subsequent design experiment stage.

INTRODUCTION

An essential area of study in mathematics is geometric transformation [1]. Geometry transformation consists of reflection, translation, rotation and dilation [2]. Studying geometric transformations is crucial because it enhances students' mathematical skills, develops their spatial competence, critical thinking abilities, and skills in mathematical proof [3, 4]. However, in practice, geometric transformation remains a challenging topic for students to grasp [5, 6].

Difficulties faced by students in geometric transformation material include identifying the position of the image, solving problems related to shifting the position of objects, drawing reflection results on the line $y = x$, choosing the right formula to solve the problem, and identifying the image of the line after rotation [4, 6, 7]. This difficulty is influenced by several factors, including teacher-centered learning [7] and the lack of use of technology to provide clear visuals so that students can absorb the material optimally [4].

Through teacher-centered learning, students become passive, hesitant to express their opinions, have low self-esteem, lack critical thinking, and are not productive [8]. Teacher-centered learning can impede students' educational development because it does not provide them with the freedom and responsibility to develop their own knowledge [9]. Students memorize concepts without understanding their meaning. This method of learning can lead to low learning outcomes. Low learning outcomes are caused by several factors, including: teachers do not connect learning with real life or students' daily lives, teachers use traditional teaching models that emphasize lectures and assignments, students participate passively in class activities, interactions between students and teachers rarely occur, minimal use of learning media [10], and less interesting learning [4, 11].

Therefore, an appropriate learning model is needed to incorporate real life into the presentation of geometric transformation material and learning media that can provide visuals from real situations to mathematical symbols, increase learning motivation, and increase students' understanding of concepts. As an alternative to solving

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040023-1–040023-9; https://doi.org/10.1063/5.0242442
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difficulties in learning geometric transformation material, learning planning was carried out using Realistic Mathematics Education (RME) assisted by GeoGebra software by highlighting the usefulness of the concept [12]. Learning through RME is often used to improve students' low interest, attitudes and skills [13–15]. The context used in previous studies which has been proven to be beneficial for mathematics learning outcomes is ethnomathematics [14–17]. Apart from that, the use of GeoGebra software can help in providing visualization of real situations (context) into mathematical symbols [18]. The use of GeoGebra software in learning has been proven to be able to realize effective learning [19], increase motivation [20], increase student learning independence [21], and increase students' understanding of concepts in geometry material [22].

The characteristics of the RME concept are the use of models, context, creation, use of nature and Indonesian culture [23]. Some contexts for mathematics learning activities that can be utilized include traditional games [14], folklore, legends, community customs [15, 17, 24], and wayang stories [25], and historical buildings [13].

One context that can be used as a starting point for geometric transformation material is the *Tedhak Siten* tradition. The author opted for the *Tedhak Siten* traditional context as the research's starting point because its equipment can symbolize reflection, translation, rotation, and dilation. Hence, students have the chance to interpret mathematics, showcase mathematical precision and cultural insight, and become more motivated to engage in collaborative mathematics learning. Learning is structured using a Hypothetical Learning Trajectory (HLT), which will be shaped into learning objectives and tools to support learning. In this scenario, conjectures serve as guiding principles that emerge and evolve in each learning activity, remaining adaptable and open to revision. Based on the explanation above, researchers are interested in exploring the *Tedhak Siten* tradition as a starting point for learning geometric transformations.

METHOD

The methodology employed in this study was design research aimed at developing the learning instruments utilized. The participants in this research were 9th-grade students from SMP N 6 Semarang. Data collection took place from August to September 2023, involving various activities such as observation, video recording, collection of student work, administration of pre-tests and post-tests, and conducting interviews. The collected data is utilized to understand the learning process undergone by students. In design research, there are three primary stages [26]. The first stage, preliminary design, encompasses several activities, including conducting a literature review, assessing student abilities, and developing a HLT. The second stage, design experiment, consists of two parts: a pilot experiment (testing the HLT in small groups) and a teaching experiment (testing it in the actual class after refining the data from the pilot experiment). The third stage, retrospective analysis, involves analyzing all data collected according to the HLT (comparing the HLT with actual learning) to inform the design for the next activity. This article focuses on the first stage, preliminary design, which involves examining the fundamental competencies possessed and required by students and formulating a hypothetical learning trajectory within the context of the *Tedhak Siten* tradition on geometric transformation material.

RESULT AND DISCUSSION

In the initial stage of design research, several key activities are performed. These include conducting a literature review to gather information on geometric transformation material from books, as well as reviewing literature on RME and design research to inform an initial design strategy. Additionally, students' initial abilities are assessed to identify their prerequisite skills. The data collected from this assessment is used to formulate a dynamic HLT that can be refined during teaching experiments. This article focuses on the initial abilities of students and the formulation of the HLT:

Examining the Basic Competencies that Students Have and Need in Geometry Transformation Material

In learning geometric transformation material, there are several basic competencies that grade 3rd elementary school students already possess, namely: 1) analyzing how to measure angles with a protractor and 2) analyzing and determining the size of the rotation angle. Next, grade 7th of Junior High School, namely: 1) doing addition and subtraction of integers and 2) doing multiplication and division of integers. Next, grade 8th of Junior High School, namely: 1) determine the position of the point relative to the reference point (0,0), 2) determine the position of the point relative to the reference point (a, b), 3) determine the position of the point relative to the x-axis, and 4) determine the position of the point regarding the y-axis.

Developing a Hypothetical Learning Trajectory

Following a literature review and assessment of students' abilities, the next step was to develop a HLT for geometric transformation material within the context of the *Tedhak Siten* tradition. The HLT consists of a sequence of learning processes, comprising six activities, aimed at improving students' understanding of the material, fostering motivation, and creating meaningful learning experiences.

The learning objective in activity 1 is to find the definition and properties of geometric transformations (reflection, translation, rotation, and dilation). Activity 1 begins with students observing the context video to find an object that experiences reflection, translation, rotation, and dilation. Next, students are asked to draw objects that experience reflection, translation, rotation and dilation on the student worksheet. After drawing, students are asked questions that address the properties of reflection, translation, rotation, and dilation. After finding properties, students are asked to define reflection, translation, rotation, and dilation using their own language. The teacher's role in activity 1 is to provide direction to students in finding and drawing objects that experience reflection, translation, rotation and dilation so that later students can discover the properties and definitions of reflection, translation, rotation and dilation.

FIGURE 1. *Tedhak Siten* tradition

In activity 1 the assumptions of students' thinking are presented in table 1.

TABLE 1. Conjecture students' thinking in activity 1

No	Activity	Conjecture
1	Observing the video in the context of the *Tedhak Siten* tradition.	Students can identify objects that experience reflection, translation, rotation, and dilatation.
2	Doing activity 1	Students can discover the properties of reflection, translation, rotation, and dilation.
		Students can define reflection, translation, rotation, and dilation in their own language.

Reflection on activity 1: After observing the video, students will easily find an object that experiences reflection, translation, rotation and dilation; Students will easily answer questions related to the properties of reflection, translation, rotation, and dilation based on the objects they have drawn; Based on previous activities (drawing and discovering the properties of geometric transformations), students will easily define reflection, translation, rotation and dilation using their own language.

(a) (b) (c) (d)

FIGURE 2. Objects in context that undergo geometric transformation

The learning objective in activity 2 is to find formulas and draw reflections. Activity 2 begins with students observing a video of the traditional *Tedhak Siten* equipment which experiences reflection, namely the sugar cane ladder. Next, students are asked to determine the coordinates of several points before and after they are reflected with the help of GeoGebra software on the student worksheet. After determining the coordinates of several points, students are asked to determine the pattern which will later produce a reflection formula. This activity is carried out repeatedly based on the position of the mirror, namely: x-axis, y-axis, point (0,0), line $y = x$, line $y = -x$, line $x = a$, and line $y = b$. After that, students are asked several questions related to the reflection of an object. Students are asked to determine the image of an object after it is reflected based on the formula and reflection properties they obtain. The teacher's role in activity 2 is to provide direction to students in finding formulas and how to use formulas correctly.

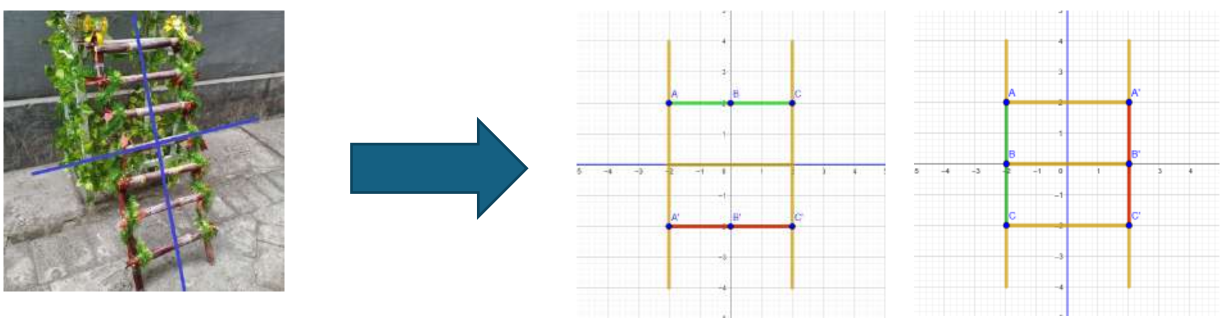

FIGURE 3. Image of sugar cane stairs and visual reflection in GeoGebra software
Source: https://cf.shopee.co.id/file/bbb03c088549068e48296801becf3792

In activity 2 the assumptions of students' thinking are presented in table 2.

TABLE 2. Conjecture students' thinking in activity 2

No	Activity	Conjecture
1	Observing the reflection on the sugar cane ladder	Students can understand the concept of reflection that occurs on sugar cane ladder
2	Doing activity 2	Students can operate GeoGebra that has been designed Students can find patterns in reflection results Students can use formulas correctly

Reflection on activity 2: After observing several points on the cane ladder, students will easily determine the coordinates of these points, both before and after being reflected; With direction from the teacher, students can find patterns in reflection. However, students will likely have difficulty determining the reflection pattern on line $x = a$

and line $y = b$; After finding the reflection formula, students will be able to easily determine the reflection results of an object.

The learning objective in activity 3 is to find formulas and translation results. Activity 3 begins with students observing a video of the *Tedhak Siten* tradition which experiences translation, namely a baby walking. Next, students are asked questions related to translation as far as (a, b), what happens if the value of a is positive, zero, and negative, as well as for the value of b. Next, students are asked to determine the coordinates of several points before and after they are translated with the help of GeoGebra software on the student worksheet. After determining the coordinates of several points, students are asked to determine the pattern which will later produce a translation formula. This activity is carried out twice, namely the translation direction is positive and the translation direction is negative. After that, students are asked several questions related to the translation of an object. Students are asked to determine the image of an object after being translated based on the formula and translation properties they obtain. The teacher's role in activity 3 is to provide direction to students in finding the formula and how to use the formula correctly.

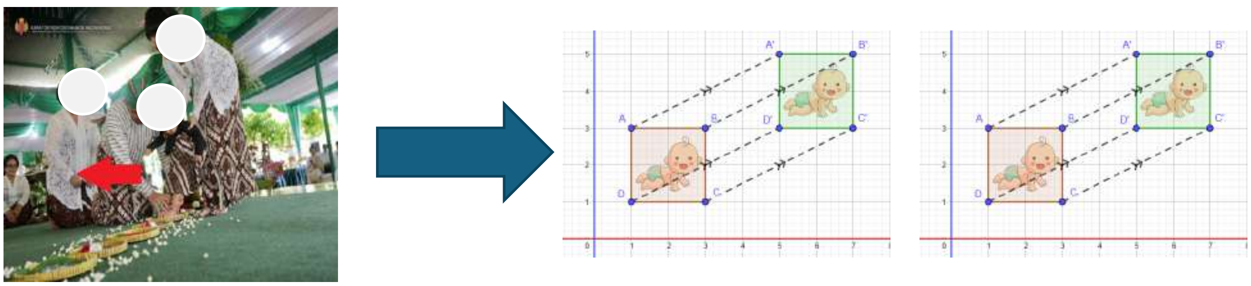

FIGURE 4. Baby images and visual translation in GeoGebra software

In activity 3 the assumptions of students' thinking are presented in table 3.

TABLE 3. Conjecture students' thinking in activity 3

No	Activity	Conjecture
1	Observing the translation on the baby shifts	Students can understand the concept of translation that occurs on sugar cane ladder
2	Doing activity 3	Students can operate GeoGebra that has been designed Students can find patterns in translation results Students can use formulas correctly

Reflection on activity 3: After observing several points on the baby shifts, students were easily determine the coordinates of these points, both before and after translation; With guidance from the teacher, students can find patterns in translation; After finding the translation formula, students will be able to easily determine the translation results of an object.

The learning objective in activity 4 was to find the formula and rotation results. The activity began by observing a video related to the traditional *Tedhak Siten* equipment which was undergoing rotation, namely the decorations on the jadah. Next, students are asked questions about what directions of rotation are and what causes positive and negative rotation angles. Next, students are asked to determine the coordinates of several points before and after rotation with the help of GeoGebra software on the student worksheet. After determining the coordinates of several points, students are asked to determine the pattern which produced a rotation formula. This activity was-carried out three times, namely rotation: 90° counterclockwise and 270° clockwise, 180° counterclockwise and clockwise, 270° counterclockwise and 90° clockwise. After that, students were asked several questions related to the rotation of an object. Students are asked to determine the image of an object after it is rotated based on the formula and rotation properties they obtain. The teacher's role in activity 4 is to provide direction to students in finding the formula and how to use the formula correctly.

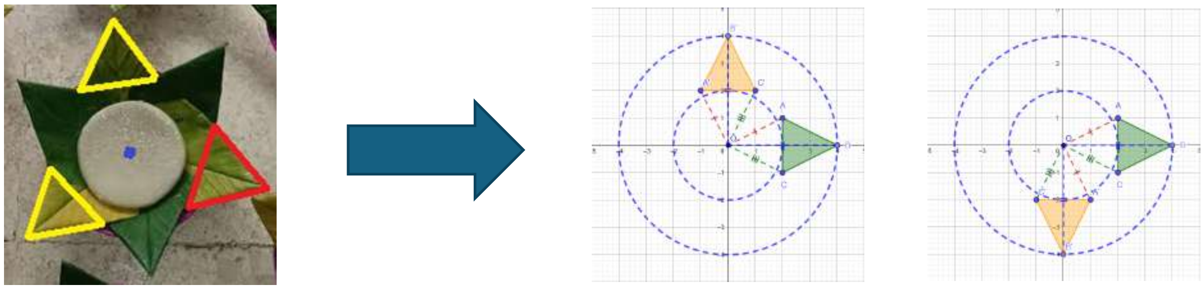

FIGURE 5. Jadah decoration images and rotation visuals in GeoGebra software

In activity 4 the assumptions of students' thinking are presented in table 4.

TABLE 4. Conjecture students' thinking in activity 4

No	Activity	Conjecture
1	Observing the rotation of leaves on jadah	Students can understand the concept of translation that occurs on leaves on jadah
2	Doing activity 4	Students can operate GeoGebra that has been designed Students can find patterns in rotation results Students can use formulas correctly

Reflection on activity 4: After observing several points on the leaf decoration on the prayer rug, students will easily determine the coordinates of these points, both before and after rotation; With teacher guidance, students can find patterns in rotation; After finding the rotation formula, students will be able to easily determine the rotation results of an object.

The learning objective in activity 5 was to find the formula and results of dilation. The activity began by observing a video of the traditional *Tedhak Siten* equipment being dilated, namely the chicken cage. Next, students are asked questions about what causes the dilation results to enlarge and shrink. Next, students are asked to determine the coordinates of several points before and after dilation with the help of GeoGebra software on the worksheet. After determining the coordinates of several points, students are asked to determine the pattern that produced a rotation formula. This activity was carried out four times, namely dilation with a scale factor: less than -1, between -1 and 0, between 0 and 1, and more than 1. After that, students were asked several questions related to the dilation of an object. Students are asked to determine the image of an object after dilation based on the formula and dilation properties they obtain. The teacher's role in activity 5 is to provide direction to students in finding the formula and how to use the formula correctly.

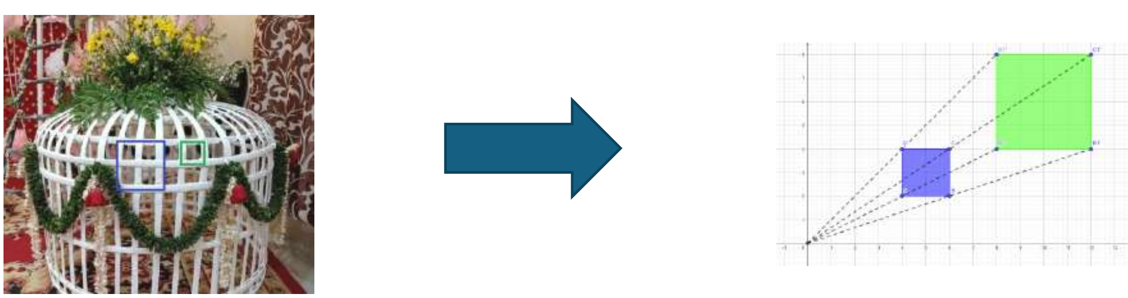

FIGURE 5. Image of chicken cage and visual dilatation in GeoGebra software

TABLE 5. Conjecture students' thinking in activity 5

No	Activity	Conjecture
1	Observing flat shapes of different sizes in cages	Students can understand the concept of dilatation that occurs on chicken cage
2	Doing activity 5	Students can operate GeoGebra that has been designed Students can find patterns in dilatation results Students can use formulas correctly

Reflection on activity 5: After observing several points on the chicken cage, students were-easily determine the coordinates of these points, both before and after dilation; With teacher guidance, students can find patterns in dilation; After finding the dilation formula, students were be able to easily determine the result of dilation of an object.

After completing the five activities above, students enter activity 6. The goal in this activity is that students can solve contextual problems related to geometric transformations. Students are given several questions related to reflection, translation, rotation, and dilatation that have been studied before. The teacher's role here is to monitor and provide direction to all students.

In activity 6 the assumptions of students' thinking are presented in table 6.

TABLE 6. Conjecture students' thinking in activity 6

No	Activity	Conjecture
1	Solving contextual problems related to geometric transformations	Students are able to solve problems related to geometric transformations

The initial stage of design research involved several activities aimed at preparing for experiments. These activities included conducting literature reviews, assessing students' competencies, and formulating a HLT. The strategies developed through these activities serve as the foundation for initial learning designs. This approach is consistent with [27] which suggests that literature reviews can inform initial learning strategies and the formulation of the HLT. The initial design of this lesson is crucial for facilitating students' comprehensive understanding of geometric transformation material, progressing from informal to formal stages. The context of RME-based learning, used as a starting point and learning resource, can aid in studying geometric transformations. Apart from that, the context used will be packaged in GeoGebra software to provide a better picture to students. This is in accordance with [22] who emphasized that the GeoGebra software can aid students in understanding the material. Furthermore, the selected context can enhance comprehension of the material, as supported by [27]. Furthermore, research suggests that learning within a relevant context can stimulate, enhance comprehension, and promote meaningful learning experiences [14].

The learning design is adapted to the characteristics of RME [27], namely 1) using context, the context of this research is based on the *Tedhak Siten* tradition from Central Java. 2) using models, which facilitates students' transition from informal knowledge to formal mathematical understanding. 3) student contribution is crucial in every activity to achieve learning objectives. 4) interactivity is a vital aspect, encompassing discussion, explanation, response, collaboration, and evaluation, 5) connectedness is another essential characteristic, allowing students to learn multiple concepts simultaneously, as mathematical concepts are inherently interconnected.

CONCLUSION

This research developed a HLT for geometric transformations, grounded in the traditional context of the Tedhak Siten, to enhance students' understanding, motivation, and meaningful learning. The HLT, formulated in the initial stage of the research design, can be utilized in the subsequent stage, which involves an experimental design. This geometric transformation HLT consists of 6 activities, namely: 1) find the definition and properties of geometric transformation; 2) find the formulas and reflection results; 3) find formulas and translation results; 4) find formulas and rotation results; 5) find the formulas and dilation results; and 6) solving contextual problems related to geometric transformations.

During the initial stage of design research, educators must create learning situations that closely mirror real-life scenarios, allowing students to explore and gather informal knowledge. This informal information is then formalized using modeling. Furthermore, the tools employed in the design should facilitate student understanding, such as activity sheets, and provide teachers with a supportive role as mentors and guides for students who may encounter difficulties. Additionally, reflections on each activity within the HLT are crucial to refine the designed instruments and anticipate potential student mistakes and challenges in executing activities.

ACKNOWLEDGMENT

The author would like to express gratitude to the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for providing a 2023 Student Creativity Program grant with number 2383/E2/DT.01.00/2023. Additionally, the researchers extend their appreciation to SMP Negeri 6 Semarang for their cooperation and willingness to facilitate and grade 9th students who participated in this research.

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Mathematical Literacy Ability of High School Students Examined in Relation to Hippocrates-Galen Personality Types and Gender

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Abstract. This research aims to determine the levels of mathematical literacy ability (MLA) among public high school students (SMAN), considering the Hippocrates-Galen personality types, and to investigate whether personality type and gender have an impact on MLA. The research methodology employed in this study is quantitative, utilizing a survey approach, with data processed using the Rasch model and multiple linear regression. The research population consists of 5,561 eleventh-grade students from SMAN for the Academic Year 2022/2023 in the city of Depok. A purposive sampling technique was applied, resulting in a sample size of 412 students. Research instruments used included tests and questionnaires. Following validation using the Rasch model, a fit sample of 191 students was obtained. The results from the person wright map indicate that the majority of eleventh-grade students from SMAN in Depok exhibit moderate levels of mathematical literacy ability, with a prevalent phlegmatic personality type. Female students demonstrate superior MLA in comparison to their male counterparts. The highest levels of MLA are predominantly found in the sanguine and melancholic personality types, with seven students each, followed by five students in the phlegmatic personality type, and two students in the choleric personality type. Furthermore, based on the results of simultaneous test using multiple regression, it is evident that both the independent variables, namely, Hippocrates-Galen personality type and gender, collectively influence MLA. However, the results of the partial test reveal that only gender significantly affects MLA, while the Hippocrates-Galen personality types do not exert a significant impact.

INTRODUCTION

Mathematical literacy, as a fundamental aspect of education, plays a pivotal role in preparing students to navigate the complexities of both academic and real-world challenges. It encompasses not only the capacity to perform mathematical calculations but also the ability to employ mathematical concepts and reasoning to resolve intricate problems and make well-informed decisions. Understanding the factors that influence students' mathematical literacy ability (MLA) is of paramount importance in educational research. In this context, this study examines the mathematical literacy abilities of high school students, focusing on the potential impact of Hippocrates-Galen personality types and gender as contributing factors.

Mathematical literacy, characterized as the proficiency in using mathematics to interpret, analyze, and address problems encountered across various life situations, is recognized as an essential skill for active participation in modern, technology-driven societies [1] It extends beyond mere computational competence to encompass a deeper comprehension of mathematical concepts and their practical applications [2] Mathematical literacy holds a central position in educational systems worldwide, prompting educators to continually refine their teaching methods to enhance students' mathematical proficiency [3].

Personality types, as outlined by the Hippocrates-Galen personality theory, have long been associated with diverse facets of individual behavior, including learning preferences [4] This theory categorizes individuals into four primary

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040024-1–040024-8; https://doi.org/10.1063/5.0241947
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personality types: choleric, melancholic, phlegmatic, and sanguine, each characterized by distinctive traits and tendencies [5]. Research within the field of educational psychology has explored potential links between personality types and learning styles, suggesting that individuals with varying personalities may exhibit preferences for specific learning approaches and excel in different academic domains [6]. Gender has emerged as a significant area of interest in educational research, particularly regarding disparities in mathematical performance. Based on the research conducted by [7], in general, males tend to develop and utilize their left-brain hemisphere, enabling them to engage in abstract and logical thinking. Conversely, females tend to lean towards their right brain hemisphere, leading them to act imaginatively, artistically, and relying more on visual forms of cognition. Although it is widely acknowledged that there are no inherent gender differences in mathematical abilities [8] empirical studies have highlighted disparities in mathematical achievement between males and females [9]. Understanding the role of gender in mathematical literacy is crucial for promoting equitable educational practices.

This study seeks to contribute to the existing body of knowledge by investigating the relationship between the mathematical literacy abilities of high school students and their personality types according to the Hippocrates-Galen theory, as well as their gender. Utilizing a quantitative approach involving surveys, Rasch modeling, and multiple linear regression, this research aims to explore potential correlations and determine whether specific personality types and gender have an impact on mathematical literacy ability. The findings from this study hold the potential to offer valuable insights for educators, curriculum designers, and policymakers, facilitating improvements in mathematics education and addressing potential disparities in mathematical achievement among high school students.

METHOD

This study was conducted in public high schools across the city of Depok. The population of this study consisted of 5,561 eleventh-grade students attending public high schools in the city of Depok. The sampling technique employed was purposive sampling, wherein a sample size of 412 students was selected based on specific considerations within the eleventh-grade student population in Depok's public high schools.

The questionnaire instrument comprised 40 items related to the Hippocrates-Galen personality types, while the test instrument consisted of four mathematical literacy test items. The questionnaire instrument for the Hippocrates-Galen personality types was adopted from a previous study conducted by [10]. The mathematical literacy test items had been validated by expert validators. The indicators of mathematical literacy abilities are as follows: Interpret solutions to solve mathematical problems, Formulate problems in solving mathematical problems, Apply mathematical concepts in solving mathematical problems, and Evaluate the results of solutions to solve mathematical problems [11].

The research flowchart employed can be seen in Figure 1. Rasch model will be applied to answer the reseach questions: distribution of students' mathematical literacy ability based on Hippocrates-Galen personality type and gender. The software for the Rasch model is Winstep. The suitability of the individual data points was assessed by examining the criteria of outfit MNSQ, outfit ZSTD, and PT. Measure Corr [12]. An individual's data point was considered fit or appropriate if it met at least two of the three criteria, and the data point was removed if none of the criteria were satisfied [13].

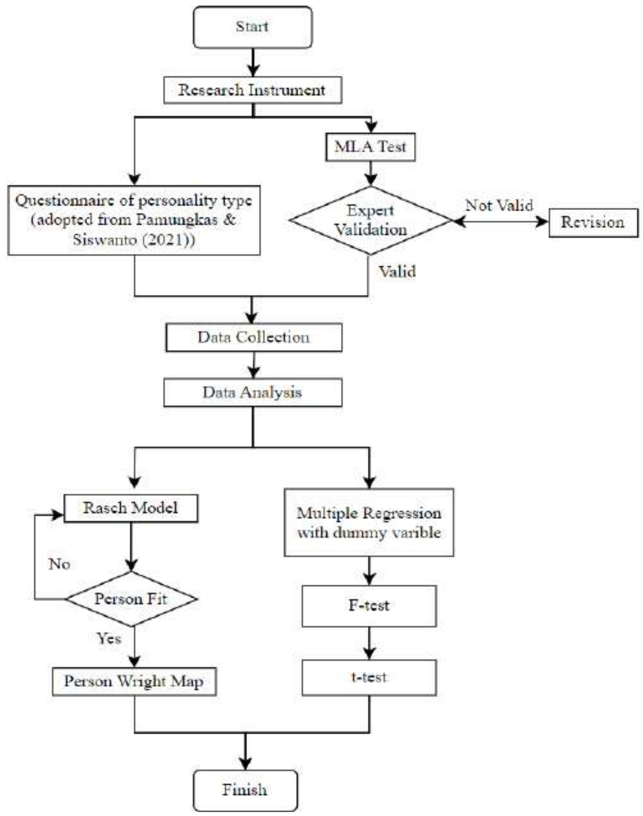

FIGURE 1. Research Flowchart

After analyzing the data using the Rasch Model, it was determined that 191 students met the criteria for being considered fit respondents. Subsequently, based on the Person Wright Map, the categorization of the levels of mathematical literacy ability of students was examined in relation to personality types and gender.

In addition to utilizing the Rasch Model, another step in the analysis process to address the second research question, which examines whether Hippocrates-Galen personality types and gender have an influence on students' mathematical literacy abilities, involved the use of multiple linear regression with dummy variables. This was necessary because both the "Hippocrates-Galen personality type" and "gender" variables are measured nominally. Consequently, three dummy variables were employed for the Hippocrates-Galen personality type variable, while one dummy variable was used for the Gender variable, as depicted in Table 1 and Table 2.

TABLE 1. Dummy Coding Variables of Hippocratus-Gelen Personality Type

Hippocratus-Gelen Personality Type	**Dummy Variables**		
	P1	**P2**	**P3**
Sanguinis	0	0	0
Choleris	0	0	1
Melancholis	0	1	0
Pleghmatis	1	0	0

TABLE 2. Dummy Coding Variable of Gender

Gender	Dummy Variable
	G
Male	0
Female	1

RESULT AND DISCUSSION

Table 3 shows that the results of the MLA test, from a sample of 191 respondents, yielded the highest score of 95, the lowest score of 5, and an average score of 55.6. Additionally, Table 4 indicates that based on the results of the Hippocrates-Galen personality types of questionnaire, there were 44 students with a sanguine personality type, 17 students with a choleric personality type, 57 students with a melancholic personality type, and 73 students with a phlegmatic personality type. The highest average score for MLA was observed among students with a sanguine personality type, with an average score of 57.8.

TABLE 3. Score test of MLA

		N	Maximum	Minimum	Average
Personality Type	Sanguinis	44	92.5	17.5	55.3
	Choleris	17	87.5	32.5	57.8
	Melancholis	57	92.5	5	57.3
	Phlegmatis	73	87.5	20	53.9
Gender	Male	85	92.5	5	50.6
	Female	106	92.5	17.5	59.5
Score test of MLA (Global)		191	92.5	5	55.6

The Person Map, visually represented in Figure 2, effectively stratifies students' mathematical literacy abilities into three distinct and discernible categories: high, signifying a robust mastery of mathematical concepts and skills; moderate, denoting a satisfactory level of competence; and low, indicative of a need for further improvement and development in mathematical literacy.

Following this meticulous categorization within the Person Map, a comprehensive analysis was conducted to derive insights into the distribution patterns of students' mathematical literacy abilities. Specifically, this analysis sought to elucidate how these mathematical proficiency levels varied in relation to both Hippocrates-Galen personality types and gender. By delving into the interplay between students' cognitive strengths, as reflected in their mathematical literacy, and these key factors, we gained a richer understanding of the multifaceted dynamics that contribute to mathematical proficiency within the student population.

Table 5 indicates that students with Hippocrates-Galen personality types exhibit varying levels of mathematical literacy abilities, consistent with the findings of Sugiarto (2020). Additionally, differences in mathematical abilities were observed between male and female students. The categorization of mathematical literacy proficiency can be detailed as follows:

a. Students with a dominant sanguine personality type displayed a moderate level of mathematical literacy abilities, with 18 out of 44 sanguine-type students being female. In this context, a majority of these students demonstrated the ability to interpret solutions for mathematical problems, aligning with the characteristics associated with the sanguine personality type. This is congruent with [14] research, which suggests that students with sanguine personalities tend to resist being confined to given examples but can also positively stand out. Sanguine individuals are characterized by a tendency to be less precise and less serious in their responses, as evidenced by the personality questionnaire, placing them in the moderate category. Female students exhibited higher mathematical literacy abilities, as supported by [15] who posited that female students are more meticulous in drawing conclusions, careful, and proficient in communication.

b. Students with a choleric personality type demonstrated moderate mathematical literacy abilities, with 9 out of 17 choleric-type students being male. This is attributed to their difficulty in applying and considering strategies and challenges in understanding strategy application [16] This corresponds to incomplete responses from most students in this category, as many failed to provide comprehensive answers aligned with the given indicators. In this context, male students tended to outperform females, as males think theoretically, making them more adept at applying strategies to problem-solving.

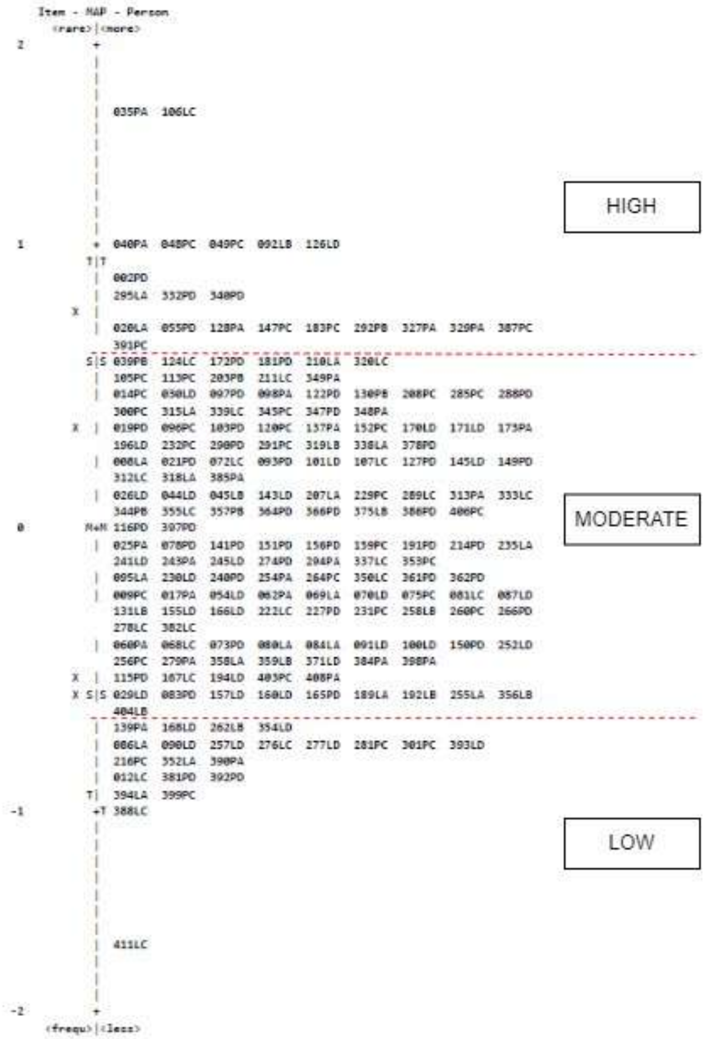

FIGURE 2. Person Map of MLA

c. Students with a melancholic personality type exhibited moderate mathematical literacy abilities, particularly among females, with 23 out of 56 melancholic-type students being female. This aligns with the characteristics of melancholic individuals, who tend to be pessimistic, have low resilience, and frequently experience despondency. This is evident in the suboptimal results of mathematical literacy assessments, where students' answers often did not align with all the indicators. This finding is consistent, which suggests that female students have superior mathematical communication skills compared to their male counterparts.

d. Students with a phlegmatic personality type demonstrated moderate mathematical literacy abilities, particularly among females, with 36 out of 74 phlegmatic-type students being female. According to [17], phlegmatic individuals tend to be slow, apathetic, and lethargic. This characterization is reflected in the research findings, which show that female students exhibited moderate mathematical literacy abilities, with the majority falling within the moderate category on the Wright Map. This aligns with the results of the [1] assessment, which indicates that the mathematical abilities of female students in Indonesia surpass those of their male counterparts.

TABLE 4. Distribution of MLA in terms of Hippocrates-Galenus Personality Type and Gender

Category of MLA	Personality Type											
	Sanguinis			***Choleris***			***Melancholis***			***Plegmatis***		
	M	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**	**M**	**F**	**T**
High	2	5	**7**	2	-	**2**	1	6	**7**	1	4	**5**
Moderate	14	18	**32**	9	5	**14**	18	23	**41**	25	36	**61**
Low	3	2	**5**	1	-	**1**	4	4	**8**	6	2	**8**
Total	19	25	**44**	12	5	**17**	23	33	**56**	32	42	**74**

With: M = Male, F = Female, and T = Total.

The mathematical literacy abilities of students who have this sanguine personality type are classified as moderate, because the sanguine type has the nature of being careless and not careful in doing things. In the choleric personality type, students' mathematical literacy abilities are classified as moderate because they have difficulties in applying considering strategies and difficulties in understanding how to use strategies [16] Meanwhile, for the melancholic personality type, mathematical literacy abilities are classified as moderate because they are pessimistic, have little fighting spirit, and often give up hope. Then, for the phlegmatic personality type, mathematical literacy abilities are classified as moderate, because the phlegmatic type is slow, apathetic and lazy.

The results of F-test of the Multiple Regression with Dummy Variables (Table 5) indicate that simultaneously, Hippocrates-Galen personality types and Gender have an influence on mathematical literacy abilities. However, upon conducting a partial test (t-test), it becomes apparent that only the Gender variable significantly affects mathematical literacy abilities, whereas the Hippocrates-Galen personality types do not. The coefficient of determination obtained from this multiple regression analysis is 7.1%.

TABLE 5. Result of Multiple regression with dummy variable[a]

	Coefficients	**Sig.**
Regression		**0.008***
(Constant)	3.000	0.000*
P1	3.323	0.684
P2	3.495	0.619
P3	5.003	0.373
G	2.557	0.000*

a: dependent variable = MLA
*): significant at $\alpha = 0.05$

The findings from the Multiple Regression with Dummy Variables analysis indicate that only the Gender variable significantly affects mathematical literacy abilities, while the Hippocrates-Galen personality types do not. This suggests that gender plays a more significant role in determining mathematical literacy abilities than personality types.

The coefficient of determination obtained from this multiple regression analysis is 7.1%. The coefficient of determination, also known as R-squared, represents the proportion of the variance in the dependent variable (mathematical literacy abilities) that can be explained by the independent variables (Hippocrates-Galen personality types and Gender). In this case, the coefficient of determination of 7.1% indicates that the independent variables explain only a small portion of the variance in mathematical literacy abilities.

These findings align with previous research that has explored the relationship between various factors and mathematics and reading literacy. For example, a study by [18] investigated the relationships between working memory, negative affect, and personal assets, and their influence on mathematics and reading literacy. The study found that these factors explained a unique and shared portion of the variance in mathematics and reading literacy. This suggests that multiple factors, including gender, can contribute to literacy abilities.The results of the simultaneous multiple regression test unequivocally demonstrate that both the independent variables, Hippocrates-Galen personality types, and gender, have a collective influence on students' mathematical literacy ability (MLA). This aligns with prior research that has explored the multifaceted nature of MLA and its association with various individual factors [1] Numerous studies have explored the interplay between personality traits and academic achievement. For instance, [19] noted that students with sanguine personalities tend to resist strict guidelines and are often more imaginative and creative in their approach to problem-solving, which might influence their mathematical literacy abilities.

A noteworthy finding from this study is the significant influence of gender on students' mathematical literacy ability. This result is consistent with a substantial body of research that has explored gender differences in mathematical achievement [9] Although there is a consensus that there are no innate gender differences in mathematical abilities, empirical studies have consistently shown disparities in mathematical performance.The higher mathematical literacy ability observed in female students in this study is in line with the findings of [15] which shows that female students tend to show greater attention to detail and precision in solving math problems and communication. This contradicts traditional stereotypes regarding gender and mathematics.

The partial test results reveal that the Hippocrates-Galen personality types, despite their initial collective influence, do not exert a significant impact on MLA when considered independently of gender. This finding underscores the complexity of the relationship between personality traits and academic performance, indicating that other factors, such as gender, may play a more dominant role in predicting MLA.This outcome is in harmony with research by [16] who observed that students with choleric personality traits may struggle in applying strategies and understanding their utility in mathematical problem-solving. However, when gender is factored into the analysis, it becomes apparent that gender differences in cognitive approaches appear to override the influence of personality traits within the scope of this study.

CONCLUSION

The Person Wright Map from Rasch model reveals that a significant proportion of eleventh-grade students attending SMAN in Depok display intermediate levels of mathematical literacy proficiency, with a prevailing inclination towards a phlegmatic personality type. Female students exhibit a higher degree of proficiency in mathematical literacy when compared to their male peers. The most elevated levels of mathematical literacy are primarily concentrated among students categorized as having sanguine and melancholic personality types.

Based on Multiple regression with dummy variables, this study demonstrates that both Hippocrates-Galen personality types and gender simultaneously influence students' mathematical literacy ability of eleventh-grade students of SMAN Depok City. However, when examined independently, gender emerges as the primary predictor of MLA, whereas personality types do not exert a significant direct impact. The coefficient of determination indicates that the independent variables explain only a small portion of the variance in mathematical literacy abilities. These findings are consistent with previous research that has explored the relationships between various factors and literacy abilities. Further research is needed to better understand the complex interplay between different factors and their influence on mathematical literacy abilities.

These findings have several implications for educators and policymakers. Understanding the interplay between gender and mathematical literacy can aid in the development of targeted interventions to bridge the gender gap in mathematical achievement. Moreover, recognizing that personality traits may not be direct determinants of mathematical literacy highlights the need for a more nuanced approach to understanding the factors that contribute to academic success in mathematics.

Future research in this area should explore additional variables and contexts to gain a deeper understanding of the intricate dynamics involved in mathematical literacy. Furthermore, investigating the interaction between personality types and gender in influencing academic performance can provide valuable insights into enhancing educational practices and promoting gender equity in mathematics education.

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RBL-STEM Learning Activity Framework: Improving Students' Computational Thinking Skills for Solving Strong Rainbow Antimagic Coloring and Its Application Scheme to Analyzing River Erosion Using STGNN

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Abstract. Computational thinking refers to a problem-solving approach that draws on concepts and techniques from computer science to address complex problems and tasks. It is not just limited to computer programming, but it is a fundamental skill set that can be applied to various fields and everyday life. In this era, these skills should be endorsed in the classroom so that the young generation possesses these skills. However, in reality, students' computational thinking skills still need to improve since the learning model applied in the classroom has yet to be able to foster these skills. The indicators of computational thinking consist of problem decomposition, algorithmic thinking, pattern recognition, abstraction and generalization. This paper described the learning activities of RBL-STEM to improve students' computational thinking skills in solving the strong rainbow antimagic colouring (SRAC) problem and its application scheme to analyzing river erosion using spatial, temporal graph neural networks (STGNN). Let $G(V(G), E(G))$ be a connected, undirected, and simple graph with vertex set V(G) and edge set E(G). By SRAC, we mean that for a bijective function $f: V(G) \rightarrow 1,2,...,|V(G)|$, the associated weight of an edge $uv \in E(G)$ under f is $f(uv)= f(u)+f(v)$, the function f is called an edge-antimagic vertex labelling if for every edge has distinct weight. If for every two vertices u and v of G, there exists a rainbow u-v geodesic path, then f was called a strong rainbow antimagic labelling of G. This research uses a qualitative narrative approach, starting with developing a prototype of the application scheme in analyzing river erosion using RAC and STGNN and continues with formulating the stage of learning activities in regards with RBL-STEM. The results of this research are in the form of an RBL-STEM learning framework consisting of six stages of learning activities, which have been ready to be used on the RBL-STEM maker space learning materials development for further research.

Keywords: Computational thinking skills, SRAC, RBL-STEM, River erosion, STGNN

INTRODUCTION

Computational thinking skills are becoming increasingly important in today's digital era. To adjust the rapid development of information and communication technology, humans must think more computationally in solving problems and making decisions. These skills include decomposing a problem into steps that a computer can execute, recognizing patterns in data, and developing solutions using algorithms and programming. Computational thinking is an essential 21st-century skill critical to developing students' critical and analytical thinking, as well as creativity and competence in problem-solving [1]. Computational thinking has also recently received considerable attention in education policy initiatives (e.g., [2], [3]). In addition, this capability is gaining attention as technology develops (e.g., [4]–[6]). The output of this ability is to express solutions with information processing on computer algorithms and other technologies, so this computational skill is required in all other disciplines such as science, technology,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040025-1–040025-12; https://doi.org/10.1063/5.0242232
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

engineering, mathematics, social sciences, and literacy because digital literacy and technology are increasingly required for these disciplines [7]. The indicators of computational thinking are listed in Figure 1.

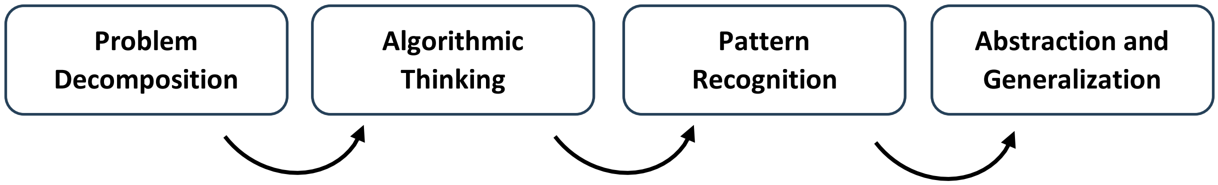


FIGURE 1. Indicators of computational thinking skills

One of the things that lecturers can do in improving the students' computational thinking skills is to choose the Research-Based Learning (RBL) model to be applied in learning. RBL is a learning approach emphasizing direct experience, exploration, and experimentation in understanding concepts and solving problems [8]. This approach encourages learners to be actively involved in the acquisition of knowledge through a process of investigation and discovery. In research-based learning, students play the role of researchers who seek answers and solutions to questions or tasks given to them. In essence, RBL encourages students to learn more deeply and meaningfully by involving them in exploring topics or issues that are interesting and relevant to them [9]. The research process helps students develop important skills such as data analysis, evidence-based decision-making, and presenting their findings clearly and logically. In an educational context, RBL also prepares students to be critical and innovative thinkers as they learn to formulate the right questions, search for reliable sources of information, and build arguments based on their findings [10]. In addition to memorization, students are equipped to become independent and resourceful researchers in the face of real-world challenges. There are seven stages of research-based learning, which consist of (1) problem posing, where open problems are identified in the research group; (2) learners are encouraged to develop problem-solving strategies; (3) data collection, including orientation, tabulation, and hypothesis formulation; (4) data analysis, prediction process, and validation; (5) formulation of conjectures, corollaries, hypotheses/lemmas, theorems, and generalizations; (6) group discussion in the research group; and(7) RBL reporting.

Globally, science, technology, engineering and mathematics (STEM) systems have become the focus of K-12 education, and the role of student learning attitudes in STEM education is also an important research agenda [11], [12]. One of the main approaches in STEM education is to embed computational thinking elements in STEM topics [13]. Computational thinking is a way of thinking that involves the use of mathematical algorithm concepts to solve problems, which has recently been advocated as a skill everyone should have, not just mathematical scientists [14]. Currently, some research is trending towards integrating computational thinking into K-12 education [15], [16]. So, based on this, researchers integrated it with the STEM approach to optimize the RBL learning model in improving students' combinatorial thinking skills.

Many countries, such as the United States, China, Australia, and Finland, have issued policies to incorporate computational thinking skills into STEM education [17], [18]. STEM has become a natural field for integrating computational thinking into the classroom. Therefore, it is clear that fostering students' computational thinking has become one of the main goals of STEM education [19]. International studies have found that a STEM approach can be implemented with other learning methods [20], [21]. One is the Research Learning (RBL) method, which also has the same characteristics that can develop critical thinking and problem-solving skills. [22].

Not a few researchers have applied the Research Based Learning model by integrating the STEM approach [10], [23], [24]. However, more research still needs to be done on whether Research Based Learning integrating STEM approaches will positively impact students' computational thinking skills. Addressing this knowledge gap, this study will explore the RBL-STEM learning model for students to improve their computational thinking skills, especially in studying relatively new material, namely the Strong Rainbow Antimagic Coloring Study concerning river erosion. Thus, the results of this paper review can provide an alternative to teaching Strong Rainbow Antimagic Coloring through RBL-STEM learning.

The results of this paper review can provide an alternative to teaching Strong Rainbow Antimagic Coloring (SRAC) through RBL-STEM learning. The discussion of river erosion is important because it is included in the Sustainable Development Goals (SDGs), including the protection of terrestrial ecosystems and freshwater ecosystems at point 15. Especially for students, it is also necessary to be introduced to river erosion so that a river erosion management system is found through the RBL-STEM approach. Therefore, this research will introduce an Activity Framework for RBL-STEM learning that focuses on river erosion problems appearing in each STEM element, a framework for solving River Erosion Problems using SRAC, and an instrument for assessing computational thinking skills in solving river erosion problems using SRAC.

METHOD

This study was a qualitative research with narrative method. This research started by exploring a contextual problem of STEM makerspace integrated in RBL activities to teach Strong Rainbow Antimagic Coloring (SRAC). We then analyzed the involvement of the four STEM subject areas (Science, Technology, Engineering, and Mathematics), and outlined the role of each subject area in solving the river erosion problem using the strong rainbow antimagic coloring technique. In science, we outline the conceptual aspects of the STEM problem, namely the definition, causes and impacts of river erosion. In technology, we describe the involvement of software applications, the development of STGNN coding using Matlab and Python software and the use of the IoT analytic platform, namely the ThingSpeak and ThingViewer program to connect some smart sensors for river erosion with mobile phone. In engineering, we analyze and describe prototypes related to STEM makerspace contextual problems for the purpose of implementation in classroom learning. In mathematics, we analyze the scheme of applying the Strong Rainbow Antimagic Coloring lemma or theorem to solve contextual STEM makerspace problems, namely river erosion problems.

Based on the scope of STEM discussion, we focused on the discussion of Strong Rainbow Antimagic Colloring with the application scheme on river erosion problem. We then observe and compare the performance, permutation, and uniqueness between different models. After that, we consider that the involvement of the four studies to solve STEM makerspace contextual problems. We continue the research by writing a framework of learning activities according to the syntax of RBL-STEM integration in solving STEM makerspace contextual problems in the form of several stages of learning activities. Finally, we presented the learning outcomes and objectives, including the development of indicators and sub-indicators for students' computational thinking skills.

RESULTS

Syntax of Research-Based Learning (RBL) with a STEM Approach

The following presented the syntax or framework for applying the RBL-STEM model in improving computational thinking skills in the study of Strong Rainbow Antimagic Coloring, especially its implementation on river erosion problems. This framework aims to combine the Research Learning model with the STEM approach to the material's content in this study. In the early stages of the research-based learning framework, problems emerge from the research group in the form of open-ended problems. The problems caused and the STEM framework raised are shown in Figure 2.

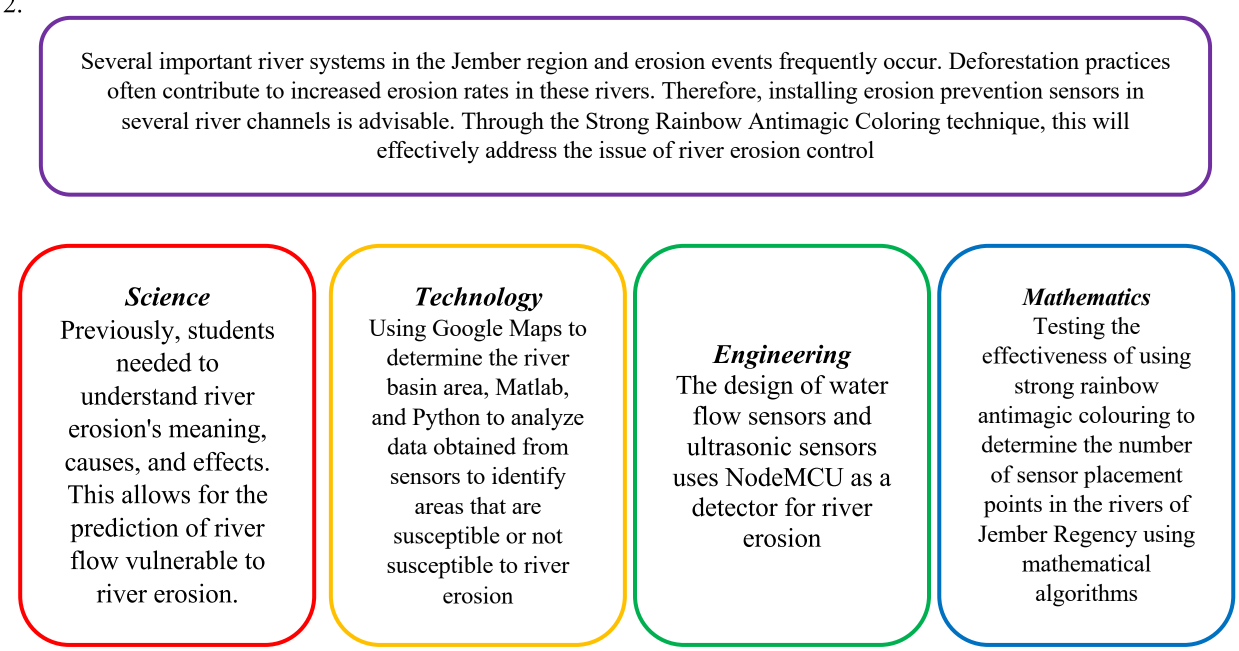


FIGURE 2. STEM Elements in River Erosion Cases

This research considers determining the number of sensors needed. Therefore, there were several stages in the Research-Based Learning model with a STEM approach, namely : (1) data collection related to the factors of river erosion and its impact (factors such as river flow discharge and watershed width will be found); (2) The use of Google Maps in representing Jember District Watershed Graphs; (3) The SRAC concept carries out graph representation on the river flow map to develop the number of admins in the river basin and determine the centre of the river erosion monitoring post; (4) Installation of a water flow sensor and an ultrasonic sensor to detect river erosion; (5) Testing the effectiveness of sensor placement from the results of the SRAC concept by monitoring data through ThinkSpeak which is then forecasted through the Python application; (6) Reporting research results and assessing student reporting results by paying attention to computational thinking indicators. The summary of the RBL-STEM integrated framework can be seen in detail in Figure 3.

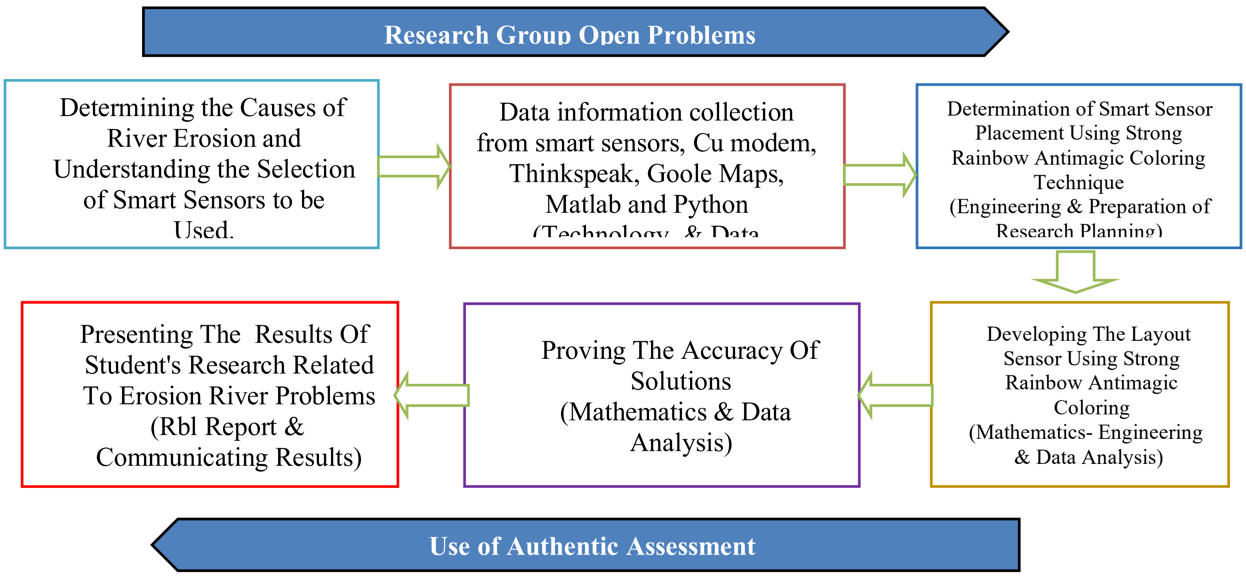


FIGURE 3. Framework RBL-STEM

SRAC study in solving River Erosion problem with RBL-STEM approach

In teaching studies related to the science of Mathematics, its relevance in everyday life is indispensable. This is in line with previous research, which argues that there is a need for direct interaction with everyday problems to get high-level thinking processes, such as forming innovative solutions, also included in the indicators of computational thinking [25]. Even the SRAC study also needs to be related to problems in life, one of which is river erosion. The following paper describes an SRAC study on river erosion problems with the RBL-STEM approach.

Science

The study certainly begins with analyzing a river erosion problem that often occurs in an area; this research area is the Jember Regency.

Problem 1: "Design a river erosion factor analysis along with the invention of a river erosion sensor."

Through the introduction of several factors that affect river erosion, such as river discharge and watershed width. From here, students analyze a sensor that can collect data related to discharge and watershed width in the Jember Regency. At this stage, students are expected to find a sensor in the form of a water flow sensor and an ultrasonic sensor.

Technology

At this stage, we were assisted by technology in the form of Google Maps, ThinkSpeak, Mathlab, and Python applications. The help of the Google Maps application represents the Jember watershed, as shown in Figure 4.

Problem 2: "Design a representation of Jember District Watershed Graph"

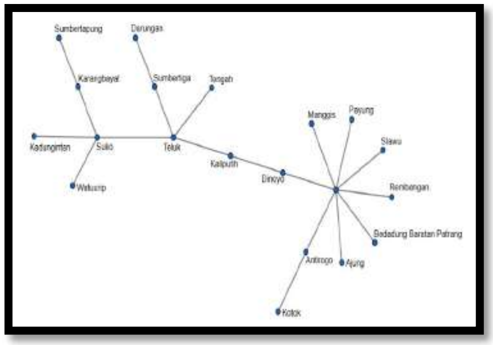
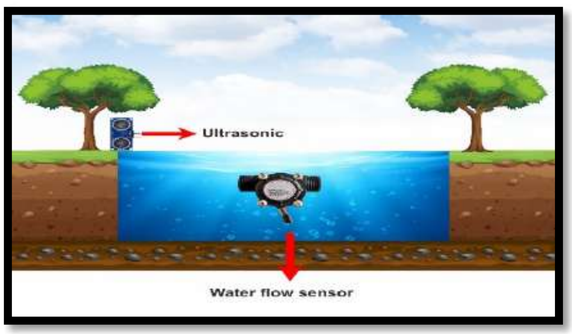
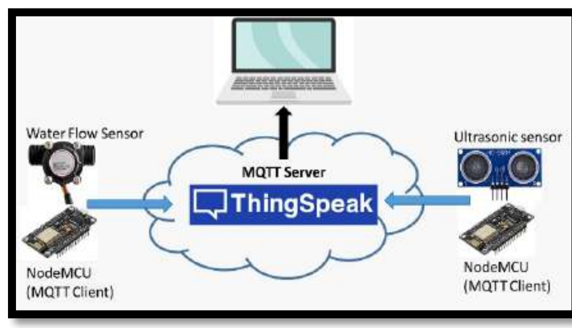


FIGURE 4. Graph representation of Jember District Watershed based on Jember District Watershed information via Google Maps

As a result of problem 1, a sensor was found to be placed in each river flow (as simulated in Figure 5a) so that this activity produces data that is integrated into the ThinkSpeak application and is ready for forecasting in the Mathlab and Python applications.

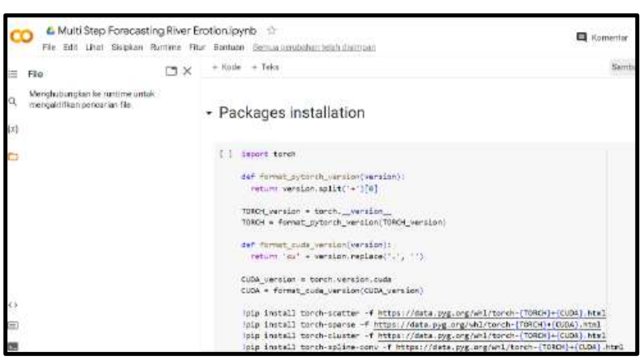


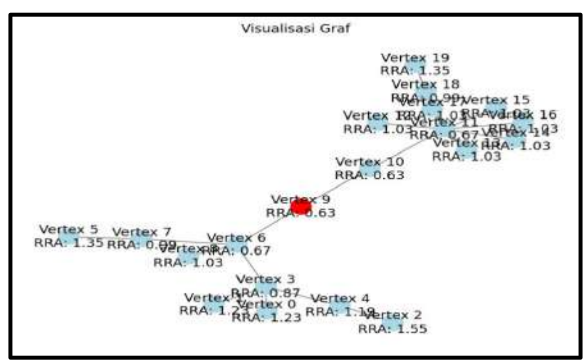


(a) (b)

FIGURE 5. Visualization of Sensor Placement (a) so that the input process can be entered into the ThinkSpeak Application with visualization of data retrieval as shown in (b)

In Problem 2, students are expected to use Google Maps technology to be able to represent it in the form of a graph. So, based on these representations, students can analyze the occurrence of river erosion by placing sensors in Problem 1. So, based on the placement of the sensor, it was be processed with thinkspeak technology in the form of Excel data output. The data output results are then forested in the Python program, which produces a graph visualization as the centre of the river erosion monitoring post is placed in Figure 6.





(a) (b)

FIGURE 6. Display of Phyton Forcesting program Usage (a) with RRA Result on Jember District Watershed Graph (b)

Engineering

In this case, the engineering aspect is a technique used in assembling a sensor until data that can predict a river erosion condition appears.

Problem 3: Design a sensor so that it can predict the state of river erosion using the SRAC technique

Of course, in Problem 3, students needed to know the application of the SRAC convention in a graph first. The concepts taught are (1) performs antimagic labelling on all nodes of the resulting graph representation such that the node labels start from one to many nodes in a graph, (2) Calculates the edge weight by summing the labels of the points connected to the edge to be calculated, (3) analyze rainbow trajectories in graphs with every two nodes in the graph having at least one rainbow trajectory, (4) if in one rainbow path, there is the same colour (edge weight), then repeat the activity from labelling points until every two points have rainbow paths with different colours.

After applying the antimagic rainbow colouring, the next step was that the number of antimagic rainbow connections was be used as a reference for determining the number of admins monitoring different river basins. Furthermore, a spatial-temporal graph neural network will be applied to determine erosion forecasting. The graph representation in Figure 7 is already tree-shaped, so each watershed would have a different admin in its path. The function of the admin is to check the validity of a river erosion that occurs so that river erosion is not only determined by one party but there are admins monitoring river erosion from other river flow areas who crosscheck. After the sensor circuit is ready, it is then integrated into the NodeMCU so that data was obtained that appears on ThinkSpeak. Hence, the ThinkSpeak output data predicted through the Python Program can provide an alarm signal for river erosion that comes to be given rapid handling. It is expected that through Problem 3, students can design as shown in Figure 7 below.

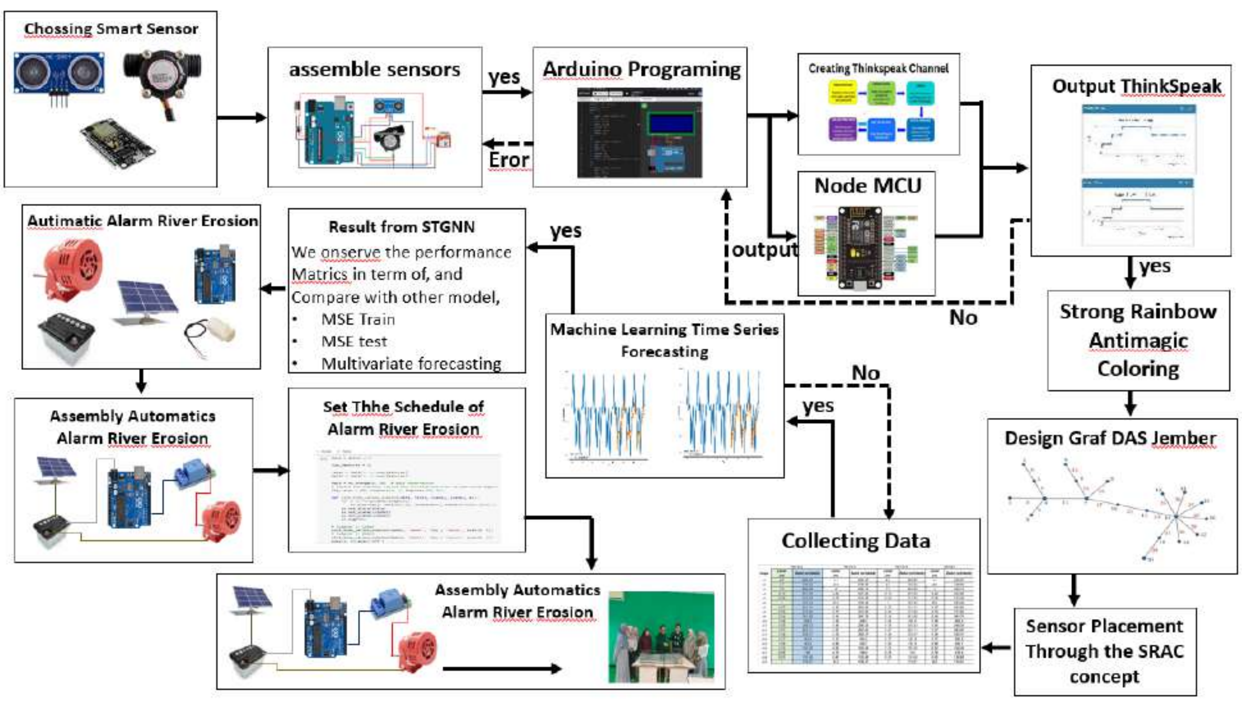


FIGURE 7. Sensor Assembly Prototype

Mathematical

This section would study the effectiveness of strong rainbow antimagic colouring concepts on river graphs. The calculation activities to study the effectiveness of the concept of strong rainbow antimagic colouring on river graph are as follow:

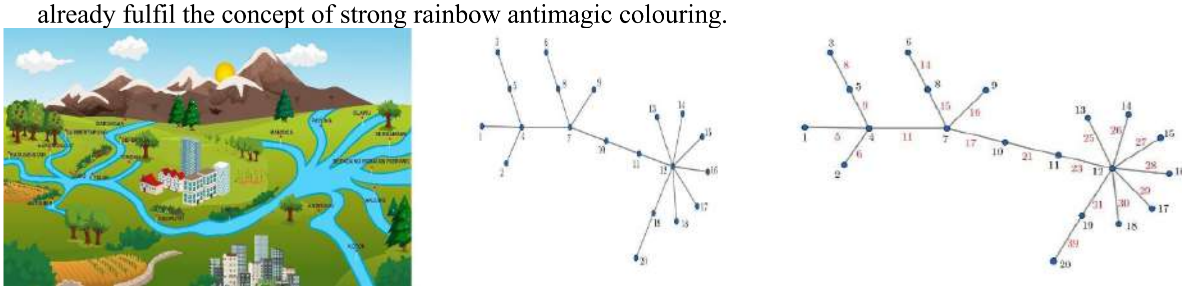
- In the first activity, we understand the lemma of strong rainbow antimagic colouring, as shown in Figure 8.

Lemma 1. Let G be any connected graph. Then, $srac(G) \geq max\{rc(G), \Delta(G)\}$.

Proof. Based on Definition 1, it is known that $rac(G) \geq rc(G)$. Let $x \in V(G)$ where $d(x) = \Delta(G)$ and $f : V(G) \longrightarrow 1, 2, ...|V(G)|$ are bijective functions such that $f(u) \neq f(x)$, for each $ux \in E(G)$ and for each $ux, vx \in E(G), w(ux) \neq w(vx)$. then, $rac(G) \geq \Delta(G)$. Based on the explanation above, it can be seen that $rac(G) \geq max\{rc(G), \Delta(G)\}$ [6].

FIGURE 8. Lemma strong rainbow antimagic colouring

- The second activity represents the watershed map into a graph (Figure 9a) and then creates a point labelling (Figure 9b) that results in different edge weight colourings (Figure 9c). Since the watershed graph is fixed and does not need to be expanded, the next step is to validate whether the edge weights that have been obtained already fulfil the concept of strong rainbow antimagic colouring.



(a) (b) (c)

FIGURE 9. Visualization of Jember District Watershed (a) with graph representation of Jember District Watershed (b) and Graph colouring result with SRAC technique (c)

The third activity then performs forecasting with the STGNN technique. For manual calculations on the STGNN process, I namely given a graph G with order n. Suppose the graph's vertex set is $V(G) = \{v_1, v_2, ..., v_{n-1}, v_n\}$ and the set of edges of a graph G is a $E(G) = \{v_iv_j | v_i, v_j \in V(G)\}$. Given the features of each vertex $H_{v_i} = \begin{bmatrix} s_{1,1} & s_{1,2} & \cdots & s_{1,m} \\ s_{2,1} & s_{2,2} & \cdots & s_{2,m} \\ \vdots & \vdots & \ddots & \vdots \\ s_{n,1} & s_{n,2} & \cdots & s_{n,m} \end{bmatrix}$. Vertex embedding can be determined by message passing from neighbouring vertex v's $h_v^l = AGG\{m_u^{l-1}, u \in N(v)\}$ with sum aggregation (.) so that $h_v^l = SUM^l\{m_u^{l-1}, u \in N(v)\}$ corresponds to the matrix $B = A + I$ where A is the adjacency matrix and I is the identity matrix.

- The fourth activity in the mathematical element is calculating the RRA (Real Relative Asymmetry) value, which is a determinant of the admin post-centre river erosion. The results of the manual calculation are then compared using the results from the Phyton program—an example of calculation using the RRA formula obtained by $RRA = \frac{RA}{G_L} = \frac{0{,}1871335}{0{,}2949866} = 0{,}63438$. Next, we validate the results of this manual RRA with the results of the Phyton program and according to Figure 6b.

Learning Activity Research-Based Learning with STEM Approach

This research has six stages of Research-Based Learning with a STEM approach. The six stages were described how students do in Research-Based Learning with a STEM approach to using the Strong Rainbow Antimagic Coloring technique to improve students' computational thinking skills in solving river erosion problems.

1. The first stage (science & problem analysis) describes the various factors of river erosion, especially river flow discharge and watershed area of a river. Therefore, the related data needed must be determined as effectively as possible. A more detailed explanation of stage 1 can be seen in Table 1

Table 1. RBL activities with STEM approach on erosion problem analysis

Stage 1	Learning Activity
Ask about some problems and what factors can affect river erosion (Science)	• The lecturer explains the dangers of river erosion • Provide triggering questions related to river erosion factors and how to slow down the rate of river erosion.

Stage 1	Learning Activity
	• Explain river erosion, which is closely related to the calculation of water discharge, watershed width, and river depth. • Students work on developing basic construction by determining the data needed in the calculation. • Students start a group discussion.

2. The second stage (Technology & Data Collection) is using smart sensor technology and ThinkSpeak Application to collect data related to river flow discharge and watershed area. A more detailed explanation of stage 2 can be seen in Table 2.

Table 2. RBL activities with a STEM approach to data collection using smart sensors

Stage 2	Learning Activity
Data analysis based on the results of numerical processing by smart sensors connected to the Think Speak application (Technology)	• Lecturer introduces smart sensor technology (Water flow sensor and ultrasonic) • Students discuss how to create a smart sensor circuit connected to the think speak application in groups. • Test the smart sensor that has been assembled in each group • Validation of smart sensors in the Think Speak application

3. Stage Three (Mathematics & Research Planning) Developing breakthroughs to overcome river erosion problems using the concept of Strong Rainbow Antimagic Coloring (SRAC). Of course, at this stage, students are first introduced to the concept of SRAC. Then, they are asked to represent the watershed in a graph and determine the Spanning Tree using the SRAC technique. A more detailed explanation of stage 3 can be seen in Table 3.

Table 3. RBL activities with STEM approach on Graph Representation

Stage 3	Learning Activity
Developing breakthroughs to overcome river erosion problems using the concept of Strong Rainbow Antimagic Coloring (SRAC) (Mathematics)	• Introducing the concept of Strong rainbow antimagic coloring • Representation of Jember Regency Watershed in Graph • Proving and Developing theorems on Strong rainbow antimagic colouring in each group of students implemented on the Graph of Jember Regency Watersheds • Determination of the placement of the center of the river erosion monitoring post which will be able to provide an alarm signal for river erosion that comes to be given rapid handling.

4. The fourth stage (Engineering and Data Analysis) is the assembly of smart sensors (Water flow sensor and ultrasonic sensor) integrated with ThinkSpeak to predict a river erosion siren warning. A more detailed explanation of stage 4 can be seen in Table 4.

Table 4. Smart sensor assembly using strong rainbow antimagic coloring technique

Stage 4	Learning Activity
Assembly of smart sensors ready to be placed in the watershed based on SRAC results (Engineering)	• Smart sensor assembly with ThinkSpeak integrated NodeMCU • Graph conversion to spanning tree • Of course, each group has a spanning tree from the conversion of the Jember Regency Watershed Graph.

Stage 4	Learning Activity
	• Simulation of smart sensor placement on each spanning tree in each student group

5. The fifth stage (Technology and data Testing) is to test the effectiveness of smart sensors based on the SRAC results on river erosion signalling. A more detailed explanation of stage 5 can be seen in Table 5.

Table 5. Testing the Results of Laying River Erosion Sensors based on the action of the SRAC concept

Stage 5	Learning Activity
Testing the results of the placement of smart sensors (Water flow sensor, ultrasonic) river erosion detection (Technology)	• Analyze the data of think Speak application results in a certain time frame. • Reporting the results of the Think Speak analysis • Evaluate and clarify the results of student research

6. The sixth stage is that students write a report on the results of the research that has been carried out, and students present the research results related to using the Strong Rainbow Antimagic Coloring technique for river erosion problems. In this case, students will participate in the Focus Group Discussion (FGD) so that other groups can observe their conjecture ability. A more detailed explanation of stage 6 can be seen in Table 6.

Table 6. Research-based learning activities with STEM approach in RTM.

Stage 6	Learning Activity
Discussion in the research group forum with RG members and other researchers about real-life problems related to the study of Strong Rainbow Antimagic Coloring (RBL Report)	• Students prepare a research report on RTM on the use of Strong Rainbow Antimagic Coloring to solve river erosion problems; • Students make presentations in front of the class for group discussion (FGD); • Lecturers evaluate and clarify the results of student research and summarize the results of the discussion. • The teacher broadcasts and clarifies the results of student research and summarizes the results of the discussion.

Framework of Computational Thinking Ability Assessment Instrument

In the study of this paper, an assessment instrument framework for measuring computational thinking skills is also described. Of course, this instrument is by the RBL-STEM method described above. The framework of the computational thinking ability assessment instrument can be seen in Table 7.

Table 7. Instrument Framework for Assessing Computational Thinking Ability

No.	Indicator	Sub Indicator	Materi Tes
1.	Problem Decomposition	a. Students are able to identify the problems given b. Students can parse information to solve the given problem	a. Explain the occurrence of river erosion mathematically! b. Based on the mathematical formula for river erosion, what factors affect the acceleration of river erosion?
2.	Algorithmic Thinking	c. Students can determine the solution steps of the given problem	a. pattern identification to determine river erosion factors

No.	Indicator	Sub Indicator	Materi Tes
		d. Students can apply the steps in solving the given problem	b. Sensor pattern identification to determine the presence of river erosion
3.	Pattern Recognition	a. Students can represent river maps on a graph. b. Students can determine the point labelling pattern on the graph representation of river erosion. c. Students can determine the edge weight of strong rainbow antimagic colouring. d. Students are able to determine strong rainbow antimagic colouring on river graph representation	a. Represent the river basin on the map in graph form. b. Write down the point labelling of the colouring pattern on the river graph c. Identify the pattern to find the edge weight of the river graph d. Construct a function from the obtained edge weights of the river graph and test the function to produce a pattern proof on the river graph.
4.	Abstraction and Generalization	a. Students can analyze the final results of the data or information obtained with the initial hypothesis when solving the problems. b. Students can write about the relationship between river erosion problems and the topic of strong rainbow antimagic colouring. c. Students can describe the relationship between river erosion problems and strong rainbow antimagic colouring.	a. Give a conclusion from the river erosion detection sensor placement test results based on strong rainbow antimagic colouring! b. Propose an open problem related to strong rainbow antimagic colouring in other problems. c. Summarize the simulation results of laying smart sensors in each river basin.

DISCUSSION

The information generated from this research is very meaningful because we know the RBL-STEM framework, especially on SRAC material. Lecturers and students, especially in the SRAC content material, can elaborate this learning model with the STEM approach, especially related to River Erosion, as we know that one of the Sustainable Development Goals (SDGs) targets is river erosion [26]. The RBLSTEM framework will provide space for students to explore the problems presented by the lecturer. Students can explore several breakthroughs, collect some data related to reducing river erosion, and analyze them according to the stages of research-based learning.

The application of STEM also significantly affects innovation in the design of environmental problem-solving [27]. This will affect students' computational thinking skills in designing river erosion problems with the SRAC concept. This learning activity would be more realistic because it is combined with the STEM approach, where in its implementation, science problems become the foundation, the use of information technology becomes the mainstay, then engineering breakthroughs become the main strategy and in the end mathematical analysis of problem-solving. Providing in-depth analysis, such as determining the number of monitoring admins in each different river basin and determining the centre of the monitoring post, students can interpolate and predict related to the preservation of the nation's cultural heritage on the number of batik motifs that are more than a thousand ethnicities of Indonesia.

In addition, the integration of RBL-STEM provided students with a basic understanding to explore various batik motifs so that students' historical literacy increased significantly [28]. Students can recognize past events, understand past narratives, demonstrate research skills, and utilize ICT to explore mathematics concepts. All of these are the main indicators of students' historical literacy that have developed well during the implementation of RBL-STEM. Student activities also show this during the implementation of RBL-STEM learning, see Figure 11. The figure shows student activities during the implementation of RBL-STEM at three stages, namely the initial stage (quite active, active and very active), the main stage (quite active, active and very active), and the final stage (quite active, active and very active).

CONCLUSIONS

The results of this study describe how the RBL syntax is integrated with the STEM approach. The main result is a framework of research-based learning activities with a STEM approach: applying the SRAC technique in solving river erosion problems to improve combinatorial ability. Included in the results of this study is the development of a framework of test instruments related to combinatorial ability. With these results, further research related to the development of tools and analysis of RBL-STEM implementation can be easily carried out.

ACKNOWLEDGEMENT

We gratefully acknowledge the support from the research members of PUI-PT Combinatorics and Graph for their help and support on finishing this paper for publication of the year 2024. In additional, we would also gratefully acknowledge the support from lecturers of Mathematics Education FKIP - University of Jember for completing this paper.

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The Use of Google Earth on the Learning Motivation Students in Elementary School

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Abstract. This study aimed to determine the impact of using Google Earth on students' learning motivation in elementary schools in the Jakarta area. The practical contribution to this research is explaining to teachers that developing teaching variations using Google Earth technology can impact students' motivation in elementary schools in the Jakarta area. The educational benefit is that they can contribute to providing analysis results using Google Earth on students' learning motivation with the read, answer, discuss, explain, and create (RADEC) model approach. The study's results stated that 52% of students were motivated to learn by using Google Earth.

INTRODUCTION

Education is a vessel that is used to be able to prepare quality human resources and be able to compete in the era of globalization. One of them is that the teacher is part of human resources, which is very important in school teaching and learning activities [1]. Therefore, it is necessary to improve the quality of teaching and learning, especially for elementary schools, in terms of the methods and learning media used [2]. Currently, education and learning are very closely related to technology as a learning medium. Significantly elementary school students will be inquisitive about the technology used as an interactive learning medium. Therefore, teachers as professional teaching staff must be more adaptive to developments and technological changes in the current era, especially in industry 4.0, so that teachers in teaching do not only use the lecture method but must be more varied in developing their teaching, namely by using technology as a learning medium [3], [4].

The condition of education in elementary schools still has problems that need to be overcome so as not to fail in the implementation of the learning process. The low learning motivation of students in elementary schools is due to the tedious learning process. It can have an impact on the activeness of students in participating in the learning process. In traditional learning, students usually sit, listen and record what the teacher has said [5]. The facts in the field are that many teachers still teach only using the lecture method [6]. They said they were comfortable with the lecture method. This study invites teachers to be able to adapt to the learning process using technology. The goal is to make the learning situation interesting.

Exciting and fun learning is learning that makes students motivated and have high enthusiasm in the learning process. In addition, students become active in asking questions because they do not make students afraid when learning [7]. In creating exciting learning and teaching for students, development is needed, such as using technological media to support elementary school students learning and teaching process [8]. Technology is currently considered to help minimize a dull atmosphere and increase students' curiosity in the learning process. Thus, students confidently ask the teacher.

Formal educational institutions have mainly carried out the use of technology in the learning and teaching process. However, many teachers still cannot use instructional media to support their teaching process because they need more skills to utilize the available technology. Therefore, developing teaching strategies to be more interactive can increase student motivation [9]. Teachers must be able to increase competence through digital literacy, so it is easier to provide updates to teaching in class because teachers can already use technology to support teaching and learning process activities. There are many technological media to support the learning and teaching process in class, one of which is the google earth technology media, which is a helpful way to provide updates in teaching in class so that google earth is considered capable of increasing student learning motivation in elementary schools.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040026-1–040026-6; https://doi.org/10.1063/5.0246820
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Google earth is an application that can provide accurate image visualization so that students can see real locations or new places they have never visited for free. In addition, on google earth, teachers can present material, give interactive quizzes, and even provide detailed explanations of the material presented [10]. Based on this explanation about google earth, the researchers chose the google earth application in this study to increase student learning motivation. Google earth can be used in interactive online and offline learning processes. The easy and fast use of google earth makes users feel helped by the existence of google earth.

Generally, google earth is used only as a guide or location. However, now it has changed its function as a learning medium for students at school. The many advantages of google earth can provide up-to-date information, see changes in relief in an area, measure distances from one place to another, and see the depth of the ocean and mountains [11]. Then, I can describe a place in detail. Thus, google earth can be a learning medium for writing descriptive essays for elementary school students [12].

There needs to be a learning model for implementing google earth as an exciting learning medium to motivate elementary school students to learn. Because student learning motivation can influence several things, one of which is student learning outcomes. So, researchers need to choose an appropriate learning model so that learning can be student-centered. The learning must create a conducive, fun, and interactive learning atmosphere. So that students become motivated, and by the 2013 curriculum system in Indonesia, teachers can combine learning models with technological media. This makes learning more exciting and efficient in utilizing time. The researcher chose the read, answer, discuss, explain, and create (RADEC) model because students get direct experience in the learning process [13]. The advantage of the read, answer, discuss, explain, and create (RADEC) model is solving problems, thereby increasing students' critical thinking skills. The read, answer, discuss, explain, and create (RADEC) model has the principle that students have the same abilities in terms of knowledge and skills. In addition, the read, answer, discuss, explain, and create (RADEC) model provides a stimulus to students.

Based on this explanation, an elementary school in Jakarta was chosen because it would make it easier for researchers to reach research data. Jakarta is the capital city of Indonesia, which has the largest population. In addition, the development of technology and the internet in Jakarta is speedy. Schools in Jakarta have facilities and infrastructure that are complete and adequate compared to other cities. So that it can support researchers in analysis the use of google earth on students' learning motivation in elementary schools properly.

This study aims to determine the use of google earth in teaching and learning activities in elementary schools in Jakarta. The practical contribution to this research is explaining to teachers that developing teaching variations using google earth technology can impact students' motivation in elementary schools in the Jakarta area. The educational benefit is that they can contribute to providing analysis results using google earth on students' learning motivation with the read, answer, discuss, explain, and create (RADEC) model approach.

LITERATURE REVIEW

Learning Motivation

Motivation can be defined as the desire or power within a person where a person struggles to do something. In this context, someone desires to learn something by achieving achievements and goals. Therefore, the concept of motivation to learn is a need and desire, but also in conditions that someone can take directly to satisfy their needs and desires [3].

Learning Media

Learning media is essential and needed to support the teaching and learning process, which can be adapted to the age level of students. Learning media is a tool used by teachers to make it easier to convey messages to students. Teaching and learning that uses tools to support this process are learning media. Learning media combines software and hardware learning resources (teaching and learning processes). With the help of learning media, the teacher will find it easy to convey material messages so that learning objectives can be adequately achieved [14].

METHOD

This study uses the read, answer, discuss, explain, and create (RADEC) model. The first few stages are reading. Namely, students will read the material that the teacher will deliver. Second, answer, namely the teacher will give interactive questions to students according to the material that will be given using google earth. Third, discuss, namely, the teacher will discuss with students the answers to questions that have been given to students. Fourth, the teacher explains the material discussed to students using google earth. So that the explanation given to students can be more easily understood with more realistic visuals; Fifth, create, namely, students can create an idea or product from the material provided to solve a problem related to the material provided to students [15]. The read, answer, discuss, explain, and create (RADEC) model is a model that is considered appropriate for increasing student learning motivation today, which is influenced by rapid technological developments.

RESULTS AND DISCUSSION

Based on the results of data collection that have been done by giving questionnaires, observation, and documentation to students regarding the use of google earth in teaching and learning activities in elementary schools in Jakarta. This study made two observations, namely learning before and after using the read, answer, discuss, explain, and create (RADEC) model in using google earth to increase elementary school students learning motivation. The subjects of this study were 40 elementary school students in Jakarta.The following observations can be seen in table 1.

TABLE 1. Implementation RADEC Model in Learning Google Earth

Learning stage	First meeting (before)	Second meeting (after)	Average
Read	50%	75%	62.5%
Answer	40%	65%	52.5%
Discuss	45%	65%	55%
Explain	20%	40%	30%
Create	15%	40%	27.5%
Average	34%	57%	45.5%

From the results of implementing learning using the read, answer, discuss, explain, and create (RADEC) model in google earth to increase the learning motivation of elementary school students in Jakarta. Based on table 1, at the first meeting before using google earth on the learning process, students' learning motivation was low from the five stages of learning that students had carried out. The first and most common learning stage carried out by the teacher is reading, with a percentage of 50% of students who have read the material provided by the teacher, while the other students are just joking and there is no motivation to learn. The second stage is to answer as much as 40%, which can answer the questions given by the teacher on the material that the teacher has delivered. This percentage is small because not half the students can answer the questions correctly. The occurrence of failures in the learning process has been carried out because of students who are not motivated to learn at school.

Furthermore, the discussion stage obtained a percentage of 45%. In this discussion stage, only a few students were active in the discussion group, while the others were busy and passive in conducting discussions in the learning process. The teacher must provide a stimulus first to be able to make students active in the discussion. The explaining stage is when the teacher explains the results of the discussions that have been carried out with the students. At this stage, before using google earth, it has a percentage of 20%. In addition, at this stage, students are likelier not to listen to the teacher's explanation. The last step is to create students who can provide solutions or solutions related to the material presented, only 15%. There are still many students who do not dare to express their opinion about a problem that the teacher has given. Based on table 1, the second meeting was held after using google earth in the students' learning process in Jakarta's elementary schools. There is an increase in the five stages of learning which is influenced by increased student motivation.

The reading stage is the teacher presents the material being taught to students. The teacher asks students to read the material presented. Thus, students can understand the learning material. This reading stage, presented by the teacher using google earth, is not only in the form of text but in the form of authentic visualization images. They are creating an atmosphere of learning the stages of reading to be fun. Students are motivated when reading does not bore students. After completing the reading stages, students are considered to have understood the material, and the teacher gives quizzes to students. So that the percentage of students gets 75%. Thus, by using google earth, students experience a significant increase in learning.

The teacher uses the google earth quiz section at the answering stage to provide interactive questions to elementary school students. Questions are in the form of multiple choices and can be cast. The percentage of students answering has increased to 65%. In the quiz section, the teacher can choose many categories to be innovated by the teacher to students. So, students feel comfortable with the questions given. In addition, students can easily understand and understand the questions given so that students can work on quizzes efficiently.

Following the discussion, the teacher and students discussed the material and quiz answers given to students with the help of google earth, which obtained a percentage of 65%. While explain has a percentage of 40%. The last stage is creation, where students can give opinions about the teacher's material. At this stage, the teacher builds self-confidence and the courage of students to argue. So, the resulting percentage is 40%. So, at this second meeting, with the use of google earth as a learning medium, there was an increase in the five stages of learning through the read, answer, discuss, explain, and create (RADEC) model with an average result of 45.5% increasing the learning motivation of elementary school students in Jakarta.

Learning motivation is one factor determining the maximum effectiveness of the student learning process [16]. If students' learning motivation is good, it will create a pleasant learning atmosphere. Learning will be of higher quality because of the response and feedback given to students in the learning process. So, it is essential to encourage student learning motivation, one of which is by using technological media, namely the Google Earth application [16], [17].

TABLE 2. Students Learning Motivation

Motivation	Intrinsic	Extrinsic
Students	Support from within students.	Support from outside the students.
	High interest in learning from within yourself. Besides having the initiative in learning without having to be ordered.	Students should be given rewards for interest in learning. Students learn only to get something. So it must be given advice and suggestions from the outside like a teacher.
	Students tend to be active in teaching and learning activities without having to be asked by the teacher.	Students tend to be passive in teaching and learning activities.
	Students quickly understand the learning material provided by the teacher.	Students tend to be slow in understanding the material provided, therefore the need for interesting learning media.

The advantage of using google earth as a learning medium in elementary schools is that it can make it easier for teachers to explain material concretely (naturally) with 3-dimensional visualization images. In addition, students can understand and know cities and even countries that have never been visited. Using google earth can make students think critically with quizzes that can be given to students interactively [11].

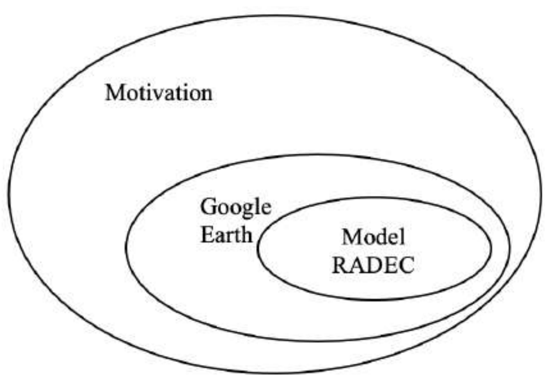

FIGURE 1. Relationship RADEC Model, Google Earth, and Motivation

Figure 1 is known that through the RADEC model combined with google earth it can increase students learning motivation. This happens because they are interconnected with one another to build and encourage student's motivation that comes from outside the student's self. Through five stage of RADEC model that can be implemented with the help of technology-based learning media, namely google earth.

Learning using google earth with the RADEC model can influence elementary school students' perceptions of learning activities. In addition, learning with google earth makes elementary school students feel happy [18]. Thus, it can be accepted by students more easily. The feeling of pleasure that students have when learning activities can have a positive impact, including increasing students learning motivation. Students pay attention to the explanation given by the teacher carefully. Analysis of the results of using google earth on students learning motivation significantly mediates a very good relationship. Learning carried out becomes more effective.

CONCLUSION

Based on an analysis of the use of google earth on the learning motivation of elementary school students, applying the read, answer, discuss, explain, and create (RADEC) model can experience a tremendous increase in students with an average yield of 45.5%. Utilizing google earth in the learning process builds student learning motivation because of curiosity about using google earth. In addition, there are many features that teachers can use in making learning materials on google earth. Then, google earth makes it easy to understand learning material. Students become the focus of the learning process and are motivated when learning because the material can be explained in real terms to students. So, the google earth application can be used as a learning medium for students in elementary schools in Jakarta. However, the limitations of this study are only to find out students' motivation in carrying out the learning process with google earth media. However, what factors successfully increase student motivation using google earth media has yet to be discovered.

Learning will become more attractive to elementary school students in Jakarta. The importance of being able to increase the learning motivation of Jakarta elementary school students because it can provide good learning outcomes for Jakarta elementary school students, thus creating a fun learning atmosphere and making it easier for students to understand the material that the teacher has given. So, the role of technology in education is very influential in motivating students, especially the use of google earth in elementary schools in Jakarta.

For future researchers, it is hoped that they can utilize technology as an innovative and compelling learning medium for students. One of them is using google earth based on the read, answer, discuss, explain, and create (RADEC) model to increase learning motivation for elementary school students. In addition, further research is needed regarding what factors influence the success of using google earth media in increasing student motivation so that from this research, it is hoped that it will not only stop finding out the results of the analysis of using Google Earth on student learning motivation but can develop a model. Relating to the successful use of google earth learning media and student motivation in elementary schools.

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The Analysis of Newman's Error in Solving Ordinary Differential Equation

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Abstract. Ordinary differential equations are one of the compulsory subjects in the mathematics education department, Faculty of Education, University of Jember. The relationship between mathematics and its implementation in daily life can be connected by ordinary differential equations. The process of solving a problem is the main indicator of the learning achievement score in ordinary differential equations courses. Students often experience errors in solving ordinary differential equations. Errors made by students need to be analyzed in order to minimize subsequent errors. This study aims to describe the types of errors made by students based on the Newman method. The subjects of this study were students of the 3rd semester mathematics education study program. The data collection instrument used tests and interviews. The results of this study found that the types of errors made by students with high early mathematical abilities were coding errors, then students with early mathematical abilities were experiencing processing errors and coding errors, while students with low early mathematical abilities experienced misunderstandings, transformation errors, completion process errors, and coding errors. Thus, students with high initial mathematical abilities made fewer errors than students with moderate and low initial mathematical abilities.

INTRODUCTION

The paper Mathematics learning is an important branch of science, which have an important role in real life. Mathematics has an important role in the process of forming critical, logical, systematic, and creative traits. In addition, mathematics is also a tool in solving daily life problems (Collins et al, 1989). The relationship be-tween mathematics and its implementation in daily life can be connected by ordinary differential equations. The process of solving a problem is the main indicator of the learning achievement of graduation in ordinary differential equations courses. This Ordinary Differential Equation course includes: Basic GDP Concepts, Low Order GDP Concepts, Initial Value Problems, High Order GDP Concepts, GDP Applications, GDP System and Practicum using MAPLE software. GDP is one of the subjects that are considered difficult for students to understand (Czocher, Tague & Baker; 2013). This is because GDP involves many derivative and integral procedures (Ning-sih and Rohana, 2018). In addition to students being required to have a high initial mathematical ability, students must also have good reasoning skills.
The inability of students to build their own concepts regarding the basic concepts of GDP is one of the student difficulties in studying GDP (Valcarce & Diaz, 2013). Students tend to memorize the concepts of GDP without knowing the meaning contained in the concept, thus when students solve problems with GDP students often make mistakes and do not find solutions to solving the problem. Based on observations made, through giving pre-test questions to students, information was obtained that the most common mistakes made were failures to understand the concept of derivative and integral. Whereas understanding the concept of derivative and integral is very important in the process of solving ordinary differential equations.

The level of student errors in solving ordinary differential equations problems such as student errors in the data collection process, errors in using mathematical operations, and errors in determining the right formula are indicators of the non-optimal absorption of the material provided by the lecturer (Mahmuda, 2011). This has an impact on the learning achievement of ordinary differential equations is still low, which means that students' skills in solving GDP problems are also low. Based on those analysis, it is necessary to analyze the errors that students usually made in solving ordinary differential equations. Through the error analysis, lecturers can make a mapping of the types of errors and can make

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040027-1–040027-8; https://doi.org/10.1063/5.0241474
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strategies to minimize the student mistakes. It can make an impact on learning ordinary differential equations in order to make the quality of the learning higher and able to increase the learning achievement. The analysis used to analyze the types of student errors is using error analysis based on Newman's criteria. Therefore, this study aims to analyze student errors in solving second-order differential equations based on Newmann's criteria.

RESEARCH METHODOLOGY

The process of analyzing student errors in this study used a qualitative descriptive approach. Through the analysis process, it provided an overview of the errors made by students in solving ordinary differential equations. The subjects in this study were the students in third semester of the 2019/2020 academic year of the Mathematics Study Program, Faculty of Teacher Training and Education, University of Jember. The number of students who became the research subjects were 29 people. Data collected through written tests and interviews (Luneta et al, 2010). The instruments of this research were test questions and interview guidelines. The research begins by giving a pretest with the aim of classifying students' initial abilities. Furthermore, a final test (post-test) was given to analyze student errors in solving problems related to GDP. The test consisted of six description questions given at the end of the lecture activity. Then, the test results were analyzed for errors based on the Newman error indicator (White, 2010). The types of Newman errors are presented as follows.

1. Reading Error, indicator:
   a. Students misread and understand ordinary differential equations.
   b. Students are not able to read ordinary differential equations correctly.
   c. Students can read the problem correctly but are unable to retrieve important information in ordinary differential equations.
2. Comprehension Error, indicator:
   a. Students cannot determine what they know and what the meaning of the question in ordinary differential equations.
   b. Students are wrong in determining what is known and what is asked of ordinary differential equations.
   c. Students do not use the information or have not captured the in-formation contained in ordinary differential equations.

3. Transformation Error, indicators:
   a. Students are wrong in determining the steps of completion and which steps take precedence in solving ordinary differential equations.
   b. Students inaccurately determine the formula used in the steps for solving ordinary differential equation.
   c. Students inaccurately determine the mathematical model of ordinary differential equations.
4. Process Skills Error, indicators:
   a. Students inaccurately determine the operating calculations in solving ordinary differential equations regardless of previous errors.
   b. Students inaccurately determine the systematics of solving contextual mathematical problem with ordinary differential equations.
   c. Students inaccurately determine arithmetic operations in solving ordinary differential equation.
5. Encoding Error, indicator:
   a. Students inaccurately determine the final answer or do not determine the final answer to the problem of ordinary differential equations.
   b. Students inaccurately determine conclusions or not determining conclusions from the final answer to ordinary differential equations.
   c. The student was wrong because of the previous process and did not determine the unit in the final answer of the ordinary differential equation problem.

The next stage is the interview. Structured interviews were conducted in order to explore the reason of these students in making mistakes in solving ordinary differential equations. The list of questions is as follows: How do students think about the problems of ordinary differential equations given, What are the obstacles faced when solving problems?, How do students understand the material related to ordinary differential equations?, what is the most difficult part faced by students in answering the questions given?, and What causes students to make mistakes in the process of answering the questions given?. After the tests and inter-views were conducted, further data analysis was carried out. Data analysis was conducted by reducing data, presenting da-ta, and triangulation. The triangulation carried out was method triangulation, be-tween the test method and the interview method. Triangulation was conducted by comparing the results obtained during tests and interviews. The error analysis process when doing the test uses Newman's criteria and is classified based on. The last step was taking conclusions from the data analysis. The procedure for conducting the research to determine the types of student errors is presented in the following chart.

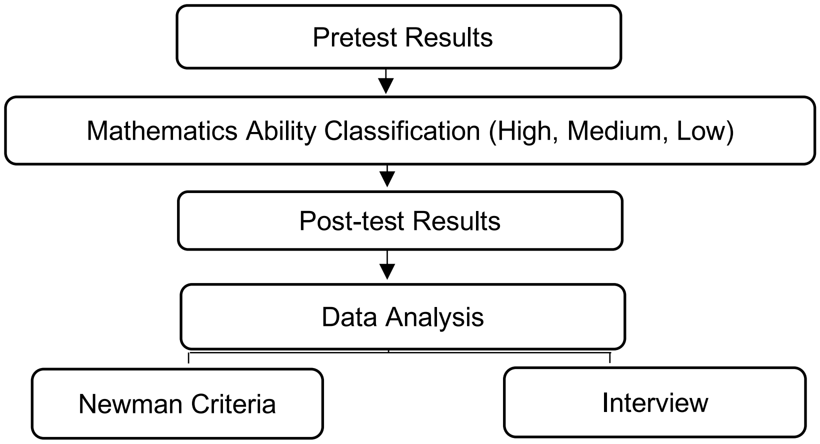


Figure 1. Research Procedures for Analysis of Stu-dent Errors in Solving the GDP Problem

RESULT AND DISCUSSION

Based on the results of the pretest, information is obtained about the percentage of students who have high, medium, and low initial abilities which are presented in the following chart.

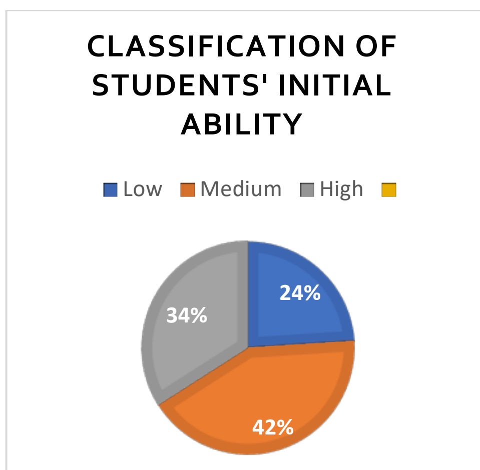
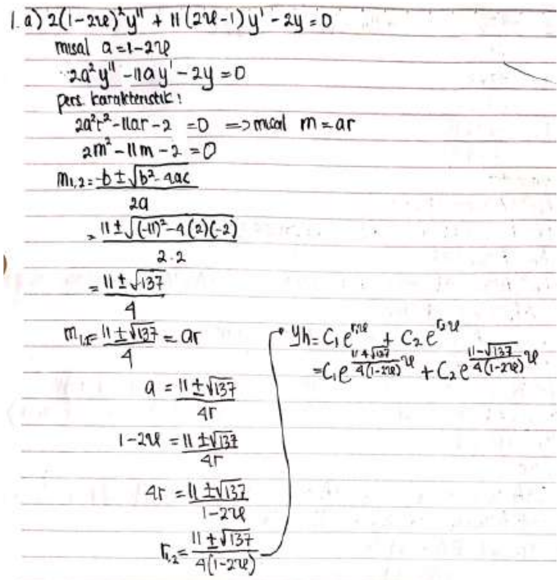


Figure 2: Classification of Students' Initial Ability

Students with high early mathematical abilities, namely coding errors, then students with early mathematical abilities were experiencing processing errors and coding errors, while students with low early mathematical abilities experienced misunderstandings, transformation errors, completion process errors, and coding errors. The following are examples of the types of student errors with low, medium or high initial mathematical abilities.



1. a) $2(1-2x)^2y'' + 11(2x-1)y' - 2y = 0$

misal $a = 1-2x$

$2a^2y'' - 11ay' - 2y = 0$

pers. karakteristik:

$2a^2r^2 - 11ar - 2 = 0 \Rightarrow$ misal $m = ar$

$2m^2 - 11m - 2 = 0$

$m_{1,2} = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$= \frac{11 \pm \sqrt{(-11)^2-4(2)(-2)}}{2 \cdot 2}$

$= \frac{11 \pm \sqrt{137}}{4}$

$m_{1,2} = \frac{11 \pm \sqrt{137}}{4} = ar$

$a = \frac{11 \pm \sqrt{137}}{4r}$

$1-2x = \frac{11 \pm \sqrt{137}}{4r}$

$4r = \frac{11 \pm \sqrt{137}}{1-2x}$

$r_{1,2} = \frac{11 \pm \sqrt{137}}{4(1-2x)}$

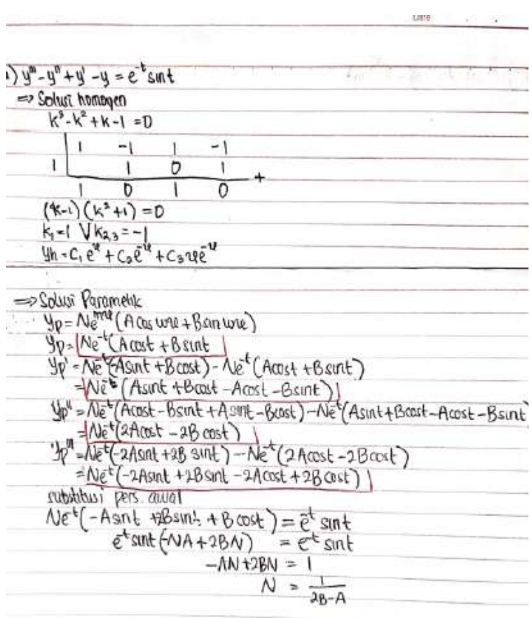
$y_h = C_1e^{r_1x} + C_2e^{r_2x} = C_1e^{\frac{11+\sqrt{137}}{4(1-2x)}x} + C_2e^{\frac{11-\sqrt{137}}{4(1-2x)}x}$

Translation:
Misal : Suppose
Per. Karakteristik : Characteristic Equation

Figure 3: Results of Answers to Ordinary Differential Equations Number 1

The student uses a method to solve a second-order ordinary differential equation even though the given equation is a second-order Cauchy Euler equation. Therefore, the given equation must first be converted into the general form of the second-order Cauchy-Euler equation as follows: $2(-2x+1)^2y'' - 11\,(-2x+1)y' - 2y = 0 \leftrightarrow (-2x+1)^2y'' - \frac{11}{2}\,(-2x+1)y' - y = 0$.The student immediately determines the characteristic equation of the given differential equation. The student experienced difficulty in understanding the questions given so that it affected the next process, namely transformation errors, process skills errors, and encoding errors.

Based on the results of interviews conducted with students, information was obtained that the error occurred because students were not proficient in classifying differential equations. This results in students having difficulty in determining the appropriate method for the given problem.



1) $y''' - y'' + y' - y = e^{-t}\sin t$

$\Rightarrow$ Solusi homogen

$k^3 - k^2 + k - 1 = 0$

1	1	−1	1	−1
		1	0	1
	1	0	1	0

$(k-1)(k^2+1) = 0$

$k_1 = 1 \vee k_{2,3} = -1$

$y_h = C_1e^x + C_2e^{-x} + C_3xe^{-x}$

$\Rightarrow$ Solusi Parametrik

$y_p = Ne^{mx}(A\cos wx + B\sin wx)$

$y_p = Ne^{-t}(A\cos t + B\sin t)$

$y_p' = Ne^{-t}(A\sin t + B\cos t) - Ne^{-t}(A\cos t + B\sin t)$

$= Ne^{-t}(A\sin t + B\cos t - A\cos t - B\sin t)$

$y_p'' = Ne^{-t}(A\cos t - B\sin t + A\sin t - B\cos t) - Ne^{-t}(A\sin t + B\cos t - A\cos t - B\sin t)$

$= Ne^{-t}(2A\cos t - 2B\cos t)$

$y_p''' = Ne^{-t}(-2A\sin t + 2B\sin t) - Ne^{-t}(2A\cos t - 2B\cos t)$

$= Ne^{-t}(-2A\sin t + 2B\sin t - 2A\cos t + 2B\cos t)$

subtitusi pers. awal

$Ne^{-t}(-A\sin t + 2B\sin t + B\cos t) = e^{-t}\sin t$

$e^{-t}\sin t(-NA + 2BN) = e^{-t}\sin t$

$-AN + 2BN = 1$

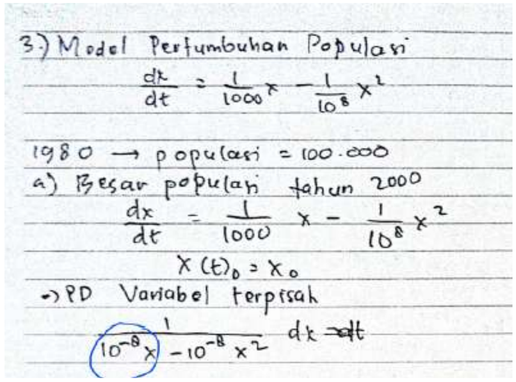
$N = \frac{1}{2B-A}$

Translation
Solusi Homogen : Homogenous Solution
Solusi Parametrik : Parametric Solution
Subtitusi Pers. Awal: Initial Equation Subtitution

Figure 4: Results of Answers to Ordinary Differential Equations Number 2

The student has correctly determined the homogeneous solution of the ordinary differential equation: $\boldsymbol{y''' - y'' + y' - y = e^t \sin t}$, but the student has yet to accurately generate the solution, which is a special solution of the inhomogeneous PD. This problem can be solved using the method of indeterminate coefficients, the key in this method is to assume that it $\boldsymbol{y_p}$has an expression similar to $\boldsymbol{r(x)}$, which involves unknown coefficients which must be determined by substituting $\boldsymbol{y_p}$in the equation. Based on the questions given, students should choose the following equation: $\boldsymbol{y_p = Ae^{kt}(B\sin t + C\ \cos t)}$. Based on the description above, it can be concluded that the type of error made is included in the type of transformation error or the student is wrong in determining the formula $\boldsymbol{y_p}$.

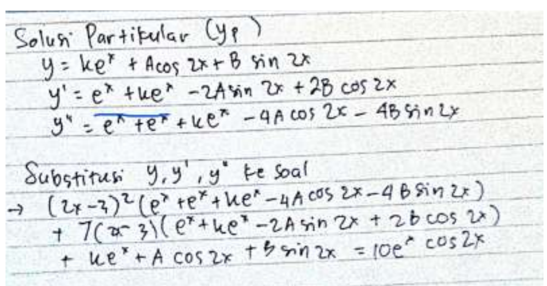
Through the interviews, the student informed that they are still having difficulties in finding particular equations using the constant coefficient method. Students are also still not careful in determining the derivative of the particular equation that has been built.



Translation:
Model Pertumbuhan Populasi : Population Growth Model
Besar populasi Tahun 2000: The number of population in 2000
PD Variabel Terpisah : Separated Variable Differential Equation

Figure 5: Results of Answers to Ordinary Differential Equations Number 3

Students with moderate early math skills tend to make process skill errors. Figure 3 shows that students struggle in carrying out the calculation process in solving ordinary differential equations, they should be $\boldsymbol{\frac{1}{1000}}$changed in the form $\boldsymbol{10^{-3}}$ not to$\boldsymbol{10^{-8}}$**.** Based on the results of interviews that have been carried out, it can be concluded that students with early mathematical abilities are experiencing misconceptions about arithmetic operations with exponents. Students are less careful in converting fractions into exponents. Another mistake made by students is not writing conclusions from the answers obtained.



Translation:
Solusi Partikular : Particular Solution
Subtitusi y, y’, y’’ ke Soal : Subtitution y, y’, y’’ to exercise

Figure 6: Example of Process Skill Error

Apart from the previous error, namely an error in determining the formula $\boldsymbol{y_p}$, the student also made an error in determining the first derivative of the form $\boldsymbol{y = ke^x}$should be written as follows: $\boldsymbol{y' = ke^x}$. This error belongs to the encoding error.

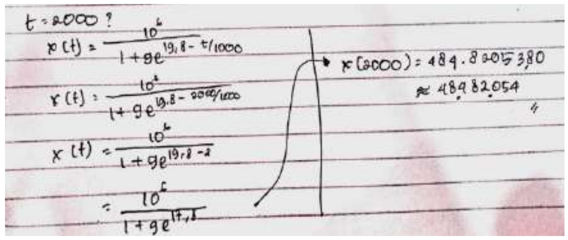


Figure 7: Example of Encoding Error

Students who do not include the units of the results given should be written down. $\boldsymbol{x(2000) \approx 48.482.054 \approx 48}$ million population.Students with high initial mathematical abilities also do not provide conclusions from the final answers to the questions given to the application of second-order differential equations. These errors fall into the category of encoding errors.

Figures 5 and 6 are examples of mistakes made by students with high early mathematical abilities. Based on the results of interviews, information was obtained that students were not accustomed to writing conclusions from a statement. Students also sometimes forget to add units from the results obtained. Inaccuracy is the main factor causing errors made by students.

Table 1. Quantitative results of students' responses to problem solving

Items	Number of students who give the right answer	Percentage (%)
1a)	19	66
1b)	6	20
2a)	3	10
2b)	0	0
2c)	0	0
3	8	28
4	25	86
5	20	69
6	26	90

Table 1 shows the number of students who gave correct and complete answers in solving the given ordinary differential equations. Based on the data obtained, it can be seen that almost all students have difficulty in solving questions no. 2a and 2b. This problem contains material for non-homogeneous differential equations of order n. The solution of the nth order non-homogeneous GDP consists of two solutions, namely homogeneous and non-homogeneous solutions. Based on the analysis of student work, almost all students were able to determine the homogeneous solution but were wrong in determining the non-homogeneous solution. Based on the results of interviews conducted, students still find it difficult to determine the particular solution. In addition, students also still have difficulty in determining the first derivative of a predetermined particular solution, resulting in errors in determining the second and third derivatives.

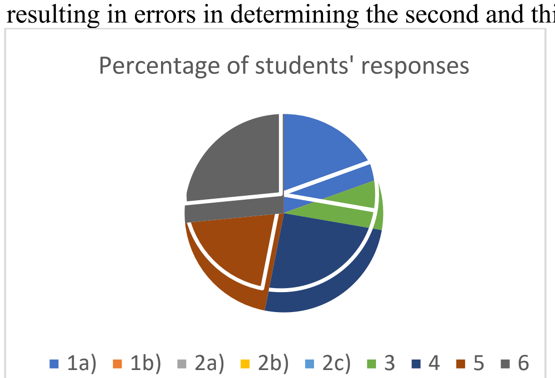


Figure 8. Pie Chart of the Percentage of Student Work

Figure 8 is the percentage of student work presented in a pie chart. The largest percentage of students who gave the correct answer lies in question number 6, which is 90%. While the smallest percentage is in question number 2, which is 0%. This shows that almost all students are able to solve problem number 6 while on the contrary for question number 2.

Table 2. Descriptive analysis of students' tendency levels to make errors according to types.

Item No.	Type of Error I	II	III	IV	V
1a)	7 (24%)	7 (24%)	9 (31%)	10 (34%)	10 (34%)
1b)	9 (31%)	9 (31%)	27 (93%)	28 (97%)	28 (97%)
2a)	8 (28%)	7 (24%)	20 (69%)	23 (79%)	23 (79%)
2b)	11 (38%)	11 (38%)	19 (66%)	20 (69%)	20 (69%)
2c)	19 (66%)	19 (66%)	4 (14%)	12 (41%)	12 (41%)
3	0 (0%)	0 (0%)	9 (31%)	21 (72%)	21 (72%)
4	0 (0%)	0 (0%)	3 (10%)	4 (14%)	4 (14%)
5	0 (0%)	0 (0%)	3 (10%)	7 (24%)	8 (28%)
6	0 (0%)	0 (0%)	2 (7%)	3 (10%)	3 (10%)

Table 2 explains the percentage of student errors for each type of error in solving the PDB questions. Problem number 1 contains the material for the second-order Cauchy Euler equation. In this problem, students are asked to determine the general solution of the given second-order differential equation. The percentage of process skills error types for questions 1 a and 1 b are 34% and 97%, respectively. Almost all students make mistakes in the process of determining the roots of the characteristic equations that have been built. This causes students to make mistakes in determining the solution of the given second-order differential equation. In problem 1 b, the student made an error in determining the particular solution of the given nonhomogeneous differential equation. The error is because students still do not understand the overall intent of the questions given so they cannot interpret the keywords (Abdullah, et al; 2015) (Sumule, et al; 2018). In question number 2, students are asked to determine a second-order GDP solution using the method of indeterminate coefficients or parameter variations. Student errors in solving problem number 2 belong to the type of reading error and process skill error. This is caused by the weakness of students in determining the right formula to solve the given problem. Students fail to develop strategies/plans in solving problems (Abdullah, et al; 2015) (Alhassora, et al; 2017). Questions number 3 and 4 contain the application of the first order PDB, namely Newton's law of cooling and the rate of decay of radioactive materials. Questions number 5 and 6 contain the second order PDB application material, namely the Undamped Free Oscillation of the Spring Mass System and electrical circuits. Types of errors for questions number 3-6, mostly included in the encoding error. Students are not able to give the correct conclusion because there is an error in the final calculation result. In addition, some students also forgot to give units in the answer results. The percentages for this type of error in solving questions in questions number 3-6 are 72%, 14%, 24%, and 10% respectively.

CONCLUSION

Based on the results of the data analysis using Newmann's criteria and the inter-view process, it can be concluded that some mistakes which often made by students in solving second-order GDP problems include transformation errors, pro-cessing abilities, and coding. Students are not able to convert story problems into mathematical sentences. In addition, students have difficulty in determining strategies to solve questions on the questions. Process skill errors made by students were arise because students do not understand the concept of derivatives and integrals. In addition, students have difficulty in choosing the appropriate mathematical operations. The difficulty level of the questions also affects the students' ability to correctly interpret the questions in the form of solutions. This mistake eventually leads to inaccurate solution. Therefore, it is necessary to increase the understanding of the second-order GDP concept and related concepts in deter-mining the solution of the equation.

ACKNOWLEDGEMENTS

The author would like to acknowledge the support of the Mathematics Education Study Program, FKIP University of Jember due to the completion of this research.

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Developing Research-Based Learning Tools with STEM Approach to Improve Students' Metaliteracy Ability to Solve Functional Relations Problems and Its Application on the Design of Stripe Batik

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Abstract. The development of increasingly complex technology emphasizes the importance of metaliteracy ability in education. Metaliteracy is a comprehensive and referential thinking framework that integrates evolving and expansive technologies compared to other types of literacies. However, the metaliteracy ability of students is still relatively low. This can be seen from the types of questions that have been given, which have not been able to support the improvement of metaliteracy skills. The instructional tools used have also not been effective enough in supporting the enhancement of metaliteracy ability. Additionally, based on the pretest results, it is evident that students' metaliteracy abilities are still considered low. Therefore, to support the improvement of metaliteracy ability, this research will apply the Research-Based Learning model integrated with the STEM approach to solving function relation problems. Based on the fundamental competencies that students must understand in comprehending function relations, they should be able to determine a function, including its domain and range, and apply contextual learning, such as applying function relation material to the design of batik motifs with lines. The next step is to develop Research-Based Learning and STEM tools in learning to improve students' metaliteracy. The research findings reveal that the Research-Based Learning device with the STEM approach developed met the validity, practicality, and effectiveness criteria.

INTRODUCTION

One of the important subjects in education is mathematics because mathematics provides a foundation for analytical thinking and problem-solving. In addition, mathematics is also needed for the development of mathematical literacy. The ability to formulate, apply, and comprehend mathematics in a range of circumstances is known as mathematical literacy [1]. However, knowing mathematical literacy alone is not enough. Technological developments bring complexity to the access and availability of information so that students not only rely on traditional information sources but can also access information via the Internet and various digital platforms [2]. Therefore, amid the rapid development of technology and information, apart from the need to have a good understanding of learning materials, students also need to develop metaliteracy ability. Metaliteration is related to the ability of students to access, analyze, evaluate, use, and participate critically with various information [3]. Metaliteration focuses on critical and collaborative thinking in the digital age. The metaliteration indicator by Jacobson and Mackey implementing the Internet of Things (IoT) is shown in Table 1.

TABLE 1. Indicators of Metaliterate Thinking

Indicator	Sub-Indicators
Produce	1.1 Analyzing the nature/characteristics of a problem 1.2 Get a breakthrough 1.3 Develop and define stages, phases, syntax, and algorithms
Incorporate	2.1 Identify patterns from solutions 2.2 Generalize patterns 2.3 Integrate outcomes using the Internet of Things' platforms, apps, and software
Use	3.1 Conduct testing/assess the results

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040028-1–040028-12; https://doi.org/10.1063/5.0241487

Indicator	Sub-Indicators
	3.2 Analyze results 3.3 Interpret results 3.4 Apply results
Share	4.1 Using the Internet of Things (Social media, OER, MOOCs, Teaching Platforms) 4.2 Reflect and evaluate feedback 4.3 Evaluate the number of participant responses 4.4 Analyze responses to read trends using the software
Collaborate	5.1 Collaborate with others using the Internet of Things platform 5.2 Enrich the product by asking for some suggestions from others 5.3 Encourage others to do more to contribute findings 5.4 Getting co-works and products to publish 5.5 Defining future work together for the wider society

The metaliteracy ability of students in Indonesia is still relatively low. This is supported by the results of the Program for International Student Assessment (PISA) survey which measures students' literacy skills in reading, mathematics, and science indicating that, although they do not specifically measure metaliteracy, the low PISA results in literacy and science abilities indicate challenges in develop metaliteracy abilities in students [4]. The learning experience of students by giving questions that still rely on conventional approaches and tend to lead directly to solutions and do not fully meet indicators of metaliteracy abilities is something that must be evaluated.

The learning tools used are also something that must be considered in supporting the improvement of metaliteracy abilities. Learning tools that are less interactive and based on contextual problems are also obstacles to increasing students' metaliteracy abilities. One example of mathematical material related to contextual problems is function relation material. Based on the basic competencies that must be understood by students in understanding functional relation material, namely, students can determine a function that includes the area of origin and the result area and apply contextual learning such as applying relational material to the design of stripe batik. In this research, we will introduce the concept of graph coloring in solving function relation problems that are applied to the design of stripe batik. The codomain of a function in the design of stripe batik is the label of the edge set of a graph, the codomain of a function is the weight of the side of a graph coloring while the range of results is all the second ordinates of the ordered set (A, B) contained in the function f. The range of a function in the design of stripe batik can be determined by taking into account the nature of the function, namely the nature of the surjective function if and only if the range f equals B or $f(A) = B$. In this study, creating resources that enhance the effectiveness of learning activities is essential to raising students' metaliteracy abilities.. The development of learning tools is very necessary to meet the availability of materials according to curriculum demands, characteristics, goals, and problem-solving demands [5].

Therefore, the learning process carried out also influences the improvement of students' metaliteracy abilities so that corrective steps are needed in the preparation and implementation of learning tools so that they can meet the complex needs and challenges of modern education through appropriate learning approaches. One approach that can be applied is the STEM approach. STEM represents an interdisciplinary approach that integrates Science, Technology, Engineering, and Mathematics into a problem-based learning framework. According to [6], STEM involves exploring or investigating various knowledge areas through the school curriculum, specifically focusing on these four disciplines. This approach encourages students to engage in both mental and practical activities through problem-solving processes [7]. To implement this effectively, a suitable learning model is required. One such model that fosters problem-solving skills and aligns with the STEM approach is the Research-Based Learning model..

Research-Based Learning (RBL) is a learning model that promotes active learning in both student and educator activities and integrates elements of research into the learning process. According to [8] define Research-Based Learning as a learning model that emphasizes the integration of research activities as a learning process for students by involving knowledge processes and other skills relevant to research activities. [9] stated that Research-Based Learning has advantages, namely in addition to helping students understand the content of learning material, it also provides opportunities for students to practice conducting searches, making hypotheses, collecting and processing data or information, and making conclusions to obtain more complete and in-depth information. [10] also added that Research-Based Learning has benefits for students, such as increasing problem-solving abilities, especially for complex problems, making students more active, and increasing student learning motivation.

This can be proven from the results of research by [11] it was found that learning through the Research-Based Learning model with the STEM approach was proven to be able to increase students' understanding of learning material and students' creativity compared to conventional learning. In addition, research by [12] shows that Research-Based Learning model is recommended in the implementation of education to produce higher student motivation and can improve learning outcomes and be able to apply it in life. Student worksheets, learning outcomes assessments, and learning implementation plans are the types of learning resource which that must be created in this study in order to support the success of a STEM approach activity using a research-based learning model and meet the learning objectives.

RESEARCH METHODS

This type of research is research and development. Development research involves creating or enhancing a product through a systematic process. This process follows the Thiagarajan 4D-Model, which includes defining, designing, developing, and disseminating phases. The study focused on 11th-grade MIPA 8 students at SMA Negeri 1 Jember, aiming to create learning tools using a Research-Based Learning model within a STEM framework. The outcomes of this study include Learning Implementation Plans, Student Worksheets, and pretest and posttest questions..

RESULT

This study produced a mathematics learning tool using the Research-Based Learning model with a STEM approach to the matter of functional relations and its application to the design of stripe batik. The STEM problems in this study include: (1) Science, students understand the problems of striped batik design and can analyze the use of colors so that good and attractive colors are created, (2) Technology, students use the internet to collect information related to things that will be the solution to the problems given, (3) Engineering, students get a breakthrough by using graph coloring techniques to solve coloring problems for design of stripe batik, and (4) Mathematics, students prove the coloring results and interpret them into function relation material by formulating a mathematical function. The resulting learning tools are in the form of Learning Implementation Plans, Student Worksheets, and pretest and posttest questions that contain indicators of metaliteracy abilities. Device development in this study refers to the development of 4D-Model tools consisting of defining, designing, developing, and disseminating.

A STEM-related Research-Based Learning paradigm should be integrated into the final learning resources. Each created learning tool must emphasize elements related to metaliteracy ability indicators to improve students' metaliteracy skills. The next stage involves validation, carried out by three validators: two lecturers from the Mathematics Education Study Program at the Faculty of Teacher Training and Education, Jember University, who are experts in education, and one mathematics teacher from SMA Negeri 1 Jember. Generally, the assessment of these validators indicates that the Learning Implementation Plans, Student Worksheets, and Learning Outcomes Tests can be used with minor revisions. These learning tools are validated before classroom testing to evaluate their practicality and effectiveness in implementing the Research-Based Learning model within the STEM approach. The results of the validation, as well as the practicality and effectiveness summaries obtained during the development of these tools, are described below.

Validity Test

The criteria for the validity of the device are measured from several aspects, namely aspects of format, content and language, and writing. The validation technique used in this study is using Likert scale questions 1 – 4. The results of the validation recapitulation of student response questionnaire sheets from the validators can be seen in Table 2 below.

TABLE 2. Results of Recapitulation Validation of Student Response Questionnaire Sheets

Rated aspect	Average score	Average percentage
Format	3.67	92%
Fill	3.92	98%
Language and Writing	3.83	96%
The average score of all aspects	3.81	95%

The learning implementation plan's format aspect receives an average score of 3.67 and a percentage of 92%, its content aspect receives an average score of 3.92 and a percentage of 98%, and its language and writing aspects receive an average score of 3.83 and a percentage of 96%, while the validation results for the learning implementation plan are summarized in Table 2. The overall average score of the validation of the learning implementation plan is 3.81 and the overall average percentage of the validation is 95%. Based on the validity criteria, the learning implementation plan developed meets the valid criteria, because the average overall validation score is in the range $3,25 \leq V_a < 4$.

The results of the recapitulation of student worksheet validation from the validators can be seen in Table 3 below.

TABLE 3. Student Worksheet Validation Recapitulation Results

Rated aspect	Average score	Average percentage
Format	3.67	92%
Fill	3.67	92%
Language and Writing	3.78	94%
The average score of all aspects	3.70	93%

Based on the recapitulation of the validation results for the student worksheets as shown in Table 3, the format aspect of the student worksheets gets an average score of 3.67 and a percentage of 92%, the content aspect of student worksheets gets an average score of 3 .67 and a percentage of 92% and the language and writing aspects of student worksheets get an average score of 3.78 and a percentage of 94%. The overall average score of student worksheet validation is 3.70 and the overall average percentage of validation is 93%. Based on the validity criteria, the developed student worksheets meet the valid criteria, because the average overall validation score is in the range $3,25 \leq V_a < 4$.

The results of the recapitulation of the learning outcomes test validation from the validators can be seen in Table 4 below.

TABLE 4. Results of Learning Outcomes Test Validation Recapitulation

Rated aspect	Average score	Average percentage
Format	3.67	92%
Fill	3.61	90%
Language and Writing	3.67	92%
The average score of all aspects	3.65	91%

Based on the recapitulation of the validation results for the learning outcomes test as shown in Table 4, the format aspect of the learning outcomes test received an average score of 3.67 and a percentage of 92%, the content aspect of the learning outcomes test received an average score of 3.61 and a percentage of 90% and the language and writing aspects of the learning outcomes test got an average score of 3.67 and a percentage of 92%. The overall average score of the learning outcomes test validation was 3.65 and the overall average percentage of the validation was 91%. Based on the validity criteria, the developed student worksheets meet the valid criteria, because the average overall validation score is in the range $3,25 \leq V_a < 4$.

Practicality Test

The practicality test of this learning device is carried out by analyzing the implementation of the Research-Based Learning model with the STEM approach during learning. The recapitulation of the learning implementation observation results is presented in Table 5 below.

TABLE 5. Recapitulation of Observation Results of Learning Implementation Scores

Rated aspect	Average score	Average percentage
Syntax	3.60	90%
Social System	3.67	92%
Principles of Reaction and Management	3.68	92%
The average score of all aspects	3.65	91%

Based on the summary of the observation results for the learning implementation presented in Table 5, the syntax aspect shows an average score of 3.8 for indicator 1 (I_1) and 3.4 for indicator 2 (I_2), resulting in an overall average score of 3.60 for the syntax aspect (A_1). In the social system aspect, both indicators 1 (I_1) and 2 (I_2) receive an average score of 3.6, while indicator 3 (I_3) scores 3.8, giving an overall average of 3.67 for the social system aspect (A_2). For the principle aspect of reaction and management, indicator 1 ($I1$) and indicator 2 (I_2) each score an average of 4, indicator 3 (I_3) scores 3, indicator 4 (I_4) scores 3.4, and indicator 5 (I_5) scores 4, leading to an overall average score of 3.68 for this aspect (A_3).

The overall average score (SR) of the implementation of learning using Research-Based Learning tools with the STEM approach is 3.65 with a percentage of 91%. Based on practicality criteria with an overall average score of learning implementation in the range $90\% \leq SR \leq 100\%$, then the implementation of learning is in the very good category. Thus, the implementation of a Research-Based Learning model learning with the STEM approach to improve students' metaliteracy abilities can be said to be practical.

Effectiveness Test

Testing the effectiveness of learning tools is obtained by analyzing the completeness of students in working on tests, observation sheets of student activities and the results of student response questionnaires. Data and analysis of the effectiveness of learning devices are explained as follows.

Student Learning Outcomes

Based on the analysis of the student learning outcomes test data, out of 26 students, 22 achieved individual completion while 4 did not. This translates to 85% of students completing and 15% not completing. Since the percentage of students who completed exceeds 80%, it meets the criteria for classical completeness. Therefore, it can be concluded that the students' learning outcomes fulfill classical completeness. The analysis of the learning tools indicates that the developed products are effective.e.

Observation Result of Student Activities

The results of observing student activities were carried out by observers during the learning process. Observations made are measured from several aspects, namely the preliminary aspect, the activity aspect, and the closing aspect. The results of observations made by observers while observing student activities are presented in Table 6 below.

TABLE 6. Recapitulation of Student Activity Observation Scores

Rated aspect	Average score	Average percentage
Introduction	3.70	93%
Core activities	3.70	93%
Closing	3,20	80%
The average score of all aspects	3.53	88%

Indicator 1 receives an average score (I1) of 3.4 and indicator 2 receives an average score (I2) of 4, resulting in an average value for preliminary aspects (A1) of 3.70 based on the summary of the findings from observations of student activities as shown in Table 6 in the preliminary aspect. The average score for indicator 1 in the core activity aspect is 4; the average score for indicator 2 is 3.2; the average score for indicator 3 is 3.8; the average score for indicator 4 is 3.6; the average score for indicator 5 is 4; the average score for indicator 6 is 3.8; and the average score for indicator 7 is 3.4; and the last indicator which is indicator 8, the average value is 3.8. Based on these results, we got the average score of all aspect is 5,53 with 88% in percentage. This value is in effective category, because the average score is in the range $80\% \leq SR < 90\%$ in percentage range. It means that the device RBL based on STEM which is developed is effective to increase the student skill.

Student Response Questionnaire Result

Student responses to the Research-Based Learning learning model through the STEM approach were obtained by using student response questionnaires. The overall percentage, the accumulation for the statement "Yes" is 98%, and for the statement "No" is a percentage of 2%, because the average positive response of students is more than 80% and more than the negative responses of students to the implementation of learning with the Research-Based Learning through the STEM approach, based on effectiveness criteria with the percentage of student responses in the range

$80\% \le P_r \le 100\%$, so that the response of students to learning is in a very positive category and shows that the tools that have been developed are said to be effective.

Test the hypothesis in this study using the paired-sample t-test. The normality test results are presented in Figure 1.

Tests of Normality

	Test	Kolmogorov-Smirnov[a] Statistic	df	Sig.	Shapiro-Wilk Statistic	df	Sig.
Hasil Belajar Siswa	Pre Test	.128	26	.200*	.937	26	.114
	Post Test	.176	26	.038	.942	26	.147

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

FIGURE 1. Normality Test Results

Based on Figure 1 normality test results, the significance value of the pretest data is 0.114 > 0.05 and the significance value of the posttest data is 0.147 > 0.05 so it can be concluded that the data that has been obtained is normally distributed. Furthermore, the paired sample t-test was obtained by entering the pretest and posttest data of the students. The hypothesis will be formulated in the form of a null hypothesis (H_0) and an alternative hypothesis (H_1). The basis for decision-making used is as follows:

1) If the value of Sig. (2 Tailed) < 0.05, reject H_0 and accept H_1, meaning that there is a significant difference between the results of the pretest and posttest.
2) If the value of Sig. (2 Tailed) > 0.05 accept H_0 and reject H_1, meaning that there is no significant difference between the results of the pretest and posttest.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Nilai Pre Test	46.46	26	11.977	2.349
	Nilai Post Test	78.46	26	5.580	1.094

FIGURE 2. Statistics on Paired Samples

The test results in Figure 2 are that the average post-test value is higher than the average pretest value. The average pretest score was 46.46 and then increased to 78.46 on the average posttest score. It can also be seen that a lot of data was included in the pretest and posttest, namely as many as 26 data.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Nilai Pre Test & Nilai Post Test	26	.382	.054

FIGURE 3. Correlation in Paired Samples

The test results in Figure 3 with as many as 26 data, namely the pretest and posttest correlation values of 0.382 > 0.05. This shows that the correlation or relationship between the two average pretest and posttest results is strong and significant.

Paired Samples Test

		Paired Differences Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Nilai Pre Test - Nilai Post Test	-32.000	11.114	2.180	-36.489	-27.511	-14.681	25	.000

FIGURE 4. Paired Samples T-Test Results

The test results in Figure 4 are the probability or Sig value. (2-tailed) is equal to 0.000 with an alpha of 0.05, so 0.000 < 0.05. In this study, a significance level of 95% was used with a 5% probability of error. So that H_0 is rejected and H_1 is accepted, meaning that there is an influence of STEM-based Research-Based Learning devices on student metaliteration. In the posttest results, it was found that the student's scores had increased which indicated that the learning tools that had been developed were able to improve students' metaliteracy abilities.

Before being given treatment, namely the learning process using the Research-Based Learning model with the STEM approach, the results of the pretest scores were analyzed using the score interval for determining the Student Mastery Level (TPS), where there were 0 students in the range with a percentage of 0% having very high metaliteracy abilities, 1 student is in the range with a percentage of 4% having high metaliteracy abilities, 0 students in the range with a percentage of 0% having moderate metaliteracy abilities, 16 students are in the range with a percentage of 62% having sufficient metaliteracy abilities and 9 students in the range with a percentage of 35% having low metaliteration abilities. The following is a graph of the distribution of students' pretest results in Figure 5.

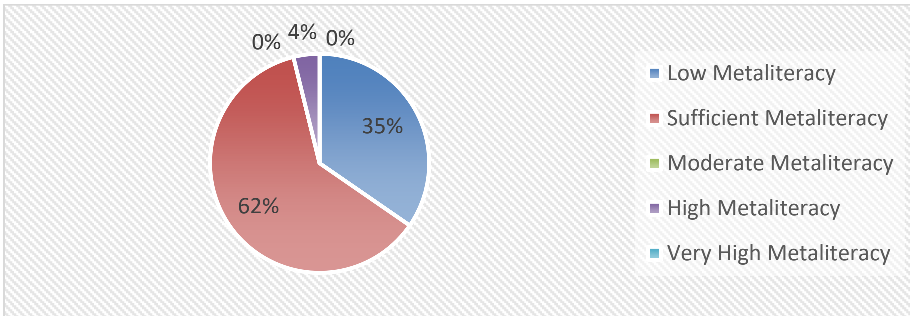

FIGURE 5. Pretest Percentage Graph

After carrying out the pretest and being treated with Research-Based Learning-based worksheets with the STEM approach, a posttest is carried out to find out the final ability of students after participating in learning. The results of the posttest scores were analyzed using interval scores for determining the Student Mastery Level (TPS), where there was 1 student in the range with a percentage of 4% having very high metaliteracy abilities, 9 students are in the range with a percentage of 35% having high metaliteracy abilities, 14 students are in the range with a percentage of 54% having moderate metaliteracy abilities, 2 students in the range with a percentage of 8% having sufficient metaliteracy abilities and 0 students in the range with a percentage of 0% has low metaliteration abilities. The following is a graph of the distribution of students' post-test results in Figure 6.

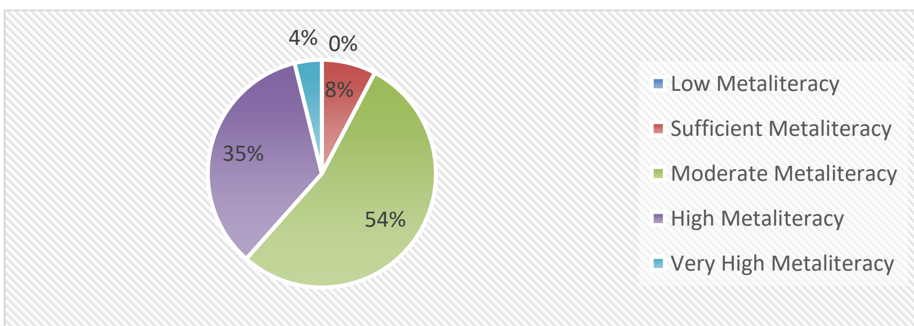

FIGURE 6. Posttest Percentage Graph

Portrait Phase

The portrait phase is a description of the flow of thinking of students in solving problems that are visualized in the form of graphs. Phase portraits are obtained from the results of selecting phase portrait cards by students. These cards contain indicators of metaliteration abilities. The flow of thinking of students' metaliteracy abilities can be seen based on the results of the posttest work and the results of students' work in solving problems in Student Worksheets.

The results of the first student are very high scores posttest criteria. The work of student 1 with a very high metaliteracy category. The results of Student 1's work are presented in Figure 7.

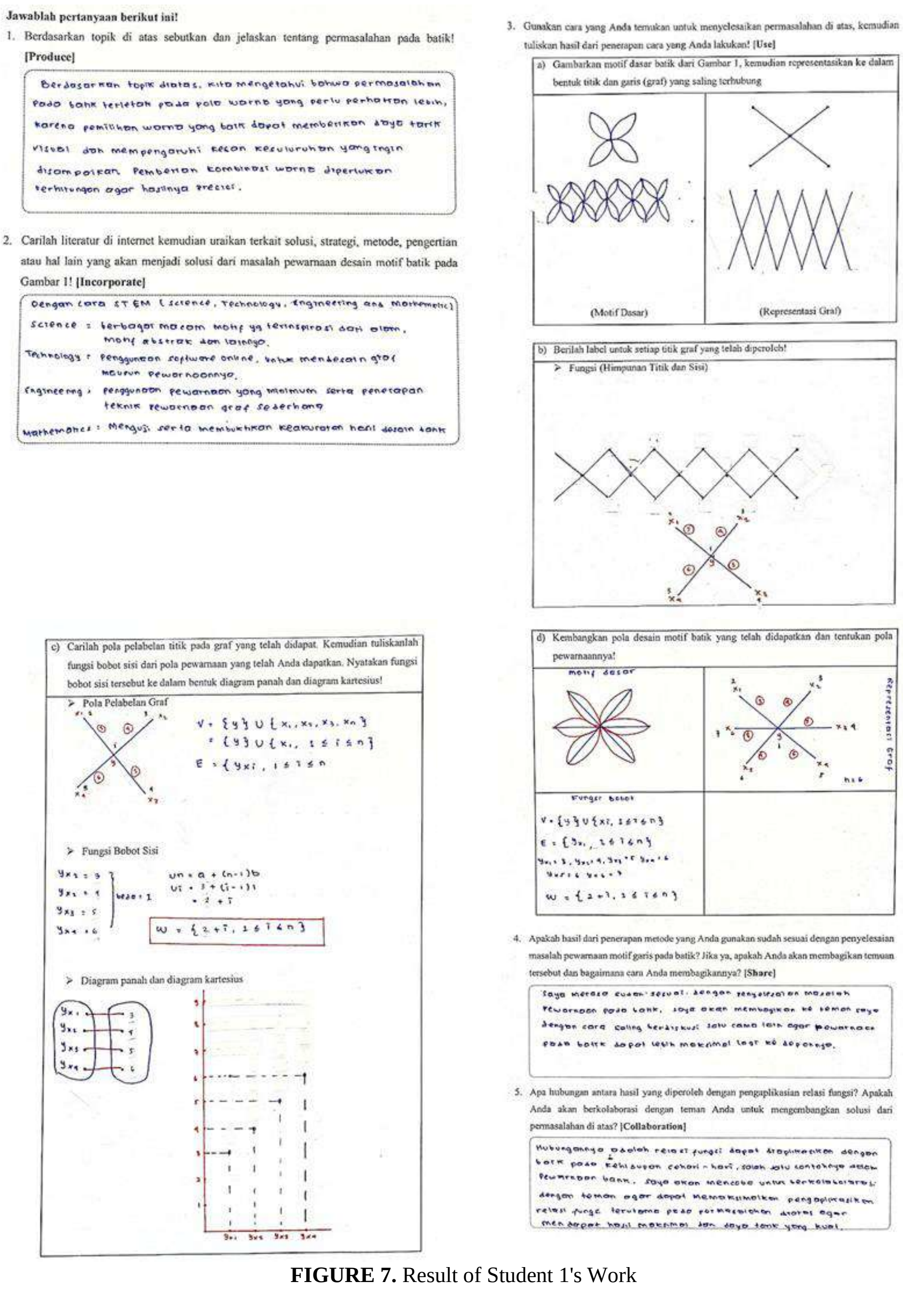

FIGURE 7. Result of Student 1's Work

Posttest results show that student 1 can solve all problems related to the application of functional relations to the coloring of striped batik designs using graph coloring techniques. The following is a representation of the flow of thinking of student 1 with a very high metaliteracy category in the form of a graph.

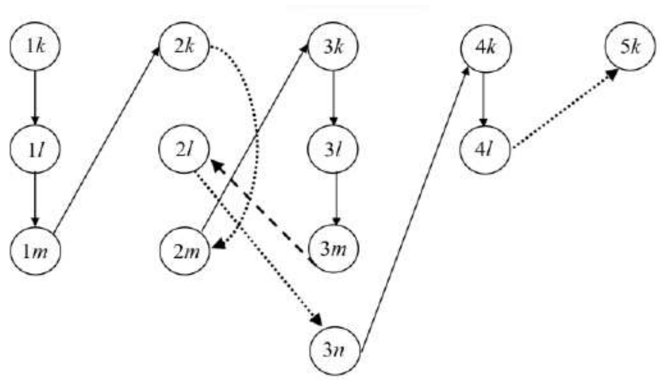

FIGURE 8. Portrait of Student 1's Phase with Very High Metaliteracy

Figure 8 has the provisions that the solid line is the forward flow, the dotted line is the jumping line and the dashed line is the backward line of thought. Students with very high metaliteracy abilities meet 13 sub-indicators of metaliteracy. Furthermore, an analysis was carried out on the flow of thinking of student 1's meta literacy using Total Depth (TD), Mean Depth (MD), and Relative Asymmetry (RA). The benefit of this analysis is to find out the metaliteracy ability of student 1 from a flow configuration perspective. Total Depth (TD) is the total path length of the observed sub-indicators. Based on [13] if the RA value is lower but not negative and is in the range, then the value has a high integrity value or can be categorized as good $0 \leq RA \leq 1$. The sub-indicator that has the lowest RA value is found in sub-indicator 3.2, which is 0.020 so that it can be said that sub-indicator 3.2 has a better RA value than the others. In sub-indicator 3.2, student 1 feels the magnitude of the benefits of solving STEM problems with the design of stripe batik.

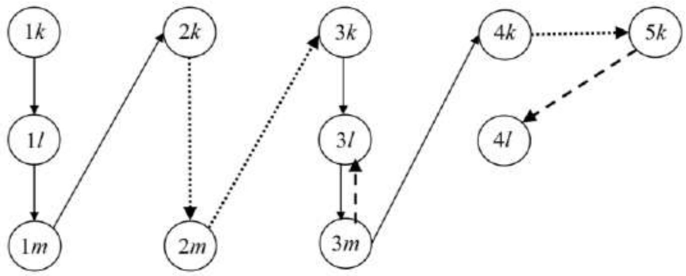

FIGURE 9. Portrait of Student 2's Phase with High Metaliteracy

The results of the second student are with high scores posttest criteria. The posttest results showed that student 2 could solve problems related to the application of functional relations to the coloring of striped batik designs using graph coloring techniques, but student 2 could not apply the results by generalizing the basic pattern of batik motifs. Students with high metaliteracy abilities fulfill 11 sub-indicators of metaliteracy. Furthermore, based on the analysis of the Total Depth (TD), Mean Depth (MD), and Relative Asymmetry (RA) value obtained the sub-indicator that has the lowest RA value is found in sub-indicator 3.2, namely 0.026 so it can be said that sub-indicator 3.2 has a better RA value than the others. In sub-indicator 3.2, student 2 feels the magnitude of the benefits of solving the problems given. Figure 9 is a representation of the flow of thinking of student 2 with a high metaliteracy category in the form of a graph.

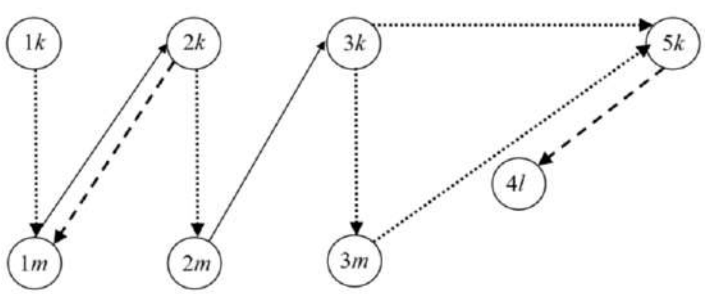

FIGURE 10. Portrait of Student 3's Phase with Moderate Metaliteracy

The results of the third student are the posttest criteria with moderate scores. The results of the posttest showed that student 3 could solve some of the problems related to the application of functional relations to the coloring of striped batik designs using graph coloring techniques, student 3 could not write down the point set, edge set, and formulate side weight functions, and could not apply the results by generalizing batik basic pattern. Students with moderate metaliteracy abilities have fulfilled 8 sub-indicators of metaliteracy. Furthermore, based on the analysis of the Total Depth (TD), Mean Depth (MD), and Relative Asymmetry (RA) value obtained the sub-indicator that has the lowest RA value is found in sub-indicator 4.2, namely 0.033 so it can be said that sub-indicator 4.2 has a better RA value than the others. In sub-indicator 4.2, student 3 feels the magnitude of the benefits of solving the problems given. Figure 10 is a representation of the flow of thinking of student 3 in the moderate metaliteracy category in the form of a graph.

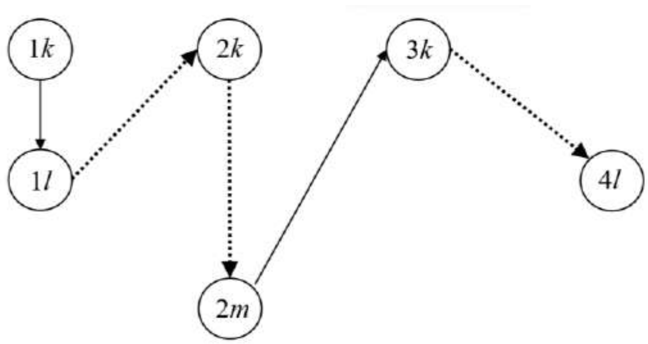

FIGURE 11. Portrait of Student 3's Phase with Low Metaliteracy

The results of the fourth student are with low scores posttest criteria. The results of the posttest showed that student 4 was less able to understand the problems given, such as not being precise when sketching basic batik motifs into graphs, not being careful or not synchronizing what was being analyzed, not being able to formulate side weight functions, and not being able to apply the results by generalizing the basic pattern of batik motifs. Students with low metaliteracy abilities only fulfill 6 sub-indicators of metaliteracy. Furthermore, based on the analysis of Total Depth (TD), and Mean Depth (MD) values, student 4 has a negative Relative Asymmetry value. So, based on [13] the thinking flow of student 4 does not yet have a high integrity value or cannot be categorized as good. Figure 11 is a representation of the flow of thinking of student 4 in the low metaliteracy category in the form of a graph..

DISCUSSION

The development of Research-Based Learning tools with a STEM approach followed the 4D-Model proposed by Thiagarajan. The learning tools created in this study include Learning Implementation Plans (RPP), Student Worksheets (LKPD), and Learning Outcomes Tests (THB). These tools incorporate the syntax of the Research-Based Learning model combined with STEM principles. The student worksheets present group problem-solving tasks, while the learning achievement tests contain questions designed to assess metaliteracy skills individually. The goal of developing these Research-Based Learning tools with a STEM approach is to enhance students' metaliteracy abilities in solving functional relation problems and applying these skills to designing stripe batik. The developed learning tools have been validated and meet the criteria of validity, practicality, and effectiveness as per the evaluations of three validators. This aligns with [14]'s assertion that high-quality research products and learning tools should fulfill these criteria. The validity of the learning tools is confirmed by the scores from the validation sheets reviewed by the three validators. Based on the results of the data analysis of the validation results of learning tools, the lesson plan validation score was 3.81 (95%), Student Worksheets (LKPD) was 3.70 (93%) and Learning Outcomes Tests (THB) was 3.65 (91%). Based on the validity criteria, the learning tools and research instruments meet the valid criteria, because the overall validation score is in the range $3,25 \leq V_a < 4$.

Furthermore, the practicality criteria for learning tools are obtained from the results of the analysis of the implementation of the Research-Based Learning model with the STEM approach during the learning process in the classroom. Observation of learning activities observed by the observer. Based on the results of observing the implementation of learning, a score of 3.65 (91%) was obtained. So that it can be concluded, the implementation of learning is in the very good category because the overall average score of learning implementation is in the range $90\% \leq SR \leq 100\%$. The results of this study also show an increase in student learning outcomes based on test results. The test results showed that of the 26 students who took the test, 22 of them had achieved the school's Minimum Completeness Criteria (KKM), which was 76 out of a maximum total score of 100. The results showed an increase in posttest results.

The next result of this study is a portrait of the students' metaliteration phase. The categories used are four students with very high metaliteracy abilities, high metaliteracy, moderate metaliteracy, and low metaliteracy. The phase portrait description is then analyzed by looking at the RA (Relative Asymmetry) value where the RA value must be within the range $0 \leq RA \leq 1$, with a note that the lower the RA value, the better. Students with very high metaliteracy abilities fulfill 13 sub-indicators with an RA value of 0.020, students with high metaliteracy abilities fulfill 11 sub-indicators with an RA value of 0.026, students with moderate metaliteracy abilities have fulfilled 8 sub-indicators with an RA value of 0.033, while students with low metaliteracy abilities only fulfilled 6 sub-indicators with negative RA values. Based on a comparison of the RA values of the four students, student 1 shows the optimal flow of thinking criteria with a very high metaliteration category.

CONCLUSION

The development of Research-Based Learning tools using the STEM approach to enhance students' metaliteracy abilities has met the criteria for validity, practicality, and effectiveness. The validity was confirmed by the validator team's assessment, with the Learning Implementation Plan (RPP) scoring an average of 3.81, the Student Worksheets (LKPD) averaging 3.70, and the Learning Outcomes Test averaging 3.65. These scores indicate that the learning tools are valid. The practicality of the learning tools was supported by observation data, which showed an average implementation score of 3.65, categorizing the tools as practical.. Based on the practicality criteria, the implementation of the learning model is in the very good category. the results of the study showed an increase in posttest results, the activeness of students in the class of 3.53 (88%) fulfilled the active category and the accumulated percentage of positive responses was 98%, so it can be concluded that the majority of students had a very positive response to learning. Based on the criteria for the effectiveness of learning devices declared effective. Phase portraits were seen from four samples of students representing very high, high, medium, and low metaliteracy categories. Based on the RA value criteria, the lower the RA value, the better. The lowest RA score is owned by students who have very high metaliterate abilities, so this indicates that students with very high metaliterate abilities have the best RA values. This Research-Based Learning model can be applied in modern classrooms that implement student-centered learning, resulting in students becoming more active, creative, and able to think more critically compared to conventional teaching methods. This aligns with a study conducted by [15] that learning in conventional classrooms tends to make students less active and less motivated to cultivate their potential. Furthermore, results of previous studies, such as research by [11] show the results that the application of the Research-Based Learning model with the STEM approach is more effective than conventional learning methods.

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The Effectiveness of Project Based Blended Learning Ecoliteracy E-Module to Improve Environmental Care Character

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Abstract. A major worry in the midst of ongoing technology advancements is environmental care character education. Along with the hope is a stronger sense of responsibility for improving the learning environment for pupils. In actuality, though, the character issue is becoming more complicated, particularly in elementary school. It is becoming more and more troubling that pupils are not more conscious of environmental issues. Students' integration into academic courses is one technique to foster a greater sense of environmental consciousness. In order to raise awareness of the environment, this study employs the E-Module Ecoliteracy, which is based on project-based blended learning. The study approach is quasi-experimental and employs a posttest-only control design type, meaning that not all outside factors influencing the experiment's outcome can be controlled. Students in elementary schools are eager to engage in project-based learning because it allows them to explore their creative potential and collaborative skills. It is impossible to give up on the use of learning technology in the new normal of education; one way that educators can do this is by implementing blended learning models. An average of 79.25 was obtained by the control class posttest value. In the meantime, the experimental class's posttest results showed an average score of 88.45. This demonstrates that, naturally, there is a substantial difference in values between the control group and the experimental group as a result of the teachers', students', and parents' excellent cooperation in using project-based blended learning Ecoliteracy E-Modules.

INDTRODUCTION

The goals of the Sustainable Development Goals (SDG's) were made to answer world demands in overcoming five problems, namely humanity, planet earth, prosperity, peace, and partnerships that are interrelated to one another[1]. When there is a change in human behavior in protecting nature, peace, and the preservation of other living things, then the earth as a place to live will be well preserved. Humans and the environment are two interrelated components. Humans need various resources in the environment to meet their needs, and the environment will be sustainable with human intervention. In the past two years, the COVID-19 pandemic has contributed to the most plastic, medical, and Personal Protective Equipment (PPE) waste, and even increased to the mouth of the Jakarta Bay river, around 46-57% of the total waste found, for PPE alone, it contributes 16%, around 0 .13 tons per day, it is clear that this can harm the ecosystem[2]. According to the Indonesian Institute of Sciences (LIPI) Earth Sciences Deputy, Agus Haryono, revealed that the data shows an increase in plastic waste along with increased online shopping during the pandemic, and plastic waste is not properly processed and so it ends up in the sea[3].

In addition to increasing plastic waste, climate change in Indonesia has an impact on global warming, decreasing the quality of health, agricultural products, and water resources. Maybe not many people understand the relationship between climate change and sustainable development in Indonesia. The Environmental Quality Index (EQI) is a national environmental management performance indicator that might serve as informational resources to aid in the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040029-1–040029-8; https://doi.org/10.1063/5.0242374

policy-making processes pertaining to environmental management and protection. A national environmental management performance index is the national EQI score[4]. Combining the concepts of the Environmental Performance Index (EPI) and the Environmental Quality Index (EQI), EQI serves as a gauge of environmental management in Indonesia. In addition to serving as informational material to support environmental protection and management policy-making processes, EQI can be used to evaluate how well environmental quality improvement programs are performing.

This is a significant issue that needs to be addressed, especially for the family and the field of education. Shifts in personality orientation such as morals, morals, lack of awareness of caring for the environment marked by littering, environmental damage, and air pollution cause inconvenience to live in a society[5]. Various actions that are concerning do not care about cleanliness, for example, the cleanliness of toilets in schools, cannot separate organic and inorganic waste. Waste problems will always be related to human social and economic activities. The increasing number of people with various complexities of economic and social activities results in a lot of waste or waste being produced, such as waste from consumption product packaging made from paper, plastic, cans and Styrofoam[6]. The fact is that waste from consumer product packaging becomes a pollutant for the environment because it is difficult to decompose and takes a relatively long time.

Many researchers have revealed that children are not only victims of climate change but also actors in climate change[7]. Therefore, as a cornerstone of education, parents, educators, and the community must work together to bridge the learning process to implement an environmental curriculum, or Adiwiyata, that fosters environmental stewardship.[8]. So the importance of awareness and changes in caring behavior towards the environment is implemented from an early child.. eds to be introduced to students and integrated into a curriculum. The concept of ecoliteracy includes knowledge, understanding, and skills to participate in the environment[9],[10]. The classroom is the initial place for the formation of habituation of awareness of environmental concern, thus forming an ethic in life[11]. In elementary schools, integrated theme learning can incorporate this habituation. Teachers can provide an initial introduction to habituation and eventually become a character.

The blended learning framework can be utilized for instruction in the new normal era. Because of the demands and advancements in technology that can be incorporated into the teaching and learning process, technology-based learning can't be abandoned, especially in primary schools. With direct involvement by making a project and increasing feedback between teachers and students that blended learning provides a memorable experience for learning about the time and place of learning while doing[12]. Teachers can do mixed learning based on project based learning to produce a skill in utilizing used goods to be useful. This project allows the teacher to monitor its progress by doing it face to face and online[13]. Considering the existing problems and phenomena, project-based blended learning using the Ecoliteration E-Module is expected to increase improve the environmental consciousness of elementary school pupils.

LITERATURE REVIEW

In this section, we will discuss how the concept of project-based learning uses ecoliteracy e-modules to increase the attitude of elementary school pupils toward environmental conservation. There are numerous things teachers in elementary schools may do to help students develop a more environmentally conscious mindset. However, since 21st-century students are more technologically savvy, one approach to meet their needs is through blended learning.

Ecoliteration E-Module for Elementary School STUDENTS

Ecoliteration based on Goleman's perspective includes 1) developing empathy for every aspect of life, 2) practicing survival as a shared activity in groups, 3) increasing the visibility of what is seen, 4) foreseeing unexpected effects, 5) Being aware of how life naturally occurs[14]. Based on this understanding, it can be said that ecoliteracy is not just understanding the environment, but having a sense of empathy and acting directly on the environment. The results of the study prove that by using the ecoliteracy understanding module students increase so that it can be implemented in everyday life[15]. The existence of teaching modules can make learning more effective and efficient so that practical learning concepts can be carried out anytime and anywhere[16]. Teachers can carry out learning using modules that can be uploaded to the LMS or the learning platform used to facilitate students' independent study [17]. Learning by using the E-Module student creativity is growing and learning collaboratively becomes an integral part so it can motivate students to participate more fully in their educational experiences [18]. E-Module Ecoliteracy is a form of innovation in the development Many instructional resources that teachers can use in the blended learning approach [19]. Teachers can also provide E-Modules based on Students are encouraged to observe, formulate questions, propose/formulate hypotheses, gather data using a variety of methodologies, analyze data, draw conclusions, and convey facts utilizing information from a variety of sources to develop their environmental literacy through a scientific approach[20].

Environmental Care Character

The process of transforming an individual from their family, school, and social life is known as character education. [21]. The process of transforming an individual from their family, school, and social life is known as character education. Elementary school age needs special attention to character building and the many factors and dimensions that can improve children's character [22]. When learning during COVID-19 teachers find it difficult to internalize and implement character values, this issue arises since teachers have become used to dealing with students in person when learning takes place online. The teachers revealed that the curriculum was considered inappropriate for character development because they were still confused regarding the curriculum's implementation in primary schools' subject learning [21]. Educator resources are a determinant of achieving character education for every school that applies it in various ways to character education programs in schools[23]. Character education can still be implemented virtually or online learning through aspects of habituation, integration, and imitation that teachers can convey in the learning process both both in person and virtually with the use of instructional resources or modules [24]. Character education can also be implemented by teachers to students integrated with lessons in elementary schools thematically by using appropriate learning strategies and models[25]. Seeing the phenomenon of the decline in the character of students, one of which is caring for the environment, has become one of the focuses of various studies conducted. Schools can integrate environmental care character education through the ADIWIYATA program[26]. Ecological education is urgently needed in order to hone the sensitivity of students with an awareness of the existence of the environment as part of an ecosystem that influences sustainable life[10]. Environmental care character education can be carried out in collaboration at schools and also, of course, with the support of the community and parents who exemplify the positive habit of protecting and caring for the environment[7].

Project-Based Blended Learning

Looking at the characteristics of 21st-century students, they tend to be close to technology. So as educators should be able to understand how. There are appropriate strategies for learning in the 4.0 era. learning using the Project Based Blended Learning (PJB2L) model requires an integrated online learning processing system such as a Learning Management System (LMS) or other device platforms that can support learning[27]. After learning is carried out face to face, then the students carry out activities to complete the project by monitoring the teacher through the LMS, the following is a login image for the LMS and the student activity menu:

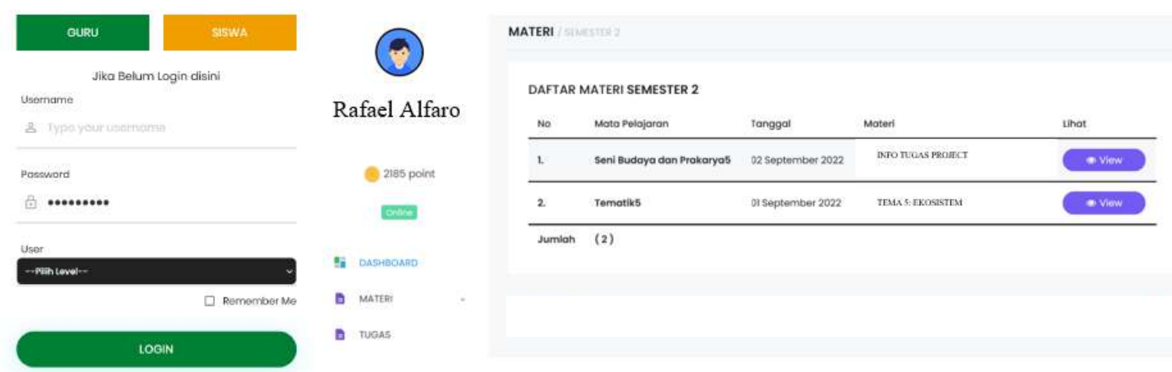

FIGURE 1: Display when logged in LMS and Lesson Materials

PjB2L learning process activities combine project-based learning and online learning, both synchronous and asynchronous. In the initial stage, the teacher gives orientation to the problem which is carried out face-to-face in class and then students construct it. It is expected of students to solve challenges actively and creatively, finding solutions with a project, of course by collaborating between teachers and students and students with students, as well as students and parents[28]. The research findings prove that using Through knowledge exchange and interactive discussion activities, the project-based blended learning paradigm can help students become more proficient academically..[29]. As a result, the researcher wishes to investigate in greater detail how the Ecoliteracy E-Module project-based blended learning paradigm might enhance primary school students' environmental consciousness.

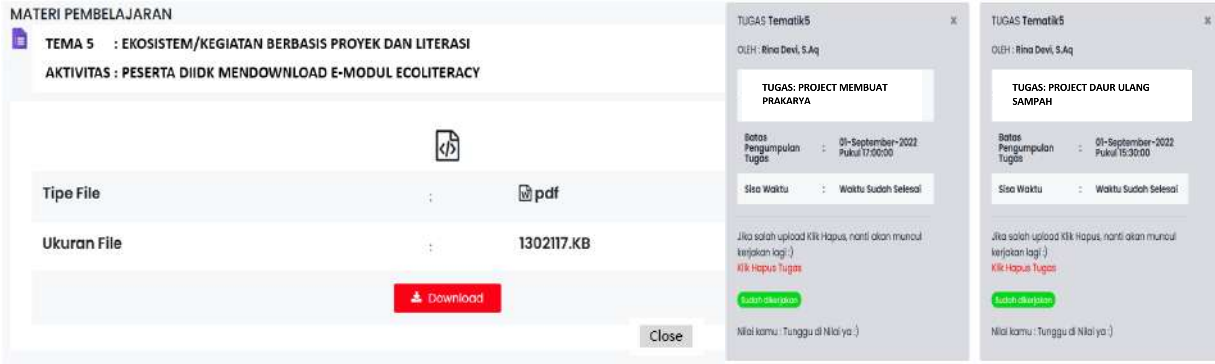

FIGURE 2: Student Activities Download E-Module Ecoliteracy

METHODOLOGY

The researcher's study is a quantitative experiment that employs a quasi-experimental research methodology and a posttest-only control design type, meaning that not all outside factors that could influence the experiment's outcome are under the researcher's control. The samples used in this investigation were divided into two groups: the experimental class and the control class. The learning experimental class employed a project-based blended learning methodology based on E-Module Ekoliteracy, whereas the control class received instruction using traditional methods. With a posttest-only control design, the experimental class and the control class will be subjected to this sort of quasi-experimental study design.

TABLE 1: Research design

Group	Treatment	Post-test
Experiment	X	0_1
Control class	-	0_2

Explanation:

0_1 : After utilizing the project-based blended learning framework based on the Ecoliteracy E-Module, the experimental group took a post-test.

0_2 : post-test in the control group following their engagement with traditional teaching techniques.

X : The Ecoliteracy E-Module-based project-based blended learning paradigm was used to teach the experimental group's therapy.

\- : Conventional techniques of instruction are used to provide treatment to the control group.

Population and Research Sample

There were 58 students in the study's population, 30 of whom were in the VA class and 28 of whom were elementary school kids in the VB class. This study's sample is drawn from the total population. This study's sample strategy employed a non-probability sampling approach. According to the saturated sampling method's criterion of non-probability sampling, 58 samples were student[30].

Instrument Test Analysis

Examine the validity of the 30 students that responded and the 10 things in the questions. The computed value for 30 students, or n = 30, at a significant level of 5% is 0.361, according to the computation findings. At a significance level of 5%, the product-moment correlation coefficient value, or 0.361, is compared to the product-moment correlation r value for n = 30. The clauses that are determined to be legitimate in each item are $r_{count} > r_{table}$.

TABLE 2: Validity Test Results

Classification	Number of Questions	Item Number
Valid	8	1, 2, 3, 5, 7, 8, 9, 10
Invalid	2	4, 6

Eight valid questions and two invalid questions made up the classification of the validity test items from the ten questions assessed, according to the table. Six questions were utilized in this study by the researchers in order to minimize the workload for blended learning students. The purpose of this reliability test is to evaluate the consistency of an instrument that may be used in any class V or in several schools with largely consistent findings. Once the questions that are already legitimate are known, the reliability test is conducted. The researcher uses the Alpha Cronbach algorithm to determine the instrument's reliability test after determining that there are eight legitimate questions. As a measurement instrument, reliability characterizes how accurately test takers answer the questions, the if $r_{count} > r_{table}$. After performing calculations using the Alpha Cronbach formula, the rcount value is obtained as follows:

TABLE 3: Reliability Test Results

Calculated r_{count}	r_{table} value	Explanation
0,697	n = 30 α = 0,05 0,361	$r_{count} > r_{table}$ Reliable Instrument

After doing the calculations, the results were obtained which concluded that $r_{value} = 0.697$. r_{table} at α 0.05. n = 30 of 0.361. $r_{count} = 0.697 > 0.361$ r_{table}. In light of this, the environmental care character instrument is rated as "Reliable," meaning it is very dependable and appropriate for use as an evaluation tool.

After that, the experimental Classes Data Normality Test results. After doing the calculations obtained a Lcount of 0.1460. When compared with the Liliefors table at a significant level α = 0.05 and n = 30, Ltable = 0.1618 (See the table of moment product r values in Appendix 21 page 165). Thus H0 is accepted because of Lcount < Ltable, namely 0.1460 <0.1618. In summary, the data from the group being studied is derived from a population that is regularly dispersed.

TABLE 4: Normality Results of Test Calculation

Class	n	Lcount (Lo)	Ltable (Lt)	Criteria	Explanation
Control Class	28	0,1509	0,1674	Lo < Lt	Normal Distributed Data
Experiment Class	30	0,1460	0,1618	Lo < Lt	Normal Distributed Data

Next is the calculation of the homogeneity test. Data from the experimental class and control class were acquired, S12 = 56.602 and S22 = 48.935 with a significant level α = 0.05 with dk quantifier = 30-1 = 29 and dk denominator = 28-1 = 27. Then α = (0, 05, 29, 27) Price Ftable = 1.891.

Fcount is less than Ftable, 1.157 <1.891, therefore it may be said that H0, which states that the variances of the two groups are homogeneous, is accepted.

TABLE 5: Homogeneity Test Calculation Results

Group	n	Variant	Fcount (Fh)	Ftable (Ft)	Criteria	Explanation
Experiment Class Control Class	30 28	56,602 48,935	1,157	1,891	Fh < Ft	Data Sampel Homogen

The price of the ttable is 2.003, as can be seen from the t-test calculation in the table, which utilizes a significant level of α = 0.05 with dk = 58, dk = 58 – 2 = 56. Tcount, however, is 3.514. Then, 3.514 > 2.003, or tcount > ttable. Thus, H0 is rejected and H1 is accepted based on the test criteria.

TABLE 6: Hypothesis Test Calculation Results

T_{count}	t_{table}	Synopsis
3,514	(α = 0,05), dk = 56, 2,003	$t_{count} \neq t_{table}$ Rejecting H0 with the conclusion Effectiveness of using PJB2L-based Ecoliteracy E-Modules to cultivate in primary school pupils a spirit of environmental consciousness

Based on the graph in Figure 4, the average pretest and posttest values between the experimental and control classes demonstrate that the experimental class's values are higher than the control class's. These findings show that, with a difference for the posttest of 70.40, the two classes' final abilities are different. The graph illustrates how the experimental class differs from the control class in the following ways.

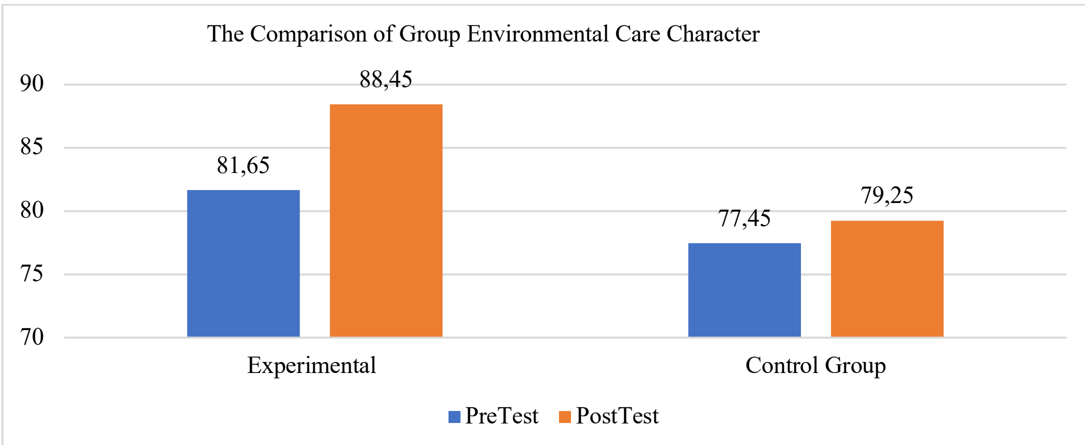

FIGURE 4: Student Activities Download E-Module Ecoliteracy

CONCLUSION

This research shows that employing the Ecoliteracy E-Module is a very effective way to assist primary school children develop a more environmentally conscious character. Teachers and students alike greatly benefit from the process of implementing learning through modules, particularly when learning is done through the project-based blended learning approach. Particularly in Indonesia, this concept has not been extensively implemented in elementary schools. The E-Module that students can utilize in blended learning can help teachers supervise student projects more easily, while many teachers find it challenging to do so. Through the competency achievement of 21st-century students, project-based learning will help students build their critical and creative thinking abilities as well as their ability to collaborate in groups. The control class value was derived from an[31]. Since they were born into an era of advanced technology, elementary school students are highly excited about using technology for learning. Thus, students in elementary schools employ technology-based learning or blended learning models extremely successfully, but this cannot be done without parental supervision. Additional research indicates that students in elementary schools today prefer to complete tasks through integrated learning[32].

ACKNOWLEDGMENTS

The researcher expresses gratitude to everyone who made this research possible. praising elementary school students, instructors, principals, and lecturers for their outstanding assistance and collaboration. It requires time to conduct further research related to environmentally conscious learning using a project-based blended learning model, for this reason, the researcher hopes for further research.

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Integrating Entrepreneurship into Mathematics Learning on Students' Mathematical Literacy Ability: A Mixed Method Study

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Abstract. This research is a mixed method research that aims to determine the mathematical literacy skills of students after being given entrepreneurship integrated mathematics learning through LKPD to further analyze how students' mathematical literacy skills. The research instruments used in this research are test instruments (Mathematical literacy test instrument) and non-test instruments (Student attitude observation sheet, student response questionnaire, and interview guidelines). The research method used is mixed methods using sequential explanatory design where the research is conducted in two stages, namely quantitative research by testing mathematical literacy skills after being taught with entrepreneurship integrated mathematics learning through LKPD and then will continue with the analysis of mathematical literacy skills. The quantitative research took a sample of seventh grade students of SMPN 1 Rengasdengklok, while the qualitative research took the research subjects of seven students from the class. After the students of the class received the learning and took the algebra ability test, it was found that the use of entrepreneurship-integrated mathematics learning through LKPD helped students achieve mastery in the mathematical literacy ability test on mathematics has an influence on the level of mathematical literacy ability possessed.

INTRODUCTION

The optimal mathematical literacy skills must be possessed by students as a provision in solving problems both in learning and in everyday life. Reasoning mathematically and using mathematical concepts, procedures, facts, and tools in explaining and predicting phenomena help one recognize the role of mathematics in the world and make the judgments and decisions needed as citizens(Johar, 2012; OECD, 2012; Stecey & Tunner, 2015). However, the facts in the field based on interviews from several vocational teachers show, that students' ability to solve problems is still relatively low. Judging from the students, 75% of students have not been able to convert real problems into mathematical models to look for solutions, creative ideas and publications, conceptual and problem solving. This means that the literacy skills possessed by students are not optimal.

Mathematical literacy skill is related to the entrepreneurial spirit of students. Entrepreneurship is a person's ability that is cored in creative thinking and innovative actions that are used as the basis and resources to solve problems and create opportunities to achieve success in business or life.(Drucker, 1994; Suryana, 2013; Zimmerer & Scarborough, 1996). Entrepreneurship can simply be interpreted as trading but in reality it is far more complex than that because that, entrepreneurship is an activity that is accompanied by innovation and creation and adds value to an object, For example if a person's used drink is then modified into a pencil case, then he actually already has an entrepreneurial spirit because has added the value of an object, or someone who does the activity of making bags from used coffee shells, in fact, he has also added the value of an item. According to Marques and Albuquerque in entrepreneurship, a person must have three abilities, namely basic abilities, the ability to build relationships with other people, and conceptual abilities.(Marques & Albuquerque, 2012). Based on these abilities, it can be said that mathematical literacy skills are intertwined with the entrepreneurial spirit.

Teachers play an important role in efforts to form an entrepreneurial spirit. Several things need to be done so that teachers can optimize their mathematical literacy skills and entrepreneurial spirit as follows: 1) Looking for themes or materials that are closely related to the business world so that they can be well correlated in the learning process;

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040030-1–040030-8; https://doi.org/10.1063/5.0241655
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

2) Doing good planning by involving other teachers so that the learning can run well; and 3) Creating teaching materials that can provide students with an understanding of the entrepreneurial spirit. one way to optimize mathematical literacy skills and entrepreneurial spirit is through the use of teaching materials. The teaching materials contain knowledge, skills and even include attitudes that students must understand to achieve predetermined competency standards [8].

The teaching materials used in this study were entrepreneurship-based mathematics learning materials which were made to assist students in learning mathematical literacy skills independently. Therefore, researchers are interested in trying these teaching materials for students. The purpose of this study was to determine the achievement and description of mathematical literacy skills using entrepreneurship-oriented LKPD-assisted mathematics learning. To this end, the following research questions were examined: a) Is the achievement of mathematical literacy skills with Entrepreneurship Oriented Student Worksheet Assisted Mathematics Learning (LKPD) better than that with conventional worksheet? and; b) How is mathematical literacy skill with Entrepreneurship Oriented Student Worksheet Assisted Mathematics Learning (LKPD) ?

RESEARCH METHOD

Mixed methods is expressed as a combination of quantitative and qualitative approaches of study methods(Tashakkori, A., & Teddlie, 1998). Mixed method is a method of collecting qualitative and quantitative data in a study and analyzing the data according to its importance (Creswell, 2003a). In this way, researchers can better explain the information obtained from the experimental process by collecting qualitative data in addition to experimental studies(Plano Clark, V. L., & Creswell, 2015). The method in this research is a quantitative research design (Mixed Method Design) with sequential explanatory design model. The instruments used were observation sheet; entrepreneurship level questionnaire and mathematical literacy test questions. Data analysis with the following stages. The first stage is to analyze qualitative data to produce learning design and learning process and the process of using learning design. The second stage is quantitative data analysis to determine the effectiveness of the use of learning that integrates entrepreneurship into mathematics learning through student worksheets (LKPD).

In the sequential explanatory research design, quantitative methods play a role in obtaining measurable quantitative data that can be descriptive, comparative and associative. Qualitative methods play a role in proving, deepening, expanding, weakening and invalidating quantitative data that has been obtained at an early stage. The following is a picture of the research in the Sequential Explanatory Design model.

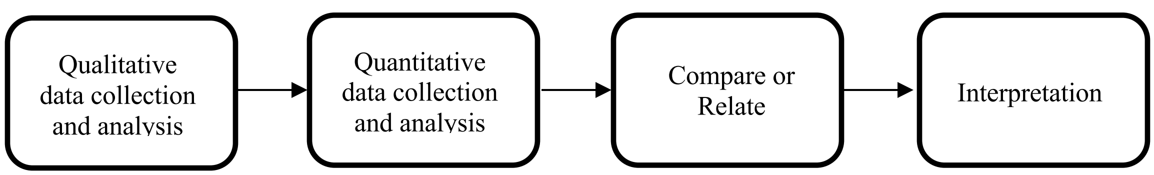

FIGURE 1. Sequential Explanatory Design (Creswell, 2003b)

The research was conducted in two stages: first, quantitatively, and then qualitatively. Students' mathematical literacy skills after the entrepreneurship-integrated mathematics learning was the target of this quantitative study. The students were then divided into three categories based on their mathematical literacy scores. Based on the math literacy test scores of the three groups. Students in the first group, students in the second group, and students in the third group constituted the bottom group. Students in the first group, students in the second group, and students in the third group form the bottom group. Students' mathematical literacy test scores form the basis of this categorization, which is based on a ranking system.

2.1 Quantitative Research Methods

In this study, the approach used was a quantitative approach with a quasi-experimental type. The population in this study were all seventh grade students of SMPN 1 Rengasdengklok which amounted to 240 students. While the samples in this study were students of class VII-A as the experimental class and class VII-C as the control class, each totaling 30 students. Sampling was done using purposive sampling technique. Sampling. Data collection techniques in this study were carried out using the test method. The test method was used to obtain data on students' mathematical literacy skills in learning mathematics before and after being treated. While the instrument used is a mathematical literacy test question in the form of a description question and consists of 8 items. This test question is prepared based on indicators of mathematical literacy skills. The test questions given to the experimental class were the same as those given to the control class.

Data analysis techniques are carried out in two stages, namely initial data analysis and final data analysis. The final stage. Initial data analysis was carried out to test the pretest results data which consisted of a normality test, homogeneity test, and mean similarity test. normality test, homogeneity test, and mean similarity test. While the final stage data analysis was carried out to test the posttest data which also consisted of normality test, homogeneity test, and hypothesis testing.

2.2 Qualitative Research Methods

The qualitative research subjects in this study were students of students of class VII who were then given treatment in the form of learning with entrepreneurship-integrated mathematics learning to determine students' mathematical literacy skills. While the research subjects of qualitative research are three students from one of the VIIII classes that are known in advance characteristics. The object of research is determined based on the initial ability test score students' mathematics initial ability test scores. In learning mathematics, the initial ability of students will also affect student success. Interviews were conducted by taking 6 students from each class who were selected based on the results of the literacy ability test and grouped into three criteria, namely students with high, medium, and low mathematical reasoning abilities. While the object of research is integrating Entrepreneurship into Mathematics Learning through Learner Worksheets (LKPD).

Qualitative data collection techniques used for data collection in this study are non-test methods. The non-test methods used are observation, interviews and field notes. According to Sugiyono (2015: 336), data analysis in qualitative research is carried out since before entering the field, during the field, and after completion in the field. However, in qualitative research, data analysis is more focused during the field process along with data collection. In this study, data credibility testing was carried out using triangulation techniques with methods, which means comparing and checking both the degree of trust in information obtained through different times and tools in qualitative research.

RESULT AND DISCUSSION

The quantitative and qualitative data collected during the research process were analyzed according to the research problem and the findings obtained. The quantitative findings are shown in the table of statistical test results. Qualitative findings were obtained from the results of the questionnaire and the level of entrepreneurial spirit.

a. Is the achievement of mathematical literacy skills with Entrepreneurship Oriented Student Worksheet Assisted Mathematics Learning (LKPD) better than that with conventional worksheet ?

TABLE 1. Descriptive Pretest and Posttest Data on Mathematical Literacy Ability in Both Classes

Value	Pretest	Postestt
$\bar{x}$	53,20	79,40
S	8,069	13,578
Max.	70	99
Min.	38	55

Table 1 above shows The results of the recapitulation of pretest and posttest data using the SPSS application, the maximum value of the pretest was 70 and the minimum value was 38. Meanwhile, the maximum posttest value is 99 and the minimum value is 55. The average pretest score was 53.20 and the postest score was 79.40. Standard deviation pretest was 8.069 and postest was 13.57. This means that the distribution of the final mathematical literacy skill of class students who acquire learning LKPD-assisted math entrepreneurship oriented more spread out than classes that receive conventional learning.

TABLE 2. Normality Test Result

Tests of Normality						
	Kolmogorov-Smirnova			**Shapiro-Wilk**		
	Statistics	df	Sig.	Statistics	df	Sig.
Pretest	.092	45	.200*	.980	45	.615
Posttest	.084	45	.200*	.973	45	.362
a. Lilliefors Significance Correction						
*. This is a lower bound of the true significance.						

Based on the Kolmogorov-Smirnov test in Table 2 above, a significant value was obtained for mathematical critical thinking skills in the class that received learning mathematic assisted by LKPD entrepreneurship oriented Sig. = 0.200 then H0 is accepted, meaning that the sample comes from a normally distributed population. While in the class that received conventional learning, the significance value was 0.200 > , then H0 was accepted, meaning that the sample came from a normally distributed population. Because both classes are normally distributed, the homogeneity test is continued$\alpha = 0{,}05$

TABLE 3. Test of Homogeneity of Posttest Scores of Mathematical Literacy Skill Experiment Class and Control Class

Test of Homogeneity of Variances			
Combined posttest experiment control			
Levene Statistics	df1	df2	Sig.
6.318	1	89	.014

In the table 3 above, it is known that the significance value is 0.014. The significance value is 0.014 <0.05 so that based on the test criteria then H0 is rejected in other wordsthe normalized variance of the data gain of students who receive mathematics learning assisted by LKPD entrepreneurship oriented and students who get homogeneous conventional learning.

TABLE 4. Independent Sample T-Test for Control and Experimental Group Equivalence

T-Test For Equality Of Means								
							95% Confidence Interval of the Difference	
		T	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**Lower**	**Upper**
Combined Posttest Experiment Control	Equal variances assumed	2.108	89	.038	2.67150	1.26707	.15386	5.18914
	Equal variances not assumed	2.116	81.860	.037	2.67150	1.26262	.15968	5.18332

Based on the results of the Independent Sample T-Test with the value of 0.019 <0.05 then based on the criteria for testing the hypothesis H0 is rejected, meaning that the mathematical literacy skill of students who get learning LKPD-assisted math entrepreneurship oriented better than students who get conventional learning. The predetermined KKM is 76. Hypothesis testing was conducted to determine whether the proportion of students whose mathematical literacy mathematical literacy skills more than the KKM in entrepreneurship integrated mathematics learning is more than or equal to 85%. To test this, the z test was used to test the proportion (π) of students' mathematical literacy skills in the research class. research class. The proportion test used is the left party test.

TABLE 5. Hypothesis Testing

Z_{count}	Significance level	$-Z_{tabel}$	Conclusion	Description
0,81	0,05	-1,84	$Z_{count} > Z_{tabel}$	Percentage of completeness ability test results literacy mathematical thinking ability of students in learning mathematics learning integrated with entrepreneurship is less than 85%

b. Overview of Achievement of Mathematical Literacy Skills with Entrepreneurship-Oriented Mathematics Learning Assisted Student Worksheets (LKPD)

Since this research uses a mixed research design, the next step is to see and analyze the use of entrepreneurship-oriented assisted mathematics LKPD on mathematical literacy skills. Learning took place for eight meetings, where at the end of each lesson a mathematical literacy test was given with the intention of seeing the entrepreneurial-oriented Learner Worksheet (LKPD) at each meeting. Before the learning and research began, the researcher first explained about mathematics learning assisted by Entrepreneurship-Oriented Learner Worksheets (LKPD). The next step is followed by providing teaching materials that students can learn during the learning process.

Data documented in the form of written test results to measure mathematical literacy skills for eight meetings, then analyzed and further converted into qualitative data to see the mathematical literacy skills of each student. When compared to the level of mathematical literacy before learning, the level of mathematical literacy of students after learning entrepreneurship integrated mathematics is significantly higher. A statistically significant increase from the previous mean score of 53.20 on the mathematical literacy assessment was seen in students taught with entrepreneurship-integrated mathematics learning, whose score reached 79.40. The applied entrepreneurship-integrated mathematics learning received very favorable comments from the students. A total of 87.96% of students gave positive feedback on the learning and learning materials used. The learning and resources used were well received by the students as evident from their comments. The students were categorized into three groups: high, medium and low based on the mathematical literacy test analysis results.

TABLE 6. Mathematical literacy skill table on math learning Entrepreneurship Oriented Student Worksheet (LKPD)

No	Grouping Criteria	Category	Number of Students
1	Value ≥ 61	High	13
2	45 ≥ Value ≥ 61	Medium	12
3	Value < 45	Low	5

From Table 6 above, it can be seen that from 30 students there are 13 students who achieve very high mathematical literacy ability is high, 12 people are in the medium category and 5 people are in the high category. The next step is to describe the results of the scores or scores from the mathematical literacy indicator test for eight meetings using mathematics learning Entrepreneurship Oriented Student Worksheet (LKPD). This is to reinforce the assumption that with Entrepreneurship Oriented Student Worksheet (LKPD). It is an achievement academic prowess is better when compared to conventional. To see an overview mathematical literacy skills of students who use mathematics learning Entrepreneurship Oriented Student Worksheet (LKPD). After learning, a test is given to measure mathematical literacy skills. The results of the description of students' mathematical literacy skills for eight meetings are as follows:

TABLE 7. Mathematical Literacy Skill Table On Math Learning Entrepreneurship Oriented Student Worksheet (LKPD)

No	Mathematical Literacy Indicator	Skill	Meeting-							Average Final score
			1	2	3	4	5	6	7	

1	the ability to formulate real problems in understanding the problem	67.28	70.52	70.66	75.66	81.38	80.52	78.79	74,299
2	the ability to use mathematics to create problem-solving plans	68,288	70.52	79.66	75.69	71.38	70.52	78.79	74.564
3	the ability to interpret solutions in carrying out problem solving plans	66.21	66.72	74.14	76.38	75.86	76.38	73.28	72,738
	Average	67,259	69.253	74,820	75,910	73,620	75.807	76,953	77.083

Occurrence for each indicator of mathematical literacy skill during learning entrepreneurship-oriented mathematics assisted student worksheet (LKPD) can be seen in Table 7 above. The final score is obtained by calculating the average score of all indicator students and each meeting, which is then divided by the maximum score and the result is multiplied by 100. Thus, the overall average score of mathematical literacy skill is 77.08. Students' mathematical literacy in statistical material with learning Entrepreneurship-Oriented Mathematics Assisted Student Worksheet (LKPD) is high. In statistical material, it focuses more on problems-optimization problems in industry, banking, education, and other problems that can be expressed in the form of everyday life. The following table shows the average levels of mathematical literacy among students in three groups: low, medium, and high, as measured by entrepreneurial mathematics learning through LKPD.

TABLE 8. Mathematical Literacy Test Results Based on Student Grouping

Student Group	**Number of students**	**Many students reached the literacy level**					
		Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Low	3	3	3	1	-	-	-
Medium	16	16	16	7	9	-	-
High	11	11	11	11	11	11	11

The difficulty of the questions is varied between the levels. Due to the easy nature of the questions, pupils at levels 1 and 2 have no trouble. The ability to organize pertinent material and provide general context in response to inquiries is level 1 mathematical literacy. At the second level of mathematical literacy, however, one can solve simple algorithms and provide clear explanations. Data interpretation from several sources was a challenge for students at the third level of mathematical literacy. When solving systems of linear equations, students often struggle with using the graph technique. This stems from interview data collected from students who are unfamiliar with graph analysis. Because they aren't accustomed to drawing conclusions and solving difficulties based on mathematical problems extracted from real-world scenarios in line with context, pupils at levels 4 and 5 struggle with problem analysis. None of the students with lower or medium abilities were able to complete the most difficult level, level 6. According to the above explanation, low-income populations' mathematical literacy skills are improved through entrepreneurship-integrated mathematics instruction through LKPD. Even though they are only at level 3, students are able to handle challenges that are relevant to the actual world. Levels 4, 5, and 6 all present challenges for pupils to overcome; among these, the most fundamental is the one involving problem analysis. The level has a direct correlation to the level of the results. The reason behind this is that students typically deal with practical calculations and are not well-versed in problems that necessitate reasoning to solve. Furthermore, pupils have a hard time analyzing story problems when they look at the problem form. Students' ability to read, translate, and understand texts is consistent with the indications of mathematical literacy, which are communication skills (Sumarto et al., n.d.).

Entrepreneurship-oriented student worksheets contain indicators of entrepreneurial character. To be competent as an entrepreneur is to possess all the traits, knowledge, and skills that are necessary for the venture to be a success. The capacity to build new businesses and bring practical ideas to fruition in development is part of this, as is the ability to communicate effectively, organize one's work, manage projects, take risks, and be vulnerable (Bikse & Riemere, 2013). In the activity of answering questions to develop independently and communicatively. Prastowo explained that the LKPD is a sheet containing tasks that support mastery of the material and can train students' independence(Prastowo, 2012). Cooperation to answer questions can improve communicativeness in students (Farkhati, A. dan Sumarti, 2019). Activities to design and make products develop creatively and innovatively. In designing and creating projects, students are not only able to acquire science content but are also able to express creative and innovative thinking skills through scientific knowledge (Amir, N. dan Subramaniam, n.d.). The activity of testing products that have been made refers to the indicators of being willing to take risks. This is in accordance with the statement of Ulfiatun et al. that the ability to dare to take risks can be developed through the manufacture of products with various kinds of risks to be faced. Then the "Let's Sell Your Product" activity on Instagram is used to develop self-confidence. Zulaidah's research (Ulfiatun, Dewi, N. R. dan Kusniati, 2017) reports thatand product sales activities can develop self-confidence.

CONCLUSION

Based on the stages of research activities that have been carried out by researchers, it can be concluded that there are 1) the achievement of students' mathematical literacy skills obtained by learning entrepreneurship-oriented mathematics assisted student worksheet (LKPD) higher than those using conventional learning; 2) students' mathematical literacy in learning entrepreneurship-oriented mathematics assisted student Worksheet (LKPD)are in high criteria

ACKNOWLEDGMENT

The authors would like to express their gratitude to the Rector of Singaperbangsa University of Karawang through LPPM for facilitating the research and providing funding for the research up to the completion of this study.

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Development of Learning Applications on Mobile Phones Based on RME For Permutation of Several Same Elements

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Abstract. The huge use of mobile phones needs to be utilized to improve student learning outcomes. For this reason, it is necessary to develop interesting learning on mobile phones. In order for the presentation of learning on mobile phones to be interesting, especially for learning mathematics, it is necessary to make connections with human activities. Mathematics learning activities that connect with human activities are known as Realistic Mathematical Education (RME). The novelty of this research is to create an RME-based mobile phone application for permuting several of the same elements. The research method used is development research which consists of 4 stages, namely; (1) planning; (2) development; (3) evaluation; and (4) testing and production. RME-Based Mobile Phone Learning Application for Permutations of the Same Elements, consists of 5 parts, each part consists of RME model learning stages, namely presenting real problems and displaying several model levels towards mathematical concepts.

INTRODUCTION

The huge use of mobile phones needs to be utilized to improve student learning outcomes. For this reason, it is necessary to develop interesting learning on mobile phones. The advantage of mobile phone-based learning is that students have the opportunity to repeat learning anywhere and at any time. Several studies show the effectiveness of learning using mobile phone facilities, such as research by Astra (2015) [1], Uwais (2015) [2], Amin (2021) [3], Watomakin (2017) [4], Shuib (2015) [5], and Ruhimat (2020) [6].

In order for the presentation of learning on mobile phones to be interesting, especially for learning mathematics, it is necessary to make connections with human activities. Mathematics learning activities that connect with human activities are known as Realistic Mathematical Education (RME). The characteristic of RME is that learning starts with real problems and continues by generating several models leading to mathematical formulas [7]. Several studies show that RME can improve mathematics learning outcomes, such as Saleh's research et. al[8] , Altaylar [9], Laurent [10], Rasmussen [11], Majeed [12], Kusumah Ningsih [13] , Aksu [14], Putri [15], and Uyen et. al [16].

State of Art

Several studies show the effectiveness of using mobile phones in learning. Astra Research (2015) developed an application on mobile phones for "properties of ideal gases such as Boyle's law, Charles's law, and Gay Lussac's law"[1]. Uwais (2015) developing learning applications on mobile phones for chemistry lessons [2]. Amin's research (2021) on The Effectiveness of Mobile Blended Problem Based Learning on Mathematical Problem Solving for the subject of sequences and series at Senior High School [3]. Watomakin's (2017) research on Mobile Application Design for Ordering Clean Water [4]. Study Shuib (2015) Designing an Intelligent Mobile Learning Tool for Grammar Learning [5]. Study Ruhimat (2020) developing Interactive Mobile Learning Software for electronics lessons [6].

By looking at research on the use of mobile phones for learning, it inspired the author to create interesting mathematics learning on mobile phones. Learning mathematics will be interesting if the learning of mathematical concepts is linked to human activities. This learning activity is known as Realistic Mathematic Education (RME). Several studies show that RME can improve mathematics learning outcomes. Saleh et al researched RME learning for fraction material in elementary school [8], Altaylar researched RME learning for statistics material in elementary school (Elementary School)[9], Laurent did RME research for geometry material in junior high school

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040031-1–040031-10; https://doi.org/10.1063/5.0245249

[10], Rasmussen researched RME for differential equations in college [11], Majeed researched RME for functional materials in 5th grade elementary school, this research shows that RME-based teaching materials make learning interesting [12], Kusumah Ningsih researched RME for algebra material in Class VII Middle School [13], Aksu researched RME learning for geometry in junior high school [14] Putri researched RME for spatial abilities and motivation of junior high school students [15], Uyen et al's research on RME learning for statistics material in junior high school (Grade 7) [16], Azhar researched the influence of RME on Madrasayah Aliyah students' mathematical communication skills [17] , Azhar developed an RME-Based Opportunity Theory Learning learning tool [18]. From the trial results, it can be seen that teachers and students enjoy using this learning tool. [19]

Guided by the learning tools that Azhar has created [18] developed 10 learning applications on mobile phones based on RME for Probability which can be downloaded at the link https://play.google.com/store/apps/details?id=com.uhamka.aplikasi_rme. This article is the fourth application of 10 applications created.

Contribution of This Paper to the Literature

There has been a lot of research developing applications on mobile phones for learning, as stated in the previous section. There is also a lot of research on RME. However, there has been no research to develop an RME-based mobile phone application for Probability content in Senior High School, especially Permutation. RME-Based Mobile Phone Learning Application for Permutations of the Same Elements, is one of the results of 3 years of research funded by the Director General of Higher Education 2019-2021. The results of this research can be downloaded on Google Playstore with the link https://play.google.com/store/apps/details?id=com.uhamka.aplikasi_rme. The contribution of this article is to explain the process and results of developing an application model on a mobile phone based on the concept of permutation if there are several elements that are the same. The contribution of this article to the literature study can be illustrated by Figure.1

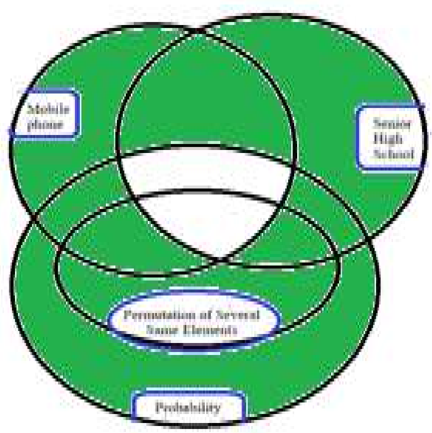


FIGURE 1. Novelty of Research

METHODOLOGY

To produce a permutation concept learning application if there are elements that are the same as the RME model on a mobile phone, the method used is the research and development method. According to Astra (2015) research and development method has four main steps: 1) planning, 2) development, 3) evaluation, 4) application product in the form of simulation, see Figure.2.

The first stage is designing a display scenario on a mobile phone. The second stage develops the application based on the scenario that was created in the first stage. The third stage is application evaluation involving mathematics experts, teachers and several students. The final stage is simulation and improvement according to teacher and student input during the simulation. Improvements made according to suggestions from teachers and students during the simulation were to make the display colors more contrasting.

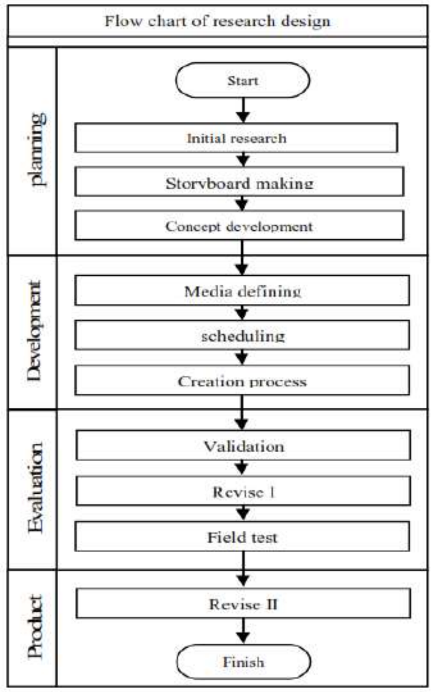


FIGURE 2. Research Desain from Astra (20115:1083)

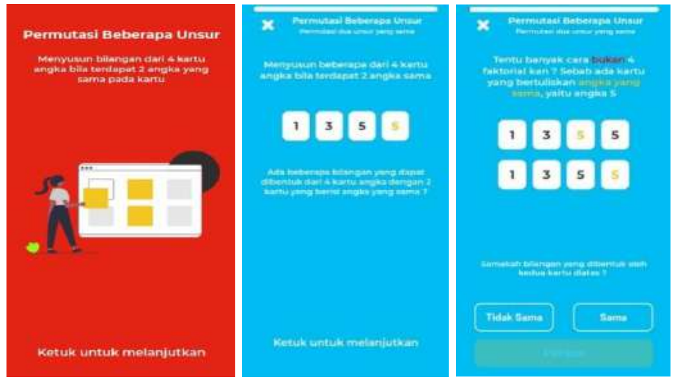
RESULTS AND DISCUSSION

RME-Based Mobile Phone Learning Application for Permutations of the Same Elements, consisting of 5 parts, namely:

- the first part about arranging numbers from 4 number cards if there are 2 of the same numbers on the card;
- the second part is about arranging numbers from 4 number cards if there are 3 of the same numbers on the card;
- the third part about arranging numbers from 4 number cards if there are 2 pairs of the same numbers on the card;
- the fourth part about arranging numbers from 5 number cards if there are 2 of the same numbers on the card;
- the fifth part is about arranging numbers from 5 number cards if there are 3 of the same numbers on the card.

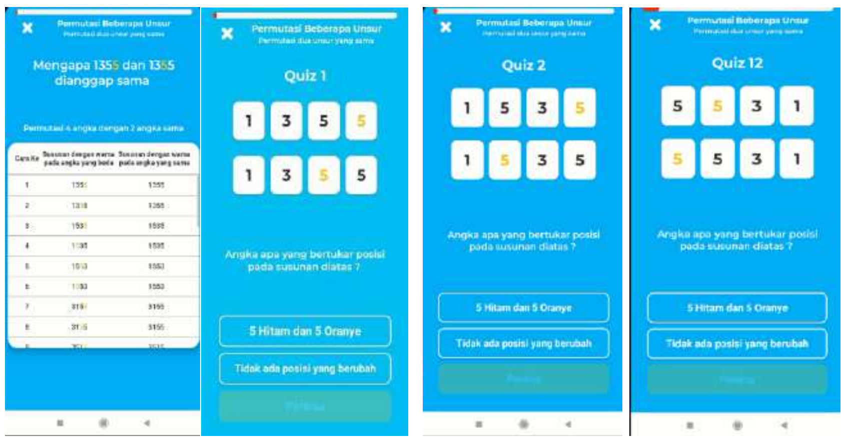
Explain the arrangement of numbers from 4 number cards if there are 2 of the same numbers

The presentation begins by presenting a real problem more Figure. 3. Continued with several model levels such as Figure.4 and Figure.5. The table in Figure.4.a is the first model, followed by the second model from Quiz 1 to Quiz 12 which are displayed in Figure.4.b, Figure.4.c, and Figure. 4.d. Ending with the final model leading to the concept $\frac{4!}{2!}$.



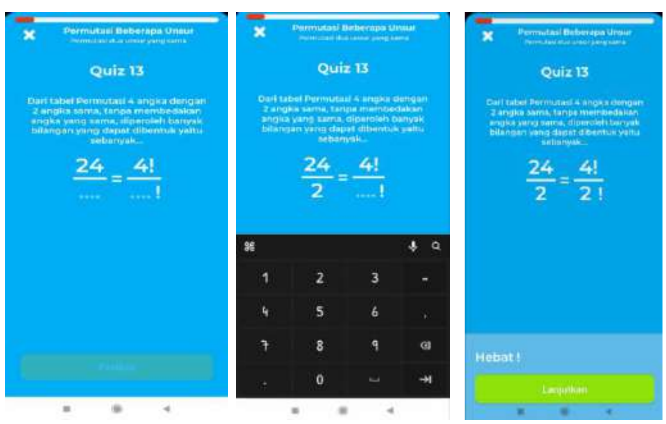
(a) (b) (c)

FIGURE 3. Present real problems for students



(a) (b) (c) (d)

FIGURE 4. Models appear as a link between real problems and mathematical concepts

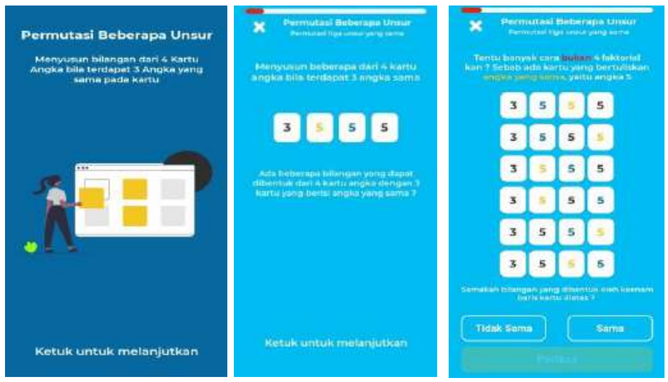


(a) (b) (c)

FIGURE 5. The final model goes to the $\frac{4!}{2!}$

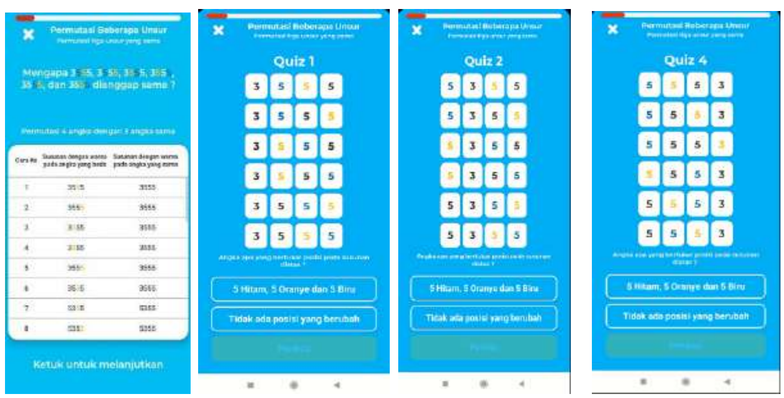
Explains the arrangement of numbers from 4 number cards if there are 3 of the same numbers on the card

The presentation begins by presenting a real problem more Figure. 6. Continued with several model levels such as Figure.7 and Figure.8. The table in Figure.7.a is the first model, followed by the second model from Quiz 1 to Quiz 4 which are displayed in Figure.7.b, Figure.7.c, and Figure. 7.d. Ending with the final model leading to the concept $\frac{4!}{3!}$



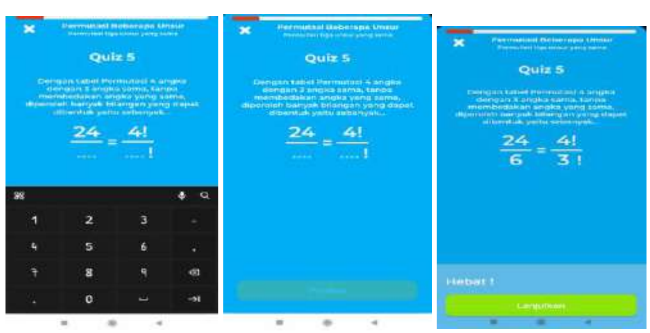
(a) (b) (c)

FIGURE 6. Present real problems for students



(a) (b) (c) (d)

FIGURE 7. Models appear as a link between real problems and mathematical concepts

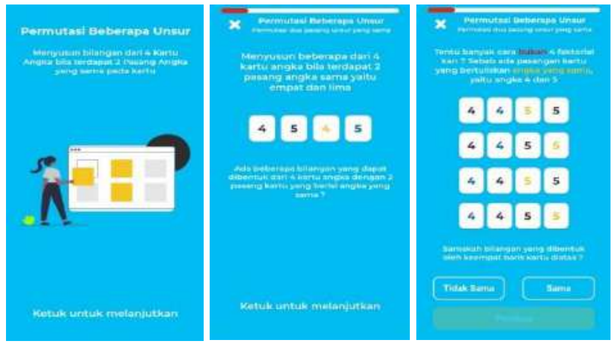


(a) (b) (c)

FIGURE 8. Final model to concept $\frac{4!}{3!}$

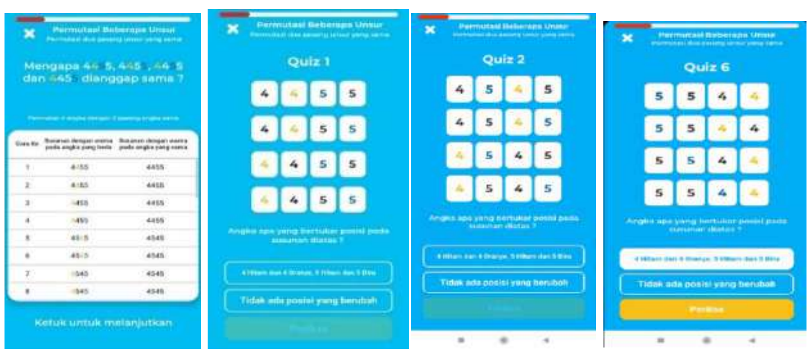
Explains the arrangement of numbers from 4 number cards if there are 2 pairs of the same numbers

The presentation begins by presenting a real problem more Figure. 9. Continued with several model levels such as Figure.10 and Figure.11. The table in Figure.10.a is the first model, followed by the second model from Quiz 1 to Quiz 6 which are displayed in Figure.10.b, Figure.10.c, and Figure.10.d. Ending with the final model leading to the concept $\frac{4!}{2!}$, see Figure.11.



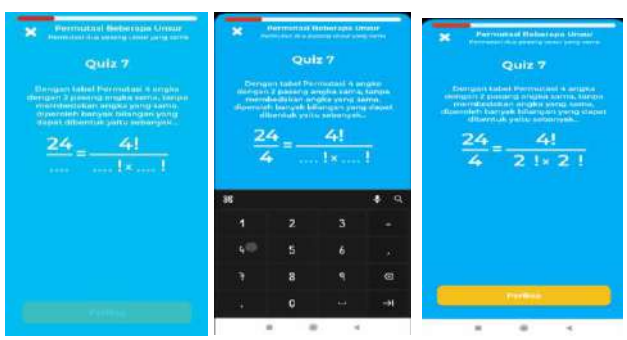
(a) (b) (c)

FIGURE 9. Present real problems for students



(a) (b) (c) (d)

FIGURE 10. Models appear as a link between real problems and mathematical concepts

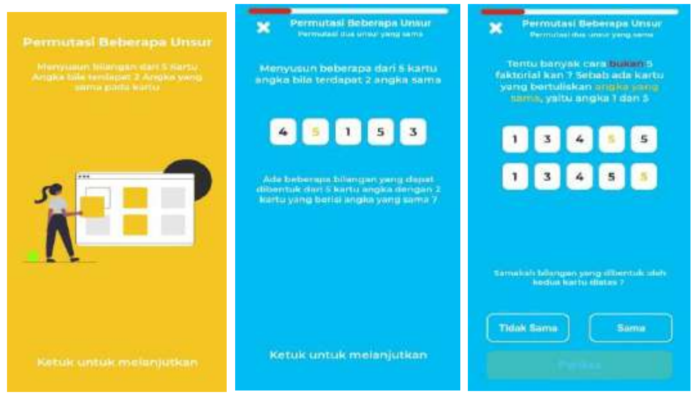


(a) (b) (c)

FIGURE 11. The last model Into the concept of $\frac{4!}{2!\,2!}$

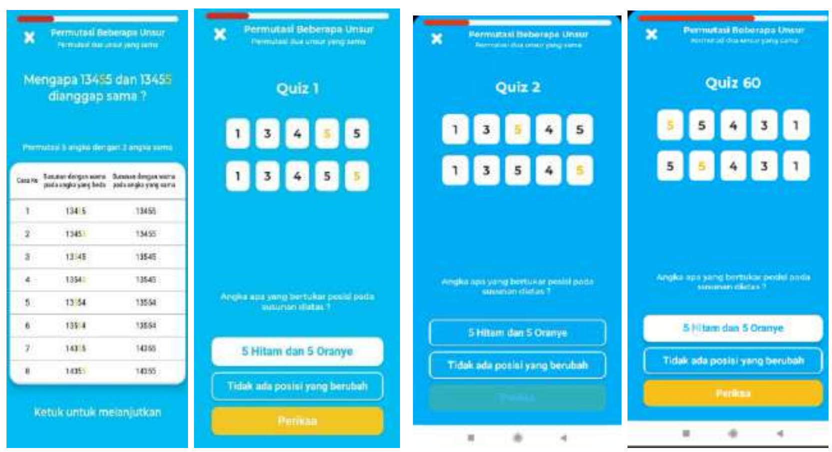
Explains the arrangement of numbers from 5 number cards if there are 2 of the same numbers

The presentation begins by presenting a real problem more Figure. 12. Continued with several model levels such as Figure.13 and Figure.14. The table in Figure.13.a is the first model, followed by the second model from Quiz 1 to Quiz 60 which are displayed in Figure.13.b, Figure.13.c, and Figure. 13.d. Ending with the final model leading to the concept $\frac{5!}{2!}$, see Figure.14.



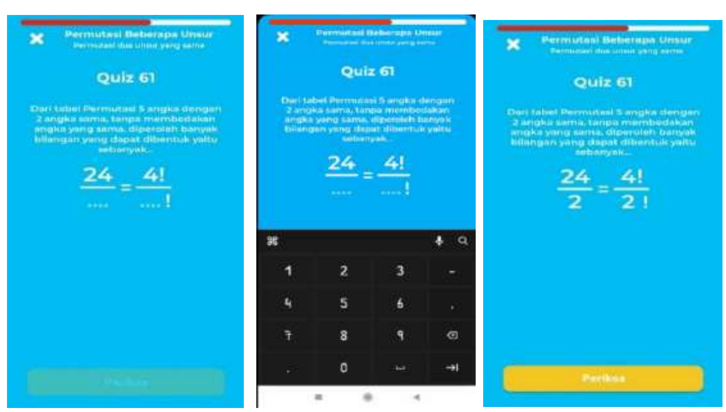
(a) (b) (c)

FIGURE 12. Present real problems for students



(a) (b) (c) (d)

FIGURE 13. Models appear as a link between real problems and mathematical concepts

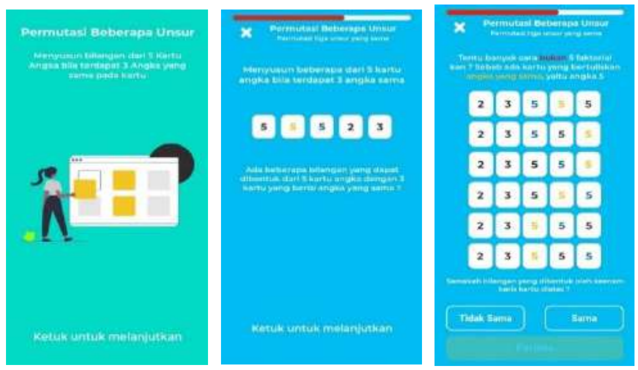


(a) (b) (c)

FIGURE 14. Final model to concept $\frac{5!}{2!}$

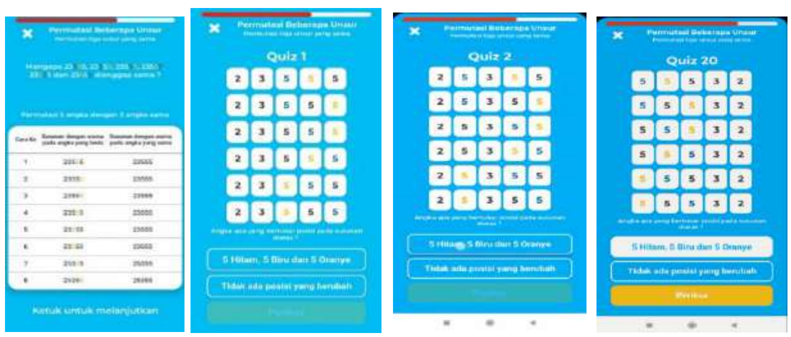
Explain the arrangement of numbers from 5 number cards if there are 3 of the same numbers

The presentation begins by presenting a real problem more Figure. 15. Continued with several model levels such as Figure.16 and Figure.17. The table in Figure.16.a is the first model, followed by the second model from Quiz 1 to Quiz 20 which are displayed in Figure.16.b, Figure.16.c, and Figure. 16.d. Ending with the final model leading to the concept$\frac{4!}{2!}$, see Figure.17.



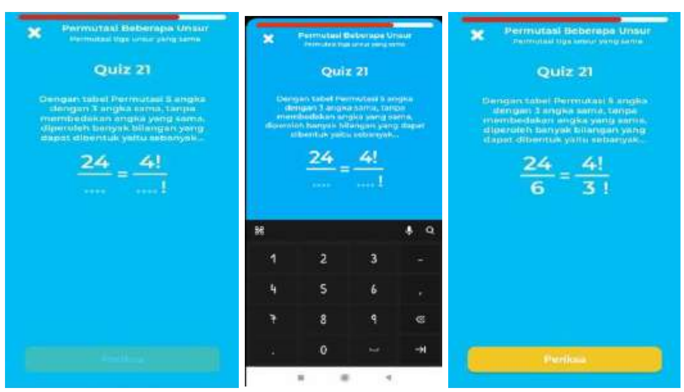
(a) (b) (c)

FIGURE 15. Present real problems for students



(a) (b) (c) (d)

FIGURE 16. Models appear as a link between real problems and mathematical concepts



(a) (b) (c)

FIGURE 17. Final model to concept $\frac{5!}{3!}$

CONCLUSION

Research is a development research that produces learning applications on mobile phones. The presentation of material on mobile phones follows the RME learning model. This application consists of 5 parts. The first part is about arranging numbers from 4 number cards if there are 2 of the same numbers on the card. The second part is about arranging numbers from 4 number cards if there are 3 of the same numbers on the card. The third part is about arranging numbers from 4 number cards if there are 2 pairs of the same numbers on the card. The fourth part is about arranging numbers from 5 number cards if there are 2 of the same numbers on the card. The fifth part is about arranging numbers from 5 number cards if there are 3 of the same numbers on the card. The presentation of each section follows the RME model, namely presenting real problems for students, followed by an interaction process by generating several levels of models leading to mathematical concepts.

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Integrating Local Wisdom and Project-Based Learning to Enhance Critical Thinking, Collaboration, and Creativity in Mathematics Education: A Pilot Study with Eighth Grade Students in Malang

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Abstract. This pilot study develops an innovative mathematics learning model Incorporating Local Wisdom and Project-based learning (ILWP) and does research on how the integrated model enhances critical thinking, teamwork, and creativity. This study uses classroom observations, semi-structured interviews, and student artifact analysis. The participants are eighth-grader students and their math teacher. The study involves students in local wisdom context-based mathematics activities and collaborative project-based tasks. The findings show that integrating the ILWP learning model facilitates students' critical thinking, creativity, and collaboration skills. Active participation, communication, and collaborative problem-solving are encouraged in project-based learning. Students' critical thinking skills are developed by applying mathematical concepts to culturally relevant circumstances. Local wisdom and project-based learning can foster creativity by enabling students to find varied solutions to challenging situations. The study also highlights the necessity to link curriculum objectives with local cultural components and scaffolding to achieve fair student engagement. To strengthen the study. Future research could explore the long-term effects of this integrated approach on students' academic performance and 21st-century skill development. Additionally, investigating the perspectives of educators and parents regarding this innovative teaching method could provide a more comprehensive understanding of its impact on the overall learning experience.

INTRODUCTION

Individual's need to possess critical thinking, collaboration, and creativity skills has become increasingly evident in today's fast-shifting global landscape [1,2]. These skills are essential components of the skill set required in the 21st century [3]. To effectively navigate and achieve success in both personal and professional lives, individuals must cultivate the skills due to the complex and interrelated nature of the numerous aspects and challenges encountered in the 21st-century [4]. The ability to think critically is crucial in the 21st century as it empowers individuals to analyse and evaluate information and arguments, hence facilitating them to make informed decisions and solve complex problems [5]. Furthermore, this capability allows individuals to examine underlying assumptions critically, recognise inherent biases, and engage in independent thinking, establishing innovation and creativity [6]. In addition, collaboration is equally important in the 21st century [7], as it facilitates individuals' collaboration efficiently with persons from various backgrounds and viewpoints. This enables them to harness a team's collective knowledge and abilities, accomplishing shared objectives [8,9]. The acquisition of creativity is vital, as it empowers

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040032-1–040032-13; https://doi.org/10.1063/5.0241446
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individuals to engage in divergent thinking, produce original concepts, and devise inventive resolutions to intricate problems [10]. These core skills are of utmost importance in achieving personal success and are equally critical in addressing the pressing global challenges. The necessity for individuals to possess critical thinking, collaboration, and creativity abilities in the 21st century arises from the swift and profound transformations occurring [11].

Developing critical thinking abilities within mathematics is crucial in equipping students with the necessary tools to navigate the complexities and demands of the 21st century [12]. Mathematics education plays a vital role in improving the quality of human resources and developing mathematical solid thinking skills [13]. Previous studies have indicated that cultivating critical thinking abilities in mathematics can significantly enhance students' problem-solving capabilities and comprehension of mathematical concepts [14]. Furthermore, acquiring critical thinking abilities in mathematics empowers students to analyse and evaluate material, establish logical connections, and generate innovative solutions to mathematical problems [15]. Mathematical critical thinking involves employing mathematical knowledge and principles to engage in reasoning, strategic thinking, and problem-solving [16,17]. By integrating critical thinking activities and strategies into mathematics education, educators can strengthen students' critical and creative thinking capacity in solving mathematics problems [18]. A practical approach for fostering the development of critical thinking abilities in mathematics education is providing students with complex and challenging mathematical problems that require higher-order thinking skills [16].

Collaboration is a crucial component in mathematics education for several reasons. Firstly, collaboration allows for the maximisation of participation from every student [19]. It enables them to collaborate, share ideas and strategies, and collectively resolve challenging mathematical problems [20]. It supports student’s learning outcomes and fosters efficient problem-solving skills [21]. This promotes a dynamic and engaging learning environment where students can learn from their peers through discussion [22], gain different perspectives, and develop their mathematical reasoning skills [23]. Collaboration skills encourage mathematical reasoning and promote critical thinking and creative thinking skills essential for success in the twenty-first century [24].

The role of creativity in mathematics education is of considerable importance, as it encourages students to approach problems from different perspectives and engage in non-conventional thinking [25]. By incorporating creative problem-solving activities and tasks into mathematics education, educators have the potential to cultivate an atmosphere that facilitates student exploration of diverse approaches, strategies, and solutions [26]. It can lead to developing unique and innovative approaches to perform mathematical challenges [27]. When students actively participate in creative problem-solving within mathematics, they can effectively utilise their critical thinking abilities to generate innovative solutions [15]. Moreover, incorporating creativity into mathematics education can potentially augment students' interest levels and motivation towards the topic [25]. Educators can generate students’ excitement and curiosity, leading to a deeper understanding and appreciation for the subject by providing students with opportunities to be creative in their mathematical thinking [28].

In today's globally interconnected and rapidly evolving society, the urgency of incorporating local wisdom learning in mathematics education has become increasingly evident [29]. Local wisdom refers to the knowledge and values deeply rooted in a particular community or culture [30,31]. The utilisation of indigenous knowledge as a means of education and empowerment within 21st-century learning [48]. Prior research endeavors to explore the measurement concepts in mathematics learning, including using traditional measuring tools such as bamboo and can for measuring agricultural products using traditional measuring units from the Gayo tribe [32]. Previous studies stated that incorporating local wisdom into education creates a more meaningful and relevant learning experience for students [33]. Formal education should consider the combination of mathematics learning and culture to bridge mathematics and the local wisdom and culture that is the basis of daily life [29]. In addition, project-based learning also needs to be applied in learning. The emerging approach is the integration of locally-based learning models and projects [34,35]. Project-Based Learning (PjBL) is a learning model that focuses on the main principles of a discipline, involves students in problem-solving and reasoning activities, and provides opportunities for students to work independently, construct their learning, and produce products [36]. This type of learning creates an active, collaborative atmosphere that can boost students' self-confidence [37]. It focuses on engaging students to participate actively through teaching that integrates theoretical knowledge acquired with practical skills, including real-world projects within mathematical concepts [38].

Educational institutions should integrate interactive and culturally relevant teaching methods to enhance these skills. Emphasising real-world applications can foster a deeper understanding of these skills. The present study employs a qualitative pilot study to develop and implement an innovative mathematics learning approach incorporating local wisdom and project-based learning to facilitate critical thinking, collaboration, and creativity. In prior studies, researchers have developed syntax and student worksheets of the integrated local wisdom and project-based (ILWP) learning model [39]. This study examines how the ILWP learning model supports students' 21st-century skills, especially critical thinking, collaboration, and creativity. Integrating local culture and project-based learning in mathematics education is vital as it facilitates a direct correlation between students' cultural backgrounds and personal experiences [40,41].

RESEARCH METHOD

This pilot study aims to develop and implement an innovative mathematics learning approach incorporating local wisdom and project-based learning to enhance critical thinking, collaboration, and creativity. The first stage is the development of learning models carried out in previous research [39] utilising the Plomp model. The second stage is the selection of research subjects and model teachers. The next process is the preparation and conditioning of the learning model trial. Teachers are mentored and given briefings related to syntax that will be tested. Hence, there are no misconceptions when implementing syntax, and they are given supporting tools to share with students. The purpose of students studying and resuming material at home is to build on students' initial knowledge. The implementation of research is carried out through project-based learning that integrates Malang's local wisdom into mathematics learning materials. During this stage, data is collected through interviews, observations, student activities tasks and projects, and documentation of learning activities. The collected data is then analysed qualitatively to illustrate how the learning model could enhance students' critical thinking, collaboration, and creativity skills. Findings from data analysis are used to evaluate the extent to which learning has improved students' skills. From the results of this evaluation, conclusions are drawn. The stages of this pilot study are illustrated in Figure 1.

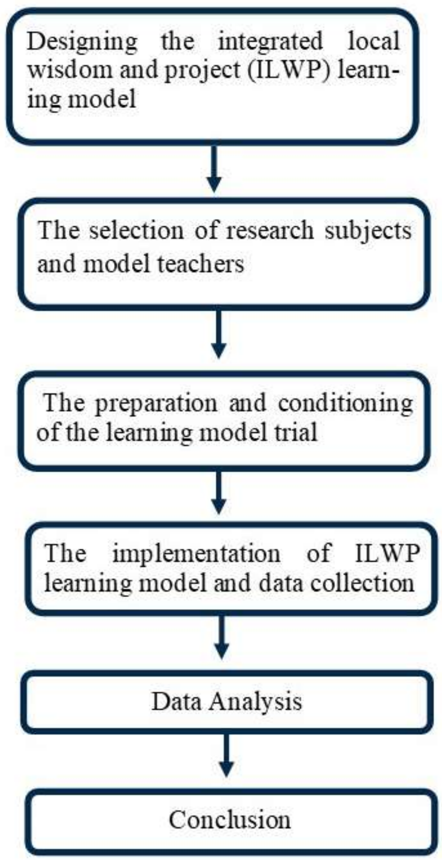

FIGURE 1. Stages of the pilot study

Further description related to research design, participant, method, and learning model design is described.

1. Research design

This pilot study was followed by a qualitative research design that aims to implement an innovative mathematics learning approach integrated with local wisdom and project-based learning (ILWP). The pilot study in this research refers to a preliminary investigation conducted on a smaller scale, sometimes referred to as feasibility studies. It involves the pre-testing or trial of the research instrument [42].

2. Participant

The participants are eighth-grader students and their mathematics teachers from a public secondary school in Malang, East Java, Indonesia. The study included a sample of juvenile students, both male and female, with an approximate age range of 13 to 15 years. Teachers who instruct the implementation of learning model trials are educators who possess substantial expertise in teaching students at the eighth-grade level and hold a master's degree in mathematics education. This level of qualification enables teachers to comprehend and effectively execute the syntax and support system associated with the learning model trials.

3. Method

The method to collect the data of this pilot study encompassed various techniques, including classroom observation, documentation, student activities tasks and projects, and semi-structured interviews. The classroom observations were conducted to observe the implementation of local wisdom and project-based learning activities. The observation sheets were used to examine the performance of syntax in the classroom. During the classroom observations, the researchers observed how students engaged in critical thinking, collaboration, and creativity while working on mathematical tasks and projects incorporating local wisdom and followed the teaching and learning process, including the researchers' and students' activities. The ability to think critically, creatively, and collaboratively is evaluated through the observation of teachers and observers during learning. They observe students' interactions and abilities when asking, answering, and discussing. The observations are written in field notes and observation sheets. In addition, these abilities are measured from the activity sheet and project instrument that students from two meetings have worked on. A summary of the descriptions and capabilities of the 21st century is shown in Table 1.

TABLE 1. 21st-century skills and research instrument

21st-century skill	Descriptions	Instrument
Critical thinking	Developing critical thinking skills by applying mathematical concepts to culturally relevant circumstances and criticizing different ideas	• Field notes • Observation sheet of Observer and teacher • The activity sheet and project instrument
Creativity	Fostering creativity by enabling students to find varied solutions to challenging situations	
Collaboration	Active participation, communication, and collaborative problem-solving are encouraged in project-based learning.	

All the data during the research were documented in photos, videos, and field notes and then analysed using the source triangulation technique [43]. The researchers obtained ethics clearance from the participants before collecting data, ensuring that all ethical guidelines and principles were followed throughout the pilot study [44]. The interviews aimed to gather information about the school's current state of mathematics learning and understand the teachers' and students' perspectives on integrating this learning model. The researchers interviewed the mathematics teachers and the eighth-grade students to gain insights into their experiences, perceptions, and attitudes towards mathematics education.

4. Learning Model Design

The syntax and student worksheets of the integrated local wisdom and project (ILWP) learning model had been designed in a prior study [39] utilising the Plomp model, encompassing three phases: preliminary research, prototyping, and assessment [45]. The theoretical underpinnings of this learning model are based on the paradigm proposed by Joyce et al., which comprises syntax, social systems, reaction principles, support systems, and instructional and nurturant effects [46]. The learning model's design is initiated by designing the constructivist principles proposed by Sa'dijah [39,47,48]. It also adapts Banks' learning model and local wisdom theory in developing local learning activities [49]. The ILWP learning model integrates the contextual aspects of Malang local wisdom into implementing each syntax and developing worksheets and project activities, serving as a supportive system. The model incorporated cultural traditions, historical events, and environmental phenomena relevant to Malang's local setting and exemplifying contextualised local wisdom. The material of the worksheet as the support system focuses on the probability of eighth grade.

The pilot study was conducted on the probability material on 18-24 August 2023 in three eighth-grader students since the developed worksheet focuses on probability. It involved a trial on the syntax of the ILWP learning model and student worksheets, which were developed based on the indigenous knowledge of Malang and project-based learning. These experiments were conducted in three classrooms, totalling 2 x 2 lesson hours. The initial two-hour period of instruction is dedicated to individual orientation, small group and classical discussions, and project preparation. The subsequent two-hour teaching session focuses on the execution phase of the project, exhibitions, and project presentations.

Table 2 shows the syntax, the description of the purpose of each syntax, and its targeted skill. It also shows that critical thinking skills are assessed in each syntax, creative thinking skills are assessed in each syntax in the 1st to 4th syntax, and collaborative ability assessment is carried out in the 2nd to 4th syntax.

TABLE 2. Syntax, goals, and targeted skills of the ILWP learning model

No	Syntax	Goals	Targeted skills
1	Individual Orientation	Students can write down mathematical topics related to Malang's local wisdom through summarising, taking notes, giving examples, and solving problems individually.	Critical thinking and creativity
2	Small group and classical discussions	Students can understand mathematical topics related to Malang's local wisdom through discussions in small groups, and students can strengthen and expand their understanding by presenting, comparing, and critiquing different ideas.	Critical thinking, creativity, and collaboration
3	Project Preparation	Students can plan projects and carry out mathematical project activities related to Malang local wisdom to solve real problems involving the context of Malang local wisdom.	Critical thinking, creativity, and collaboration
4	Exhibitions and Project Presentations	• Students can present project products and understand mathematical concepts and strategies involved in designing and implementing projects related to Malang local wisdom • Students can reflect on learning processes and outcomes	Critical Thinking, creativity, and Collaboration

Figure 2 summarises the syntax of the ILWP learning model that had been developed [39].

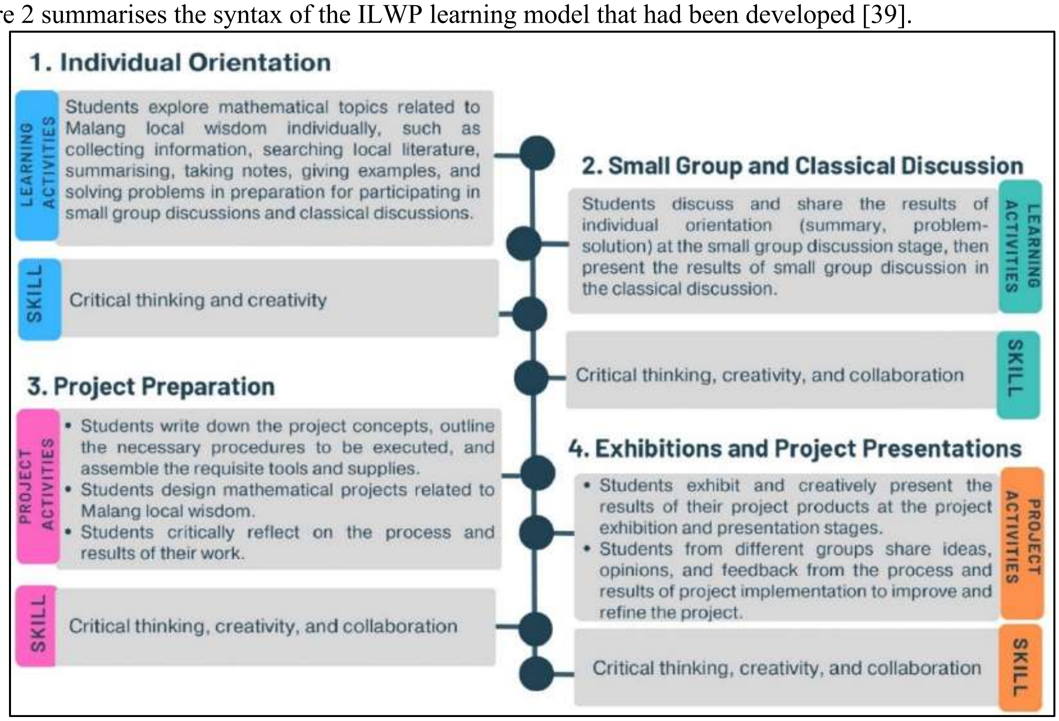

FIGURE 2. Syntax of the ILWP learning model

RESULT AND DISCUSSION

In this pilot study, the researchers aimed to develop and implement an innovative mathematics learning approach incorporating local wisdom and project-based learning to enhance critical thinking, collaboration, and creativity. This study examines how the integrated model enhances students' 21st-century skills. The researchers adopted an innovative mathematics learning approach integrated with local wisdom and project-based learning (ILWP) using the Plomp model and constructivism approach, requiring students to think critically and collaborate to work on math-related projects based on local cultural practices and knowledge. Constructivist learning emphasises the active participation of learners in constructing their knowledge and understanding [50]. Constructivism in mathematics education shifts the focus from rote memorisation of formulas and procedures to a deeper understanding of mathematical concepts and their application in real-life situations. It promotes active student engagement in mathematical tasks, allowing them to construct their understanding of concepts through problem-solving and critical thinking.

Incorporating constructivism in mathematics education is through project-based learning and local wisdom. Project-based learning is a student-centred approach that allows students to engage in authentic, meaningful projects that require them to apply their knowledge and skills to solve real-world problems [51]. By engaging in project-based learning, students can explore mathematical concepts in a practical and hands-on manner [52]. They can work collaboratively in groups, using critical thinking and problem-solving skills to gather data, analyse patterns, and devise solutions. Integration of incorporating indigenous knowledge into the field of mathematics education as a means of enhancing academic performance in mathematics [53,54]. By integrating local wisdom into the constructivist learning model, educators can create a more culturally responsive and relevant learning experience for students. Furthermore, integrating local wisdom allows exploring students' immediate surroundings and familiar contexts.

Pilot research was conducted from Friday, August 18, to Thursday, August 24, 2023, targeting eighth-grade students in a secondary school located in Malang. The trial was conducted across three classrooms comprising students with diverse levels of academic proficiency. The study encompassed an examination of syntax and student worksheets that were developed using the indigenous knowledge of the Malang region. These materials were used in many classrooms, with each session lasting four instructional hours. The initial two-hour training period includes individual orientation, small group and classical discussions, and project preparation. The subsequent two-hour session of instruction focuses on the execution phase of the project. The last syntax is dedicated to the exhibitions and project presentations.

Before the pilot study, researchers prepare syntax and supporting devices of the learning model. Researchers also designed colorful ink ballpoints to facilitate students learning and writing because, in this study, learning used black, blue, and green inked ballpoints. Black-inked ballpoints are used to resume and work on individual assignments and activities at the orientation stage. Blue ink ballpoints are used to revise inappropriate task answers when discussing with groups. Green-inked ballpoints adjust wrong assignment answers after other groups have presented them. In addition, researchers also prepare teacher preparations. Teachers are given briefings and directions related to syntax that will be tested. Hence, there are no misconceptions when implementing syntax, and they are given supporting tools to share with students. The supporting tools used in this study use the Malang context. Before the meeting, the teacher is also asked to remind students to study and resume the material to be studied with a pen in black ink. The purpose of students studying and resuming material at home is to build on students' initial knowledge. This phase is the initial phase of orientation. This phase is not carried out at school but assigned at home in order not to reduce student learning hours at school.

The trial of the implementation of the learning model is divided into two in each class, namely the implementation in the first two hours and the second two hours, which are carried out on different days. In the first two hours of lessons, the syntax is divided into three, namely the syntax of orientation and individual activities, classical discussion, and project preparation. The following describes the trial implementation of the learning model in the first two hours.

FIGURE 3. Implementation of the ILWP Learning Model

1. Individual orientation

The individual orientation stage represents the early phases of this particular learning approach. Based on the observation, it is noted that the teacher initiates the lesson by extending a greeting, inquiring about the condition of the students, verifying their completion of the prescribed task of studying the topic and preparing a summary, as instructed at the preceding session. In this study, the dissemination of supportive aids takes the form of student worksheets, which are provided to students along with instructions to complete them independently using black ink ballpoint pens.

Based on observations made during the individual orientation stage of the trial, it may be inferred that certain students encounter challenges in comprehending the material and completing assigned tasks, impeding their ability to engage in individual assignments effectively. To proactively address this matter, educators will conduct a cursory review of the tables to ascertain the outcomes of the resumes, instilling a sense of accountability among students to engage in diligent research and resume preparation. The supporting materials provide a concise overview of the content, serving as a resource for students to study, particularly those who are unfamiliar with resume writing. The inclusion of supporting devices in the educational material is linked to the context of Malang local knowledge, aiming to enhance students' comprehension and foster a deeper understanding. Students can engage more effectively with the information by utilising a context closely aligned with their daily lives. Furthermore, children demonstrate an enhanced level of awareness regarding their surroundings and cultural context.

A conducted interview focused on allocating a resume assignment to one of the pupils according to the syntax of individual orientation. The subsequent passage presents an extract from the interview between the researcher and Participant 1 (P1).

Researcher : *"I intend to conduct interviews to gather input. I would like to inquire about the resume assignments and worksheets utilised in the individual orientation syntax of the learning. Have you resumed providing supporting references?"*

P1 : *"Yes, I have complied with the teacher's instructions by resuming the given references and my own references."*

Researcher : *"Good job. Do you feel overwhelmed when you must review and resume the material out of the classroom before instruction?"*

P1 : *"It's just so-so for me because yesterday there was not much schoolwork, and the previous day was a holiday, so I think it's okay."*

Researcher : *"Then what do you think the assignment from the teacher should be?"*

P1 : *"It's helpful for me because I was allowed to resume the material using my style and language so I remember and understand the material earlier, but in my opinion, it should not be given every meeting because we sometimes have difficulty dividing time to do assignments at home because we come home from school in the afternoon."*

Researcher : *"What do you think about assigning individual assignments at the beginning of the lesson?"*

P1 : *"There are some questions that I can't answer, but there are also questions that I can answer because I have previously made notes related to the material studied today*."

Based on the interview, P1 has resumed the assignments before the class. P1 stated that he had no objection to the resume assignment but suggested that it should not be given at every meeting. This indicates that P1 feels that the frequency with which each session resumes tasks can be taxing on students. P1 stated that he, as a student, had difficulty managing his time to do assignments for other subjects. P1 says that giving a resume assignment before learning does not make it possible to solve the problem immediately. Still, it makes it easier for him to take notes using his language so that it is easier to understand the concept being learned. This shows that the resume assignment is more helpful in helping P1 prepare to understand the material to be studied.

2. Small group and classical discussions

The second stage of this instructional method is distinguished by small group and classical dialogues. Students are instructed to proceed with or revise their assignments at this stage by engaging in group discussions with their peers. In the context of classroom discussions, students are granted the opportunity to rectify any mistakes or inconsistencies detected in their worksheet responses by rewriting them using a pen filled with blue ink. The composition of discussion groups is set through mutual agreement between the teacher and the students, whereby the groups may be formed based on the teacher's discretion, the student's preferences, or through a random selection process. The students engage in collaborative work by participating in two sessions, each lasting 2 hours, with two meetings. Following the discussion phase, the instructor requested that representatives from each group present their work. Students must critically analyse ideas and offer constructive comments to the presenting group. The collective engagement of students in the class through representative group presentations and subsequent discussions is sometimes called classical discourse.

The observation regarding the small group and classical discussion phase is that certain students may not effectively integrate with their group members due to a perceived lack of compatibility, and specific individuals may struggle with collaborative work in general. Collaboration is an essential skill for students in junior high school, and it is incumbent upon instructors to reinforce its advantages. Since collaboration is considered a fundamental competency in the 21st century, educators should emphasise its benefits to students in this context. During the classical discourse phase, students employ a strategic approach to rectify errors by meticulously documenting revisions of their work with black ballpoint pens, ensuring that any modifications remain inconspicuous. Using black and blue inked pens is to ascertain the procedural aspects of employment, errors, and students' comprehension of individual assignments and group discussions. Hence, educators must reinforce the concept of integrity among pupils, as the essence of acquiring mathematical knowledge lies mainly in the procedural aspects. During this phase, the evaluation of students' reasoning abilities is also conducted. Students are expected to refrain from simply transcribing responses provided by their peers without engaging in critical analysis. Students are additionally expected to be able to articulate their unique concepts to peers, thereby ensuring that the ideas expressed reflect the students' creativity.

An interview was conducted to explore the process of reworking a worksheet through group discussions and to inquire about using classical presentation in the syntax of the small group and classical discussion. The subsequent passage presents a segment of the interview between the researcher and Participant 2 (P2).

Researcher	:	*"What do you think about the discussion session on small group and classical discussions?"*
P2	:	*"I like to have discussion sessions because unresolved and ununderstood issues are discussed with other group members. So, I understand better, and almost all the problems are solved. But sometimes, we get even more confused if no one understands the problem. I was also annoyed with the group members who didn't help anything or make any contributions to the group."*

The interview results showed that the discussion session was beneficial to deepen the understanding of mathematical concepts and solve related problems. However, in some cases, there are pretty significant obstacles. One of them is when the material discussed is not understood by any group member, causing the discussion to be unsmooth and unproductive. However, other problems arise when some group members do not actively engage in the discussion and do not contribute anything to the group. This disrupts group dynamics and reduces the effectiveness of the discussion sessions in achieving shared learning goals.

3. Project Preparation

The project preparation stage constitutes the third phase of the learning model. At this syntax, students are tasked to create a project whereby they are required to present instances of empirical and theoretical probability related to Malang's local wisdom. The initial meeting about this trial solely progressed to the project planning phase. During the initial project planning phase, students must write down the project concepts, outline the necessary procedures to be executed, and assemble the requisite tools and supplies. The continuation of project execution, findings, and reflection will be discussed during the subsequent meeting, which is scheduled for two lesson hours.

Project execution is carried out during mathematics class hours at school. During the execution phase, students are asked to engage in the further development of project planning discussed in the preceding meeting. The project's preparatory phase, encompassing planning, execution, findings, and reflection, has been meticulously replicated and organised for presentation. Certain groups choose to present their project preparations in PowerPoint presentations, while others prefer to utilise the design platform Canva for their project designs. Students choose Canva as their preferred design tool for their projects because of its wide range of visually appealing and user-friendly presentation templates, available at no charge.

An important consideration throughout the project stage is the equitable workload distribution among group members, whereby teachers must ensure that no single student bears an excessive strain. The project idea employed is the original concept proposed by the collective, with the unanimous consent of all group members, ensuring that each student is obligated to contribute to the project's execution.

The following passage presents an excerpt from the interview between the researcher and Participant 3 (P3). An interview about the syntax of project preparation encompasses project planning, implementation, findings, and reflection.

Researcher : *"Are there any difficulties when preparing the project?"*

P3 : *"Yes, we have trouble understanding the instructions and terms on the project sheet."*

Researcher : *"Then what else are the obstacles in preparing the project?"*

P3 : *"We have difficulty finding ideas related to the probability material and Malang's local wisdom. So, we have to find and read sources from the internet first to find information related to local knowledge of Malang. So, the work is getting longer while the time is limited."*

Researcher : *"From the difficulties you encountered while working on project tasks, is there anything you gained from project learning?"*

P3 : *"Although it was difficult and unfamiliar at first, I became more of an example of applying huge amounts of material to my daily life. I also became more familiar with Malang, such as knowing tourist attractions, typical foods, and Malang regional dances".*

Researcher : *"Then, do you have any suggestions for overcoming the problem?"*

P3 : *"In my opinion, the project preparation time is increased so that we are not rushed and can complete the project tasks well."*

The interview results concluded that the difficulty in preparing the project consists of several things. First, students have difficulty understanding the project instructions listed on the project sheet. Second, they have difficulty finding ideas related to local wisdom in Malang. Third, finding references that can be used as a source of information about Malang's local knowledge is difficult, causing project completion to take time. Nevertheless, students realised that the process provided a deeper insight into the culture and life in Malang. They suggest additional time in project preparation so as not to rush and the importance of careful project preparation to minimise difficulties they experienced.

4. Exhibitions and project presentations

The last stages of the learning model encompass the exhibition stage and project presentation. The teacher instructs the students to engage in a cycle of visits wherein they visit distinct groups to observe their projects, pose inquiries, and provide constructive evaluations of their project concepts. Teachers must engage in group monitoring during project exhibitions to ensure the active participation of all students. After completing a project exhibition, representative students deliver presentations on their group projects. The variety of projects undertaken by students exhibits significant diversity and inherent curiosity. However, when selecting presentation groups, students appear to lack confidence in their respective projects, resulting in a reluctance among groups to show their work. With the teacher's provision of incentives and subsequent reiteration of instructions, a group has emerged that demonstrates a willingness to present the project.

The exhibition stage necessitates that educators establish a conducive learning environment for pupils, wherein they are instructed to refrain from generating noise and disrupting adjacent sessions. Educators must ensure the active engagement of all students during project exhibitions. Furthermore, teachers must offer encouragement, reinforcement, and constructive comments to foster students' self-assurance and encourage them to present their ideas confidently.

The following are the transcribed results of the interviews conducted by the researcher with Participant 4 (P4). An interview was conducted to address the topics of exhibitions and project presentation syntax.

Researcher : *"Did you look around the project exhibitions of other group presentations?"*

P4 : *"yes, I went around looking at the project tasks of other groups. The results of other group projects have varied ideas, and the presentation design was very nice and neat. I was* *embarrassed because our group wasn't that good."*

Researcher : *"No, why should you be embarrassed? Your group has done its best. Do you think there is a positive impact on not seeing other groups' project exhibitions?"*

P4 : *"Yes. I know how other groups design the project. I also gained a lot of insight into probability material because sometimes some friends are reluctant to show their personal or group assignments for fear of being copied."*

Researcher : *"Any suggestions for learning this local wisdom-based math project?"*

P4 : *"In my opinion, the group of presenters who will present should be randomly selected and carried out rolling by the teacher so that all groups prepare the material well, not only certain groups. So each group feels like a presenter and airs their projects so that their work feels appreciated and gets input directly from the teacher."*

Based on the interviews, P4 expressed her insecurity when she saw the results of projects from other groups because she felt that the projects, she worked on were not as good as other groups' projects. She said she gained valuable ideas and insights through the exhibition project. P4 also suggests that the selection of groups to make presentations is random. This is so that not only do certain groups always present their projects, but all groups have the same opportunity to present their work. Thus, all groups are expected to feel appreciated and have a fair chance to present the projects they have worked on.

In addition to interviews with students, researchers also explored the perspective of teachers as model teachers in this study. The interview asked teachers about their experiences, perceptions, and attitudes toward implementing the ILWP learning model.

Researcher : *"How was your experience teaching mathematics with the ILWP learning model?"*

Teacher : *"It was interesting and exciting. Learning activities were carried out interactively because students were indirectly directed to explore local wisdom in Malang. This could be an example of problems caused by the material being studied. In addition to making students more aware of things around them, especially local wisdom, students also became more aware of the material learned through discussions with their peers (both in one group and another). It occurs when the discussion determines the examples of local wisdom that will be raised in the project."*

Researcher : *"Do you have problems implementing the ILWP learning model as a teacher?"*

Teacher : *"I don't have any problem implementing this model because it does not require special equipment and media. Students are simply presented with initial material, appropriate instructions, and devices used for exploration and documentation, and then this learning model can be implemented. As a teacher, I need to maximise mentoring by implementing this model so that each student does individual assignments and all students are actively involved in discussions and project work. The students' ideas are diverse and can be an insight for teachers in developing the advancement of learning. The students' abundance of ideas and concepts can occasionally present a challenge, as they may be uncertain which ones will be executed into projects. Ideally, This learning is carried out during field outing classes so that students can get direct information and raise concerns about existing local wisdom. However, due to the limitations of existing rules, the learning is only conducted in class. Students' exploration is done through cyberspace by accessing the information they need. Although it is only done in class, the results are very satisfying."*

Researcher : *"Is there a change in students' skills and character after learning?"*

Teacher : *"Based on my observation the critical thinking, collaborative, and creative skills are visible in the learning process. When each member in each group comments on and challenges the ideas and ideas of other members. Later, during the visit, students were also seen criticising project ideas from other groups. Collaborative ability is seen when each member in a group works together to find data and information, which is then processed to be prepared in the form of presentations. Student creativity is seen by students' many and varied ideas and ideas and based on the uniqueness and diversity of ways and presentation media prepared by each group."*

Based on the interviews, the experience of teachers in implementing the ILWP learning model seems to be very positive. Teachers feel that this approach makes learning more interesting and exciting. With ILWP, classroom activities become more dynamic, and students are indirectly encouraged to explore local wisdom that can be connected to the material being studied. In addition to helping students become more aware of the things around them, especially local wisdom, this approach helps students understand the subject matter better. Teachers see that discussions between students, both in groups and between groups, enrich their understanding. The debate that arises when they choose an example of local wisdom that will be raised into a project also provides valuable experience for students.

Teachers stated that the ILWP learning model is applicable without special equipment. This learning model can run smoothly by presenting initial material, clear instructions, and using devices for exploration and documentation. The teacher emphasised the importance of maximum assistance to each group as enrichment in learning. Teachers appreciate students' various ideas as a source of valuable insights for future learning development. However, this diversity of ideas sometimes becomes an obstacle for students because they have difficulty choosing which ideas to execute into projects. Ideally, this kind of learning should be done in the field during outing classes so that students can immediately feel and care about existing local wisdom. However, due to limited rules, learning can only be carried out in the classroom with student exploration through cyberspace. However, the results obtained from learning in the classroom still provide high satisfaction.

Teachers said that based on the observation integrating the ILWP learning model facilitates students the critical thinking, creativity, and collaboration skills. This is reflected when each group member gives comments and challenges to the ideas and ideas of their colleagues. In addition, students were also seen critiquing project ideas from other groups, showing improvement in their critical abilities. Students' collaborative abilities are seen when each group member works together to find and collect data and information that will be processed to be presented in the form of presentations. Students' creativity can also be seen from the diversity of ideas and ideas and the variety of ways and media of presentation chosen by each group. These show significant development in students' critical, collaborative, and creative abilities during the learning process.

Based on observations active participation, communication, and collaborative problem-solving are encouraged in this ILWP learning model. Students' critical thinking skills are developed by applying mathematical concepts to culturally relevant circumstances. Local wisdom and project-based learning can foster creativity by enabling students to find varied solutions to challenging situations. The study also highlights the necessity to link curriculum objectives with local cultural components and scaffolding to achieve fair student engagement. Several challenges were experienced by students when implementing the ILWP learning model. The first challenge is that students have difficulty managing time to do resume assignments if given every meeting because they intersect with other subject assignments. The frequency with which teachers assign mathematics tasks to students becomes an important aspect of their educational experience and needs to be considered [55]. The second challenge is an unsmooth and unproductive discussion in which no group members can understand the material. Unsmooth and unproductive discussions are caused because no group members understand the material discussed. Previous research claimed that It occurs when they encounter difficult mathematics problems [56]. The third challenge arises when some group members do not actively engage in the discussion and do not contribute anything to the group. This disrupts group dynamics and reduces the effectiveness of the discussion sessions in achieving shared learning goals. The next challenge is that students have difficulty understanding the project instructions on the sheet. They also have difficulty finding ideas related to local wisdom in Malang, and finding references that can be used as a source of information about Malang's local knowledge is difficult, causing project completion to take time. The teacher delivered the last challenge, that students have various and complicated ideas. It sometimes becomes an obstacle for students because they have difficulty choosing which ideas to execute into projects.

CONCLUSION

The findings show that integrating the ILWP learning model facilitates students the critical thinking, creativity, and collaboration skills. Active participation, communication, and collaborative problem-solving are encouraged in project-based learning. Students' critical thinking skills are developed by applying mathematical concepts to culturally relevant circumstances. Local wisdom and project-based learning can foster creativity by enabling students to find varied solutions to challenging situations. The study also highlights the necessity to link curriculum objectives with local cultural components and scaffolding to achieve fair student engagement. Local wisdom and project-based learning can foster creativity by enabling students to find varied solutions to challenging situations. Future research could explore the long-term effects of this integrated approach on students' academic performance and 21st-century skill development. Additionally, investigating the perspectives of educators and parents regarding this innovative teaching method could provide a more comprehensive understanding of its impact on the overall learning experience.

ACKNOWLEDGMENTS

The authors would like to thank Universitas Negeri Malang for the internal research funding, with contract number 5.4.442/UN32.20.1/LT/2023.

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Ideology and Power in Indonesia Education Roadmap 2020-2035

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Abstract. In Islamic communication and proselytization, education must be provided to all groups of society. Education must unite, not contradict religious teachings with culture or state ideology. The Indonesian Education Roadmap 2020-2035 (PJP) is a preconcept related to the ideology and power that shape it. The major research question is, how is the PJP in the perspective of ideology and power? The minor question is, why is there conflict in the preparation of PJP? To what extent does the conflict in the preparation of PJP affect the substance of PJP? The theory used in this research is the theory of ideology and power Gill Branston and Roy Stafford (2003: 117-147) about the views of Marxism, postmarxism and critical pluralism, as well as discourse and culture of life. In an Islamic perspective, the defense of the *underprivileged* and the distribution of wealth (*ra'sul maliyah*) are important so that there is no class conflict between Qobil (bourgeois) and Habil (proletariat). Because humans are not differentiated (QS. al-Hujurat: 11-13). This research shows that PJP formulated the vision of Indonesian education 2035 without including religious phrases. The secular nationalist regime's communication pattern that eliminates the phrase "religion" in PJP is a form of opposition to correct information (*tabligh*) and the voice of the Muslim majority as the general audience of message recipients. PJP in the perspective of ideology and power is mechanical and secular, its meaning is oriented towards technological and sociocultural changes, and forgets the philosophy of education that is deeply rooted in tradition and religion.

INTRODUCTION

Education is one of the important aspects in shaping future generations. Education forms a whole person (*kaffah*), developing all human potential both physically and spiritually [1]. Education as an activity that is carried out in a planned and systematic manner to develop the potential of students based on Islamic principles. Education aims to achieve a balance of human personal growth as a whole through psychological exercises, reason, intelligence, feelings and senses.

In the development of education in Indonesia, the implementation of Indonesian education is faced with various problems and weaknesses. The occurrence of information technology disruption, demographic bonus, Covid-19 pandemic , current and future labor market demands, and the problem of low human resource quality are faced with problems in the implementation of the learning process which is still unequal between access to education on the island of Java and other regions, the proliferation of expensive private and foreign schools, limited school and campus infrastructure, low teacher quality and lecturer productivity, lack of alignment with services for children with special needs and disability groups, and the availability of a limited number of teachers and their welfare.

The education that has been implemented has not provided a balance between religious, moral, character and national education that is integrated and structured. National education should emphasize in its curriculum the realization of character education based on the excellence of the archipelago, religiosity, and nationalism.

Various problems and weaknesses in the implementation of education above require the government to have a clear and measurable *blueprint for* education. So that the policies taken in the development of education, not partial and patchy. Policies taken should be intact in describing the difficulties and problems faced in national education, and contains content that is precisely able to resolve the various problems of education that exist.

The Indonesian Education Roadmap 2020-2035 (PJP), which was submitted and discussed in the Working Meeting between Commission X of the House of Representatives and the Ministry of Education and Culture on May 20, 2020 and December 11, 2020, did not include the phrase "religion" in the vision of Indonesian education in

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040033-1–040033-9; https://doi.org/10.1063/5.0246809
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

2035. PJP also does not include four important issues in education, namely: access, quality, relevance, and governance.

The preparation of the PJP is not in accordance with the constitutional mandate, namely the fourth alienia of the Preamble of the 1945 Constitution of the Republic of Indonesia, as well as the provisions of Article 31 and Article 32 of the 1945 Constitution of the Republic of Indonesia. PJP is not in line with the provisions of Article 3 of Law No. 20/2003 on the National Education System, which aims to produce Indonesian human beings who are faithful and pious to God Almighty.

There are government communication issues in the preparation of the PJP and public concerns that ideologically, the PJP is not in line with expectations. The major research question is, how is PJP in the perspective of ideology and power? The minor question is, why is there conflict in the preparation of PJP? To what extent does the conflict in the preparation of PJP affect the substance of PJP? What is the ideological configuration between Islamic and secular groups?

Theoretical Framework: Ideology and Power

Gill Branston and Roy Stafford (2003) say that ideology has a key role in making connections between media and different types of power, by giving more visibility to different views. Discourse helps us explore the "in-between" areas of how overarching and long-term ideologies become part of everyday practices, especially language, its assumptions, and the way it positions readers and users [2].

Marxist approach

According to Branston and Stafford, a set of ideas, even if they form a system, even a *rigid one*, cannot necessarily be classified as an "ideology". A person may have obsessive ideas about personal matters and relate them systematically to the circulatory phases of the moon. But this is not called an 'ideology' because it does not relate to the distribution of social power. Ideology refers to:[2] a set of ideas that give some account of the social world; ideas that are usually partial (in the second sense) and selective (as all positions are); the relationship of these ideas or values to the ways in which power is socially distributed.

Ideology is often used as one of the means by which dominant economic classes extend their control over others; and one of the ways in which dominant values and meanings appear 'natural' and 'obviously' socially aligned, in other words, how they work with, or against, a particular set of powers.

Marx argues that class distinctions, or people's relationship to the way in which goods and wealth are made and distributed ('the means of production'), are key to the kinds of values and political ideas they have. Did they own and profit from factories, banks, state estates, or did they have to earn their living by working for the owners of factories, banks and so on? Marx was interested in the capitalist relationship of the factory owners with those they employed. For him, the working class had the power to change history with their united action and practical experience. Marx saw the class conflict between these two groups as the motor of historical change in society [2].

Marx used the concept of ideology to help account for how the capitalist class is able to protect and preserve its economic interests. According to Marx, there are three emphases related to ideology in media studies, namely [2]: *First*, dominant ideas, which become part of the *common sense of* society, that they work in the interests of the ruling class in securing its dominance. *Secondly*, Marx argues there is a clear relationship between the ways in which the basic needs of the social order are met (through factory production in industrial capitalist orders, or rural production in landlord and peasant relations for example) and its superstructure. The second is political and ideological institutions such as religion and cultural life. Such models are often called economic determinants. *Thirdly*, through this set of power relations, the dominant class is able to make workers believe that the existing relations of exploitation and oppression are natural and unavoidable.

For media and cultural studies, the term dominant ideology is what Antonio Gramsci (1891-1937) called hegemony, which is about how a dominant value system changes and controls society. For Marxists, the emphasis on economics and class struggle as the basis of ideology has been replaced by an interest in other things, namely: a). oppression (repression, oppression); b). structures of power; and c). the ways in which the circulation and challenge of dominant assumptions play out through the power of a particular discourse [2].

Post-Marxism and Critical Pluralism

Changes that led to questions about the strengths and weaknesses of Marxism and its abandonment as a scientific approach. This is on the basis that:

a. To speak of only one dominant ideology, which is directly linked to economic power, implies a free ruling class. Whereas when it comes to capitalism, it is rooted in competition and a certain kind of contradiction. Such a 'single ideology' approach often makes very patronizing assumptions about anyone other than the person doing the analysis.
b. More recent political challenges have offered ways to analyze other types of oppression. Such as basing it on gender or ethnicity affecting life chances. They are not seen as absolute determinants, as class is in the Marxist model. But there is an important debate about the difference between diversity and inequality.

We live in a highly unequal capitalist society, driven by profit, high consumption and inequality that operates on a global scale. Meanwhile, a pluralist model of media ownership has evolved, media as free-floating power, and emphasizes diversity and a clear choice of media forms and products. There is diversity in media, especially in the internet age (social media), where website owners and large corporations are encouraged to circulate many different ideas and identities to remain profitable.

Discourse and Culture of Life

Media studies tend not to use a single dominant model versus an oppositional set of ideas, both rooted in class struggle (Marxist model) [2]. Discourse is a system of language use (arguments, descriptions, theories, etc.) constructed as part of a particular field of practice (e.g. law, fashion, politics, medicine) [2].

Discourse according to Michel O'Shougnessy and Jane Stadler (2005) is a paradigm or way of understanding communicated through text and language use, which organizes knowledge and social power [2]. Discourse can be traced from the work and thought of Foucault. Discourse is an integral part of the power of some practices. Foucault argues that discourse creates "regimes of truth" and shapes our perceptions [2]. In a certain *discursive* formation, Foucault said [2].

In the context of culture, our attention to *lived cultures* leads us to Gramsci. Gramsci emphasized that hegemony is a lived process, never simply imposed, or existing in ideas alone. The power of "*common sense*" (rather than what he called "*good sense*") comes from its connection with cultural practices, rituals and activities [2].

Everyday cultural practice involves visual discourse as well as verbal discourse, deals with gender and family ideologies, explores national identity, wields political power and fights for economic interests [2].

METHODOLOGICAL CONCEPTS

The Islamic Concept of Mustadh'afin and Ra'sul Maliyah

The term *mustadh'afin* (the oppressed) refers to human groups who are in an "inferior" social status, excluded, socio-economically oppressed, and politically discriminated against. The term *mustadh'afin* has a contextual meaning and can represent other lower social classes, such as *arâdzil* (the excluded), *fuqarâ'* (the poor), and *masâkin (the* poor).

The term *mustadh'afin* presents three figures, namely: *First*, those who are *mustadh'afin*; *Second*, those who oppress and mistreat; *Third*, *those* who help the mustadh*'afin*. Ali Shariati says that the *mustadh'afin* are a group of people who rise up against tyrannical rule. A face-off between the *mustadh'afin* and the *mustakbirin*. Habil is portrayed by Shariati as the oppressed, controlled and common people (*mustadh'afin*), while Qabil is the oppressor, ruler and elite. In the history of humanity, this image has manifested in two opposing classes of society.

Farid Esack says that someone is called *mustadh'afin* if there is someone responsible for their suffering. Someone only becomes *mustadh'afin* due to the behavior or policies of the arrogant authorities [3]. Meanwhile, Hasan Hanafi in his theological reflection says that even though according to the verses of the Qur'an we are one people (*ummatan wahidah*), objectively we are separated into poor people and rich people.

Understanding the concept of *mustadh'afin* above is in line with the prohibition of monopoly in terms of wealth. Where, *ra'sul maliyah in the* form of property, money, investment, jewelry, and other wealth must be understood within the framework of public benefit and used in supporting life (*wasilat al-hayah*). Assets must have social value. Treasure is a trust entrusted to humans according to al-Hadîd (57): 7. According to az-Zamakhsharî the treasure is not your property. Your position towards the treasure is only as a representative and trustee [4].

Wealth must be utilized, because if it is piled up and not utilized, the available capital (*ra'sul maliyah*) will be reduced, which can reduce the welfare that the Qur'an envisions [5]. The concentration of wealth in one or two groups of people will have the effect of reducing the circulation of wealth functions, both among individuals and groups (QS. al-Hasyr [59]: 7).

Islam's Critique of Critical Pluralism

Islam's commitment to social order is egalitarian and reflects equal justice and prosperity for all. In Surah al-Hujurat verses 11-13, it is mentioned that the ethics of creating peace and avoiding disputes by developing *ta'aruf*, avoiding ridicule, *suudhdhan, tajassus, ghibah,* and boasting about each other because human degrees before Allah SWT are equal.

Shariati is of the view that humans are able to acquire their own knowledge through social interaction in the real world and coordinate with the interactive relationship between God, nature, and humans. The ability of humans to acquire and master knowledge is because humans have consciousness, have freedom of choice, and have creativity [6]. Islamic scholars in this group are what Shariati calls *rûshanfekr*, scholars.

Cultural Discourse in Islam

In the context of culture, conflicts between values, beliefs or interests in the discourse of ideology and power are certainly something that cannot be avoided. Culture in Islam is understood in an open construction as part of religion. Culture is an aspect of Islamic teaching in *muamalah dunyawiyah, the* affairs of human relations with other humans and their environment. This is different from the views of E.B. Taylor, Ernest Cassirer, or Bronislaw Malinowski who saw religion as part of culture, thus setting aside the "sacredness" of religion as God's revelation. Of course, this secular view is not in accordance with the *Islamic worldview* and our beliefs as Muslims.

Islamic education is education that aims to form a complete Muslim person (*kaffah*) [7], developing all human potential both physically and spiritually [1]. This is as stated in QS al-Nahl/16: 125.

According to Bakti, in the science of da'wah and communication, there are four levels of success in communication, one of which is the level of conveying (*tabligh*) messages to others, in this case the target is understanding and meaning. With *tabligh*, the Islamic education level will be able to deliver the human person to the balance and harmony of communication, both with God and with others. Islamic communication is not only horizontal communication with others but also vertical communication with Allah SWT. Andi Faisal Bakti has developed various communication theories that become alternative communication which we then call Islamic communication that upholds human values and the nature of human creation [8].

SUBJECTS AND OBJECTS OF RESEARCH

History of the Education Roadmap

The Education Road Map (PJP) is actually only a "pre-concept" as stated by Ledia Hanifa Amaliah, a member of Commission X DPR RI or as said by the Chairman of Commission X DPR RI Syaiful Huda that the PJP designed by the Ministry of Education and Culture is only a strategic plan. It has not fulfilled the regulatory context, has not fulfilled the various prerequisites when this roadmap is considered a national education roadmap.

The birth of PJP, according to Ledia, was originally the idea of the Minister of Education and Culture (Mendikbud) Nadiem Makarim to the request of Commission X DPR RI to create a blueprint for Indonesian education. A blueprint concept that can explain where Indonesian education is going. Improvement and refinement of the quality of Indonesian education is adjusted to the educational problems faced and the challenges of global developments that occur. PJP is directed as a conceptual strategy for the development of Indonesian education in the next few years. The preparation of this PJP refers to the *grand design of* national education and is adjusted to the planned revision of Law Number 20 of 2003 concerning the National Education System.

The idea of the need for a PJP emerged in various meetings of Commission X of the House of Representatives around the end of 2019. Then came the request of Commission X of the House of Representatives to the Ministry of Education and Culture to compile an educational "blueprint". In the process, the Minister of Education and Culture presented a concept that was later called PJP in several Commission X DPR RI meetings. At the meeting on May 20, 2020, the Minister of Education and Culture submitted a 73-page draft of the Indonesian Education Roadmap 2020-2035 in pdf file format.

Commission X of the House of Representatives formed a Working Committee (Panja) to discuss the draft PJP before it was discussed in the internal meeting of Commission X. Panja PJP conducts Hearing Meetings (RDP) and Public Hearing Meetings (RDPU) by inviting education experts, religious organizations, education institutions and associations, student and youth organizations, ministries and institutions, and other education stakeholders. The results of the RDP / RDPU are made as study materials along with Commission X recommendations submitted to the Minister of Education and Culture.

Indonesia's Education Roadmap 2020-2035

The 75-page PJP draft dated December 11, 2020, does not include the phrase "religion" in Indonesia's 2035 education vision. Chairman of PP Muhammadiyah Haedar Nashir on March 1, 2021 called the omission of the phrase "religion" a form of going against the constitution (unconstitutional) because referring to the legal hierarchy, policy derivative products such as road maps cannot contradict the regulations above, namely: Government Regulations, the National Education System Law, the 1945 Constitution, and ultimately, Pancasila. Haedar's statement then sparked public debate and criticism of the PJP draft material.

PJP contains the following table of contents: a. Global trends and the future of learning; b. An overview of education in Indonesia and its challenges; and c. Indonesia's education roadmap.

The first section "Global trends..." consists of 12 slides that explain about global technological, social and environmental changes; the Covid-19 pandemic and rapid structural changes in learning; how to work in the future due to changes; problem solving, cognitive and social skills are increasingly important, while physical skills are decreasing; future learning in the *OECD Learning Compass 2030* forum; adaptation of the education system (*benchmark*) from other countries; the need for changes in Indonesia's education system related to the needs of superior HR trends needed; demographic changes; digital literacy, political stability and success in poverty eradication; changes in the labor market; and the need for educated, noble, adaptive and collaborative human resources to achieve the 2045 development target.

The second section "education overview..." consists of 12 slides on the essential elements of education; enrollment rates and education gaps; low equality of access to education; the PISA evaluation of primary and secondary learning outcomes showing problems with teacher quality, infrastructure and gaps in governance; problems with teacher quality, curriculum/programs and industry collaboration in higher education; inequality in the quality of education in Java and other parts of Indonesia due to governance, regulatory and geographical constraints; and the importance of private and industry involvement in education.

The third section "Roadmap..." consists of 46 slides that explain the key strategies and policies that the government must undertake to achieve the Indonesian education vision 2035. The formulation in this subchapter is particularly polemical because it does not include the phrase "religion" in the vision of Indonesian education 2035.

ANALYSIS RESULTS AND DISCUSSION

Ideology and Power in the Education Roadmap

The most fundamental thing about the preparation of PJP is "*Global Trends and the Future of Learning*" which is characterized by global technological, social and environmental changes. This description refers to the occurrence of technological disruption, structural changes due to the Covid-19 pandemic, sociocultural and demographic changes, energy and climate change issues, as well as the adaptation of the future of Indonesian education by looking at the secular education system *benchmarks of* Australia, the Netherlands, Finland, Canada, Germany, China, Singapore and South Korea.

Changes in the future of Indonesian education are directed towards the realization of educated, noble, adaptive and collaborative human resources as the 2045 development target. A structured and systematic description as a rational-empirical (positivistic) framework a la August Comte (1798-1857) when describing the stages of positivist European society. The emphasis on the phrase "educated, noble, adaptive and collaborative" is in line with Indonesia's 2035 education vision as stated in PJP: 14, 29.

The construction of the formulation of PJP from the beginning did not make religion a foundation. This is evident from the framework used as the basis of the argument for change and the future of Indonesian education, which eliminates the phrase religion. The absence of religious phrases in PJP was recognized by Ledia Hanifa Amaliah, a member of Commission X of the House of Representatives. According to her, since the beginning of the preparation of the "pre-concept" of the education blueprint requested by Commission X, Minister of Education and Culture Nadiem Makarim submitted PJP drafts dated May 20, 2020 and dated December 11, 2020, which did not mention religious phrases in it.

This reality can be analogized to Karl Marx's criticism of religion by considering religion as an opium. The trend of change and the future of Indonesian education is only seen mechanistically, especially in emphasizing economic problems, market needs, and in accordance with development targets. The goal of secular-materialistic education can produce smart people who master science-technology through the general education they follow. But such education has proven to fail to shape the personality of students and mastery of Islamic civilization. The foundation of secular materialism only provides long-term failures and dilemmas for the future of Indonesian education.

It must be remembered that as stated by Nurcholish Madjid expressed by Dawam, by quoting John Gardner, a scholar and Minister of Culture in the Cabinet of John F. Kennedy who stated that all the great civilizations of the world, always based on religion [9].

Removing the phrase religion in the PJP according to Prof. Dr. Haedar Nashir is contrary to Article 31 paragraph (5) of the 1945 Constitution of the Republic of Indonesia. Religion, Pancasila and culture are three interrelated entities. All three are an important part in strengthening Indonesian education as a *public good*, said Prof. Dr. Azyumardi Azra, CBU. Therefore, separating religion from the state is unconstitutional and ahistorical, said Prof. Dr. Abdul Mu'ti, General Secretary of PP Muhammadiyah. Religion has proven to play an important role in the struggle for Indonesian independence and is constitutionally guaranteed in Article 29 of the 1945 Constitution. Therefore, education as an important part of building the nation's generation, must pay special attention to religion.

In addition to the loss of the phrase "religion", PJP is also faced with structural interventions that are systemically adapted from the *benchmark* secular education systems of other countries. Whereas in the current practice of organizing national education, our education is faced with cultural interventions from various other education systems such as the use of foreign curricula, international standard schools, the opening of foreign schools, and others. This has clearly violated Article 1 of the National Education System Law which states that national education is education based on Pancasila and the 1945 Constitution which is rooted in religious values, Indonesian national culture and responsive to the demands of changing times [10].

The direction of education outlined in the PJP is different from the concept of *tabligh* and education in Islam which is in line with the functions and objectives of national education. Where education in the Islamic concept is universal and comprehensive, which should be without any partition walls that separate it [11]. This is indicated by basing education on a solid educational philosophy based on divine values (faith-prayer, monotheism), not secular, not dichotomizing between religion and science. Because all knowledge boils down to one goal, namely to recognize (*ma'rifah*) to Allah SWT and worship Him [12].

Nationalist vs. Islamic faction clash

Whether we realize it or not, the formation of ideology is influenced by the needs of the originators and the reality of the time. The existence of political parties is inseparable from the orientation and perception of the party founders about the urgency of ideology as the basis for the party's movement and work. According to Gabriel A. Almond (1956) [13] , religion, ethnicity, profession, and other sociological groupings can be factors in the establishment of political parties. More than that, people's religious orientation will more or less affect their political choices [14].

In the context of the preparation of the PJP, which neglected to include the phrase "religion" in it, it actually has similarities to the "ideology and power" at play in the process of discussing the National Education System Law in 2003. The debate on the Sisdiknas Law revolved around whether or not to include the discourse of "religion" in the law. In its rejection, PDIP stated that:

"We need a cooling down phase first, to explain the vision and mission of this bill to the public. For him, this issue has deviated and entered a vulnerable area and can threaten the integrity of the nation, so calm is needed in order to explain things that have already become a conflict, said Roy BB Janis, Chairman of the FPDIP faction."

Indeed, PDIP's rejection of the "religion" discourse represents the "ideology and power" that has been practiced by PDIP or secular nationalists. The deletion of seven words in the first precept of Pancasila was lobbied by PNI figures, Hatta on the issue of rejection or secession from Eastern Indonesia. The same narrative was voiced by President Megawati Sukarnoputri when she opposed the discussion of the National Education System Law.

"If the law is passed, Mega asked that the law be immediately socialized properly. That way, there will be no more rejection because it can trigger the disintegration of the nation. You see, various elements of society - especially eastern Indonesia - have threatened to separate themselves from the Republic of Indonesia if the law is passed."

Genealogically, the PJP policy represents government policy as a whole, because it was stated in the Limited Cabinet Meeting on June 4, 2020, chaired by President Joko Widodo. The exclusion of the phrase "religion" is a "deliberate or political power strategy" that is repeated to reinforce the ideological representation and power will of the regime, which is actually secular.

Communication Context and Influence

In the context of communication or *tabligh*, there is a theory developed by Andi Faisal Bakti (2004) that communication is related to the equalization of understanding between the sender of the message and the recipient of the message, and what is known by the recipient of the message. Bakti [15] states that communication has several stages. *First*, communication by experts who convey their opinions in scientific discussions and orations. *Second*, communication through certain media. *Third*, communication that gives effects. This concept gave birth to effect theory and satisfaction theory. The first effect theory is that communication has a beneficial effect on the *receiver* (message recipient). The second effect theory explains that communication not only has a beneficial effect on the receiver but also has a satisfying effect [2]. *Fourth*, communication is human consciousness, resulting in a new concept.

The communication pattern carried out by the secular nationalist regime by eliminating the phrase "religion" in the PJP is a form of opposition to correct information (*tabligh*) and the voice of the majority of Muslims as the general audience of message recipients. The omission or separation of religion from public policy is reflected in the attempt to clash religion (Islam) with Pancasila. We can read this from the PJP text on page 30 which mentions the term "*Pancasila Students*" as the new jargon offered to replace the phrase "humans who believe and fear God Almighty". The politics of confronting (dichotomizing) Islam and Pancasila is an orchestra that is played in the political policies of the Jokowi regime, which is famous for its jargon "*I am Indonesia, I am Pancasila*".

The strong impetus for the power of secular ideology in eliminating the phrase "religion" is quite clear with the strategy implemented by Nadiem Makarim through the Ministry of Education and Culture with various educational policies that are not based on strengthening an intact and comprehensive philosophy of education in line with the provisions of the National Education System Law, which is based on the value of religious teachings (faith-prayer) and national culture (cultural values and national pluralism). As implied in the main strategy of Merdeka Belajar, which is open to change but is not assertive or denies "inward strengthening" for the realization of humans with faith and piety. The strengthening only looks outward, towards the liberalization of other countries' education systems, pragmatism towards economic interests (markets) and technological changes, even though it is wrapped in "Pancasila Students".

CONCLUSION

Ideology and power is a discourse that is filled with struggles over meaning and interests. It represents a conflicting perspective in reading and interpreting a discourse. Moreover, the discourse shows the "truth claim" that the ruling ideological political power wants to show to other parties who have different views from it.

The discourse on national education and the dichotomy between secular and religious education are ideological battles from a Marxist perspective. The battle shows a discursive formation in the struggle for ideological interests and the power that sustains it. The interpretation and analysis built by one party will strengthen its power, while eroding the role and power of the other party. Indeed, power always tries to produce the same and repeated discourse to maintain and preserve its ideological interests. This can be seen in the struggle over the phrase "religion" or its opposition in Indonesian political policies, especially in the case of the Indonesian Education Roadmap 2020-2035.

In the review of communication and da'wah, the communication strategy shown by the secular nationalist regime as the communicator is inappropriate, because it contradicts the communication theory developed by Bakti (2004), that communication is related to the equalization of understanding between the sender of the message and the recipient of the message, and what the recipient of the message knows. When the message conveyed contradicts or does not match the aspirations of the audience, the message will fail to be conveyed properly, and will even give birth to dissatisfaction, resistance and the birth of counter-messages.

Resistance or dissatisfaction with the message conveyed will encourage audiences or communicants to convey "other messages" as a form of opposition, *counter hegemony*, or *discursive formation* that requires changes in the message conveyed. The omission of the phrase "religion" in the PJP, eliminates *trust* and creates a feeling of being treated unfairly (discrimination), thus encouraging the audience to loudly demand the inclusion of the phrase "religion" in the PJP content material. In this way, the inaccuracy in the delivery of messages, although ideological in nature, tends to cause uproar and losses for actors or communicators as messengers to communicants or audiences.

The exploration of the disappearance of the phrase "religion" in the PJP marks the play of ideology and power of the secular nationalist regime. Genealogically, the removal or deletion of the phrase "religion" is in line with the contestation of secular nationalist power in the deletion of the 7 words of Pancasila or the ratification of Law 20/2003 on the National Education System. The deletion effort strengthens the ideological roots of Nadiem Makarim as the Minister of Education and Culture who drafted the PJP, the PDIP faction and the Jokowi regime as accomplices of power and party ideological interests.

The omission of the phrase "religion" means that national education is directed more towards mechanistic changes that only rely on technological, social and environmental change trends globally. A pattern of thinking that may succeed in producing breakthroughs in physical-material progress, but will fail and be empty of the essence of human nature and the meaning of education itself. The foundation of secular materialism only provides failure and long-term dilemmas for the future of Indonesian education.

Education as a mirror of *tabligh* to convey the message of goodness (*amar ma'ruf*) and prevent the *munkar* (*nahy munkar*) so that society and future generations who are faithful and knowledgeable will experience obstacles. The audience of Muslims as *khayriyyat al-umma* (exemplary community) will certainly not remain silent and allow the message conveyed to be ideologically contrary to the religious values and cultural traditions believed.

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Fraction Learning Using Lemang Context to Construct Argumentation Ability of Students in Grade V Elementary School

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Abstrak. This research started with the fact that students have low mathematical argumentation skills when solving contextual problems. Since fraction learning focuses on memorizing fraction operation rules and procedures, the argumentation ability is hampered. Students should be taught what fractions are first so that they can explain how to solve fractions. The purpose of this study is to determine the role of lemang context in fraction material in building students' argumentation ability. The study also produced a hypothetical learning trajectory on fractions through the use of lemang context. This study conducted a validation study type design research. The design research stages described in this study only reached the pilot experiment stage (cycle 1). The subjects in this study used two classes in one of the schools in Muara Enim. Pretest, observation, interview, and documentation were the data collection methods in this study. The hypothetical learning trajectory produced by this study consisted of two activities. The designed activities started with measuring materials to make lemang and using the right canting to measure fractions. The retrospective analysis results of the pilot experiment showed that using the context of lemang can improve the argumentation skills of elementary school students. The results showed that groups 1 and 2 could demonstrate the argumentation elements of data, claim, warrant, and backing.

INTRODUCTION

The study of fractions is an important part of elementary level math [1] and must be learned because of its relevance to everyday life [2]. Fractions are a basic level material that is important to understand for students studying algebra and advanced math [3]. This important material is a basic lesson that is difficult for students to understand [4] and is the part of math material that is least understood by elementary school students [5]. The context of fractions is familiar to students even before they enter formal schooling. Students use fractions when interacting with their environment, although not in mathematical term [6]. This shows that fractions are very useful in everyday life. Students' difficulties in calculating fractions may be caused by imperfect classroom learning. Because in carrying out learning activities is not always successful, sometimes we encounter obstacles that lead to failure in learning.

Through observation of the learning process, the learning outcomes achieved are still mostly in the form of homework and assignments. This causes poor student understanding due to the limited teacher explanation and the limited time of the ongoing teaching and learning process. It is rare to use props/media when the teacher explains the material, and most teachers continue to teach without using an appropriate learning model.

Teachers need to find ways to introduce fraction in a simpler and easier to understand way. Presenting fractions in the form of pictures before switching to symbolic fractions will actually help students better understand the concept of fractions [4]. Students' understanding of the concept can be shown through their arguments both written and oral. In learning mathematics, argumentation is very important for students to understand concepts [7]. Many studies have

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040034-1–040034-10; https://doi.org/10.1063/5.0241617
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

emphasized the importance of argumentation, as effective argumentation skills are essential for good conceptual understanding [8]. One's understanding is important for the quality of arguments presented [9]. Argumentation is the activity of presenting a conclusion supported by evidence with the aim of convincing the audience of the proposed conclusion [10]. In general, argumentation analysis is based on the argumentative model proposed by Toulmin, which follows the process from data to conclusion. One way to study the factors that encourage argumentation in mathematics learning is to study the strategies teachers use to manage argumentation [11].

One of the solutions used by researchers is to hypothesize the learning trajectories that students will experience. The resulting hypothesis provides a learning process that can be used as a reference in planning lessons to overcome the problems faced by students. Learning trajectory is the process of student learning in the process of understanding learning, including clues, activities, and hypotheses about the learning process that describe student thinking and understanding during the learning process of learning [12]. Appropriate learning trajectories are important to support students' mathematical understanding [13]. Gravemeijer [14] argues that when designing a learning process, teachers should start by conducting thought experiments, namely imagining the learning process taking place until it reaches the process of self-exploration, called the Hypothetical Learning Trajectory (HLT).

To support this HLT, various approaches are needed that can support students' argumentation skills on fractions worth. The approach used in this research is the realistic mathematics approach. In this approach, the role of the teacher is no more than a facilitator, moderator, or evaluator while the role of students is more and active to think, communicate their arguments, and train students to be able to respect the opinions of other friends [13].

Some previous studies have produced hypothetical learning trajectory with PMRI approach [15]. Based on the results of HLT design research using PMRI, it was concluded that HLT through a realistic mathematics approach helped students in understanding mathematics. The PMRI approach is an approach that refers to realistic problems so that the learning process carried out must be based on a context that encompasses the experience or that is in the daily lives of students, learning like this is expected to be meaningful to them [14]. One of the contexts that can increase the relevance of mathematics learning by linking mathematical concepts to students' daily lives is the context of Lemang. The use of contexts that are familiar or close to students' lives can increase their motivation to learn mathematics. Students tend to be more interested and excited when they see the connection between the subject matter and their own experiences. By involving students in concrete situations such as calculating the ingredients to make lemang or planning the size of lemang, they can better internalize mathematical concepts. It is hoped that by utilizing the context of lemang, teachers can create a more meaningful mathematics learning experience, improve students' understanding, and arouse their interest in the subject.

Based on the description above, this study aims to design a hypothetical learning trajectory to develop students' argumentation skills on equivalents fractions using lemang context.

METHOD

This research used design research, validation study type. The main purpose of this research was to produce a learning trajectory by designing a Hypothetical Learning Trajectory (HLT) on fraction material to construct students' argumentation skills with the PMRI approach. Gravemeijer [14] stated that HLT consists of three main components, namely (1) learning objectives, (2) learning activities and media used in the learning process, (3) the alleged learning process how to find out students' understanding and strategies that appear and develop when learning activities are carried out in the classroom. This research was conducted in the even semester of the 2023/2024 academic year. The research subjects were fifth grade students of SD IT Muara Enim. The stages passed in validation study type research, namely (1) preliminary design, (2) design experiment, and (3) retrospective analysis.

The first stage is preliminary design. The researcher conducted a literature review whose data collection used articles on the analysis of learning difficulties of fraction materials, how to overcome them in elementary school students, students' argumentation skills, and the PMRI approach. At the design experiment stage, there are two stages, namely, pilot experiment and teaching experiment. The design research stage described in this study only reaches the pilot experiment stage (cycle 1). The pilot experiment or preliminary teaching experiment aims to test the HLT that has been designed to collect data to adjust and revise (if needed). After the learning activities were completed, researchers and model teachers reflected on the learning activities that had been carried out in order to improve the next learning.

Researchers collected data by documenting student learning activities through video recordings and photos of activities as evidence related to the implementation of the study, written data such as the results of pretests and pilot experiments given to students, observation sheets as supporting data from video recordings, and interviews will be conducted with several students to find out abilities related to fraction multiplication material and argumentation skills of these students. The instrument used in the pilot experiment stage is an activity sheet that has been validated by experts. The results of expert validity showed that the activity sheets were good in terms of content, construct and language. The activity sheet effectively measures what is desired, the skills that should be measured, and uses language that is appropriate and clear for student understanding. The activity sheets can be used reliably in assessing students' abilities related to the competencies or concepts being measured.

RESULT AND DISCUSSION

In the preliminary design stage, researchers first reviewed the literature related to the difficulties of fraction material, how to overcome difficulties in learning fraction material, and learning using the PMRI approach. Research [16] argues that students have difficulty in performing fraction operation calculation procedures whether the denominators are the same or different. The results of the research analysis of the factors causing these difficulties are the lack of understanding of the concept of fractions in students. from the results of the research provided advice for teachers to be able to understand the situation of students and bring up the necessary schemes when students have difficulty in working on fraction operations. This is in line with [17] which mentions a lack of understanding of the concept of fraction multiplication which is characterized by students still having difficulty completing fraction multiplication calculation operations. Research [18] found that there are some difficulties in learning math fraction material, namely difficulties in learning concepts, difficulties in applying principles, and difficulties in solving verbal problems. According to [19] it is appropriate to describe and analyze students' mathematical argumentation process early on because students' early mathematical argumentation skills have a role in the learning process. Research [10] concluded that the application of learning and learning theory and PMRI principles had a logical impact on students' argumentation components.

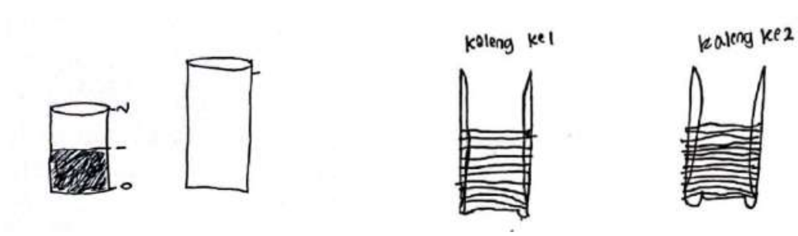
Prior to the cycle 1 experiment, a pretest was conducted for class V.A students as many as 33 students to see the initial abilities of students, besides that the pretest aims to measure the extent to which students understand the prerequisite material and see students' argumentation skills in solving fraction problems whether students have understood the meaning of fractions and can make the right fraction from a whole part. The questions given used problems related to daily life, fraction operations, and lemang context, where in the next learning process the lemang context will also be used to teach fraction material.

Problem 1.

1. It is known that 2 empty milk cans will be filled with water. The first can will be filled with half and 1/2 cans of water while the second can will be filled with 2/4 cans of water. Draw 2 cans that contain as much water as the information from the question!

FIGURE 1. Pretest Problem Number 1

Problem number 1 is used to determine whether students can express fractions in the form of images and can understand fractions worth from the images made. The following are the results of students' answers in solving problem 1 in Figure 1.



(a) (b)

FIGURE 2. Some Student Answers to Pretest Question Number 1

From Figure 2 student 3 (Figure 2.a) can show half as much water but cannot show 2/4 as much water. While student 2 (Figure 2.b), can be showed the water as much as 1/2 and 2/4 correctly. This shows that student 2 can make a claim correctly. The results of the interview, it was found that student 2 could show other argumentation components. The following is the transcript of the teacher and student 2 interview.

Teacher : what is asked in the questionnaire?
Student 2 : told to draw 1/2 and 2/4.
Teacher : is this the result? (pointing to the answer number 1)
Is this the first picture of the can that is 1/2?
Student 2 : yes
Teacher : this one? (pointing to the 2nd can picture)
Student 2 : 2/4
Teacher : why is the line here? (pointing to the 1st can picture)
Student 2 : because I think 1/2 is half.
Teacher : ooo, because it is in the middle. The 2nd can is 2/4, why is it the same border?
Student :because 1/2 and 2/4 are the same

The transcript of the teacher and student 2 interview above, shows that student 2 can explain the data and warrant that supports the claim that has been made on the answer sheet of question number 1.

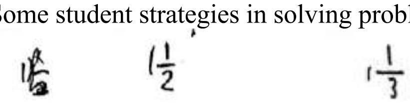
The pretest results show that the answers of student 1, student 2, and student 3 have shown that students can solve problem number 1. While student 4, student 5, student 6, and other students are still not correct in solving the problem. Students can draw water as much as 1/2 but cannot draw water as much as 2/4, in this case the same as the answer of student 3 (Figure 2.a). In addition, students can draw 1/2 water and students can draw 2/4 water, but the amount of water 1/2 is not the same as the amount of water 2/4. Students draw 2/4 more water than 1/2 water. This shows that students do not understand the meaning of fractions worth and cannot explain fractions in the form of pictures.

Problem 2.

2. Find the equivalent fraction of 2/3.

FIGURE 3. Pretest Problem Number 2

The question in Figure 3. is made based on the learning objectives that have been formulated, namely to determine and explain the meaning of equivalent fractions. Students are asked to determine the fraction worth of 2/3. The answer to the question of the fraction worth 2/3 is 4/6, 6/9, 8/12 and so on. The pretest results show that student 3 can solve question 2 correctly. Student 3 wrote the answer 2/3 = 4/6 = 6/9 = 8/12 = 16/24 = 18/27 = 20/30. From the results of the interview with student 3, it was found that student 3's understanding in solving fractions worth is by multiplying the same number in the numerator and denominator of the given problem. Student 2 and 2 other students wrote the equivalent fraction of 2/3 is 4/6. Some student strategies in solving problem number 2 can be seen in Figure 4 below.



(a) (b)

FIGURE 4. Some Student Answers to Pretest Question Number 2

Figure 4.a (student 6) and Figure 4.b (student 1) answered by converting the fraction in question into a mixed fraction form. The following is the result of student 6's interview regarding the answer number 2 written on the answer sheet.

Teacher : what does fraction worth mean, have you ever heard of fraction worth?
Student 6 : I have, but I forgot.
Teacher : fraction worth of 2/3, why can you get 1 1/2?
Student 6 : this is 2 × 1 = 2, plus 1 equals 3, so 3/2.
Teacher : ohh, turn it into a mixed fraction
Student 6 : yes
Teacher : the answer was 3/2, but in question number 2, you're looking for the fraction worth 2/3.
Student : wrong sir, it means 1 1/3, ummm don't know sir, don't understand.

The transcript of the teacher and student 6 interview above shows that student 6 has not been able to determine and explain the meaning of fractions worth correctly. This is because students forget the meaning of fractions worth, besides that student 6 is also in a hurry in solving problem number 2. Students can convert fractions of 3/2 into fractions of 1 1/2, which shows that student 6 understands how to convert ordinary fractions into mixed fractions. However, for fraction 2/3 students were confused to convert it. In addition to student 1 and student 6, the results of other students' answers also show that students do not understand and cannot explain equivalent fractions. This can be seen from the results of other students' answers which are the same as the results of student 1's answers, namely answering 1/3, 11/2, 2, 9/6, 1 and not answering the question number 2 given.

In this study, the Hypothetical Learning Trajectory (HLT) consists of two activities designed for students to understand fraction learning using lemang context in learning activities.

TABLE 1. HLT Activity 1

Learning Objectives	Activities	Student Thinking Conjecture
Students can understand the meaning of fractions	Estimating the amount of glutinous rice 1/2 canting by drawing a picture.	• Students draw a canting and then divide it into two equal parts, then put a mark stating the amount of glutinous rice 1/2 canting. • Students know the number of 1/2 glutinous rice with the help of canting media and then sketched in the picture.
	Estimating the amount of glutinous rice 1/4 canting	• Students draw a canting and then divide it into four equal parts, then put a mark stating the amount of coconut milk 1/4 canting. • Students know the amount of 1/4 coconut milk with the help of canting media and then sketched in the picture.
	Conclusion	• Students can conclude that 1/2 canting glutinous rice is obtained from drawing one canting and then dividing it into two equal parts, then filling the canting with glutinous rice as much as one part of the canting. • Students can conclude that 1/4 canting coconut milk is obtained from drawing one canting and then dividing it into four equal parts, then filling the canting with coconut milk as much as four parts on the canting.

TABLE 2. HLT Activity 2

Learning Objectives	Activities	Student Thinking Conjecture
Students can perform and explain equivalent fractions	Determining 5/4 canting coconut milk water using canting with the measurement provided	• Students show 5/4 coconut water canting using 1 full coconut water canting and 1/4 coconut water canting. • Students use canting measure 1/8 to make coconut milk as per the information in the question. • Students use 1/8 canting of coconut milk, then transfer 10 canting of 1/8 coconut milk to empty canting. • By considering the amount of coconut milk 5/4 and the amount of coconut milk 10/8 , students determine that 5/4 canting can be found using 10/8 canting.
	Determining the 5/4 canting of coconut milk water by drawing a picture	• Students draw 1 full canting of coconut milk and 1/4 canting of coconut milk to represent 5/4 canting of coconut milk. • Students draw the same canting size as the canting from the previous drawing • Students divide the canting into eight equal parts and compare with a fully filled canting, then students make another 1

Learning Objectives	Activities	Student Thinking Conjecture
		canting to compare with 1/4 canting filled with coconut milk. • By looking at the picture that has been sketched. Students determine 5/4 canting equals 10/8 canting
	Conclusion	• Students can conclude that 5/4 canting coconut milk is equivalent to 10/8 canting coconut milk and is symbolized by 5/4 =10/8.

Pilot experiment (cycle 1) is to try out the learning design of fraction material using the context of lemang to construct students' argumentation skills in accordance with the HLT that has been designed at the preliminary design stage to 6 students of class V.B SD IT Rabbani Muara Enim with different student abilities, namely, high, medium and low abilities. The following is a display of the activity sheet used can be seen in Figure 5.

(a)

Translation

LEARNING MEDIA
CANTING

Naming Parts and Symbolizing Names
Note the amount of glutinous rice in Figure 1. The amount of glutinous rice is called "half".

Hereafter the term half is symbolized by "$\frac{1}{2}$".

Note the amount of glutinous rice in figure 2. The amount of glutinous rice is called "one-fifth", and is symbolized by "$\frac{1}{5}$".

The three parts filled with glutinous rice are called "three-sixths", and symbolized by "$\frac{3}{6}$".

(b)

(c)

Translation

ACTIVITY 1: Understanding the meaning of fractions

Lemang

The Melemang tradition is a custom of Karang Raja Village in Muara Enim Regency to commemorate the 10th of Muharram. Lemang is an obligatory food when welcoming the Islamic New Year. The process of making lemang requires glutinous rice, coconut milk, salt, banana leaves, and bamboo. The first step begins with preparing the bamboo, which is cut into 40 cm lengths and then cleaned with water and rubbed with coconut fiber to remove the noodles. The bamboo that has been cut and cleaned can only be used the next day. After that, the inside of the bamboo is coated with banana leaves so that the contents do not stick to the bamboo. The banana leaves used for this layer of bamboo are banana leaves that have been dried in the sun so that they do not tear easily when rolled. Next, put the glutinous rice mixed with coconut milk in turn until it reaches almost full and then burned for 4-5 hours.

Contextual Problem
It is known that the amount of ingredients for lemang to be cooked perfectly is by using $\frac{1}{2}$ canting glutinous rice and $\frac{1}{4}$ canting coconut milk. Can you show the amount of glutinous rice $\frac{1}{2}$ canting and coconut milk $\frac{1}{4}$ canting?

1. What are the measurements of lemang ingredients that are known from the problem above!

(d)


Menjelaskan masalah kontekstual

2. Permasalahan apa yang akan diselesaikan!

Komponen Argumentasi (Data)

Menyelesaikan masalah kontekstual

3. Buatlah dua canting yang masing-masing telah dibagi menjadi dua bagian dan empat bagian yang sama besar !

Mendiskusikan masalah kontekstual

4. Bagaimana cara kalian menunjukkan beras ketan $\frac{1}{2}$ canting dan air santan $\frac{1}{4}$ canting!

Komponen Argumentasi (Backing)

(e)

Translation

2. What problem to solve!

3. Make two canting that have each been divided into two equal parts and four equal parts!

4. How do you show glutinous rice $\frac{1}{2}$ canting and coconut milk $\frac{1}{4}$ canting!

(f)


Menyimpulkan

5. Gambar canting yang telah diisi beras ketan $\frac{1}{2}$ canting dan air santan $\frac{1}{4}$ canting!

Komponen Argumentasi (Claim)

Latihan soal

1. Perhatikan kembali media pembelajaran canting. Berilah nama dan simbol pada banyaknya canting yang diisi beras ketan dibawah ini!

2. Gambarlah canting yang sudah diisi air santan $\frac{3}{4}$ bagian!

(g)

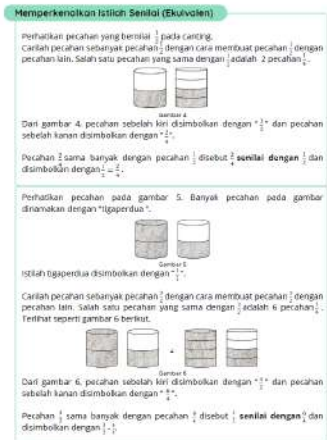
Translation

5. Draw a canting that has been filled with $\frac{1}{2}$ canting glutinous rice and $\frac{1}{4}$ canting coconut milk!

Practice question

1. Take a look at the canting learning media again. Give names and symbols to the many canting filled with glutinous rice below!
2. Draw a canting that has been filled with $\frac{3}{4}$ coconut milk!

(h)



Memperkenalkan Istilah Senilai (Ekuivalen)

Perhatikan pecahan yang bernilai $\frac{1}{2}$ pada canting.
Carilah pecahan sebanyak pecahan $\frac{1}{2}$ dengan cara membuat pecahan $\frac{1}{2}$ dengan pecahan lain. Salah satu pecahan yang sama dengan $\frac{1}{2}$ adalah 2 pecahan $\frac{1}{4}$.

Gambar 4

Dari gambar 4, pecahan sebelah kiri disimbolkan dengan "$\frac{1}{2}$" dan pecahan sebelah kanan disimbolkan dengan "$\frac{2}{4}$".

Pecahan $\frac{2}{4}$ sama banyak dengan pecahan $\frac{1}{2}$ disebut $\frac{2}{4}$ **senilai dengan** $\frac{1}{2}$ dan disimbolkan dengan $\frac{1}{2} = \frac{2}{4}$.

Perhatikan pecahan pada gambar 5. Banyak pecahan pada gambar dinamakan dengan "tigaperdua".

Gambar 5

Istilah tigaperdua disimbolkan dengan "$\frac{3}{2}$".

Carilah pecahan sebanyak pecahan $\frac{3}{2}$ dengan cara membuat pecahan $\frac{3}{2}$ dengan pecahan lain. Salah satu pecahan yang sama dengan $\frac{3}{2}$ adalah 6 pecahan $\frac{1}{4}$. Terlihat seperti gambar 6 berikut.

Gambar 6

Dari gambar 6, pecahan sebelah kiri disimbolkan dengan "$\frac{3}{2}$" dan pecahan sebelah kanan disimbolkan dengan "$\frac{6}{4}$".

Pecahan $\frac{3}{2}$ sama banyak dengan pecahan $\frac{6}{4}$ disebut $\frac{3}{2}$ **senilai dengan** $\frac{6}{4}$ dan disimbolkan dengan $\frac{3}{2} = \frac{6}{4}$.

(i)

Translation

Introducing the term equivalent

Look at the fraction that is $\frac{1}{2}$ on the canting.
Find as many fractions as $\frac{1}{2}$ by making fractions with other fractions. One of the fractions that is equal to $\frac{1}{2}$ is 2 fractions of $\frac{1}{2}$.

From Figure 4, the left fraction is symbolized by "$\frac{1}{2}$" and the right fraction is symbolized by "$\frac{2}{4}$".

The fraction $\frac{2}{4}$ equal to the fraction $\frac{1}{2}$ is called $\frac{2}{4}$ equal to $\frac{1}{2}$ and is symbolized by $\frac{1}{2} = \frac{2}{4}$.

Consider the fraction in Figure 5. The number of fractions in the figure is called "three twos".

The term three halves is symbolized by "$\frac{3}{2}$".

Find a fraction as many as the fraction $\frac{3}{2}$ by making the fraction $\frac{3}{2}$ with another fraction. One of the fractions that is equal to $\frac{3}{2}$ is 6 fractions of $\frac{1}{4}$. It looks like the following figure 6.

From Figure 6, the left fraction is symbolized by "$\frac{3}{2}$" and the right fraction is symbolized by "$\frac{6}{4}$".

The fraction $\frac{3}{2}$ equal to $\frac{6}{4}$ is called $\frac{3}{2}$ equal to $\frac{6}{4}$ and is symbolized by $\frac{3}{2} = \frac{6}{4}$.

(j)

AKTIVITAS 2
Menentukan pecahan senilai

Permasalahan Kontekstual

Diketahui akan dibuat beberapa lemang dengan ukuran bambu yang digunakan membutuhkan air santan $\frac{5}{4}$ canting. Jika canting yang tersedia memiliki takaran $\frac{1}{5}$, $\frac{1}{6}$ dan $\frac{1}{8}$. Canting dengan takaran manakah yang harus digunakan agar banyaknya air santan dapat dibuat sesuai yang diperlukan?

1. Apa saja informasi yang diketahui dari permasalahan kontekstual di atas!

2. Berdasarkan permasalahan kontekstual diatas, permasalahan apa yang akan diselesaikan!

(k)

Translation

ACTIVITY 2 Determining equivalent fractions

Contextual Problem

It is known that some lemang will be made with the size of the bamboo used requiring $\frac{5}{4}$ canting coconut milk. If the canting available has measures of $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{8}$. Which canting should be used to make the required amount of coconut milk?

1. What is the known information from the contextual problem!

2. Based on the contextual problem above, what problem will be solved!

(l)

3. Gambarlah dibawah ini canting yang telah terisi air santan sebanyak $\frac{5}{4}$ canting!

4. Buatlah gambar canting yang tersedia dengan takaran sesuai informasi dari soal!

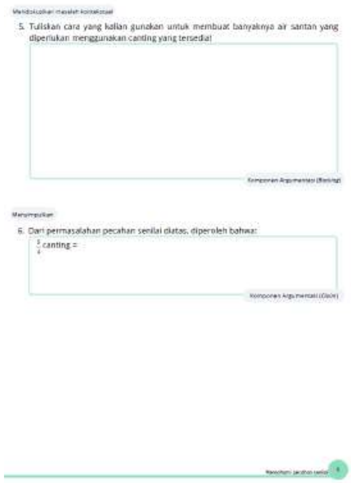
(m)

Translation

3. Draw below a canting that has been filled with coconut milk as much as $\frac{5}{4}$ canting!

4. Draw a picture of the available canting with the dosage according to the information from the question!

(n)



(o)

Translation

5. Write down the method you used to make the required amount of coconut milk using the canting provided!

6. From the equivalent fraction problem above, we found that:
$\frac{5}{4}$ canting =

(p)

FIGURE 5. Activity Sheet

The student activity sheet is designed to construct the argumentation component of students and is made in accordance with the PMRI learning stages.

Activity 1 aims to understand the meaning of fractions using the recipe for making lemang. The results of students' answers in groups 1 and 2 show that the context of lemang has a role in constructing students' argumentation skills. The results of observations in the pilot experiment found that high ability students understood that in making fractions of 1/4 in canting. Given three lines with the same distance between each line. This helped low ability students in understanding the meaning of fractions. In this activity, it can be concluded that students can show and explain the meaning of fractions and can write fraction symbols. The results of the answers of groups 1 and 2 in activity 1, showed that the HLT designed was in accordance with student activities when working on the activities given. Although some students experienced difficulties, with guided questions from the teacher students could solve the problems given so that the strategies that emerged were in accordance with the HLT designed.

Activity 2, aims to determine and explain equivalent fractions. The results of students' answers from the given activity show that students can determine the equivalent fraction of 5/4. From the answers to the activity sheets and researcher observations, students can state the claim correctly. Students can show backing in the argumentation component. Students stated that to make a fraction of coconut milk water 5/4 canting, they made 2 canting size 1/8, 1 canting filled in full and 1 canting filled in 2/8. The pilot experiment stage in activity 2 also showed that the HLT designed was in accordance with students' activities when working on the given activity.

Based on PMRI learning steps, students can understand the contextual problems given, explain contextual problems, solve contextual problems, discuss contextual problems to conclude the results of the problem. Students' argumentation skills when viewed from the results of answers and observations made by researchers during the process of completing activity 1. Students can state the claim correctly. Students can show what is known and asked from the problem, meaning that students can show the data argumentation component. In addition, students can also provide warrant and backing in the argumentation component. Students show and explain how they make a claim.

CONCLUSION

This research produced a hypothetical learning trajectory for fractions worth to construct students' argumentation ability. The HLT design was based on the results of the pretest and pilot experiment. The HLT formulated at the pilot experiment design stage will be tested in the teaching experiment so that a new and better HLT can be implemented. This HLT is flexible so that it can be adjusted to students' reactions during the learning process in the pilot experiment and teaching experiment. Retrospective analysis on the implementation of the pilot experiment showed that the use of lemang context can construct the argumentation skills of elementary school students.

ACKNOWLEDGMENTS

The author would like to thank Mrs. Reni Syaputri, S.Pd for validating the HLT as well as being a model teacher in this study and for providing suggestions and comments so that it can be used to carry out the research. The researcher is also grateful to the principal, mathematics teachers of SD IT Rabbani Muara Enim who have provided assistance in this research.

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Students' Understanding on Mathematical Concepts and Their Self-confidence in Learning Spatial Geometry

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Abstract. This research was aims to describe students' ability to understand the mathematical concepts and their self-confidence in spatial geometry courses. The research participants in this study were 3 students at mathematics education of Universitas Negeri Jakarta who were grouped based on high/low/medium levels of self-confidence. Data collection techniques were carried out using written tests on the ability to understand mathematical concepts and interviews. The data obtained were analyzed by using Miles and Huberman's stages, namely data reduction, data presentation and drawing conclusions. The results of the research show that: (1) Students who have high self-confidence tend to be able to restate a concept that has been learned, classify objects according to certain properties in accordance with the concept, provide examples and non-examples, present concepts in various forms of mathematical representation, and apply concepts in problem solving procedures, but have not been able to develop necessary or sufficient conditions for a concept; (2) Students with moderate self-confidence tend to be able to restate a concept, provide examples and non-examples, and present concepts in various forms of mathematical representation. However, students with moderate self-confidence are not yet able to classify objects according to certain characteristics, develop necessary or sufficient conditions for a concept and apply the concept in problem solving; (3) Students with low self-confidence tend to only be able to classify objects according to certain characteristics and provide examples and non-examples of a concept.

INTRODUCTION

Conceptual comprehension describes a student's capacity to master a subject, where they are able to recall or know some concepts they are learning and can articulate them in other easy to understand terms [1].The ability to understand mathematical concepts is one of the mathematical abilities that must be possessed when studying mathematics [2]. Learning mathematics means understanding mathematical concepts, namely being able to interpret, represent and conclude mathematical concepts based on one's own knowledge, not just memorizing mathematical formulas [3]. Understanding conceptual allows students to solve mathematical problems in various forms. Students with high levels of conceptual knowledge are capable solve problems they have never experienced before [4]. Because there is a connection between these concepts, the concepts that have been studied will become prior knowledge for other concepts to be learned. Thus, in students' learning mathematics. It is certain that he will experience difficulties if he does not master the prerequisite knowledge, because concept in mathematics is an abstract idea allows us to classify objects or events as well classify what objects are and those events include or not included in abstract ideas [5]. Understanding the concept is ability to comprehend deepen a concept with empower logical, critical thinking, creative, innovative, and capable apply concepts in form mathematical problem solving [6]. Each learner should have mathematical skills for mathematics to be effectively learned. Because they are creative, adaptable, efficient, and possess certain dispositional mathematical skills, students who are proficient in mathematics are regarded as good problem solvers [7].

The learning process is a conscious activity, so changes in student behavior in the affective field must also be realized, both by the teacher and the students themselves. There are many effective factors that can be assessed, self-confidence is one aspect that can be assessed in mathematics learning activities [8]. One of the psychological elements

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040035-1–040035-6; https://doi.org/10.1063/5.0243112

that is important and widely used as a research topic to determine its influence or relationship with student achievement is self-confidence [9]. An attitude or emotion regarding our own skills is known as self-confidence. A person with strong self-confidence won't act nervously, will be free to do what they want, will be responsible for their choices, will engage with people in an amicable and respectful manner, will respect others, will persevere in achieving their goals, and will be aware of their strengths and flaws [10]

Self-confidence is a person's belief in their ability to display certain behavior or to achieve certain targets [11]. In other words, self-confidence is how we feel about ourselves and our behavior will reflect this without us realizing it. Students who have high self-confidence will tend to have stability in learning. Self-confidence grows within each individual. This means that self-confidence can encourage an individual to realize hopes and aspirations, because without self-confidence a person will tend to hesitate in acting and making decisions and this can be detrimental to themselves and others. Based on some of the literature above, research is needed on students' understanding of mathematical concepts in terms of self-confidence

METHODOLOGY

Research Type

This study used descriptive research with a qualitative approach. This research was aimed to determine students' understanding of mathematical concepts when viewed from self-confidence in spatial geometry courses.

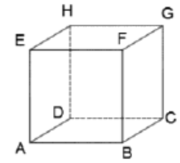
Participants

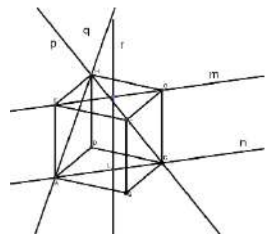
The subjects selected were 3 students from the mathematics education study program, State University of Jakarta who took spatial geometry course. These students have high/low/medium self-confidence category based on the results of the questionnaire that has been analyzed.

Instruments

Instrument in this research was a test of understanding mathematical concepts in the spatial geometry course and a self-confidence questionnaire. The test for understanding mathematical concepts consists of 6 essay questions which are arranged based on indicators of understanding mathematical concepts, namely: 1) restating a concept; (2) Classifying objects according to certain properties; (3) Give examples and non-examples; (4) Presenting concepts in various forms of mathematical representation; (5) Developing necessary or sufficient conditions for a concept; (6) Apply problem solving concepts or algorithms. The test for understanding the concept of mathematical ability can be seen in the table 1.

TABLE 1. Instrument of understanding mathematical concepts

Question Item	Indicator	Test
1	Restating a concept	What is meant by distance from point to line and point to plane?
2	Classifying objects according to certain properties	On the following cube, list each of the five instances of point-to-point and point-to-line distances. 

3	Giving examples and non-examples	Name the lines that are coplanar! 
4,5	Presenting concepts in various forms of mathematical representation Developing necessary or sufficient conditions for a concept	Draw the intersection plane of the pyramid T.ABCD with point P on TA so that TP=1/4 TA, point Q= 1/2 TB and point R on DR = 1/4 TD
6	Applying problem solving concepts or algorithms	A tapered cone-shaped lampshade wants to be fitted with cloth around it. The radius of the top circle is 9 cm and the radius of the bottom circle is 15 cm and the width of the lampshade is 10 cm, while the total length of the cone painter's line is 25 cm, determine the area of fabric needed!

While the self-confidence questionnaire was prepared according to the following indicators: (1) Have confidence in your abilities; (2) Have a positive outlook; (3) Objective; (4) Responsibility; (5) Able to think rationally and realistically. Before being given to students, test instruments and questionnaires are first validated by experts, namely 3 mathematics lecturers, 2 psychology lecturers and 1 psychologist.

Data Analysis

The data analysis technique used was Miles Huberman's qualitative data analysis technique, namely data reduction, data presentation and conclusions. Activities in data analysis were carried out interactively and continue continuously until completion. The results of data analysis of test and interview results from research subjects are presented in the form of descriptions.

RESULT AND DISCUSSION

Self-confidence Questionnaire Results

The self-confidence questionnaire was given to 40 students taking space geometry courses. The results of the self-confidence questionnaire that have been analyzed can be seen in table.

TABLE 2. Self-confidence Questionnaire Results

Level of self-confidence	Total
High	11
Medium	20
Low	9

Based on the grouping of students above, 1 student was taken who had high, medium, and low self-confidence with the criteria being that the questionnaire score was close to the upper threshold according to the level of self-confidence, had good communication skills and was willing to follow all stages of the research to completion. Next, each research subject worked on questions on understanding mathematical concepts which had been prepared according to indicators of understanding mathematical concepts and validated by experts. The subjects in this research can be seen in table 3.

TABLE 3. Research Subject

Level of self-confidence	Total Subject	Subject Code
High	1	A5
Medium	1	A14
Low	1	A2

Results of Analysis of Student Conceptual Understanding

Researchers analyzed the results of students' conceptual understanding ability test answers for each indicator of understanding mathematical concepts which were reviewed based on the level of self-confidence.

1. Analysis of students' understanding of mathematical concepts with high self-confidence

a) Restating a concept

Subject A5 was able to master the concept well. This can be seen from subject A5 being able to determine line segments that are distances in space and being able to explain them correctly. Subject A5 was able to answer verbally through interviews about what is meant by distance between points, distance from points to lines and planes, distance between lines and distance between planes.

b) Classifying objects according to certain properties

Subject A5 was able to master this indicator well. Subject A5 was able to differentiate the distance between points and the distance from points to lines, as well as determine triangles in cube space for assistance in calculating point-to-line distances.

c) Giving examples and non-examples

Subject A5 can provide the lines that are coplanar, even though he did not write down all the coplanar lines, subject A5 generally understood the material. This was obtained from the results of an interview with subject A5 who thought that he was only asked to write one of the lines that was coplanar.

d) Presentings concepts in various forms of mathematical representation

Subject A5 can now present the concept of spatial shapes into picture representations.

e) Developing necessary or sufficient conditions for a concept

Subject A5 can draw truncated geometric shapes with a base in the form of sliced geometric shapes formed from three known points. However, he was still confused about determining the area of a truncated structure. Based on the results of the interview, He did not really understand how to determine the length of the ribs of a truncated structure.

f) Applying problem solving concepts or algorithms.

Subject A5 is good at using concepts and procedures in solving everyday problems. This can be seen from the test results calculating the volume of the bucket which is a truncated cone.

2. Analysis of students' understanding of mathematical concepts with medium self-confidence

a) Restating a concept

Subject A14 was able to answer the questions well, but was still confused about answering verbally through interviews about what is meant by distance between points, distance from points to lines and planes, distance between lines and distance between planes.

b) Classifying objects according to certain properties

Subject A14 was not able to classify the distance between points and the distance from points to lines in the cube. Based on the results of the interview, subject A14 was still confused in determining which line was the shortest to calculate the distance from point to line.

c) Giving examples and non-examples

Subject A14 can provide examples and non-examples of the lines that are coplanar.

d) Presents concepts in various forms of mathematical representations.

Subject A14 can now present the concept of spatial shapes into picture representations

e) Developing necessary or sufficient conditions for a concept

Subject A14 has not been able to develop sufficient and necessary conditions for a concept. This can be seen from the test answers that subject A14 does not yet understand the known points to create a spatial intersection.

f) Apply problem solving concepts or algorithms.

Subject A14 has not been able to solve the problem of calculating the volume of a truncated geometric shape. Based on the results of the interview, subject A14 was hesitant in determining the shape of the truncated space.

3. Analysis of students' understanding of mathematical concepts with low self-confidence

a) Restating a concept

Subject A2 was not yet able to restate a concept. Subject A2 was only able to understand the concept of distance between points, but it did not understand the concept of distance between points and lines. Based on the results of the interview, subject A2 was not sure about determining the position of a point on a line that would be connected to another point by a line.

b) Classifying objects according to certain properties

Subject A2 was able to master this indicator. Subject A2 was able to connect every known point to form a triangle.

c) Giving examples and non-examples

Subject A2 can provide examples and non-examples line that are coplanar.

d) Presentings concepts in various forms of mathematical representation

Subject A2 cannot yet make points and lines on the cube according to the instructions known in the problem. Based on the results of the interview, subject A2 was confused in determining the position of a point on a line if the ratio of the line segments was known.

e) Developing necessary or sufficient conditions for a concept

Subject A2 has not been able to develop sufficient and necessary conditions for a concept. This can be seen from the test answers that subject A2 does not yet understand the known points to create spatial intersections. Based on the results of the interview, subject A2 was not sure whether the points known in the problem could be made into a flat shape.

f) Applying problem solving concepts or algorithms.

Subject A2 does not understand the problem given. This can be seen from the answer sheet for problem solving questions that were not answered. Based on the results of the interview, subject A2 did not know the meaning of the questions given.

Discussion

Based on the results of the analysis above, students with high self-confidence are overall able to answer questions well, compared to students who have low and medium self-confidence. This result is supported by Rosnawati [12], research results which state that the higher the level of student self-confidence, the better their ability to understand concepts. This is because a high level of self-confidence makes students have the confidence to be able to answer every question, both easy questions and difficult questions, so that students do not give up easily when working on questions. Students who have high self-confidence can make the right decisions when encountering difficult problems, for example in questions with indicators that develop the necessary and sufficient conditions for a concept, students with high self-confidence are able to make decisions in answering questions even though based on the results of the interview they are confused. about determining the area of truncated structure but in the end the student was able to answer well. This is in line with the results of Asdar [13] research, namely that self-confidence influences students' ability to understand mathematical concepts. Therefore, to be able to improve the ability to understand concepts, it is not enough to only pay attention to intellectual intelligence, but also students' self-confidence must be increased. Teachers must create an innovation in mathematics learning that can increase self-confidence so that ultimately it can increase understanding students' mathematical concepts.

CONCLUSION

Students who have high self-confidence tend to be able to restate a concept that has been learned, classify objects according to certain properties in accordance with the concept, provide examples and non-examples, present concepts in various forms of mathematical representation, and apply concepts in problem solving procedures, but have not been able to develop necessary or sufficient conditions for a concept. Students with moderate self-confidence tend to be able to restate a concept, provide examples and non-examples, and present concepts in various forms of mathematical representation. However, students with low self-confidence are not yet able to classify objects according to certain characteristics, develop necessary or sufficient conditions for a concept and apply the concept in problem solving. Students with low self-confidence tend to only be able to classify objects according to certain characteristics and provide examples and non-examples of a concept.

ACKNOWLEDGMENTS

The author really appreciates the financial support of the Faculty of Mathematics and Natural Sciences, Jakarta State University, and the active participation of all subjects in this research.

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Designing Hypothetical Learning Trajectory for Curved 3D Shapes using *Mitoni* Tradition Context

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Abstract. This study aims to describe the trajectory of learning to help students understand curved 3D shapes and be motivated to learn it. The context used in this study is the *mitoni* tradition as a source of learning. This study used a design research method with a Realistic Mathematics Education (RME) learning approach which consisted of three stages, namely preliminary design, experimental design (pilot experiments and teaching experiments), and retrospective analysis. The subjects in this study were grade 9 students of SMP Negeri 39 Semarang. The learning trajectory with the context of the *mitoni* tradition on curved 3D shapes material consists of 5 series of activities, namely: (1) identifying the types and characteristics of curved 3D shapes, (2) determining the surface area formula and tube volume, (3) determining the surface area formula and the volume of consciousness, (4) determining the formula for the surface area and volume of a sphere, and (5) solving contextual problems related to the shape of curved 3D shapes. This article presents the first phase of the research design, namely the preliminary design to provide a detailed explanation at the initial stages of design research so that it is ready and feasible to be tested at the experimental design stage.

INTRODUCTION

Geometry is a branch of mathematics that is important to study, because it includes measurements, shapes and geometry related to daily life (1). Geometry is easy to understand, because geometric objects have been encountered by students since childhood through the surrounding environment such as party hats that resemble the geometric idea of a cone, buckets that resemble tubes and soccer balls that resemble balls (2).

However, there are still a lot of pupils that have trouble understanding geometry, especially curved 3D shapes (3). Students have difficulty imagining shapes, elements and nets, as well as determining the area and volume of curved 3D shapes due to a lack of illustrations (4).

Some of these problems arise due to, among other things, the teacher's learning design has not been carried out (5). The use of innovative approaches and media in learning is not yet optimal (6) or teacher-centered learning (7). So that it causes students to have less opportunity to find their own concepts learned through fun activities.

Therefore, a learning design is needed using appropriate approaches, models, media, and contexts in learning curved 3D shapes. One alternative that can be used is designing a learning by using the Realistic Mathematics Education (RME) approach using the right context and innovative media (8) so that in learning it allows students to understand the material being studied (9). Learning using RME allows students to be more motivated and actively involved in discovering concepts through a set of engaging and enjoyable exercises that use context as the foundation for learning (8)(10). The use of context in learning using RME can be a bridge for learning mathematics from concrete things to abstract mathematics. Several contexts of local wisdom used in previous research include

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040036-1–040036-7; https://doi.org/10.1063/5.0242440

traditional food (11) (12), historical buildings (13), community traditions (8), traditional toys (14), fruits (15), traditional markets (16), candles (17).

The mitoni tradition is the context employed in this investigation which is a tradition from Central Java. Mitoni is a Javanese tradition to commemorate the seventh month of pregnancy. In Javanese, mitoni means seven. Therefore, this tradition is carried out at the seventh month of pregnancy (18). The series of traditional *mitoni* forms can represent curvilinear material that has never been used in mathematics learning designs. In addition, the use of this traditional context is also expected to provide opportunities for students to recognize and develop local wisdom in Indonesia.

Based on the background that has been described, research was carried out to design a learning trajectory for curved 3D shapes using the context of the *mitoni* tradition to facilitate understanding of concepts and create meaningful learning.

METHOD

This work developed theories and learning tools through design research using a Realistic Mathematics Education (RME) methodology. Students from SMP Negeri 39 Semarang in grade 9 served as the study's subjects. In August and September of 2023, a variety of methods were used to collect data, including interviews, video recording, observation, gathering student work, administering pre- and post-tests, and conducting interviews. The information gathered is utilized to observe how children learn. The design research method developed by Gravemeijer and Cobb consists of 3 steps, namely 1) preliminary design, namely the stage of reviewing literature, knowing student abilities, and formulating Hypothetical Learning Trajectory (HLT), 2) experimental design consisting of pilot experiments (HLT testing in small groups) and teaching trials (testing HLT in large groups by revising the data obtained from the pilot experiment), and 3) retrospective analysis, i.e. all data obtained is analyzed based on HLT (comparing HLT with actual learning) to develop a design on next activity. Only the first stage, or the initial design, of the study—which involved examining the fundamental skills pupils have and the ones they would need to develop in order to create a learning trajectory within the framework of the Central Javanese *mitoni* tradition—was stated by the researcher.

RESULT AND DISCUSSION

Reviewing Basic Competencies Possed and Needed by Students in Constructing Material of Curved 3D Shapes

When learning curvilinear geometry, eighth-grade students already possess a number of fundamental skills, namely 1) comparing prisms, cylinders, pyramids, cones, and spheres; 2) describing geometric shapes and combinations of several geometric shapes, as well as their surface area and volume; 3) identifying prisms, cylinders, pyramids, cones, and spheres. Furthermore, in grade IX there are several competencies required by students, namely 1) identifying the types and characteristics of curved 3D shapes; 2) determining the initial surface area and volume formulas of cylinders, cones, and spheres; 3) solving contextual problems related to curved 3D shapes and combinations of several curved 3D shapes.

Developing a Hypothetical Learning Trajectory (HLT)

The next stage is to construct and formulate the HLT to the material of curved 3D shapes in the context of Central Java's mitoni tradition, having first examined the students' capacities required to understand the content. This learning trajectory is made up of five sets of exercises designed to increase students' comprehension of the subject matter and foster meaningful learning.

Activity 1 aims to teach learners how to recognize the different kinds and traits of curved three-dimensional shapes. Students are required to watch an interactive film within the mitoni tradition as part of the first exercise. After observing the video, students are given activity sheets that have been designed according to the stages so that the learning objectives are achieved.

Figure 1. *Mitoni* Tradition Context

The hypothesis of students' thoughts in the first activity is presented in Table 1 below.

TABLE 1. Hypothesis of students' thoughts in activity 1

Activities	Hypothesis of students' thoughts
Observing contextual video	Students are able to identify a variety of curved 3D shapes from a contextual video.
Doing Activity 1	Students are able to identify and explain curved 3D shapes.

In light of exercise 1, students may find it easier to recognize and locate curved 3D shapes because they are already familiar with them.

Figure 2. Cylinder Representation On The Container

Figure 3. Cone Representation On The Tumpeng

The objective of the second task is to learn the formula for a cylinder's volume and surface area. Through the project they are working on, students and their groups investigate the source of the formula for a cylinder's surface area and volume in this activity. Students must be familiar with the surface area and volume formulas in addition to knowing the geometry of a cylinder in order to complete this exercise. Students can use the supporting applications that have been created in accordance with the content being studied in addition to the LKPD (student worksheet). In the meantime, the instructor assigns group tasks to the class in accordance with the LKPD rules. Following their work on group projects, students are asked to respond to the questions. Students complete the provided exercises and determine the formula for a cylinder's volume and surface area at the conclusion of the activity.

Figure 4. Container

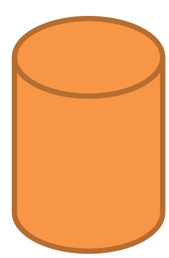

Figure 5. Tube Curved 3D Shape

In the learning process, the teacher offers hard questions, assists, and goes with the students as an effort to build critical and interactive nature.

TABLE 2. Hypothesis of students' thoughts in activity 2

Activities	Hypothesis of students' thoughts
Using a learning media aplication of curved 3D shapes	Through the use of instructional materials, students can comprehend the various shapes that make up a cylinder and can therefore calculate its surface area.
Doing activity 2	Through their work on the project, students are able to calculate the formula for a cylinder's surface area and volume, and they can accurately complete test questions that have to do with these quantities.

The reflection of this activity is that students will find it easier to find the formula for the volume and surface area of a cylinder.

Figure 6. Tumpeng

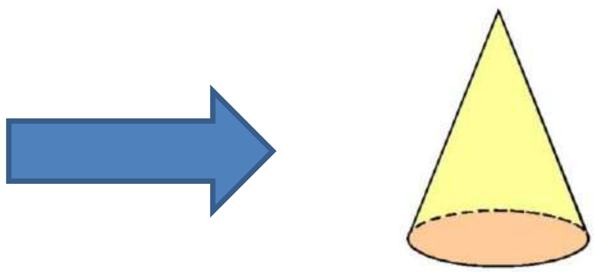

Figure 7. Cone Curved 3D Shape

In activity 3, finding the formula for a cone's surface area and volume is the aim. Students should be able to calculate the formula for the surface area and volume of a cone after they understand the formula for the surface area and volume of a cylinder. Students work on projects in LKPD 3 to start this activity, following the teacher's instructions. The purpose of the worksheets is to encourage pupils to figure out the formula for a cone's volume and surface area. The instructor supports and guides the class as they complete activity sheets as part of the learning process. The instructor holds conversations to learn about the approaches pupils take to addressing the provided tasks. The hypothesis of activity 3 is presented in table 3.

TABLE 3. Hypothesis of students' thoughts in activity 3

Activities	Hypothesis of students' thoughts
Using a learning media aplication of curved 3D shapes	Through the use of instructional materials, students are able to comprehend the various forms that go into making a cone and can therefore calculate its surface area.
Doing Activity 3	Through their work on the assignment, students are able to calculate the approximate formula for a cone's surface area and volume, and they can accurately complete the sample test questions pertaining to these quantities.

Reflection on this activity is that students will find it easier to find the formula for the volue and surface area of a cone.

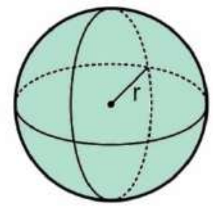

Figure 8. Kelapa Muda or Cengkir Gading

Figure 9. Ball Curved 3D Shape

The purpose of learning in activity 4 is to determine the origin of the surface area and volume formulas for flat shapes with curved 3D in the context of the Central Javanese *mitoni* tradition. In activity 4 students were directed by the teacher to work on projects in LKPD 4 with their groups. The teacher directs students during the learning activities take place. Students are asked to draw conclusions after doing LKPD 4 and also completing some practice questions. The hypothesis for activity 4 is presented in Table 4.

TABLE 4. Hypothesis of students' thoughts in activity 4

Activities	Hypothesis of students' thoughts
Using a learning media aplication of curved 3D shapes.	Students are able to understand a variety of sphere nets in order to know the surface area of a sphere by the application of learning media.
Doing Activity 4	Students are able to determine the preliminary formula of the surface area and volume of a sphere from the project they are doing, and they can do correctly the example of test items related to the surface area and volume of a sphere.

As they consider this exercise, students are urged to remember the volume formula in a tube since it may be applied to calculate the volume of a ball.

After completing activity 4, students are asked to work on activity 5. Activity 5's learning objective is to solve real-world issues involving geometric forms and combinations of many geometric shapes. Students are given a number of questions related to the surface area and volume of curved 3D shapes that have been studied in the previous activity. In working on LAS 5 the teacher always monitors and gives directions to all students.

TABLE 5. Hypothesis of students' thoughts in activity 5

Activities	Hypothesis of students' thoughts
Doing activity 5	• Sttudents are able to solve the contextual problem related to curved 3D shapes. • Students find difficulty to determine pattern to solve problem.

According to the results that have been reported, the first step in design research is the experimental preparation stage, which entails a number of tasks like evaluating the literature, assessing the competences that students need to have, and creating HLT. In order to create a learning design, the experimental stage must be ready for development. A learning design that can facilitate students' comprehension of the information on curved 3D shapes is required. Students can better understand the curved 3D geometric material with the aid of the context that serves as a learning resource.

CONCLUSION

The study's findings indicate that using the Hypothetical Learning Trajectory to construct curved 3D structures within the Mitoni tradition facilitates students' comprehension of the subject matter and fosters meaningful learning. During the experimental design stage, the HLT created during the first design phase can be utilized. This leads to a learning trajectory that consists of five sets of activities: first, identifying the different kinds and characteristics of curved 3D shapes; second, figuring out the surface area and volume formulas on cylinders, cones, and spheres; and third, solving contextual problems involving geometric shapes and shapes that combine several different geometric shapes.

Students must be given real-world scenarios to investigate and gather informal knowledge throughout the early stages of design. This information is subsequently transformed into the formal stage through the use of modeling. The learning design must be supported by the tool being utilized. To help students avoid mistakes and difficulties when completing student worksheet tasks, reflections on each HLT activity should be explained.

ACKNOWLEDGMENT

The author would like to thank the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia for providing a 2023 Student Creativity Program grant with number 2383/E2/DT.01.00/2023. Furthermore, the researchers thanked SMPN 39 Semarang for their willingness to facilitate.

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Communication Patterns of Counseling Teachers and Students in Preventing Gender-Based Violence Online

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Abstract. Today's teenagers, including high school students, are very familiar with social media. Social media is very useful for networking, but on the other hand it can also be a place where *online* gender-based violence (GBV) occurs. GBV is violence that is specifically directed at certain people based on gender and or sex. Cases of GBV are now increasing. LBH APIK data shows that until December 2020, the number of cases reached 659. Victims of GBV generally suffer psychologically and economically. There are various types of GBV cases, including *cyber stalking, cyber harrashment*, sexual *e-mail* messages, and sexually degrading hatred. This study examines the communication patterns of counseling teachers and students of Muhammadiyah High School in Jakarta in preventing GBV. Data collection was carried out by observation, in-depth interviews and literature studies. School selection was carried out by selecting the South Jakarta and South Tangeang areas. Data analysis techniques with the Miles and Huberman model. The method chosen was ethnoscience initiated by Spradley. Through this method, researchers seek to understand a particular knowledge system or subculture. Thus, researchers mostly use the point of view of the research subject or ethnic insiders under study. The subject of this research is the counseling teacher at Muhammadiyah High School.

INTRODUCTION

The advent of the Internet has changed many things in our lives. The most significant change is the way we communicate. Since then, our social world has become digital [1] Before the Internet, communication was done directly or through mass media, such as newspapers, radio, and television (TV). Since the digital era that gave birth to social media, such as Facebook, Twitter, Instagram, and YouTube, as well as smartphones, people communicate through social media. Anytime and from anywhere. People around the world who previously did not know each other can now connect through social media. Access to social media has become a primary need for everyone [2]

Social media is a medium on the Internet that allows users to represent themselves or interact, cooperate, share, and communicate with other users, and form virtual social ties [2] Some characteristics of social media include facilitating networks between users, containing information, archiving, social simulation, and interactivity of users can create messages (content). The internet as a connector in social media functions more than just a tool. The internet contributes to the formation of social ties in social media, values in virtual communities, and online social structures. With this character, social media facilitates the formation of networks between users. The interaction in it at least allows friends to *like each* other, comment on friends' posts, and friends can *share* each other's content.

Although social media brings a breath of fresh air to communication between people, it can also have a negative impact. The presence of social media facilitated by the Internet turns out to be a vulnerable area for women. The more the number of women who utilize social media, the more likely they are to experience GBV [3] The reason is that there is still gender inequality in society. This inequality makes women considered second-class creatures who are weak and men can treat them as they wish. This treatment of men towards women in the real world then migrates to the virtual world. This social media violence is referred to as *online* gender-based violence (GBV).

GBV is any act that makes someone unsafe or feel unsafe, attacks someone's gender or sexuality, and is facilitated by the Internet and technology. GBV is an invasion of privacy, as the perpetrator acts without the victim's consent [4].

Many cases of GBV have occurred in Indonesia. The Indonesian Women's Association for Justice (LBH APIK) Legal Aid Institute noted that during the pandemic the number of cases reached 659 based on Kompas News In December 2020. This number increased dramatically compared to previous years. In 2017 there were only 16 cases, in 2018 there were 97 cases, and in 2019 there were 281 cases. These cases mostly occur on social media, such as

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040037-1–040037-5; https://doi.org/10.1063/5.0244762
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Facebook (FB), Twitter, Instagram (IG), and Whatsapp (WA).

Unlike cases of violence in general, where the perpetrators are more easily identified, the perpetrators of KBGO are difficult to identify, while the digital traces of victims that have already spread on the internet are difficult to erase. This is a problem in itself for victims of GBV [5]

On social media people can create a second account, or even more, with different identities. They can also post fake photos to make themselves look more attractive. This is a vulnerable point for social media users who are not careful. Attraction to photos on social media often leads people, including young women, to accept friendship invitations from people of the opposite sex who may have malicious intentions.

LBH APIK (2020) noted that the victims were introduced to the perpetrators through social media. This online interaction familiarized them to the level of dating. This familiarity makes young women want to send their photos in tempting poses, such as wearing minimal clothing or *top less*. Once the virtual boyfriend, who turned out to be malicious, started to act by asking for some money. If refused, he threatened to spread the victim's nude photos on social media and even to pornographic content sites.

Most victims, especially teenagers, do not have the courage to report their cases to their parents or Guidance and Counseling (BK) teachers at school. Shame, fear of being scolded, and fear of the perpetrator's threats keep them silent. Whereas with openness to the closest people, such as parents and counseling teachers, victims can release their inner pressure. In addition, he will get the right solution. In every school there is usually a Counseling Guidance (BK) teacher whose function is not only to guide but also to provide counseling.

Derlega and Grzelak (in [6] have suggested five possible functions of self-disclosure, viz: self-expression, the release of pent-up feelings; self-clarification, talking about one's beliefs and opinions to clarify one's position; social validation, obtaining feedback from others, or validating one's self-concept; relationship development, acting as a vehicle for developing close relationships and finding out about the recipient; social control, operating as a tool to control and even explore others. Although circumstantial evidence exists to support this five-category system, no study has directly investigated its usefulness in classifying the functions of self-disclosure.

In Jakarta, in addition to public high schools, there are also 14 Islamic-based Muhammadiyah high schools. These schools are spread across the five cities of Central, North, South, East, and West Jakarta. Muhammadiyah high school students, like other high school students, are also active in social media. Therefore, they are also likely to experience GBV.

In every high school there is generally a counseling teacher. BK teachers function to assist individual students in adjusting to themselves and their environment, developing their abilities and potential [7] Therefore, if among the female students there are problems, so that they are disturbed in receiving lessons, it is the BK teacher who must guide them. One of the many problems faced by female students is KBGO.

The forms of KBGO vary, including online sex harassment with verbal violence, *online grooming* (convincing victims through social media to do obscene things ordered by the perpetrator), threats to spread immoral photos / videos [8]). KBGO does not target the physical victim, but the victim feels the psychological impact. Sometimes the victim also suffers economic losses, because there are times when the perpetrator uses this violence to blackmail the victim.

[9] found the types of KBGO among university students, which include *sexting, impersonation*, *cyber recruitment*, *cyber harassment/stalking*, and *revenge porn*. The driving factors, internally, are the sexual desire of the perpetrator, revenge, and jealousy of the perpetrator towards the victim, as well as the financial needs of the perpetrator. The patriarchal culture that produces gender stereotypes and considers women as weak is the cause of external factors. Law enforcement needs to be carried out for all cases of sexual violence in general and *online* gender-based violence in particular. Other factors include low awareness of the law and easy access to social media.

Even though there has been research on GBV, this research is still important considering that the number of GBV cases in Indonesia continues to grow. In addition, previous research on GBV has focused more on the types of GBV and its impact, as well as the form of campaigns to overcome it. This research is different, because it wants to understand the communication patterns of counseling teachers and Muhammadiyah high school students in Jakarta in preventing GBV. Familiar communication between counseling teachers and female students is expected to prevent female students from becoming victims of GBV.

From the explanation above, the researcher formulates this research problem as follows: "Communication Patterns of Counseling Teachers and Students of Muhammadiyah High Schools in Jakarta in Preventing *Online* Gender-Based Violence (KBGO).

LITERATURE REVIEW

Some previous studies on the communication patterns of teachers with high school students include research [10] about the BK Teacher's Interpersonal Communication Process in Overcoming Problematic Students in the Learning Process. Researchers used a qualitative research approach and descriptive research type. Data collection was carried out by observation, in-depth interviews, and literature study. The research participants consisted of the Principal, Vice Principal for Student Affairs, counseling teachers, and parents of students of SMAN 13 Medan. The research findings showed that interpersonal communication between counseling teachers and students was conducted by verbal and nonverbal communication. Factors that hinder interpersonal communication between counseling teachers and students are the students are less open, they also lack communication with their parents. To build interpersonal communication, counseling teachers with students are carried out face-to-face and through Whatsapp (WA) groups. This effort resulted in more effective communication.

Other research conducted [11] about Communication Patterns between Teachers and Students and Between Students in the Dance Extracurricular Group at SMP 1 Delanggu. This research uses a qualitative approach and descriptive type. Data collection techniques with observation, in-depth interviews and documentation studies. The results of the study found: 1) the communication pattern between teachers and students is equal but polite communication: (a) teachers place themselves as friends of students, (b) students feel comfortable with teachers, and (c) students are still polite to teachers who have the power to give grades, because teachers or extracurricular dance coaches are friendly facilitators and become friends in learning. Thus, students feel comfortable because they consider the teacher as a friend. On the other hand, students still respect teachers; 2) the communication pattern between students in the dance extracurricular group is symmetrical communication: a) they have the same power, b) communication takes place comfortably, and c) there is cohesiveness in learning dance, so that dance extracurricular activities are more fun and create a friendly atmosphere.

The two studies above, both examine communication between teachers and students. The difference with this research is in terms of the focus of the research. The first study examines the interpersonal communication process of counseling teachers and problem students. This research is about the communication patterns of counseling teachers with female students who are victims of KBGO. Although in both studies the communicator is the counseling teacher, a teacher who has a special role as a counselor, the communicator is different. One communicator is a student with a problem, while this research is a student who is vulnerable to becoming a victim of KBGO. In the first study, the counseling teacher acted as a counselor to solve the problem. In the second study, the counseling teacher acted as a counselor to prevent female students from becoming victims of KBGO. The theory used is also different. Previous research used interpersonal communication theory, while this study used the concept of communication patterns. Another difference is that the researcher chose the ethnoscience method to understand the communication patterns between counseling teachers and their students. With this method, researchers try to understand a certain knowledge system or subculture. Thus, the researcher uses more of the research subject's or ethnic insider's point of view. The difference with the second study, although both used the concept of communication patterns, the previous study looked more at the partnership relationship between teachers and students and students with students. In this study, communication patterns are used to prevent female students from avoiding GBV.

Other researchers are [12] Both of them examined the interpersonal communication patterns between teachers and students at the Bengkulu "Melati" Daycare Center. Qualitative research approach and descriptive research type. Data collection techniques with observation, interviews, and literature study. This study found that the communication pattern is primary communication which refers to the effectiveness of interpersonal communication between teachers and students obtained through openness, empathy, supportive attitudes, positive attitudes, and equality which emphasizes the closeness and equality factors that teachers build towards students. From this primary communication, students become easier to understand the teacher's message.

Azeharie and Khotimah's research although both use the communication patterns of teachers and students, but the research participants are different from the researcher's research. They studied communication between teachers and toddlers, while the researcher studied the communication patterns of high school counseling teachers with their students. BK teachers have a special task that is different from other scientific field teachers. BK teachers function to help students to achieve their individual tasks well. For this reason, he must have good interpersonal communication competence, so that he can establish a good relationship with students. Thus students are willing to do *self-disclosure*. Azeharie and Khotimah's research did not explore the concept of self-disclosure, because what was seen was the communication of PAUD teachers with their students who were still toddlers. The purpose of communication is more on how students understand the message conveyed by the teacher. By understanding the teacher's message, students can carry out the teacher's instructions. The research that researchers plan to examine the communication between counseling teachers and their students is not only limited to the students' understanding of the teacher's message, but more than that. In addition to understanding the message, it is also intended that students are willing to have interpersonal communication with the teacher. With this closeness, students are expected to be more open to the counseling teacher and willing to obey the counseling teacher's recommendations or advice, so as to avoid the KBGO trap

RESEARCH METHODS

This research uses a qualitative approach. Qualitative research is research that aims to explain phenomena with the greatest depth through the most detailed data possible [13] [14] emphasize that qualitative research findings are not obtained through statistical procedures. Similar to Strauss, [15] explains that qualitative research methods are social research methods that collect and analyze data in the form of words and human actions and this research is not to quantify data. If the data collected is in-depth and able to explain the phenomenon under study, then the researcher no longer needs to look for other informants. The researcher is an integral part of the data. He actively participates in determining the type of data desired. The results of the research are casuistic and cannot be generalized.

DISCUSSION

Online gender-based violence is violence that reflects unequal power relations between men and women and perpetuates the subordination of women to men. Within a patriarchal framework, this violence is a symbolic system that gives birth to a series of everyday practices that deny women's rights and reproduce the imbalances and inequalities that exist between the sexes [16].

Globally, gender-based violence against women is still a problem. Each country has its own coping strategy and is determined by each country's policies. In Sweden, for example, the prevention of violence is a government policy at the local and regional levels. Although in practice it faces many obstacles, such as the understanding of gender and violence in society, in addition to the lack of *bottom-up* dialogue [18].

In Indonesia, awareness of the increasing violence during the pandemic and due to *lockdown* policies in various regions prompted the establishment of the Guidelines for Protecting Women's Rights from Discrimination and Gender-Based Violence (GBV). This guide is a cross-ministry/agency guide, local government organizations, and program and service providers for women [17]. In its development, violence against women does not only occur in real life, but also penetrates into the *online* world. Therefore, the violence here is referred to as *Online* Gender-Based Violence (GBV).

Online gender-based violence still occurs frequently in schools, especially during the Covid-19 pandemic, as expressed by Ahmad Musanif *"Yes, it is undeniable that children cannot be separated from online media, especially since the pandemic yesterday, where teaching and learning activities are also through internet media. But we, as teachers, always remind them that cellphones and the internet they have have two different sides. One side can be good, on the other hand, of course there are also many negative elements. We always remind them to use these media wisely. Not for negative things".*

Many ways can be done to prevent the occurrence of KBGO, including the method used at SMA Muhammadiyah 12, *"to prevent KBGO we try to remind students not to use social media excessively, we are wise in using social media to instill students by holding training and education for students"* [19].

It is not only at SMA Muhammadiyah 12 where GBV often occurs, but also at SMA Muhammadiyah 15 Setiabudi, where GBV often occurs to students. *"Usually, GBV occurs with children who have physical deficiencies. I often meet many students who tell me they experience GBV because they have physical deficiencies, for example being called names by their friends"* .

CONCLUSION

From the research conducted, online gender-based violence still occurs a lot to students at SMA Muhammadiyah Jakarta. From the research we conducted, violence mostly occurs to female students and also to children with physical disabilities.

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Entrepreneurship Comprehension Skills through PjBL-Based e-Modules

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Abstract. This study seeks to ascertain the efficacy of android application-based entrepreneurship e-modules in enhancing student understanding of entrepreneurship, as well as the reactions of students who have used entrepreneurship e-modules. This investigation is a Pre-Experimental Design study employing a one-group pretest posttest design, which is an experiment conducted in a single group without a control group. This study was conducted with Mathematics Education Students, Faculty of Teacher Training and Education, Singaperbangsa University, Karawang. Students' responses to the entrepreneurship e-module were classified as "good" with a description of "practical" application based on the findings of this study. In addition, there are disparities between students who have used the Entrepreneurship E-Module and those who have not in their ability to comprehend mathematical concepts. Therefore, it can be concluded that the experimental posttest class using the Entrepreneurship E-Module has greater mathematical concept comprehension than the experimental pretest class that did not use the Entrepreneurship E-Module.

INTRODUCTION

Mathematics is one of the subjects studied at all educational levels, from elementary school through college. It is argued in [1] that mathematics is a fundamental skill that is essential for ordinary life and the advancement of science and technology. The advancement of information technology has had an impact on numerous facets of life, including education. The impact of this technology on education is a shift in the requisite competencies and skills. The quality of education and the quality of learning in the classroom will be influenced by teachers' anticipation of these changes [2]. On the practical level in schools, however, there are still numerous learning issues associated with the implementation of information technology in the classroom. Android is the technology that is developing rapidly and that nearly everyone has. An Android-based interactive e-module is one of the introductions to learning activities that seeks to provide students with a foundational understanding prior to learning so that they are better prepared and motivated to engage in learning [3]. E-Module is a computer-executable module with an electronic format [4]. In addition, an e-Module is a module delivered in digital format [5]. E-Module is also a learning media with an electronic-based system [6]. This study is an extension of the project-based learning (PBL)-based entrepreneurship module that has been created. The developed entrepreneurship module will be structured as an android application-based entrepreneurship e-Module in order to increase entrepreneurship comprehension.

One of the goals of mathematics education is the comprehension of mathematical concepts [7]. In addition to being a mathematical goal, understanding mathematical concepts is used to solve mathematical problems and problems in other disciplines of science must have an understanding of mathematical concepts and mathematical principles [8]. Understanding concepts is a crucial aspect of learning mathematics, because if you comprehend a concept, you can solve a problem more effectively, as problem-solving requires concepts-based rules [9]. This Entrepreneurship E-Module aims to make it simpler for students to access material during the learning process, so that the developed application can be used by lecturers as an alternative to creating ICT-based teaching materials.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040038-1–040038-6; https://doi.org/10.1063/5.0241656

The purpose of this research is to develop Entrepreneurship e-Modules that are in accordance with curriculum requirements by taking into account student needs, i.e. teaching materials that are consistent with the characteristics of teaching materials and student characteristics. While the benefits of Project-Based Learning (PBL)-based Entrepreneurship e-Module Research represent an innovation in mathematics education for students, they are not the only ones.

RESEARCH METHODS

This research is a research and development (R&D) project that focuses on the creation of Entrepreneurship e-modules. The 4D development paradigm is utilized in the creation of instructional materials aided by e-Modules: define, design, develop, and disseminate. Students enrolled in the Mathematics Education Study Programme at Singaperbangsa University in Karawang comprised this study's sample. The sampling of students was conducted using the technique of purposive sampling, which involved certain considerations. Overall, there were 26 pupils in the class. The objective is to obtain a response as a user of the developed entrepreneurship e-module. This stage measures the accomplishment of course learning, interest in the studied material, language, and the viability of the presented material. Entrepreneurship e-modules are initially validated by learning design specialists and linguists in three areas: content, presentation, and language. This research utilized expert validation questionnaires, module feasibility interviews, and student response questionnaires as its instruments. The analysis employed is descriptive quantitative analysis.

The android-based entrepreneurship e-module was initially validated by media experts, material experts, and linguists using the 4D development model: define, design, develop, and distribute. Data analysis techniques include descriptive analysis, analysis of data requirements, and hypothesis testing. The purpose of hypothesis testing is to determine whether android application-based entrepreneurship e-Modules increase student understanding of entrepreneurship prior to and after treatment. Trial information comprising a pre- and post-test on the tested subject matter. The pre-test and post-test results were then analyzed using the t test to ascertain the difference between the pre-test and post-test scores. The testing of data begins with the normality and homogeneity tests, followed by the hypothesis testing (correlated t test). The results of the pre- and post-tests are the primary data used to determine improvement in academic achievement. The research flowchart is depicted in Figure 1.

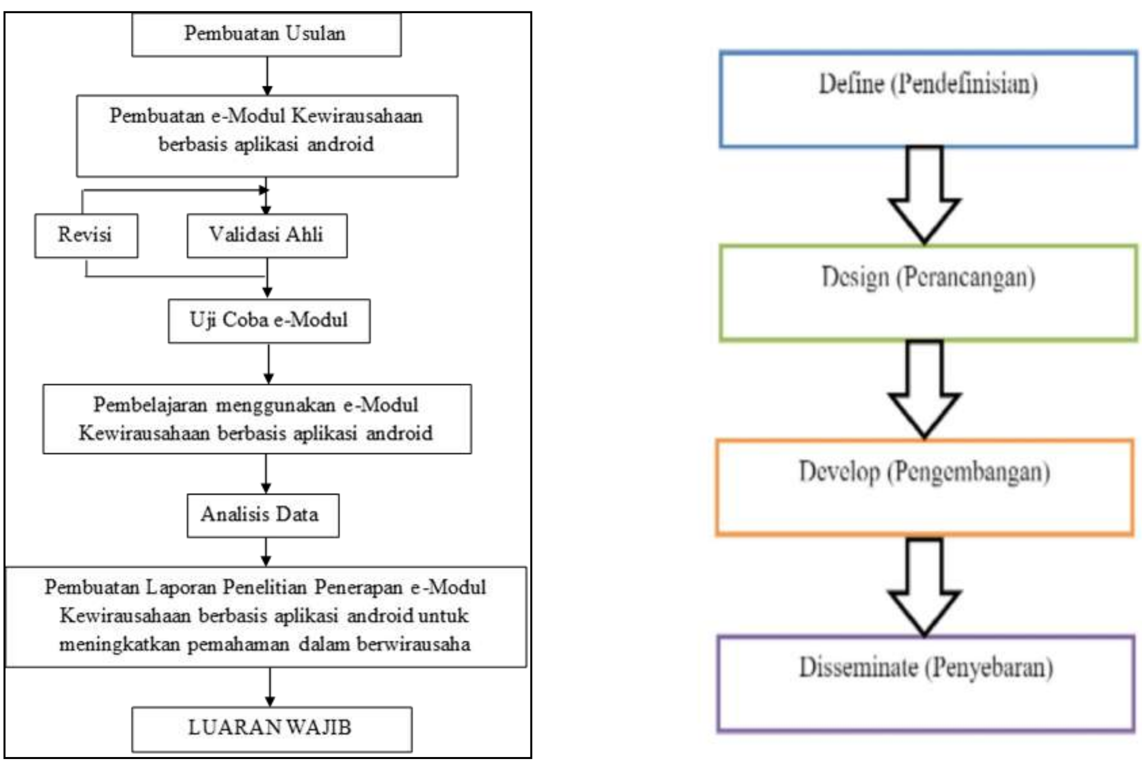

FIGURE 1. Research Flowchar

RESULTS AND DISCUSSION

Research on the Application of Android Application-based Entrepreneurship e-Modules to Increase Understanding in Entrepreneurship has the objective of producing products in the form of teaching materials assisted by e-Modules. Expert validators have deemed the e-Module-assisted teaching materials feasible, and the materials have been assessed to determine the product's feasibility based on student feedback. According to Borg and Goll (1983), research and development (R&D) is a research technique used to develop and validate educational products [10]. According to [11], the research and development (R&D) method serves to validate and develop a specific product in order to determine its efficacy, practicability, or validity. The development of instructional materials supported by e-Modules is conducted in accordance with the 4D development phases: define, design, develop, and disseminate.

1. Specifying setting
   At this juncture, the product to be developed in the form of an Entrepreneurship e-Module undergoes concept analysis. The e-Module's material and content are tailored to the level and learning objectives, which direct students to play an active, independent, and fun-learning or entertaining role.
2. Planning Phase
   The chosen format for the to-be-developed product is an entrepreneurship e-Module that can be used for both online learning and traditional or classroom-based learning.

FIGURE 2. Display of The Entrepreneurship E-Module

3. Stage of Growth
   After defining and drafting the product to be developed, this stage of development seeks to produce a product that has been revised based on expert feedback and student testing. Table 1 displays the results of the analysis of the questionnaire's quantitative data.

TABLE 1. Media Expert Assessment Results

Analysis	Validator
∑skor	107
Xmax	115
Xmin	23
Average	69
standard deviation (Sb)	15,333

Based on the results of the media expert evaluation, android-based instructional materials have been validated with a total classification score of 107 very good. The classification and information listed in Table 1 are derived from Table 2's [12] calculations.

TABLE 2. Calculation of Criteria for Media Expert Questionnaire Results

Average Score	Classification	Description
$\mathbf{X > 96,6}$	very good	Valid
$\mathbf{78,2 < X \leq 96,6}$	Good	Valid
$\mathbf{59,8 < X \leq 78,2}$	Good enough	Valid
$\mathbf{41,4 < X \leq 59.8}$	Less	Tidak Valid
$\mathbf{X \leq 41,4}$	Very Less	Tidak Valid

Table 1 displays 107 as the total tally. In the first row of Table 2, the score is greater than 96.6, indicating a very solid classification with a valid statement. Based on this, the android-based teaching module for media professionals has been validated with an excellent category.

4. The Dissemination Phase

After expert validation, small-scale product testing, and revisions following validation and testing, the product is available for distribution or application. The purpose of this phase is to disseminate to students the products that have been developed as Entrepreneurship e-Modules. Table 3 displays the results of the quantitative data analysis of the student response questionnaire.

TABLE 3. Student Response Results

Analysis	Student Response
∑skor	659
Xmax	900
Xmin	180
Average	540
standard deviation (Sb	120
Classification	Good
Description	Practical

With a total classification score of 659 out of a possible 659, android-based teaching materials have been implemented in practice based on student feedback. The classification and data listed in Table 3 are derived from the results of calculations performed according to Table 4 [12].

TABLE 4. Results of Student Response Questionnaire Criteria Calculation

Average Score	Classification	Description
$\mathbf{X > 756}$	Very Good	Practical
$\mathbf{612 < X \leq 756}$	Good	Practical
$\mathbf{468 < X \leq 612}$	Pretty Good	Practical
$\mathbf{324 < X \leq 468}$	Less	Not Practical
$\mathbf{X \leq 324}$	Very Less	Not Practical

Table 3 displays a total score of 659. In the second row of Table 4, the score is enumerated, which is greater than 612 and less than 756, so that a practical classification can be obtained. Based on this, the android-based teaching module has been practical and effective in terms of student responses. After completing the e-module on entrepreneurship, the classification results were "good" with the description "practical application." The application for the entrepreneurship e-module is therefore feasible for use as a learning medium based on the validator's assessment and the results of trials with students who fulfilled the practical criteria. According to the findings of research [13], android-based learning media is usable based on the proportion of limited trial results on school students achieving very usable criteria. The following study is a Pre-Experimental Design with a one-group pretest posttest design, which is an experiment conducted in a single group without a control group. These are the outcomes of the calculation:

a. Test for Normal Distribution

The purpose of the normality test is to determine whether the data to be analyzed are normally distributed. The test for normality was conducted using SPSS 26 software. Data is normally distributed if the Sig value is greater than 0.05, and not normally distributed if it is less than 0.05. Table 5 displays the results of the pretest data normality test.

TABLE 5. Pretest and Posttest Data Normality Test Results

	Class	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
Mathematical Comprehension Ability	*Experiment*	Statistic	df	Sig.	Statistic	df	Sig.
	Pretest	.209	29	.002	.846	29	.001
	Posttest Experiment	.259	30	.000	.817	30	.000

According to Table 5, the Sig. value of the experimental class pretest using Kolmogorov-Smirnov is 0.002 0.05, while the Sig. value using Shapiro-Wilk is 0.001 0.05. Therefore, H0 is rejected while H1 is not, indicating that the experimental class's pretest data is not normally distributed. While the Sig. value of the experimental class posttest using Kolmogorov-Smirnov and Shapiro-Wilk is 0.000 0.05 and 0.000 0.05, respectively. Therefore, H0 is rejected while H1 is not, indicating that the posttest data for the experimental class are not normally distributed. Since the experimental class's pre- and post-test data were not normally distributed, the Mann-Whitney U nonparametric test was used to test the next hypothesis.

b. verification of hypotheses

After performing the normality test and determining that the data are not normally distributed, the Mann-Whitney U nonparametric test will be used to test the null hypothesis. The Mann-Whitney U test is used to determine whether or not the means of two populations are different. If the p-value is greater than 0.05, then H0 is not rejected and H1 is rejected, indicating that there is no difference in the initial ability of students in the experimental pretest class and the experimental posttest class to comprehend mathematical concepts. Alternatively, if the p-value is less than 0.05, H0 is rejected and H1 is not, indicating that there is a difference between the experimental pretest class and the experimental posttest class in their initial capacity to comprehend mathematical concepts.

TABLE 6. Mann-Whitney U Test Results Posttest Data

	Mathematical Comprehension Ability
Mann-Whitney U	**166,000**
Wilcoxon W	**601,000**
Z	**-4,085**
p-*value*	**,000**

Based on Table 6, it is known that the p-value is 0.000 0.05, so H0 is rejected and H1 is not rejected, indicating that students who use the Entrepreneurship E-Module are better able to comprehend mathematical concepts than those who have not used the Entrepreneurship E-Module. Therefore, it can be concluded that the experimental posttest class that utilized the Entrepreneurship E-Module has a greater ability to comprehend mathematical concepts than the experimental pretest class that did not utilize the Entrepreneurship E-Module.

CONCLUSION

The conclusions drawn from the research on the Application of Android Application-Based Entrepreneurship E-Modules to Improve Understanding in Entrepreneurship are based on student responses to entrepreneurship e-modules with "good" classification results and a description of "practical" application. Students who use E-Modules

Entrepreneurship have a greater ability to comprehend mathematical concepts than students who have not used E-Modules Entrepreneurship.

ACKNOWLEDGMENTS

The authors would like to express gratitude to the Rector of Singaperbangsa University of Karawang through LPPM for facilitating the research and providing funding for the research up to the completion of this study.

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The Uniqueness of Blind Students in Creative Thinking

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Abstract. Creative thinking generates new, original, and innovative ideas not bound by conventional boundaries or existing mindsets. Disabilities, especially blind people with limited vision, have different or unique ways to adapt to their potential. This study aims to find the uniqueness of blind people in their ability to think creatively in understanding concept interpretation and problem-solving. The subjects were two blind people with totally blind and low vision types. Qualitative research with a descriptive approach was chosen to show the results of understanding concept interpretation and problem-solving. Interview and observation were the data collection techniques used. The results of this study illustrate that the same uniqueness of the two subjects in creative thinking is (a) flexibility in identification through finger perception and imagining in the mind. The indicators achieved identify the problem from different points of view as an alternative. All information from these methods in detail will generate ideas for answers using numbers and formulas. Math concepts and problems given in any form will always be focused on numbers and procedures, and (b) fluency in analogizing objects often used or encountered in everyday life. The indicators provided many suggestions or ways to do many things, and (c) elaboration (detailed thinking) can detail the media objects given. The hands accomplished are adding or describing the details of an object, idea, or situation to be more attractive; there are some differences from the uniqueness of the subject, namely the speed of intonation and firmness of speech, as well as the diversity of objects presented. (d) originality can find a new way to find the corresponding and parallel sides in space using surface area. However, side and angle lengths are usually used. The recommendation from the results of this study is to conduct further observations related to the unique behaviour of blind people in creative thinking.

INTRODUCTION

Creative thinking requires the correct stimuli to be discovered. In learning with blind subjects, of course, it requires appropriate learning. This suitability involves examining material delivery, media use, and learning time. One of the things that can be fulfilled can be seen from the learning style of blind people. Learning styles in blind people are included in the auditory and kinesthetic learning types [1]. Auditory learning style is the dominant learning style for blind people. Limitations in vision are the main reason blind people have sensitivity to the sense of hearing [2]. In addition, the kinesthetic learning style leads to the use of learning media, namely in the form of media that can be held by hand for blind people. This learning media facilitates the imagination of blind people in analyzing information captured through audio or hearing. Thus, blind people usually relate the knowledge to understand something being studied [1]. This study uses media in blocks and some objects close to every day.

Blind students are creative and even develop different and extraordinary thinking methods in their education [3]. The occurrence of creative thinking in students can be seen using predetermined indicators. Each indicator has an exciting relationship to be observed. In observing, creative thinking can be done by giving problems how students solve these problems by going through several stages. Identifying things related to the emergence of innovative thinking indicators requires detailed observation. The process that occurs during creative thinking will bring up interesting and unique items. The hands of creative thinking certainly support this. Blind students have limited vision, but their thinking ability is normal or not impaired [4]. This limitation certainly affects the development of

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040039-1–040039-9; https://doi.org/10.1063/5.0241586

their thinking, but blind people can still learn to think creatively. Proper treatment supported by good environmental conditions will help blind people to know well, and their creative thinking can emerge[5]. Several ways and media are used to bring out the ability to think creatively in blind people. Using worksheets based on Science, Technology, Engineering, and Math can train the creative thinking of blind people. In addition, project-based learning has also been developed to help blind people explore critical thinking skills [6]. It is essential to understand visually impaired students' unique preferences and needs and ensure that the learning methods used meet their needs. Communicating with students openly and listening to their needs is critical to creating a practical and inclusive learning experience [4]. Most studies show that the visually impaired have creative thinking abilities. Identifying how the visually impaired think creatively is another exciting thing to observe. With the limitations of blind people, they must have different and unique ways. Consequently, by involving college students as research subjects, researchers want to examine how the visually impaired differ in creative thinking.

The preliminary research results on two blind subjects of totally blind and low vision types have different characteristics of creative thinking. This difference is, of course, based on the level of limitations they have. In mathematics learning activities, it can be seen that the blind is limited in space. At the same time, the low vision seems more active regarding space and communication. This is very interesting to be researched further related to creative thinking. Understanding how visually impaired students think creatively is essential in ensuring better educational inclusion. It helps develop more effective and inclusive education programs for visually impaired students so that they have equal access to quality educational opportunities. Every student has their creative potential. Through this research, we can identify the strengths and uniqueness of creative thinking of visually impaired students and enable the development of their potential. This study aims to find something unique about the ability of blind students to think creatively in understanding mathematical problems. Visually impaired students have limited vision, but their thinking ability is average. However, these limitations certainly affect their cognitive development. The ability to think blind does not rule out the possibility of thinking creatively.

METHOD

Research Design

This research uses qualitative research as its research design. The selection of qualitative research because it is the research conducted, namely data collection in the field directly to the location; the researcher collects data close to the subject collected by actually talking with the issue by looking at the behaviour and actions of the subject by the material under study [7]. Qualitative researchers manage their data by direct examination, documents, observing behaviour, or interviewing subjects. A qualitative descriptive approach describes the uniqueness of the creative thinking process. Data collection steps include setting research boundaries, preparing research instruments, collecting information through observation and unstructured or semi-structured interviews, documents, and visual materials, and establishing information recording protocols. Data collection procedures using face-to-face interviews with subjects with unstructured and open-ended types and documentation by taking videos during the research. The next step is data analysis and conclusion drawing. The conclusions have been formulated as a basis for reference to provide recommendations for further research. The learning media used in the interviews are shown in Figure 1 below. The press was given to the subjects in the presence of the issues reached. Subjects were given the freedom to choose the media they wanted to observe.

FIGURE 1. Learning media for geometry material

Figure 1. is the media used by researchers in exploring information related to geometry material, which consists of building blocks, coins, and toy cars. Data is collected through unstructured interviews, and the activity is recorded as a video. The results of the interview were recorded in the results of the interview sheet. The next step is for the researcher to re-observe the video recording that has been obtained while juxtaposing the notes from

the interview. Observations were made to observe the indicators of creative thinking observed during the interview activities. The research steps taken in the research flow are in Figure 2 below.

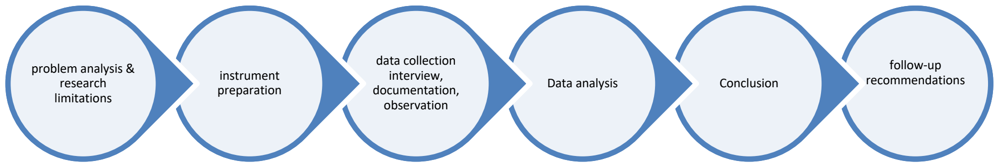


FIGURE 2: Research steps

Participants

The subjects of this study were two students of the Special Education study program, Faculty of Teacher Training and Education, PGRI Argopuro University, Jember, East Java. The subjects taken have several criteria, namely blindness with totally blind and low vision types. Blind issues (STB) experience limitations in total blind vision but not from birth, so they have initial knowledge of objects in the surrounding environment. This subject is 21 years old with total blindness since the age of 6 years. The 21-year-old low vision subject (SLV) has a visual limitation at moderate blindness since birth, meaning he can still see vaguely in the shadows. Light and shadow objects can still be seen faintly within a radius of approximately 2-3 meters. Creative thinking skills can be used in individuals with good academic abilities [8]. The selection of two subjects of different types can be made to understand better their differences, similarities, and experiences related to the research topic. In addition, selecting issues of different types can help better understand the phenomenon being studied.

Data Analysis

Data analysis in qualitative research had gone hand in hand with other parts, namely data collection and writing up findings [7]. When interviews were ongoing, for example, researchers might analyze previously collected interviews, write memos that can eventually be included as narratives in the final report, and organize the structure of the final report. The analysis stage after obtaining data is sorting because not all information is used in qualitative research. Furthermore, coding is carried out on the sorted data by the research objectives. In qualitative research, triangulation is an idea that is often used to increase the validity and reliability of research findings. Triangulation involves collecting and analyzing data from multiple sources or methods to verify research findings [7]. Researchers can collect data with various qualitative research methods, such as observation, interviews, or document analysis. Using multiple methods, researchers can verify the results from different points of view [9]. This research uses method triangulation, namely the interview and observation techniques. Researchers use the video documentation method to assist in making observations by recording the data collection process.

RESULTS AND DISCUSSION

The data obtained during the research were interview results, observation results, and video documentation. Observations made from video recordings of interview activities were carried out to determine which indicators were achieved in the hands of creative thinking. The first research data obtained was interview data. Interview activities were carried out on STB and SLV at separate times and places.

Initial data was obtained from STB subjects from interviews with unstructured methods. Interview activities started by repeating the concept of material about two-dimensional and three-dimensional geometry. The initial knowledge that is already owned is used as introductory material to continue understanding the interpretation of the concept with the help of block media and toys. Here are excerpts of interview results about STB's initial knowledge.

Researcher: Do you remember flat and spatial shapes such as squares, rectangles, triangles, blocks, cubes, etc?
STB: I remember because I have studied it during school.

STB still remembers flat and spatial shapes, so it can be interpreted that STB has good initial knowledge. When STB was given media geometry objects (wooden blocks), STB immediately held all the media individually and felt each with his fingers. The palpation starts from the length of the media's side, corner, and surface. STB, in every touch, conveyed his perception.

STB: this is the length, this is the width, ahh, this is the height, yes... Anyway, this is a block. If this is a triangle because there are three sides, what is it called? Ohh, prism, what pyramid, yes? ....prism I think

The researcher continued with questions related to the definition of shapes and the differences and similarities of existing media shapes. STB could be mentioned correctly, but the sentence was still hesitant. The intonation and information conveyed were less fluent but still in the correct category. Based on the answers (from the transcript excerpts above) that were delivered in the right type, there were still some doubts related to the concept of width and height. STB experienced a little difficulty or obstacle in distinguishing between the width and height of a building. After understanding the correct ideas of height and width, he could follow along smoothly. Furthermore, with his perception of the interpretation of the parts of the beam, STB started to the concept of size with the following interview transcript.

STB: If this one is the length, well...it's the longest. If the others are the shortest in size, it means the height, but this is the width because it is a little longer.

The size or length of the block is conveyed by perception by saying that the distance is the side whose scope is the longest, while the width is more minor and more significant than the height. The perception was then by the researcher, for example, giving a problem by providing a size to the block. For instance, for a partnership with a length of 15 cm, STB smoothly answered that the width is half more than the length, so around 8-10 cm. Then, by feeling back, STB tried to estimate the height size. He stated that the crown is half of the width. So, about 4-5 cm. in conveying observed with intonation that is not too sure and doubtful. The subsequent measurement was about measuring the volume of the block. STB seemed to start thinking and answered by summarizing everything already known. "So the length is 15cm, the width is (by feeling) 8cm, and the height is 4cm. Is the volume formula correct? Length times width and height (a little doubtful)". Then, the researcher helped that the formula is Length times width and times height. STB quickly calculated by saying 15 x 8 equals 120, then multiplied by 4, so 48 plus 0. The answer is approximately 480cm cubic, yes. There still were doubts about the answer. This doubt is because, from the beginning, STB forgot about the beam volume formula.Peneliti melanjut mewawancarai tentang sisi-sisi yang bersesuaian pada bangun balok, kubus, dan prisma segitiga. Hasil cuplikan transkrip wawancara disajikan sebagai berikut.

Researcher: Do you know which sides are the same size or paired?

STB: this side and this one (while fingering) because these have the same surface area.

Researcher: How do you know the surface area is the same?

STB: When I pull the length, it is connected and the same; it doesn't turn, which means it is straight. Every size is straight and equal, and the area is similar.

Based on the above excerpt, STB can pair the corresponding sides with the interpretation of the surface area. This surface area is formed from the same side length and its straight position, so the performance of the angle formed is the same. This discovery method is different from the general concept of finding the corresponding side by looking at the length of the side and the angle. Furthermore, when STB held the miniature toy car, STB could explain the composition of the circle, square, and rectangle—even mentioning the details of the existing size by comparing such as "smaller" and "bigger" in terms of the size of the building.

FIGURE 3. STB Using Block Learning Media

The results of video documentation became the researcher's observation material. We can see STB's learning activities in concept interpretation and problem-solving. It was observed that STB did not move too fast and seemed careful at the beginning of each object. After some time, STB seemed to have mastered the media so that his tinkering movement looked more proficient and with fast action. It was observed that the touching was done from each end to the end of a measure. STB used both hands to check the outside of the felt surface to find the corresponding side. He also appeared to move his hands several times to ensure the building was not bent and that the surface areas were the same and facing each other. After appearing confident in interpreting the corresponding side, STB explained each corresponding side smoothly, although not too fast. The following result was related to the angle on the surface. The following is an excerpt of the interview that the researcher can record.

STB: It's a rectangle and a square, even though the corners are curved and not as sharp as usual. The point is that it's pointed at the end of the corner.

From the data, STB, with his ability to feel, mentioned in detail the surface arrangement of the toy car by the perceptions and interpretations produced in his thought process. However, several times, they were delivered with a bit of doubt. In addition, STB's understanding is also helped by mentioning everyday objects encountered, such as paper, books, and tofu.

STB: *The blunt angle is square and sometimes rectangular, like tofu. But the edges are not as sharp as they should be. But it is included in the building blocks or cubes."*

Next, he continued by taking the book and paper touched at the end and pointing out that it was the pointed end of the corner of the article and book.

FIGURE 4. STB Using Toy Car Media

STB was observed while observing the miniature toy cars. STB was asked to mention what shapes of objects you can find in the thing. The subject correctly conveys that the media is a toy car while continuing to feel each part in detail, mentioning that there are circles, squares, and rectangles. Some surfaces are not square or rectangular because the sides are irregular. When the wheel, it is composed of a large circle; this part is a smaller circle, but in this deeper part, the process is the smallest. STB also seemed to relate to objects that are close to everyday life. Mainly to things that are often used every day. The results of all data from STB can be summarized in the following info-graphic image.

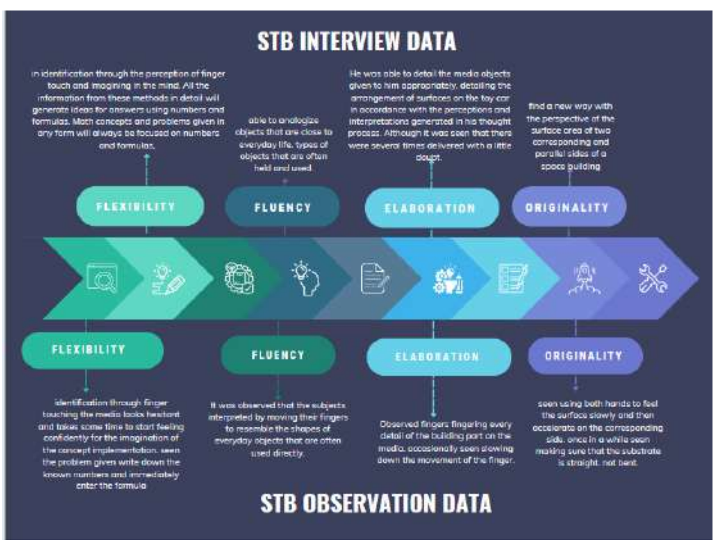


FIGURE 5. STB Interview and Observation Data

The following research data is the results of interviews with the second subject, SLV. On different days and times but with the same media and unstructured interview guideline design, the results of interview activities are documented in the interview transcript. Interview activities began with extracting information about the basics of forming two-dimensional and three-dimensional geometric shapes. The initial knowledge has been utilized as introductory material to continue understanding the interpretation of the concept with the help of media blocks and toys.

Researcher: do you still remember flat and spatial shapes such as squares, rectangles, triangles, blocks, cubes, etc?

SLV: I still remember ... like triangles, squares, rectangles, blocks, cubes. But when looking for volume, I forgot.

As shown by the transcript above, SLV recalls flat and spatial figures. This indicates that SLV has good prior knowledge. When SLV was given media geometry objects (wooden blocks), SLV immediately held the media individually and fingered each press. The palpation starts with the length of the media's side, angle, and surface. In each touch, SLV conveyed his perception.

SLV: This is the length, width, and height. So, this makes a block. Since it's a triangle, what's it called? Oh, a pyramid? It's like a prism.

The researcher continued with several questions about the definition of shapes and the differences and similarities of existing media shapes. SLV can mention correctly and looks confident, judging from how it is delivered. The intonation and information conveyed were classified as very smooth. Based on the answers (from the transcript excerpts above) provided in the correct category about the concept of width and height. SLV has no difficulties or obstacles in distinguishing between the width and height of a building. Furthermore, with his perception of the interpretation of the parts of the beam, SLV started to the concept of size with the following interview transcript excerpt.

SLV: It is the longest since it is longer than the others. If this one is wide and this one is tall

The interview results showed that SLV can confidently and accurately mention length, width, and height by emphasizing his finger touches that are confident and not hesitant. All answers in this category are undoubtedly correct about the concepts of width and height. SLV did not experience difficulties in understanding length, width, or height. This is because SLVs with low vision can more easily identify and convey results quickly and in detail. Regarding the size of the media, SLVs were confident and stated firmly and clearly that the most extended size is length; for example, the length is about 14-15 cm, or the width is half less than the length, and the smallest size is the height. The researcher then asked about calculating volume: suppose the length is 20 cm; how would you estimate the volume? SWT quickly answered: "The length is 20 cm, the width is about 10 cm, and the height is about 5-6 cm. If you want to calculate the volume, then you just need to multiply everything." The researcher then asked for the findings. SLV answered 20 x 15 x 5, so the volume is 1500 cubic cm. Although there seemed to be a time lag, she conveyed her answer. SLVs could solve the problem quickly because they had prior knowledge and could recall the volume formula.Peneliti kemudian melakukan wawancara tentang sisi yang bersesuaian pada bangun balok, kubus, dan prisma segitiga. Berikut ini adalah hasil cuplikan transkrip wawancaranya.

Researcher: Do you know which sides are the same size or in pairs?

SLV: paired sides mean that the faces are the same, and the surface area is the same. This is the same with this; this is also the same with this one... this is also the same.

Researcher: Where do you know the faces and the area are the same?

SLV: From here...the sides are connected and straight; if you hold it thoroughly, it will be more visible if this is the same facing and area.

Based on the above excerpt, SLV can pair the corresponding sides with the interpretation of the surface area. This surface area is formed by the surface of the same facing side (by feeling) and connected with a straight line. The interpretation is seen by handling the whole building. This discovery method is different from the general concept of finding the corresponding side by looking at the length of the side and the angle. Furthermore, when SLV holds the miniature toy car media, SLV can explain the composition that composes it, namely the circle, square, and rectangle—even mentioning the details of the buildings encountered as in the following interview transcript.

SLV: *for example, this is a circle, but the sizes are all the same and not too big; if this is a rectangle, this one is not a rectangle and a square, like a square, but the ends are not sharp.*

The transcript shows that SLV can detail the elements in the miniature car. One form of fact concerns the size and shapes not included in flat shapes because of the obtuse angles.

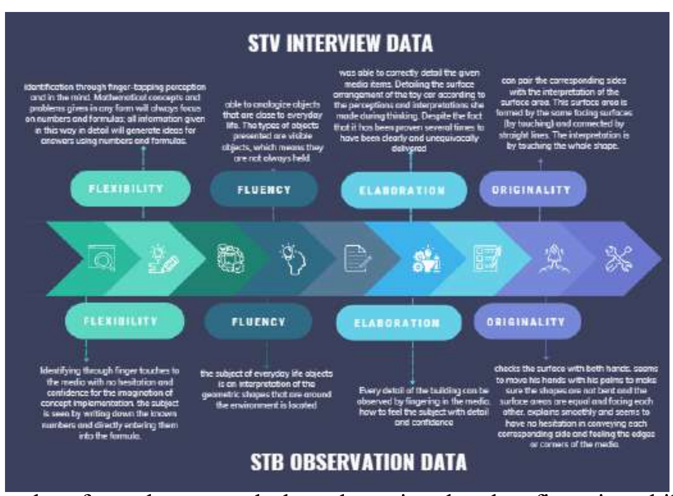
In addition, SLV can also mention everyday objects commonly seen, namely tables, doors, chairs, balls, and cans. These objects have square and rectangular details. There are many sharp corners on some of its parts. SLV matches with things close to daily life but of the type that appears far away and can be seen by the eye.

FIGURE 6. SLV using block learning media

Which is the result of video documentation during the interview. Observations from the video showed SLV learning activities in understanding concept interpretation and problem-solving. SLV felt all the media gave quickly without hesitation. His hands were seen skillfully fingering all parts thoroughly from the media. In finding the corresponding side, SLV used both hands to check the outside of the felt surface. To ensure that the building is not bent and the surface area is equal and facing, SLV also appears to move the hand with the palm and ensure that the structure is not bent or straight. After the hand interpretation of the corresponding side was proven confidently, SLV explained each corresponding side smoothly and without hesitation. SLV was then seen fingering the edges of the medium or the corners.

FIGURE 7. SLV Using Toy Car Media

In Figure 7. a medium for a small toy car is provided. The SLV was asked to name any shapes you might see in the object. The subject indicated that the medium was a toy car by feeling each part in detail, saying there were circular, square, and rectangular shapes and some irregular surfaces because they were neither fair nor rectangular. The wheel is made up of large circles, but the deeper parts have the most minor processes. The angle on the surface corresponds to the result of the next stroke. The structure is rectangular, although the curved corners are less sharp than usual. "It's the pointy end of the corner," SLV said, as the data shows. From the data, it can be seen that SLV, with her ability to feel, mentioned in detail the surface arrangement of the toy car according to the views and interpretations she made during her thinking process, despite the fact that it has been proven several times to have been presented with little doubt. The results of all data from SLV can be summarized in the following info-graphic image.



The discussion that can be taken from the research data above is related to fingering skills being the dominant thing done. This is in line with

FIGURE 8. SLV Interview and Observation Data

hat blind people from

birth provide definitions and characteristics of triangles through their perceptions by touching [10]. The blind touch with fingers or hands feels a different affective touch. The blind feels a great sense of comfort in touching an object. This tactile comfort has a good influence on perception in his mind [11]. Learning using media is very helpful in interpreting concepts owned, and problem-solving can be solved adequately. The two subjects studied. Namely, STB and SLV have similarities in using fingers to feel each media, but it appears from the observation that STB is slower than SLV. This level of speed in palpating is influenced by prior knowledge related to concept interpretation. Experience and the level of limitation in seeing become the main supporting things in interpreting something, according to Muthmainah (2015) in her research [10]. Some of how embodied tactile experience is mediated through language and states simply that language does not merely convey tactile experience but also mediates its expression [12]. As SLVs have a dim ability to see, there is a higher confidence when compared to STBs, who can not see at all. STB appears to be cautious and, at the same time, tries to understand and imagine every touch that is done.

After being sure and feeling enough information obtained, the two subjects immediately focused on the numbers and formulas they knew related to objects on the given media. Both of them answered that the key to solving the following problem after understanding the interpretation of the problem will always focus on which numbers and formulas are used. This numerical focus is used to imagine what things will be operated. The procedure that becomes the next focus is directed thinking to start using the algebraic operations involved in solving the problem. Furthermore, how is the ability of each subject to organize their imaginative thinking in calculating algebraic operations with the numbers that have been given? By using the algebraic operations used, of course, they produce different time speeds in finding the answer to the final result of the problem, in line with the results of Sundari's research on Total blind and low vision children who permanently find the area and volume of flat buildings by directly entering the formula according to the known numbers [13]. This is something interesting to research about what if given problems that cannot be solved now by entering numbers into formulas, for example, with problems in the form of analysis. Botho connects the geometry-building media with everyday objects. This is done to facilitate the interpretation of concepts and delivery back when explaining what he has understood. The difference in the diversity of things presented by the subjects can be seen. SLV more everyday items that are related to the concepts of geometry. In explaining also looks SLV can show more fluency. At the same time, the ability to identify objects of both subjects in detail and in detail mention the shapes that compose the media objects given. However, SLV subjects look more fluent and fast and have more conveyed.

Data validity testing using triangulation of interview and observation methods was carried out by juxtaposing the results of STB in Figure 5 and SLV in Figure 8. In both STB and SLV, the interview and observation data are similar. So, the data is valid. Furthermore, the data from the two subjects that have been valid on each item is presented in Figure 9 below. Each indicator of creative thinking shows the same findings; however, there are some differences, including speed in feeling, confidence, and fluency. The limitations of each subject influence this.

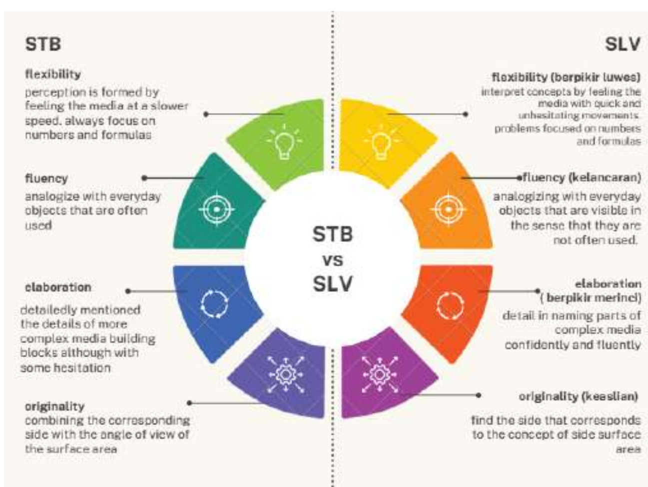


FIGURE 9. Data From Two Research Subjects

CONCLUSION

Based on the data and discussion, it can be concluded that flexibility (flexible thinking) in identification through the perception of finger feeling and imagining in the mind. The indicators achieved identify problems from different points of view as an alternative. All information from the method in detail will generate ideas for answers using numbers and formulas. Mathematical concepts and problems given in any form will always be focused on numbers and formulas, (b) fluency in analogizing objects often used or encountered in everyday life. The indicator achieved is providing many suggestions or ways to do many things, (c) elaboration (detailed thinking) is able to detail the media objects given. The indicators achieved are adding or describing the details of an object, idea, or situation to be more attractive; there are some differences from the uniqueness of the subject, namely the speed of intonation and firmness of speech, as well as the diversity of objects presented. (d) originality can find a new way to find the corresponding and parallel sides in the building space by using the concept of surface area. While in general, using the length of sides and angles.

ACKNOWLEDGMENTS

This research assists educators and education specialists in developing more effective teaching methods for visually impaired students. By understanding how they think creatively, we can design learning strategies that suit their needs. By understanding the uniqueness of visually impaired students in creative thinking, we can promote greater equality and support for them in various contexts, including in society and the world of work. This can help reduce stigma and discrimination against people with visual disabilities.

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RBL-STEM Learning Activity Framework: Improving Combinatorial Thinking Skills by solving Local (a, d)-edge antimagic coloring Problem and its application to Vertical Farming analysis Using GNN

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Abstract. Combinatorial thinking skills are needed in the technological era. Combinatorial thinking skills are essential in many fields, including mathematics, computer science, and statistics. Combinatorial thinking consists of five indicators: identifying various problems, understanding problem patterns, applying mathematical patterns, mathematical proof, and considering various combinations of problems. These indicators can be achieved by honing higher-order thinking skills. However, students' combinatorial thinking skills are still relatively low. One of the reasons for this low ability is that the learning model applied so far has not developed this ability adequately. Therefore, this study will use a research-based learning (RBL) model integrated with a STEM approach to solve local antimagic coloring (a,d) in solving vertical farming problems with artificial neural network techniques. While the local antimagic (a,d)-edge coloring of G if the set of edge colors form an arithmetic sequence with different initial values of a and d. The local antimagic (a,d)-edge chromatic number χ^' le(G) is the minimum number of colors required to color G such that the graph G satisfies the local antimagic (a,d)-edge coloring. This type of research uses qualitative methodology. This research will formulate syntax to develop learning activities using research-based learning (RBL) and STEM approach, by including assessment indicators for digital marketing literacy skills. The results show six stages of learning activities as a framework for developing RBL-STEM learning materials. Recommendations for further research related to the development of tools and analysis of RBL-STEM implementation

INTRODUCTION

How mathematical education develops is still influenced by the needs of modern society. Therefore, 21st-century learning skills—especially critical thinking, problem-solving, communication, and teamwork [1] have a strong influence on curriculum development. The ability to solve complex problems is influenced by a number of factors. Some of them are excellent mathematical skills in procedures [5]; a positive attitude toward mathematics [3]; mastery of mathematic processes such as reasoning, generalization, communication of results, or Mathematical modelling [4]; and conceptual understanding that includes arithmetic, algebra, and combination thinking.

Students can use combinatorial thinking skills in decision-making, planning, and experimental design. Combinatorial thinking skills can develop the ability to solve more complex problems and improve their critical and creative thinking skills. There are five indicators of combinatorial thinking skills, according to Dafik, including identifying several problems, understanding problem patterns, applying mathematical patterns, mathematical proof, and considering several combinations of other problems [6], [7]. Problem posing can improve in identifying new insights into students' combinatorial thinking[8]. Combinatorial thinking skills can develop the ability to solve more complex problems and improve their critical and creative thinking skills.

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040040-1–040040-13; https://doi.org/10.1063/5.0241594
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Combinatorial thinking is extremely useful in problem-solving in various fields, including computer science, applied mathematics, social sciences, and more. With the development of mathematics and computer science and their practical applications in various fields, combinatorial thinking is an important tool in solving problems and optimizing processes in the real world. Combinatorial thinking plays an important role in a wide range of applications, from computer network design to logistics planning, and this makes it one of the most relevant and important branches of mathematics and computer science. Combinatorial thinking is essential in many fields, including mathematics, computer science, and statistics. One of the learning models that can develop combinatorial thinking skills is RBL (Research-Based Learning), which is integrated with the STEM (Science, Technology, Engineering, and Mathematics) approach.

The idea of incorporating research findings and activities into learning practices is known as research-based learning, or RBL. Students who engage in RBL learning can become active learners [9]. Research-based learning is one of the learning approaches that can increase students' capacity for activity [10]. RBL basically involves students in the exploration of themes or issues that they find interesting and relevant to their lives, thus encouraging deeper and more meaningful learning [11]. RBL poses contextual and practical problems and covers at least four scientific fields (science, technology, engineering and math) [12]. Research-based learning is an educational approach that enhances the capacity of students and lecturers in the absorption and application of knowledge through analysis, synthesis and assessment activities [13]. The RBL learning paradigm should be used together with the STEM (Science, Technology, Engineering, and Mathematics) approach to help students develop their combinatorial thinking skills. The STEM approach can be used in conjunction with other teaching strategies, according to international research [14], [15]. Students' capacity for combinatorial thinking will increase when they face real STEM challenges. Vertical farming difficulties are real-world problems that can be incorporated into RBL-STEM education.

Walsh asserts that vertical farming can yield crops that are fair, inexpensive, nutrient-dense, and environmentally benign. [16]. Vertical farming is where cultivated plants are grown vertically instead of horizontally using soil media [17]. Vertical farming combines advanced technology with traditional farming practices to produce food vertically in enclosed spaces, such as office buildings, warehouses, or specialized facilities. Vertical farming aims to maximize the use of space and increase agricultural productivity by using modern technologies such as LED lighting, automated irrigation systems, and climate control. There is potential for vertical farming to be a useful tool for boosting sustainable urban agriculture, preserving food security, and increasing food output [16]. In this farming, we will use the local (a, d)-edge antimagic coloring application to arrange the location of plants on vertical farming. This study will analyze the local (a, d)-edge antimagic coloring in solving vertical farming problems with GNN techniques. Artificial neural network techniques and Python, a machine learning language, will be used in this study's software programming. The RBL-STEM Learning Activity Framework: Use of local (a,d)-edge antimagic coloring application to improve combinatorial thinking skills in addressing vertical farming using GNN technique was developed in this study by fusing the RBL learning model with the STEM approach.

METHOD

This research is a qualitative narrative method. It begins by exploring the contextual problem of STEM maker space. We then analyze the involvement of four STEM studies (Science, Technology, Engineering, and Mathematics), and outline the roles of each of these studies in resolving STEM contextual problems, namely the problem of vertical farming using local (a, d)-edge antimagic coloring with GNN technique. In the field of science, we outline the conceptual aspects of STEM maker space problems in specific scientific studies in arranging the layout of plants in vertical farming land while considering the use of colors. In technology, we describe the involvement of software applications, coding development using specific software Python programming, or the use of IoT platforms. In engineering, we analyze and describe the prototypes related to the contextual problems of STEM maker space for the implementation in the classroom learning that is about the time series forecasting prototype NPK concentration. In mathematics, we analyze the application schemes of local (a, d)-edge antimagic coloring lemmas or theorems in solving vertical farming problems in STEM maker space. We then observe and compare the performance, permutations, and uniqueness between different models. Once, we have considered that the involvement of these four studies can resolve the contextual problems of STEM maker space that is vertical farming problems, we proceed with the research with the writing of the framework of learning activities according to the RBL-STEM integration syntax in resolving these STEM maker space vertical farming problems in the form of several stages of learning activities. Finally, we will present the learning achievements and objectives, including the development of indicators and sub-indicators for students' combinatorial thinking skills.

RESULTS AND DISCUSSION

The Syntax of Research-Based Learning (RBL) with STEM approach

The foundation for integrating the RBL model with the STEM method will be presented below. This will help students become more proficient in combinatorial thinking as they analyze how local (a,d)-edge antimagic coloring applications are used to solve vertical farming problems using GNN approaches. This framework was created using Gita's suggested syntax [11]. Students are expected to comprehend the problem at hand in the first step of the RBL syntax. They are then urged to formulate a plan for fixing the problem, gather literature and information via search engines, gather and evaluate data concurrently, and write a report. One of the challenges associated with vertical farming is the need for a methodical arrangement of various plant species. The STEM problem and its four components in vertical farming are presented in the graphic below(Figure 1).

Following the syntactic integration of RBL-STEM, a narrative qualitative investigation was carried out after comprehending the STEM issues in figure 1. : (1) The first step is to determine the basic problems related to vertical farming, namely the arrangement of plant layouts with different types of plants; (2) The second one is to develop solutions to real problems, namely related to the arrangement of plant layouts using the local (a, d)-edge antimagic coloring Application; (3) Thirdly, it involves using internet technologies to gather information about plant design for vertical farming and look up relevant references. ; (4) the fourth step is to develop the aspects needed by students in the research process, namely developing a plant layout arrangement on vertical agricultural land using the local (a, d)-edge antimagic coloring Application; (5) Next, it is testing or proving the accuracy of the plant layout arrangement on vertical agricultural land that has been produced; and (6) The last one is to write in the form of a simple report about the results of the research and present it. More systematically, the RBL-STEM integration framework is presented in Figure 1.

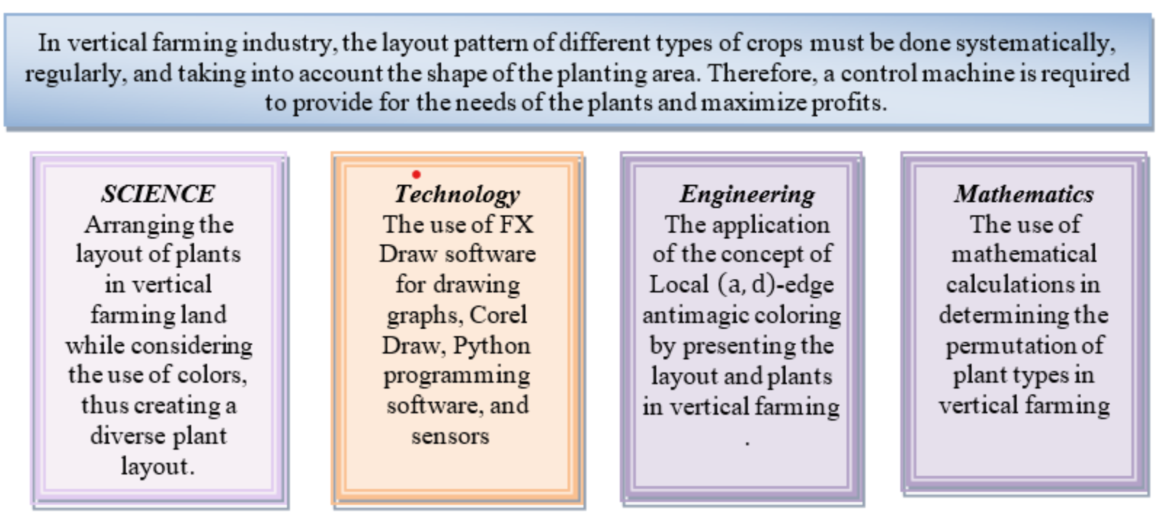


FIGURE 1. STEM problems in solving vertical farming

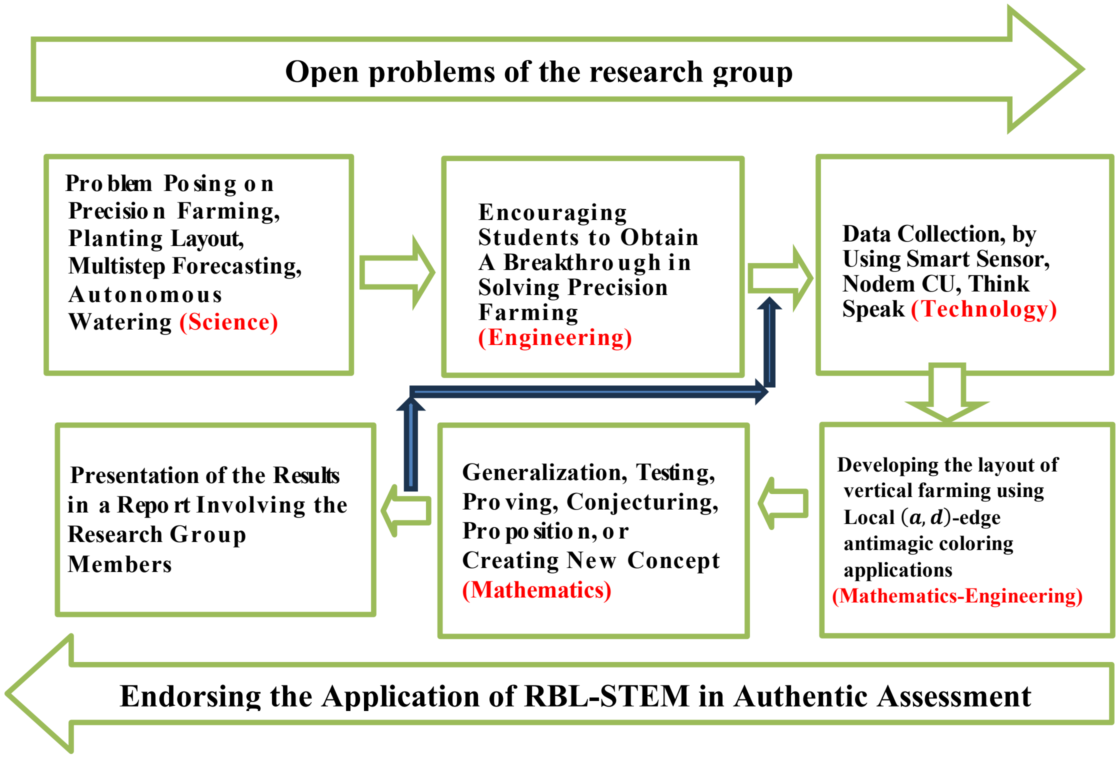


FIGURE 2. RBL-STEM Framework in Vertical Farming

Student learning outcomes and objectives

Through the use of RBL-STEM, it is anticipated that students will gain a better understanding of combinatorial thinking as they solve the local (a,d)-edge antimagic coloring application to address vertical farming. Local (a,d)-edge antimagic coloring can be used by students to create layouts, particularly in plant places. Additionally, students can use analytical and qualitative methods to test the plant layout acquired by local (a,d)-edge antimagic coloring, which yields multiple potential plant placements for vertical farming.

Through the use of the STEM approach and the RBL model's learning objectives, students can enhance their knowledge and proficiency in Science, Technology, Engineering, and Mathematics. Every component of the STEM paradigm has specific learning goals. The following is a description of the learning objectives for each of the four STEM elements.

Science- students can:
- understand the basic principles of Science related to agriculture, botany, and ecology.
- learn scientific methods to observe, measure, and analyze plant growth in vertical farming systems.
- understand the effect of local (a, d)-edge antimagic coloring on plant growth and development.
- optimize crop layout to increase productivity and efficiency in farming systems.
- identify environmental factors that affect plant growth in vertical farming.

Technology- It is expected of pupils to be able to :
- use the Internet Google and Google Scholar to identify the concept of local (a, d)-edge antimagic coloring, and vertical farming problems.
- use technology in managing and monitoring vertical farming systems with NPK sensors
- understand the role of technology in optimizing the use of local (a, d)-edge antimagic coloring to increase agricultural yields.
- utilizing corel draw application in crop layout planning.
- use the YouTube channel to find out tutorials about plant layout.
- using Python programming software to analyze the needs of Nitrogen, Phosphorus, and Potassium (NPK) with artificial neural network techniques.

Engineering- students are expected to be able to:
- design and develop efficient vertical farming systems, including appropriate plant layouts.

- apply engineering principles to ensure optimal air circulation, lighting, and watering in vertical farming systems.
- understand the application of the local (a, d)-edge antimagic coloring algorithm and how to design plant layouts in vertical farming.

Mathematics -students are expected to:

- understand mathematical concepts related to local (a, d)-edge antimagic coloring.
- use mathematical calculations, namely local (a, d)-edge antimagic coloring, to determine the number of plants that can be planted on limited land in vertical farming.
- analyze the location of plant patterns based on the local (a, d)-edge antimagic labeling obtained.
- analyze the data captured by Nitrogen, Phosphorus, and Potassium (NPK) sensors on each plant for training, testing, and forecasting.

Elements of a vertical farm using local (a, d)-edge antimagic coloring

Science Elements

Vertical farming is a modern farming method in which crops are grown in layers vertically or in stacks, often inside structures such as multi-staged buildings, greenhouses, or modified containers. Local (a, d)-edge antimagic coloring can be used to design efficient crop layouts and ensure adjacent crops do not compete for resources such as sunlight or water. The concept of local (a, d)-edge antimagic coloring from graph theory can be used in vertical farming to optimize crop layout and resources. This approach can help in improving the production efficiency of vertical farming and reducing competition between adjacent crops. Some examples of vertical farming can be presented in Figure 3

Agriculture has been the principle of many countries' economies, providing food and livelihoods for millions of people worldwide. Challenges such as climate change, population growth, and shrinking farmland make innovation essential. One promising solution is "Smart Agriculture" using modern technology, and one of them is using NPK sensors. NPK sensors are devices designed to measure and monitor nitrogen, phosphorus, and potassium levels in soil or plant nutrient solutions. NPK sensors can give farmers important information about soil nutrient levels and help make better fertilization and management decisions. Students learn about the NPK sensor, as presented in Figure 4.

FIGURE 3. Vertical Farming

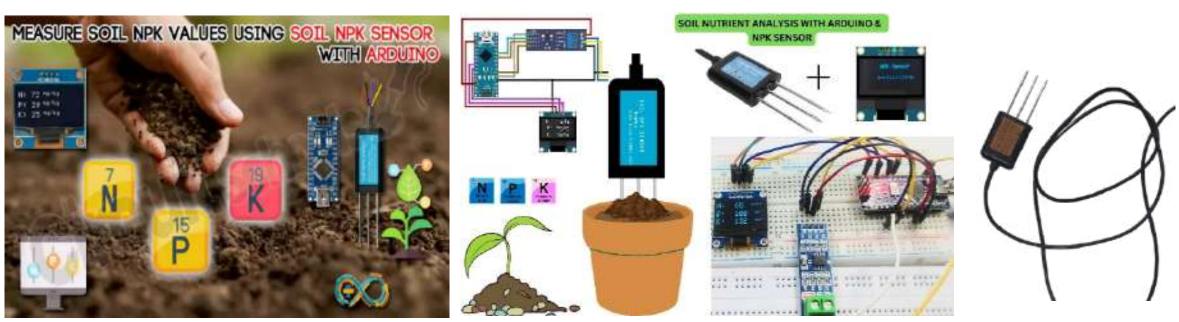
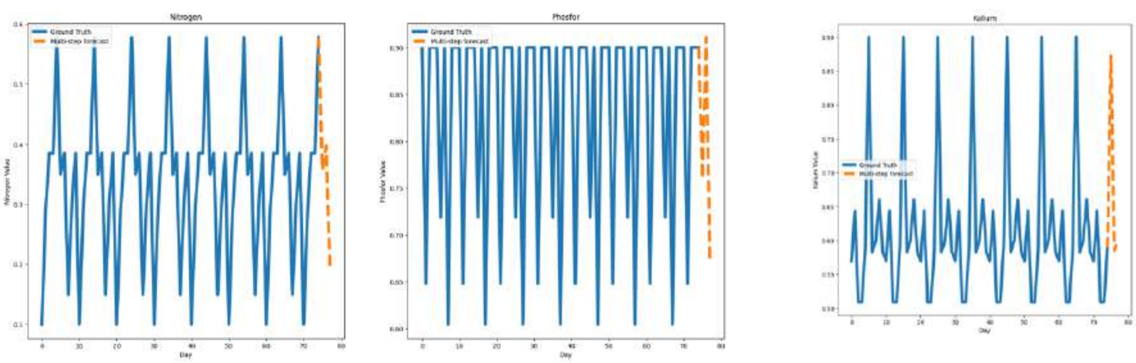


FIGURE 4. NPK Sensors

Technology Elements

Information technology, including the Internet, is currently developing very rapidly. With the 5G internet network, everything can take advantage of the use of the Internet. Through several software such as FX Draw to draw graphs and Python programming. Python programming software will be used to predict the content of nitrogen, phosphorus, and potassium levels. Furthermore, students use Python programming to perform multistep time series forecasting on NPK concentration (Figure 5b). To run the program go to the link https://colab.research.google.com/?hl=id (figure 5a)

(a)



(b)

FIGURE 5. The Training and Testing Process of Soil NPK Content on Companion Plant

Engineering Elements

In engineering, we need to design the layout of plants in vertical farming. Special techniques and NPK administration. The technique used in this study for the layout of plants on vertical farms is to apply the application of local (a, d)-edge antimagic coloring side. Then, students are given a prototype for a time series forecasting NPK concentration. The prototype for time series forecasting can be seen in Figure 6.

Mathematical Elements

The usefulness of local (a,D)-edge antimagic coloring theories in vertical farming will be investigated in this section. calculating the maximum number of plants that can be produced in vertical farming on a given amount of area by using mathematical methods, namely local (a,D)-edge antimagic coloring. Students name the graph using the theory of local (a,D)-edge antimagic coloring in mathematics elements. Selecting the appropriate graph type is the first step. Labeling the corner points is the second. The edge weights are then calculated by adding the labels of the two connected corner points. Finally, it is examined if the edge weights satisfy the conditions of local (a,D)-edge antimagic coloring, which indicates that the set of edge weights forms an arithmetic sequence. This indicates that an arithmetic sequence with a starting value of "a" and a difference of "D" is formed by the set of edge weights.

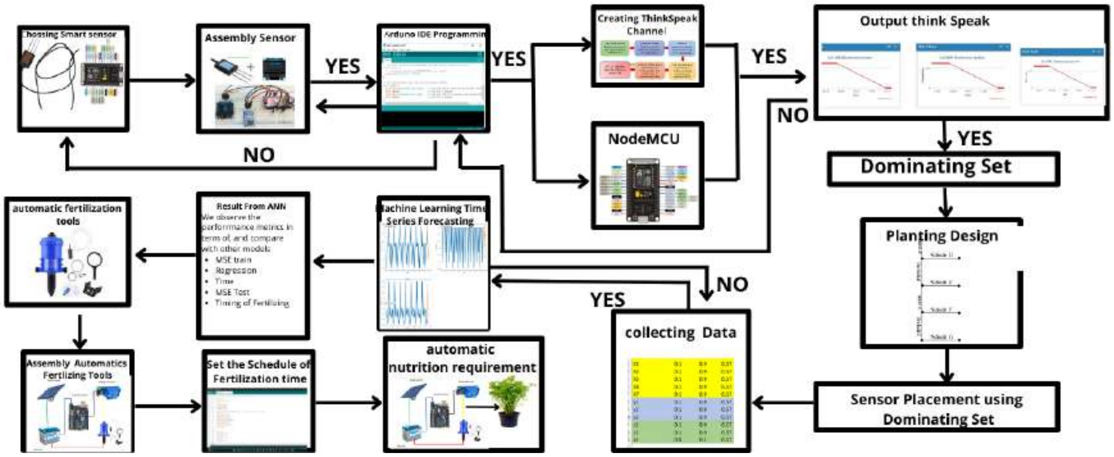
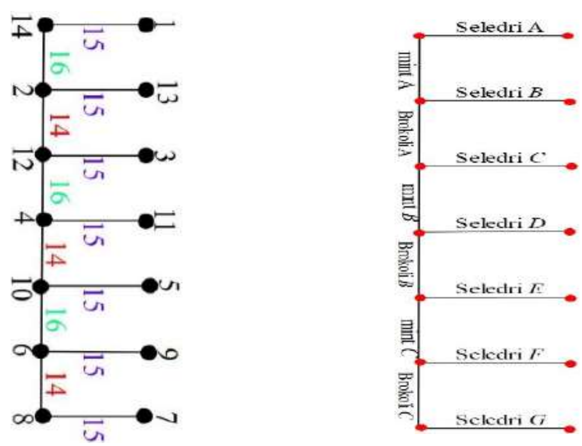


FIGURE 6. Time series forecasting prototype NPK concentration

Stage 1. Create a graph labeling based on the local (a, d)-edge antimagic coloring on the CP (7,1) graph presented in Figure 7. Then, it is a vertical farm using coloring according to the graph theorem obtained (Figure 7a).
Stage 2. Students explore theorems about local (a, d)-edge antimagic coloring to develop vertical farming. This one is represented by a centipede graph with n = 7. The graph above has three weights, namely 14, 15, and 16, so we have three different types of plants: 14 represent broccoli plants, 15 represent celery plants, and 16 represent mint plants, presented in Figure 7b.
Stage 3. Designing the vertical farm design using the centipede graph CP (7,1). After that, arrange the layout of plants on the vertical farm, as shown in Figure 8.

Theorem 2.1. Let $CP(n,1)$be a centipede graph, for $\forall n \geq 2$ then $(2n,1)$-edge local antimagic colouring number is $\chi'_{(2n,1)-ela}(CP(n,1)) = 3$.



(a) **(b)**

FIGURE 7. Local (a,d)-edge antimagic coloring on Graph CP(7,1)

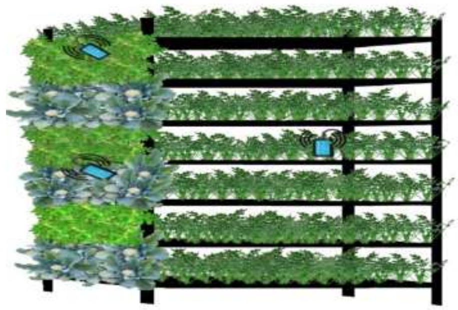


FIGURE 8. Vertical farming framework design

RBL learning with STEM approach in Vertical farming problems

Using a STEM approach, each of the six stages of the RBL learning model is covered in this part. The six steps will outline how learners apply the RBL learning model using a STEM approach to create plant layouts on vertical farms and utilize local (a,D)-edge antimagic coloring to enhance combinatorial thinking abilities. It is necessary to follow methodical planting schedules with a variety of plant species, taking into account the contours of the planting area.

1. The first stage of Science is to determine the fundamental problems related to the plant layout pattern in vertical farming. Plant layout patterns with different types of plants must be done systematically regularly, and pay attention to the shape of the planting land. RBL-STEM learning activities in stage 1 can be seen in Table 1 below.

TABLE 1. RBL-STEM learning activities in Stage 1

Stage 1	Learning Activities
Propose/determine fundamental problems related to crop layout patterns in vertical farming (**Science**).	The lecturer asked the students if they had seen a plant layout pattern in vertical farming around the house.
	The lecturer shows the students the crop patterns and types in vertical farming and asks if they can develop other crop patterns and types.
	Students work on developing a construction base with plant patterns and plant types and try to analyze the number and types of plants needed.
	Students start to have group discussions.

2. The second engineering stage of the RBL model involves learning activities that use a STEM approach. The goal is to help students strengthen their combinatorial thinking skills by solving real-world issues involving local (a,D)-edge antimagic coloring. Students are asked to identify multiple graphs with local (a,D)-edge antimagic coloring during lecture exercises. Table 2 displays the RBL-STEM learning activities for stage 2.

TABLE 2. RBL -STEM learning activities in stage 2.

Stage 2	Learning Activities
Develop solutions for solving vertical farming problems using local (a,d)-edge antimagic coloring. (**engineering**)	a. The lecturer guides students to discuss breakthroughs in solving vertical farming problems using local (a,d)-edge antimagic coloring.
	b. The lecturer explains to students the layout of plants in vertical farming.
	c. Students are asked to find the local (a,d)-edge antimagic coloring simple graph on vertical farming.

3. Learning exercises for the RBL-STEM approach's third level Technology, specifically the gathering of data and the use of the internet to look up necessary references for local (a,D)-edge antimagic coloring on vertical farming. RBL-STEM learning activities at stage 3 can be seen in Table 3 below.

TABLE 3. RBL-STEM learning activities in stage 3

Stage 3	Learning Activities
Collecting data and searching for references needed with the help of internet technology related to making vertical farms, utilizing FX Draw software for drawing graphs, and Python programming software. (**Technology**).	a. Under lecturers' guidance, students download and try to use software related to vertical farming.
	b. Data collection related to local (a, d)-edge antimagic coloring in vertical farming. By searching journals/articles and videos.
	c. Students can find research on the local (a, d)-edge antimagic coloring chromatic number by using a variety of reference sources, such as Mendeley, Orcid, Google Scholar, Publons, Scopus, Youtube, Slideshare, Python programming software, and so forth.

4. Vertical farming employs local (a,D)-edge antimagic coloring in the fourth stage (Mathematics-Engineering). Choosing the fundamental layout for the plants' placement in vertical farming and using local (a,D)-edge antimagic coloring are the first steps in this process. RBL-STEM learning activities in stage 4 can be seen in Table 4.

TABLE 4. RBL-STEM learning activities in stage 4

Stage 4.	Learning Activities
developing crop layout arrangement on vertical farmland using local (a, d)-edge antimagic coloring application (**Mathematics-Engineering**).	a. To create local (a, d)-edge antimagic coloring for a graph, the lecturer and students choose a graph, and then they test the chromatic number to determine the graph coloring.
	b. In vertical farming, lecturers and students create plant layouts with local (a, d)-edge antimagic coloring.
	c. Both instructors and students work to develop local (a, d)-edge antimagic coloring of a graph and test the chromatic number, as well as to generalize for graphs of larger order.
	d. Students create a plant layout in a vert.

5. Creating a method to verify or test the accuracy of the local (a,D)-edge antimagic coloring is the fifth stage (mathematics). For more details, see Table 5.

TABLE 5. RBL-STEM learning activities in Stage 5

Stage 5	Learning Activities
Proving the accuracy of the local (a, d)-edge antimagic coloring theorem **(Mathematics**).	a. Students identify the vertex set, edge set, order, and size of the graph of their choice.
	b. Students demonstrate the upper bounds on the edge and vertex coloring functions.
	c. Students demonstrate the theorem's lower bound, which they previously discovered.
	d. Students write down the proven theorem.

6. In order to present their research findings and write a report on their RBL-STEM research, students complete the sixth stage, known as the RBL Report. In this instance, students' combinatorial thinking abilities will be observed through their participation in a focus group discussion (FGD). For more details, see Table 6.

TABLE 6. RBL-STEM learning activities at stage 6

Stage 6	Learning Activities
Present the research results, and report on RBL-STEM research carried out by students related to using local (a, d)-edge antimagic coloring in vertical farming to improve students' combinatorial thinking.	a. To improve their combinatorial thinking, students create a research report on the application of local (a, d)-edge antimagic coloring in vertical farming.
	b. Before the class, students present their work to lead a focus group discussion (FGD).
	c. Instructors assess and elucidate every outcome resulting from students' research endeavours.
	d. Using the observation sheet, the lecturer keeps an eye on the students' combinatorial thinking abilities.

Instrument Framework for Assessing Students' Combinatorial Thinking Ability

The combinatorial thinking ability of students in the form of a combinatorial thinking ability instrument assessment framework can be seen in Table 7.

TABLE 7. Framework for assessment instruments for combinatorial thinking skills

Indicator	Sub-indicator	Test material
Identify some problems	1. Identify problem characteristics 2. Apply it in some cases	1. Explain why there is a need for a system to monitor soil nutrients 2. Identify the problem of NPK nutrient requirements for each crop in intercropping agriculture.
Understand the pattern of the problem	1. Identify problem solutions. 2. expand the problem solution by considering several possibilities	1. Consider the breakthrough by using a sensor nutrient and loca (a, d)-edge antimagic coloring 2. Determine what graph is used in vertical farming.
Apply mathematical patterns	1. Apply mathematical patterns 2. Calculate cardinality 3. Develop a solution algorithm	1 Perform vertex and edge coloring according to the definition of local (a, d) −edge antimagic coloring 2. Identify the vertex set, edge set, order and size of the selected graph 3 Create vertex and edge label functions
Mathematical proofs	1. Perform argumentation calculations 2. Perform algorithmic testing 3. Testing bijections, 4. Testing for bijection	1 Determine the cardinality of the graph up to order n 2. Create local (a, d)-edge antimagic coloring functions in the form of point function

Indicator	Sub-indicator	Test material
	5. Apply inductive, deductive, and qualitative verification	and side weight function of a graph of a certain order 3 Generalize the rumbles of local (a, d)-edge antimagic coloring functions of point and side quality functions of a graph up to the n^{th} order and be able to explain them 4 Find a local (a, d)-edge chromatic antimagic coloring of a graph of a certain order 5 Generalize the formulation of local (a, d)-edge antimagic coloring of graph up to order to n and be able to prove the false of the formulation
Consider some combination of other issues	1. Interpret the problem, 2. Propose some related problems 3. Figure out new problem combinations 4. Find potential applications in the solution	1 Explain the definition of local (a, d)-edge antimagic coloring as well as the path/step of local (a, d)-edge antimagic coloring chromatic number finding 2 Finding open problems related to concepts local (a, d)-edge antimagic coloring 3 Discovering new problems related to the concept of local (a, d)-edge antimagic coloring 4 Finding applications related to the concept of local (a, d)-edge antimagic coloring

Learning Material Process Development Framework

During the learning material development phase, the ADDIE model, developed by Raiser and Mollenda, will be used. Analysis, design, development, implementation, and evaluation are all components of this paradigm. Analysis of student characteristics, materials, learning processes, and learning media to be used is the first stage, or phase of analysis. Designed to incorporate the RBL model into the STEM approach at the second stage, which is also known as the design stage. Researchers are currently working on lesson plans, curricula, MFI, pre- and post-test, and other evaluation tools. The third step in development is testing instructional materials and tools to ensure their validity and application. Validation results include content validity values, format validity, language validity and level of practicality. The goal of the fourth stage, the implementation, is to evaluate how well the RBL-STEM teaching material is. The aim of the fifth stage, implementation is to assess how well RBL -STEM learning material helps students to use combinatorial thinking to solve vertical farming problems using local (a, D)-edge anti-magic colors. In the five-stage, the evaluation, students are given reflection training to find out whether using the model RBL learning material with the STEM approach can enhance their combinatory thinking skills.

DISCUSSION

Developing the learning activity framework of the RBL-STEM model in solving vertical farming problems with Artificial Neural Network Techniques using local (a, d)-edge antimagic coloring to improve students' combinatorial thinking is very useful to learn. In addition to being a means of getting used to thinking and acting holistically and getting to know scientific steps, the results of this research serve as guidelines for creating agricultural systems to maximize the use of space and increase agricultural productivity. This reinforces [18][19], that the five abilities of combinatorial thinking ability indicators can be maximally achieved with various supporting factors for learning. These findings provide direction for future investigation. Further research can be conducted in at least two areas: (1) creating STEM-RBL learning materials using the ADDIE development model; and (2) evaluating how RBL-STEM learning materials are used to enhance students' combinatorial thinking when utilizing artificial neural network techniques to solve vertical farming problems using local (a,D)-edge antimagic coloring. When used in the classroom, the RBL-STEM combination learning activity framework is particularly effective in helping students realize their combinatorial thinking.

CONCLUSION

The study's findings have a description of the syntax of the RBL learning model combined with the STEM methodology. The primary product is a set of instructional exercises that apply a STEM approach and the RBL concept. To improve students' combinatorial thinking, it specifically employs local (a,D)-edge antimagic coloring in vertical farming using artificial neural network approaches. The study produces a six-stage description table that functions as a framework for educational activities. Each step includes a description of the learned actions that have been done. One of the outcomes of the study is the development of a framework of assessments pertaining to students' combinatorial thinking. The results of this study make it simple to conduct and apply additional research into the creation of devices and the analysis of RBL-STEM deployment. . Recommendations for future research based on the findings of this study include device development and analysis of RBL-STEM implementation.

ACKNOWLEDGEMENT

We gratefully acknowledge the support from the research members of PUI-PT Combinatorics and Graph for their help and support on finishing this paper for publication of the year 2024. Additionally, we would also gratefully acknowledge the support from lectures of Mathematics Education FKIP – University of Jember for completing this paper and Universitas PGRI Argopuro Jember for their help and support on finishing this paper for publication.

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The Importance of Developing Elementary School Teachers' Pedagogical Competencies in 21st Century Education

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Abstract. The most important indicators used by teachers when teaching students in elementary schools are related to pedagogical competence as well as basic activities for mastering basic teaching skills. The task of teachers is not only to convey or decide knowledge to children at school, but teachers also have the task of developing the personalities of the children they educate in an integrated manner. To become a professional teacher, you need testable indicators that can show your ability to teach students in elementary schools during the school year. Teachers develop children's mental attitudes, develop children's conscience, so that children are sensitive to issues of humanity and human dignity, and also develop children's life skills in society. This type of research uses a qualitative descriptive approach with a survey method that aims to describe indicators of pedagogical competence, indicators of professional teacher competence, and determine the needs of teachers in developing their pedagogical competence. This research discusses indicators of pedagogical competence among professional teachers and describes the general situation of elementary school teachers' needs in an effort to improve pedagogical competence.

INTRODUCTION

Teacher competency is a reflection of the quality of a teacher. Competent teachers are a criterion for quality teachers. Teacher competencies include pedagogical, communication, professional, and personality [1]. Education is increasingly advanced, and the need for teachers is increasing, both in quality and quantity, so teacher education programs have become the first priority in the education development program in our country. Teachers are expected to be able to master various skills needed in order to make the teaching profession professional [2]. Teachers are the single most important factor in determining how well students learn; therefore, to begin the task at hand, one must have a thorough understanding of what must be done to teach a child or student who is a student. Apart from teaching material, teachers must also be able to develop children's personal characteristics, their potential, and their emotional well-being [3]. The main factor that contributes to the success of students' education in elementary schools is the teacher's skills in teaching students. This will be information that is relevant to the level of elementary school teachers' understanding of teacher professional competence. Pedagogical competence is a teacher's ability to understand students, design and implement learning, develop students, and evaluate student learning outcomes to actualize the potential they have. The teacher's job is not only to teach students in the learning process in class, but teachers must also play a role in developing the potential of students, both their personalities and their hidden talents.[4].

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The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040041-1–040041-6; https://doi.org/10.1063/5.0242521

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LITERATURE REVIEW

This research describes the points contained in professional teacher competence. It is hoped that a teacher, especially elementary school teachers, will be able to master competence, especially pedagogical competence, which is the main guard for a teacher in carrying out his main duties at school. In reality, nowadays many young teachers do not understand what competencies they should master and develop in order to become professional teachers, producing a golden generation of the nation's successors who are superior and have character, a generation that is ready to face the increasingly challenging challenges of the 21st century, closely linked to technological developments.

Primary School Teacher Competences

Becoming a professional teacher must include indicators that have been determined in teacher competence, namely, mastering pedagogical competence, which also includes indicators of professional teacher.[8]. It is very important for a teacher, as an educator, to have competence so that the learning process can run smoothly and achieve the desired goals. In the learning process, there is a striking difference between the way old teachers and young teachers teach. Teachers are one aspect of the success of the teaching and learning process in the classroom. A good teacher needs good competence to deliver lessons to students. Teachers who have appropriate professional competence and personality competence will be able to create a learning atmosphere that is conducive, creative, effective, and enjoyable so as to increase student learning motivation optimally. The four teacher competencies need to be understood and internalized by every teacher and prospective teacher. By mastering pedagogical, personal, social, and professional competencies, teachers can do things that teachers should do, which, of course, are really needed by students.[9].

Pedagogical Competence

A person's pedagogical expertise is a certain performance or ability in the field of education. To be a qualified teacher, you must have pedagogical skills. In the National Education Standards, the explanation of Article 28 paragraph (3) point A states that pedagogical competence is the ability to manage student learning, which includes understanding students, designing, and stating that pedagogical competency is the ability to manage learning, which includes: 1) understanding students; 2) design and implementation of learning; 3) evaluation of learning; and 4) development of students to actualize the various potentials they have.[10]. Pedagogical competencies include: 1) understanding the characteristics of students from a physical, social, cultural, emotional, and intellectual perspective; 2) understanding the needs of students in the context of community needs. 3) understanding the learning process and student motivation. 4) Facilitate the development of students' potential; and 5) Understand learning theories and principles. Considering that each student has unique abilities and personalities, a teacher's ability to understand student character is an important skill in the teaching process. Interests, attitudes, learning motivation, learning styles, thinking abilities, and available initial abilities are the main components of the individual aspects or qualities of students.[11]. To determine the initial abilities and characteristics of students, a teacher can use various methods, including: (1) carrying out an initial ability test (pre-test); (2) using available personal data of students; (3) using interviews; and (4) using questionnaires.[12]

Pedagogical competence is closely related to the teacher's mastery of the ongoing learning process of students in the classroom.[13]. This is because this competence will be used in the daily life of a teacher in carrying out his duties. According to statement before "pedagogical competence is the ability of educators to create a varied learning atmosphere and experience in managing students who fulfill the prepared curriculum." This includes the ability of educators to: (a) understand the insights or foundations of education; (b) have an understanding of students; (c) be able to develop curriculum and syllabus; (d) be able to prepare learning plans; (e) carry out educational and dialogical learning; (f) evaluate learning outcomes using correct procedures; and (g) be able to develop the potential of students to actualize the various potentials they have.Based on Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers, it is stated that pedagogical competence is "the ability to manage student learning". [14]. The Ministry of National Education (2006, p. 9) calls this pedagogical competency "learning management competency". This competency can be seen in the ability to plan teaching and learning programs, the ability to carry out interactions or manage the teaching and learning process, and the ability to carry out assessments.[15].

Professional Teacher

Teachers are professional staff who have the main task of educating, guiding, teaching, directing, assessing, training, and evaluating students for formal education in early childhood education, primary education, and secondary education. A teacher is a figure who can shape the character and soul of students. Teachers have the power to build and shape students' personalities so that they can become useful people for their homeland, nation, and religion. Teachers are the most important subject in the continuity of education.[16]. Without teachers, it is difficult to imagine how education could run. Even though there is a theory that says that the existence of people as teachers will have the potential to hinder the development of students, the existence of people as teachers cannot be completely excluded from the educational process.Teachers are an important component in the teaching and learning process. A teacher participates in efforts to form potential human resources in the field of development. The definition of a professional teacher, according to experts, is anyone who has authority and is responsible for the education of their students, whether individually or classically, at school or outside school. [17]. As an educator who takes over the duties of parents as a noble task, it is hoped that a teacher will always be honest, selfless, and only hope for Allah's approval. This attitude will be applied to the teaching and learning process so that it will produce a quality generation. Teacher professionalism is the ability of teachers to carry out their main duties as educators and instructors, including the ability to plan, implement, and evaluate learning.Every teacher needs to have professional qualifications, with the main criteria being having a commitment to hard work, having a positive self-perception that can be trusted, and helping others. The most important aspect of professional integrity is having a commitment to work long hours to support educational initiatives. A teacher's professional competence determines whether a teacher can carry out their duties and functions as a teacher well. Examples of professional competence are shown by the following teacher professional competence indicators: (1) Mastery of the subject matter being taught, including its structure, concepts, and scientific mindset; (2) Mastery of lesson Competency Standards (SK), lesson Basic Competencies (KD), and learning objectives of a lesson being taught; (3) Ability to develop subject matter creatively so that it can provide broader and deeper knowledge for students; (4) Ability to act reflectively to develop professionalism on an ongoing basis; (5) Ability to utilize information and communication technology in the learning process and also personal development.[18].

Competence is closely related to how a teacher communicates, behaves, and interacts in general, whether with students, fellow teachers, education staff, parents of students, or the community at large. Four indicators that can show a teacher's social competence are as follows: (1) The ability to be inclusive, objective, and not discriminate regarding a person's background, whether related to physical condition, social status, gender, race, family background, and so on; (2) The ability to communicate effectively, using polite and empathetic language; (3) The ability to communicate both orally and in writing. (4) Ability to adapt and carry out duties as a teacher in various environments with various socio-cultural characteristicsProfessional competence is the mastery of learning material more broadly and in depth. Includes mastery of the subject curriculum material and scientific substance that covers the learning material, as well as mastery of the scientific structure and methodology. Professional competencies include: (1) understanding educational goals to achieve them; (2) recognizing the function of schools in society as cultural centers; and (3) getting to know the principles of educational psychology that can be utilized in the teaching and learning process. In terms of skill level, teachers have a Teacher Performance Assessment, which contains 45 (forty-five) indicators related to pedagogical competence and seven (seven) aspect indicators. Identifying the characteristics of students in elementary schools Teachers can convey and use information about students' body characteristics to support the learning process. These characteristics relate to physical, intellectual, social, emotional, moral, and basic social behavior: To ensure that all students have the same motivation to participate in active learning activities during class, teachers can identify typical learning characteristics in every student.[19].

21st Century Education

National education in the 21st century aims to realize the nation's ideals, namely a prosperous and happy Indonesian society with an honorable and equal position with other nations in the global world, through the formation of a society consisting of quality human resources, namely independent individuals willing and capable to realize the ideals of their nation. [20]. 21st century learning is learning that combines literacy skills, knowledge abilities, skills, behavior, and mastery of technology. This means that in this century, students are not only required to be proficient in science. More than that, students must also be skilled in using technology, be literate people, and have good morals. That is why the competencies that must be possessed in the 21st century are called 4C, which include creativity and innovation, collaboration, communication, critical thinking, and problem solving. Learning in this century must be based on HOTS (high-order thinking skills) or high-order thinking skills.[21]. The role of a teacher in preparing for 21st century learning is very important and is at the forefront of forming students as a golden generation who are superior, intelligent, and have character. It is hoped that the stakeholders will be able to synergize and move together in efforts to advance education in Indonesia, both on a local scale and on a global stage. The Ministry of Education and Culture formulated that the 21st century learning paradigm emphasizes students' ability to find out from various sources, formulate problems, think analytically, and work together and collaborate in solving problems.[23]

Description of Primary School Teacher Competencies

Based on the results of a random survey in the Karanganyar district, 98.2% of 110 respondents stated that efforts were still needed to improve pedagogical competence. There were 5 respondents, namely principals from 5 different schools, who stated that there was still a need to improve the pedagogical competence of elementary school teachers, especially in the Karanganyar district, especially in the Jumapolo district, which is generally dominated by young teachers who still do not have much teaching experience in the field.

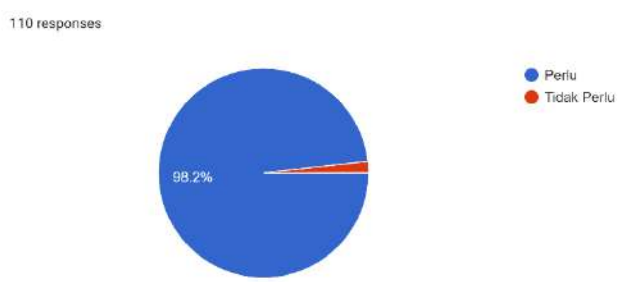

FIGURE 1. Stakeholder Survey Results: Whether Pedagogical Competence is Needed or Not Improved

Based on the data above, it shows that there is still a need for efforts to improve the pedagogic competence of elementary school teachers, especially in relation to basic teaching skills. There need to be efforts in the form of training and stimulants for teachers, especially those who are new teachers and do not have much experience in the field. Since the work period is less than three years, it is necessary to have a more in-depth mastery of basic teaching skill competencies so that the implementation of learning can achieve optimal results.

METHODOLOGY

The method used in this research is the survey method, in which the researcher collects data by distributing questionnaires, conducting interviews, and using literature studies to examine theories from various pieces of literature related to the research as well as obtain a description of the general situation in the field.[24]. Respondents from this research were from various basic education stakeholders consisting of supervisors, school principals, K3S heads, and elementary school teachers in the Jumapolo sub-district, Karanganyar, Central Java.

CONCLUSION

Based on the results above, it can be concluded that pedagogical competence is a skill or ability that a teacher must master in looking at students' characteristics from various aspects of life, be they moral, emotional, or intellectual. The ability of professional teachers is not just a myth. To achieve the indicators of a professional teacher as above, a person must have a strong work ethic. The following are several steps that smart teachers can take to become professional teachers: (a) Understand the duties and functions of a teacher; (b) Always strive to improve your knowledge, whether it's knowledge about the subject matter or knowledge about how to be a good teacher, by reading a lot, attending classes, talking with colleagues, and other similar activities. recognize underlying deficiencies and then make efforts to correct them; (d) increase the ability to adapt to new situations or ongoing changes so as not to reduce the quality of teacher education. To adapt to new situations or ongoing changes in the area so as not to degrade the quality of your education; (e) willing to advance technology to improve educational standards. The main keys for a teacher to become a professional teacher are strong will, commitment, and sincerity in carrying out his noble duties as a teacher. Primary school teachers' pedagogic competence is the main focus to continue to be improved in order to obtain optimal learning results. Efforts to increase the competency of elementary school teachers need to be carried out with various activities, starting with training programs, in an even and sustainable manner, not only for those who pass the competency enhancement program selection from the government but also for all teachers, whether selected or not, to take part in the teacher competency enhancement program. Apart from that, there is a need to develop training that is simpler and more specific but can have a positive impact on pedagogical competency training participants. Training is focused and tailored to the needs of local teachers; for example, teachers who have tenures of less than 3 years can be given special training related to pedagogical competencies related to developing basic teaching skills in schools. So that student output results can be optimal.

ACKNOWLEDGMENTS

The researcher would like to thank all parties who have helped in completing this research. Supervising lecturer, school supervisor, head of K3S Jumapolo District, school principal, and, of course, elementary school teachers for their extraordinary support and cooperation.

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RBL-STEM Learning Activity Framework: Improving Students Combinatorial Thinking Skills for Solving Image Encryption Problem Using Edge Irregular Reflexive *k*-Labeling

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Abstract. Combinatorial skills refer to the ability to analyze and manipulate combinations of elements or objects in various ways to solve problems or achieve specific goals. These skills involve understanding how different elements can be arranged or combined to create new outcomes, often systematically and organized. In this era, these skills should be endorsed in the classroom so that the young generation possesses these skills. However, in reality, students' combinatorial thinking skills still need to improve since the learning model applied in the classroom has yet to foster these skills. The indicators of combinatorial thinking consist of e identifying some cases, recognizing patterns from all cases, generalizing all cases, proving mathematically, and considering other combinatorial problems. This paper will describe the learning activities of RBL-STEM to improve students' combinatorial thinking skills in solving the edge irregular reflexive k-labelling problem and its application in image encryption. Let G be a connected, simple, and undirected graph with a vertex set $V(G)$ and an edge set $E(G)$.A total k-labeling is an edge irregular total k-labeling of the graph G if even two distinct edges have different weights. The edge weight is the sum of the labels of its incident vertices and the labels of that edge. Bača extended the above notion into an edge irregular reflexive k-labeling. The total k-labeling defined the function $f_e: E(G) \rightarrow \{1,2,3,\dots,k_e\}$ and $f_v: V(G) \rightarrow \{0,2,4,\dots,2k_v\}$ where $k = max\{k_e, 2k_v\}$. For the graph G, the total k-labeling is called an edge irregular reflexive k-labeling if the condition every two different edges x_1x_2 and y_1y_2 of G, $wt(x_1x_2) \neq wt(y_1y_2)$, where $wt(x_1x_2) = f_v(x_1) + f_e(x_1x_2) + f_v(x_2)$. The smallest value of k for which such labelling exists is called the reflexive edge strength of the graph G, denoted by $res(G)$. This research uses a qualitative narrative approach, starting with developing a prototype of the application in image encryption using edge irregular reflexive k labelling and continuing with formulating the stage of learning activities regarding RBL-STEM. The results of this research are in the form of an RBL-STEM learning framework consisting of six stages of learning activities. Based on these results, the following steps will be the development of RBL-STEM maker-space learning materials.

INTRODUCTION

Thinking is an activity of the mind to process knowledge obtained through the senses and aims at achieving truth. Combinatorial thinking is one of the thinking skills included in students' higher-order thinking skills. Combinatorial thinking skills are one of the mathematical sciences related to computing, both as a means and goal in obtaining findings and characterizing the properties of finite structures [1]. Meanwhile, combinatorial thinking skills are one of the cognitive development abilities at the formal operational stage, characterized by students' ability to conger various feasible alternative solutions in specific scenarios. According to Dafik, there are five indicators of combinatorial thinking skills: identifying several cases, recognizing patterns from all cases,

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040042-1–040042-16; https://doi.org/10.1063/5.0241675
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

making generalizations in all cases, proving mathematically, and considering other combinatorial problems [2]. This skill is essential in various fields, such as business, technology, and mathematics. Multiple activities, such as solving math problems, sketching, or playing games, can help improve a person's combinatorial and analytical thinking skills. Regular and consistent training can help people improve their combinatorial thinking skills and solve problems better [17]. Research related to students' combinatorial thinking abilities can be seen in Izza et al. and Maghfiro et al. [13][14]. Indicators and sub-indicators of combinatorial thinking skills can be observed In Table 1.

TABLE 1. Indicators and Description of Combinatorial Thinking Skills

No.	Indicator	Sub-indicators
1.	Identify some cases	1. Students can identify the properties/characteristics of the problem 2. Students can apply multiple cases
2.	Recognize patterns from all cases.	1. Students can identify patterns from case completion 2. Students can extend the pattern from the obtained case solution
3.	Generalize across all cases.	1. Students can construct the matrix to build the keystream 2. Students can calculate the matrix to create a secure keystream 3. Students can develop the algorithm
4.	Proving mathematically	1. Students can perform argument calculation 2. Students can test the algorithm 3. Students can develop a function 4. Students can validate functions 5. Students can apply inductive, deductive, and qualitative proofs
5.	Considering other combinatorial problems	1. Students can interpretation 2. Students can propose an open problem 3. Students can identify new combinatorial problems 4. Students can find potential applications

One learning model that can help improve students' combinatorial thinking skills is the RBL (Research-Based Learning) learning model. RBL is the idea of considering research findings and tasks into learning strategies [3]. Monalisa also explained RBL as a learning technique that uses contextual learning, authentic learning, problem-solving, cooperative learning, hands-on & mind-on learning, and an inquiry discovery approach to encourage students' high abilities [4]. Suntusia also states that research-based knowledge is beneficial for students by increasing learning motivation, encouraging skills to carry out specific important tasks, improving problem-solving skills, especially on complex problems, making students more active and able to solve complex problems, creating fun learning, increasing interactive features, and knowledge sharing [5]. It can also help students develop and practice communication skills, provide project management experience, and provide a learning experience where students learn to collect data and information, analyze data by data type, and disseminate research results.

Furthermore, Healey emphasized that one of the essential components of RBL is involvement and collaboration between research group members. Therefore, the presence of a research group is significant [6]. Apart from that, there are also several benefits of using the RBL model with a STEM approach, namely as follows: 1) more optimal development of research skills; 2) a deep understanding of STEM concepts; 3) encouraging students to work together in groups; 4) development of critical skills; 5) enable students to see how science and technology can be used to solve environmental and sustainability problems; 6) centred on research and practical applications that are more attractive to students; 7) problem-solving experience. An example of RBL learning syntax combined with a STEM approach can be seen in Figure 11. Research related to this can be seen in research conducted by [12][13][15].

To increase the effectiveness of the RBL learning model in improving students' combinatorial thinking skills, the RBL learning model was integrated with the STEM approach in this research. STEM is an abbreviation for Science, Technology, Engineering, and Mathematics. STEM is a cross-disciplinary learning approach integrating four disciplines into one learning framework. STEM is a learning approach that motivates students to generate mind-on and hands-on learning through problem-solving [7]. STEM education also aims to build an understanding of STEM literacy, which refers to individual thinking to apply four interrelated domains [8].

STEM education and research-based learning activities are closely related and serve as valuable approaches within the broader STEM framework [12]. The following explains the relationship and several references for further exploration: STEM education prioritizes inquiry-based learning, and research-based learning aligns with this approach by providing authentic research experiences [1]. The problem in everyday life that can be brought into RBL-STEM learning is the problem of biometric image encryption.

Biometric image encryption is the process of securing images that contain biometric data or information. Biometric data relates to an individual's physical characteristics or behaviour, such as fingerprints, face, iris, or voice. Image encryption is necessary to protect images or visual information from unauthorized access or theft. For example, when important personal, medical, or business images must be stored or shared securely, encryption can prevent others from accessing that information without permission. In addition to protecting privacy and confidentiality, image encryption can be used in applications such as copyright protection, malicious content filtering, and video surveillance security. Developing robust and efficient encryption algorithms requires a deep understanding of mathematical concepts, including combinatorial thinking skills in biometric image encryption. This thinking ability can train students to create keystreams from graph labelling. Students skilled in combinatorial thinking can analyze the security of encryption results that combine traditional cryptography with graph labelling. Several parameters that can be used as a reference for students to measure encryption results on images include correlation, UACI (Unified Average Changing Intensity), NCPCR (Number of Pixels Change Rate), and PSNR (Peak Signal to Noise Ratio). Figure 1 below illustrates biometric image encryption that utilizes graph labelling to strengthen the cryptosystem.

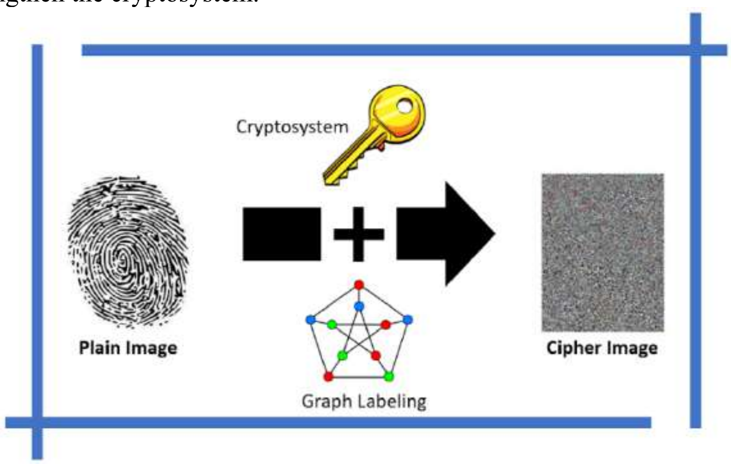


FIGURE 1. Illustration of Biometric Image Encryption.

In this research, a breakthrough was made in encrypting biometric images, namely by constructing the keystream using the edge irregular reflexive labelling technique, which in this research is known as EIRL. In edge, irregular reflexive k-labelling, the vertices on a graph are labelled with even non-negative integers. In contrast, the edges are labeled with positive integers, and the vertex and edge labels may repeated. This concept provides different results from the previous irregular labelling concept, which is interesting to develop. The minimum k of irregular reflexive edges of graph G is called reflexive edge strength and is denoted by res (G). Several studies related to edge irregular reflexive labelling can be seen at [18][19][20][21][22][23].

This research aims to determine the nature of the problem of the biometric image encryption process in each STEM element, develop an RBL-STEM research framework for solving biometric image encryption problems using edge irregular reflexive k-labelling, and create an instrument for assessing combinatorial thinking skills in solving encryption problems. Biometric images using edge irregular reflexive k-labeling. Based on this motivation and background, there are several problem formulations: (1) What are the problems of the biometric image encryption process in each STEM element? (2) What is the RBL-STEM research framework for solving biometric image encryption problems using edge irregular reflexive k-labeling? (3) What are the learning activities and instruments for assessing combinatorial thinking skills in solving biometric image encryption problems using edge irregular reflexive k-labeling?

RESEARCH METHODS

This research is qualitative research with a narrative method. This begins by exploring the contextual issues of STEM maker spaces [24][25]. We then analyze the involvement of four STEM studies (Science, Technology, Engineering, and Mathematics) and outline the role of each of these studies in solving a STEM contextual problem, namely the problem of biometric image encryption using edge irregular reflexive k-labeling. In science, we outline conceptual aspects of the STEM maker space problem in biometric image encryption. In technology, we describe a new method of building a biometric image encryption keystream involving software applications and the development of biometric image encryption process coding with edge reflexive irregular k-labelling using Matlab 2023b. In engineering, we analyze and describe the process of encrypting biometric images for implementation purposes in classroom learning. In mathematics, we analyze schemes for applying lemmas or theorems to create new lemmas and theorems based on edge irregular reflexive k-labelling concepts in solving contextual problems in STEM maker spaces. We then observe and compare the performance, permutations, and uniqueness between different encryption results. After we assess that the involvement of these four studies can solve the STEM maker space contextual problems, our research continues by writing a learning activity framework according to the RBL-STEM integration syntax in solving the STEM maker space contextual problems in the form of several stages of learning activities. Finally, we will explain the learning achievements and objectives, including the development of indicators and sub-indicators of students' combinatorial thinking skills.

RESULTS

The research results in this article are described in three sub-chapters. The research results presented in this section answer to the problem formulation proposed in the introduction. The following is a description of the research results that has been carried out.

Biometric Image Encryption Problems in STEM Elements

The process of converting information or data in its original form (plaintext) into a form that is unreadable or difficult to understand (ciphertext) using a specific algorithm or method is known as encryption. The primary goal of encryption is to keep information confidential and secure so that only those with the appropriate encryption key can decrypt and access the data. Image encryption is critical in cybersecurity and data processing, ensuring that sensitive visual data is protected from outside threats. Keeping up with the latest developments in image encryption as technology evolves is critical to maintaining better information security.

The RBL-STEM learning activity framework focusing on students' combinatorial thinking skills using EIRL is a promising innovation in STEM education. This program prepares students with strong math skills and promotes critical thinking, collaboration, and practical application of academic concepts. This opens the way to more relevant education and is oriented toward solutions to real-world problems.

Sciences Elements

Biometric data is used to identify individuals based on their unique physical or behavioural characteristics. Biometric data is used in various security and identification applications, including securing electronic devices, physical access control, and identity verification. Biometric data includes unique information such as fingerprints, faces, iris, and voice traces, which can be used to identify individuals accurately. Biometric data encryption plays an important role in maintaining the security and privacy of biometric information. The framework for Image Encryption can be seen in Figure 7. There are several reasons for the importance of biometric data encryption, namely:

1. User Privacy: Biometric data is susceptible to personal information. Encryption can help protect individual privacy by ensuring unauthorized parties cannot easily access or misuse biometric data.

2. Protection Against Theft: If biometric data falls into the hands of the wrong people, whether through physical theft of a device or online hacking, encryption can prevent unauthorized parties from using or understanding the data.
3. Regulatory Compliance: Some regulations, such as the European Union's General Data Protection Regulation (GDPR), require organizations to protect biometric data with encryption. Storing and processing biometric data without proper encryption may result in legal violations.
4. Transaction Security: Biometric data, such as fingerprints, is often used to authenticate financial and banking security payments. Encryption protects the integrity and security of this process.
5. Biometric App Security: Apps that use biometric data, such as facial recognition, to open phones or gates must ensure that the data is adequately secured. Encryption is one way to do this.
6. Data Integrity: Apart from keeping biometric data confidential, encryption ensures data integrity. This means biometric data can only be changed or corrupted with knowing.
7. Biometric System Security: Biometric recognition systems, such as fingerprint or facial recognition, can be the target of attacks. Encryption can help protect biometric data stored in the system from hacking attacks.
8. Business Interest: Many organizations collect and manage biometric data, such as security, fintech, or healthcare companies. Encryption is a necessary step to protect customer biometric data and maintain trust.
9. Preventing Abuse: Encryption can also contain internal misuse of biometric data by employees or other unauthorized internal parties.

Overall, biometric data encryption is essential in maintaining the security and privacy of biometric data and is critical to meeting security requirements and applicable legal and regulatory obligations. One type of biometric data used in research is fingerprint images. An example of a fingerprint image is shown in Figure 2.

FIGURE 2. Example of Biometric.

Technology Elements

The technological element in the Encryption process of the biometric image is constructing one of the keystream matrix components with a new method, namely constructing a keystream matrix using edge irregular reflexive k labelling with Matlab 2023b. Next, we call this matrix the EIRL matrix. The definition of irregular reflexive labelling is as follows.

Definition. *A total k-labeling is an edge irregular total k-labeling of the graph G if even two distinct edges have different weights. The edge weight is the sum of the labels of its incident vertices and the labels of that edge. $Bača$ extended the above notion into an edge irregular reflexive k-labeling. The total k-labeling defined the function $f_e: E(G) \to \{1,2,3,\dots,k_e\}$ and $f_v: V(G) \to \{0,2,4,\dots,2k_v\}$ where $k = max\{k_e, 2k_v\}$. For the graph G, the total k-labeling is called an edge irregular reflexive k-labeling if the condition every two different edges x_1x_2 and y_1y_2 of G, $wt(x_1x_2) \neq wt(y_1y_2)$, where $wt(x_1x_2) = f_v(x_1) + f_e(x_1x_2) + f_v(x_2)$. The smallest value of k for which such labelling exists is called the reflexive edge strength of the graph G, denoted by $res(G)$.*

The EIRL matrix is analogous to the adjacency matrix, whose elements are the edge weights of a graph under edge irregular reflexive k-labeling. Use edge irregular reflexive k-labelling to strengthen the keystream so the encryption results are not easily hacked. For example, the generalized sub-divided star graph theorem is used to construct the EIRL matrix.

Theorem. *Let $SS_{n,m}$ be a generalized sub-divided star graph. We have the following for every natural number: $n \geq 3$ and $m \geq 2$*

$$RES\left(SS_{n,m}\right)=\begin{cases}\left\lceil\dfrac{n(m+1)}{3}\right\rceil+1, & \text{if } n(m+1)\equiv 2,3 \pmod 6\\ \left\lceil\dfrac{n(m+1)}{3}\right\rceil, & \text{otherwise}\end{cases}$$

Based on this theorem, we can determine the edge weights in the generalized sub-divided star graph. The EIRL matrix is constructed from the edge irregular reflexive k-labeling theorem on generalized sub-divided star graphs using Matlab R2023b. The Matrix EIRL can be seen in Figure 3.

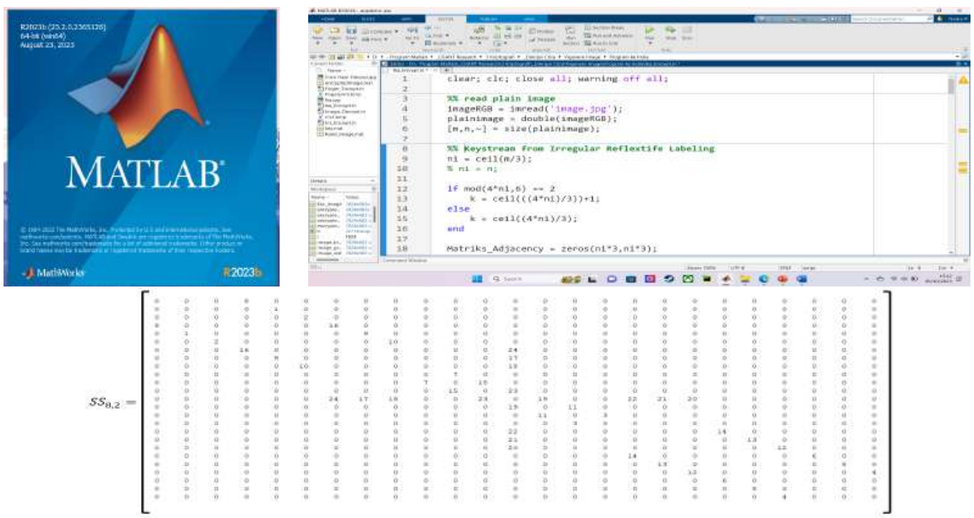
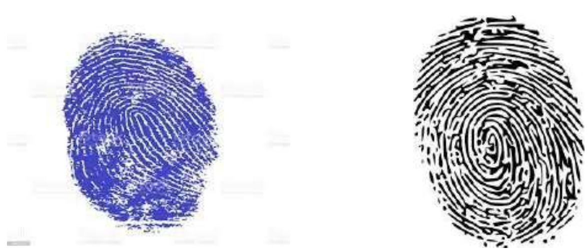


FIGURE 3. Construction of EIRL Matrix on Generalized Sub-divided Star Graph using Matlab 2023b.

Engineering Elements

The engineering element in the biometric image is the Encryption process, which is obtaining a cypher image from a plain image. The steps in getting a cypher image are as follows.

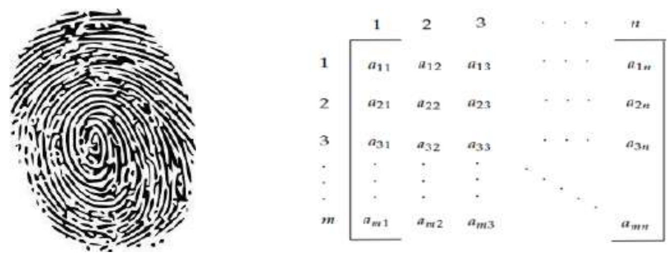
1. We are constructing a plain RGB image into a grayscale image by averaging the sum of the values in the Red, Green, and Blue color channel matrices. Figure 4 shows the construction of a plain image into a grayscale image.



(a) Plain Image (b) Grayscale Image

FIGURE 4. Construction of A Plain Image (a) Into A Grayscale Image (b).

2. We are constructing a pixel matrix in a grayscale image with Matlab 2023b. The conversion process from a plain image to a pixel matrix can be seen in Figure 5. The pixel matrix size is based on the pixel size of the image.



(a) Plain Image (b) Pixel Matrix

FIGURE 5. Construction of A Plain Image (a) Into A Pixel Matrix (b).

3. Apply the shift rows transformation to the pixel matrix in the second step.
4. Change the EIRL matrix size according to the pixel matrix size.
5. Create a Random Number Generator matrix the same size as the pixel and EIRL matrices.
6. Transform a plain image into a cypher image by encrypting it. Figure 6 shows the order in which the matrices obtained in steps 3–5 are added. The added matrix elements must be modulo 256 (pixel values must be between 0 and 255). The result of this process is a Cipher Image, as shown in Figure 7.

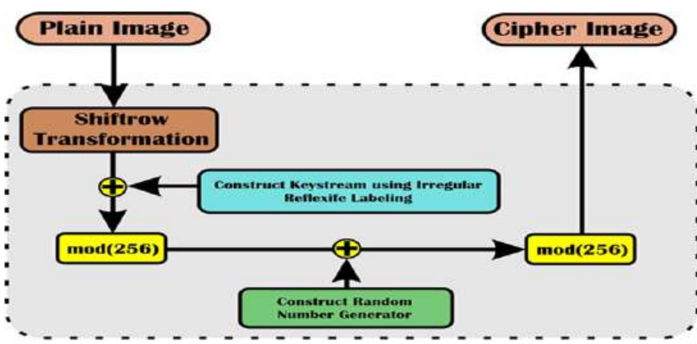


FIGURE 6. Framework on Image Encryption.

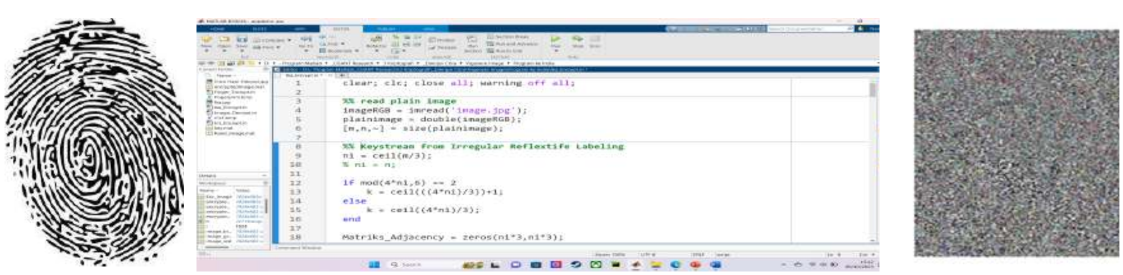


FIGURE 7. Encryption Results From Fingerprints.

Mathematics Elements

There are several things in the mathematical element, namely, building a labelling function and calculating edge weights. Edge weights in a graph are obtained from the concept of edge irregular reflexive k-labeling. For example, weight determination is carried out on the generalized sub-divided star graph in Figure 8.

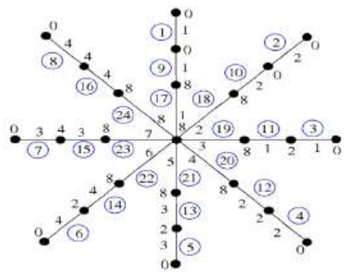


FIGURE 8. Example of Edge Irregular Reflexive $\boldsymbol{k}$-Labeling.

Based on Figure 8, we can determine the weight function, which is then used as syntax in Matlab 2023b to construct the EIRL matrix. The second mathematical element in this research is carrying out shift row transformation in the encryption process, then adding the matrix with the pixel matrix and the EIRL matrix. The third mathematical element in this research is the graphical interpretation of image encryption results, as shown in Figure 9. The next stage is analysis of the results of several parameters which serve as references for measuring encryption results in images, including correlation, UACI (Unified Average Changing Intensity), NPCR (Number of Pixels Change Rate), and PSNR (Peak Signal to Noise Ratio).

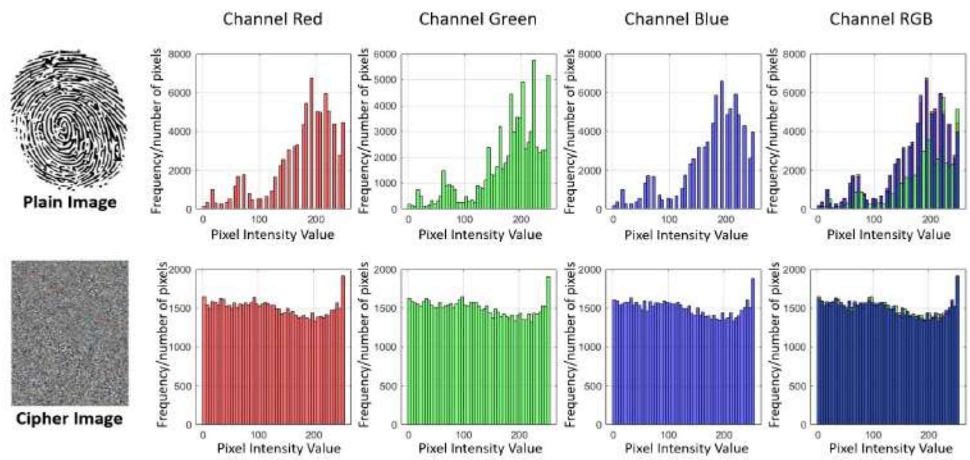


FIGURE 9. Red, Green, and Blue Channel Graphics on Plain and Cipher Image.

Research-Based Learning Framework with a STEM Approach

This research combines the RBL learning model with a STEM (Science, Technology, Engineering and Mathematics) approach. The RBL learning model triggers student creativity to solve image encryption problems using irregular reflexive labelling. The STEM approach, with its four elements, will familiarize students with studying a topic from various points of view [9]. The combination of the RBL learning model, which is integrated with the STEM approach, supports the creation of independent learning following the Ministry of Education's policy.

The following will present a framework for integrating the Research-Based Learning learning model with a STEM approach in improving students' combinatorial thinking skills by using edge irregular reflexive $\boldsymbol{k}$-labelling to solve image encryption problems. In the initial syntax stage, the Research-Based Learning model displays issues arising from open-problem research groups.

Figure 10 explains the general description of the research process, which refers to the four elements of the STEM approach. The four aspects of STEM (Science, Technology, Engineering, and Mathematics), integrated with the RBL learning model, must be presented visually. The framework for integrating research-based learning with the STEM approach can be seen in Figure 11 in detail.

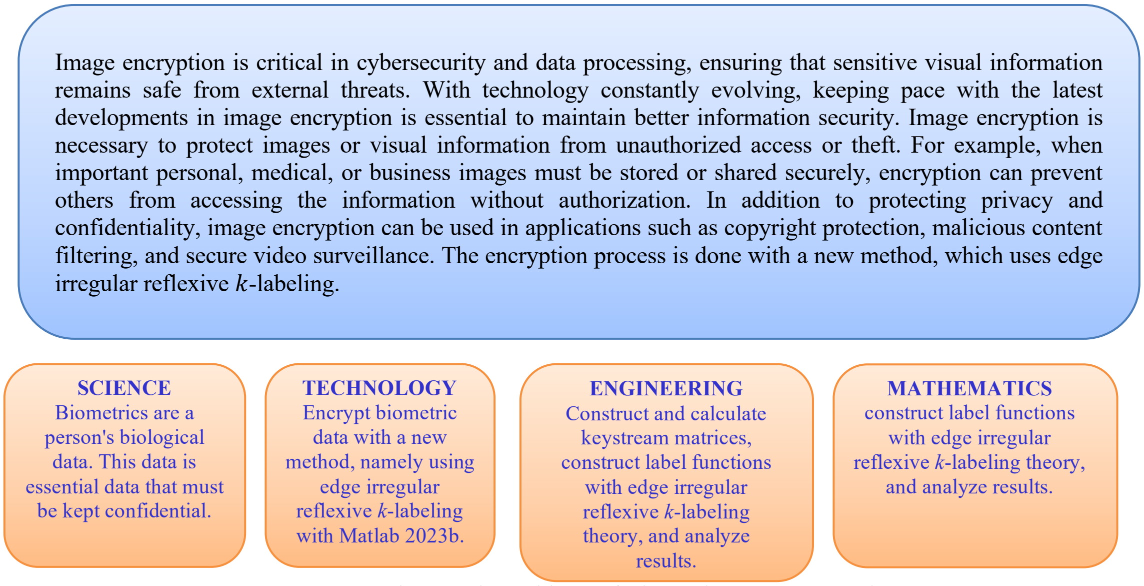


FIGURE 10. STEM Elements in Problems of Biometric Image Encryption Process.

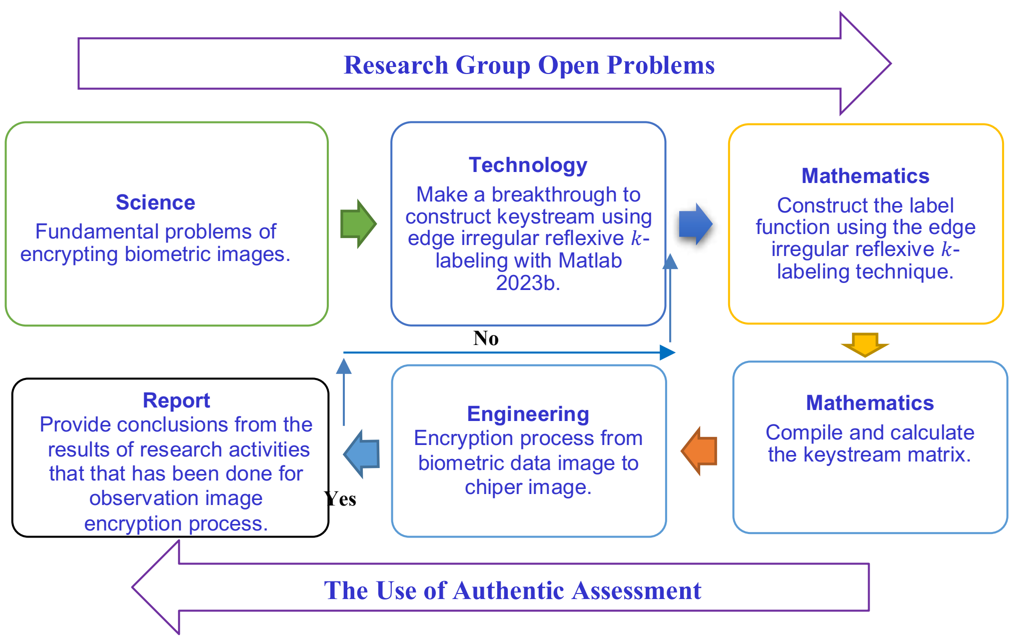


FIGURE 11. RBL Syntax Framework RBL with STEM Approach.

Learning Outcomes and Objectives

The learning outcomes are that students can use irregular reflexive labelling to solve image encryption problems and improve their combinatorial thinking skills. The resulting learning objectives of the Research-Based Learning with STEAM approach will enable students to develop knowledge and skills in science, technology, engineering, and mathematics. According to Dafik, STEM can integrate various disciplines and accommodate holistic and spatial problem-solving [14]. The objectives in each of these elements are described as follows.

1. *Science***.**
   - Explain the meaning of biometrics.
   - Explain the types of biometrics.
   - Explain why biometric data encryption is essential.
2. *Technology*
   - Using a web browser to collect data about combinatorial thinking skills, image authentication, and irregular reflexive edge labelling.
   - Use the YouTube channel to determine the relationship between combinatorial thinking skills, image authentication, and irregular reflexive edge k-labeling.
   - Explain the definition of edge reflexive irregular k-labeling.
   - Constructing keystream with edge reflexive irregular k-labeling using Matlab 2023b.
3. *Engineering*
   - Explain the keystream algorithm used.
   - Explain the encryption and decryption keys.
   - Describe the image encryption process flow chart from plain to cypher images.
4. *Mathematics*
   - Construct label function with edge irregular reflexive k-labeling theory.
   - Compile and calculate matrix in building keystream in the image encryption process.
   - Analyze the results in the form of correlation value, UACI (Unified Average Changing Intensity), NPCR (Number of Pixels Change Rate), and PSNR (Peak Signal to Noise Ratio).

Using Image Authentication to Improve Students' Combinatorial Thinking Skills

1. Science Element Problem

   In the science element, students are expected to be able to explain the image authentication problem. The first element of science is that students can explain the definition of biometrics. Furthermore, students must also know the types of biometrics. Finally, the science element in this research is that students can explain the main purpose of biometrics. Understanding some of these science elements is a start for students to understand image authentication.

2. Technology Element Problem

   In addition to IoT (Internet of Things), the technology element also includes online and offline software and data search on the website. In the learning process, the technology element is strengthened by making the results of student literacy findings and also the keystream built using edge irregular reflexive k-labelling with Matlab 2023b as part of the assessment instrument that will describe the achievement of student learning outcomes. This is something new and exciting for students.

3. Engineering Element Problem

   In the engineering element, students are required to be able to explain the keystream algorithm used. In addition, students must be able to explain the encryption and decryption keys used during the encryption process. The last engineering element is that students can describe the flow chart of the image encryption process from plain to cypher images.

4. Mathematics Element Problem

   The last element in the STEM approach is mathematics. The first mathematics element is that students can explain the definition of edge irregular reflexive k-labelling. After that, students must be able to construct the label function with the theory of irregular reflexive k-labeling. The last mathematics element is that students can compile and calculate matrices in building keystreams in the image encryption process and analyze correlation, UACI (Unified Average Changing Intensity), NPCR (Number of Pixels Change Rate), and PSNR (Peak Signal to Noise Ratio).

Learning Activity and Assessment of Research-Based Learning with STEM Approach in Image Encryption Problem Solving

This section will discuss the six stages of the research-based learning model integrated with the STEM approach individually. These six stages will illustrate how students use research-based learning with the STEM approach. The context of the RBL-STEM model in this study is solving image authentication problems in improving students' combinatorial thinking skills.

1. Based on Figure 9, the first stage (science) poses fundamental problems related to solving the image encryption problem. The keystream that is built must be as secure as possible so that it is resistant to various attacks that may occur. Researchers will ask students to consider data security before heading to the image authentication problem. For more details, please see Table 2.

TABLE 2. RBL-STEM Learning Activities Stage 1 Biometric Image Encryption Problem.

Stage One	Learning Activities
Fundamental problems of encrypting biometric images. **(SCIENCE)**	1. A general explanation of what biometrics is. 2. A general explanation of the types of biometrics. 3. A general explanation of the importance of biometric encryption.

2. The learning activities of the Research-Based Learning model with a STEM approach in the second stage (technology) are using software or utilizing technology in data collection. Details of the second stage can be seen in Table 3.

TABLE 3. RBL-STEM Learning Activities Stage 2 Biometric Image Encryption Problem.

Stage Two	Learning Activities
Make a breakthrough to construct a keystream ` with Matlab 2023b. **(TECHNOLOGY)**	1. Search for information on the web to support understanding of the material. 2. Utilization of YouTube to obtain information related to building keystream matrices using labelling with Matlab 2023b 3. Explain the definition of edge irregular reflexive k-labeling

3. Learning activities using the Research-Based Learning model with the STEM approach in the third stage (mathematics) are constructing the edge irregular reflexive k-labelling function. For more details, see Table 4 as follows.

TABLE 4. RBL-STEM Learning Activities Stage 3 Biometric Image Encryption Problem.

Stage Three	Kegiatan Pembelajaran
Construct the label function using the edge irregular reflexive k-labeling technique. **(MATHEMATICS)**	1. Constructing keystream with edge reflexive irregular k-labeling. 2. Constructing label function with edge reflexive irregular k-labeling theory.

4. Learning activities using the Research-Based Learning model with the STEM approach in the fifth stage (mathematics) is to continue the construction of the irregular reflexive edge labelling function to be built as a keystream in the image encryption process. For more details, see Table 5 as follows.

TABLE 5. RBL-STEM Learning Activities Stage 4 Biometric Image Encryption Problem.

Stage Four	Learning Activities
Compile and calculate the keystream matrix.	1. We are constructing a matrix to build a keystream

Stage Four	Learning Activities
(MATHEMATICS)	in the image encryption. 2. Menghitung matriks dalam membangun *keystream* pada proses enkripsi gambar.

5. The learning activities of the Research-Based Learning model with the STEM approach in the third stage (engineering) are developing new methods related to image encryption to increase literacy in student cryptography [1]. Lecturers ask students to identify several steps that will be carried out. For more details, see Table 6 below.

TABLE 6. RBL-STEM Learning Activities Stage 5 Biometric Image Encryption Problem.

Stage Five	Learning Activities
Encryption process from biometric image data to cypher image. **(ENGINEERING)**	1. Explain the keystream algorithm used. 2. Explain the encryption and decryption keys. 3. Describe the image encryption process flow chart from plain to cypher images. 4. Analyze the results of image encryption using several parameters, namely correlation value, UACI, NPCR, and PSNR.

6. Learning activities using the Research-Based Learning model with a STEM approach at stage six (report) carried out by students are to convey and explain the objectives and conclusions based on learning activities from research results related to the biometric image encryption process to improve students' combinatorial thinking skills. In this case, students will conduct a Focus Group Discussion (FGD) so that researchers can observe students' combinatorial thinking skills. For more details, see Table 7 below.

TABLE 7. RBL-STEM Learning Activities Stage 6 Biometric Image Encryption Problem.

Stage Six	Learning Activities
Provide conclusions from the research results that have been carried out to observe the image encryption process. **(REPORT)**	1. Panel discussion on the learning process and research results. 2. Concluding with the help of lecturers. 3. Submission of learning evaluation questions.

Student Combinatorial Skills Assessment Instrument Framework

The following presents the assessment framework for student combinatorial thinking skills instruments. The indicators given show the achievement of learning outcomes of combinatorial thinking skills. The framework of the combinatorial thinking skills assessment instrument in this study is presented in Table 8 below.

TABLE 8. The Framework of Combinatorial Thinking Skills Assessment Instrument.

Indicator	Sub-indicators	Test Materials
Identify some cases	1. Identify properties/characteristics of the problem 2. Applying multiple cases	1. Explain why a biometric image encryption security system is needed. 2. Discuss the application of some cases of biometric image encryption security systems.
Recognize patterns from all cases	1. Identifying patterns from case completion 2. Extend the pattern from the obtained case solution	1. Identify patterns to find applications of edge irregular reflexive k-labeling studies. 2. Extend the pattern of the biometric image encryption security system.

Indicator	Sub-indicators	Test Materials
Generalize across all cases	1. Constructing the matrix to build the keystream 2. Calculating the matrix to build a secure keystream 3. Develop the algorithm	1. Apply the matrix for the pattern of the created biometric image encryption security system. 2. Develop an algorithm for the biometric image encryption security system pattern.
Proving mathematically	1. Performing argument calculation 2. Testing the algorithm 3. Developing a function 4. Validating functions 5. Applying inductive, deductive, and qualitative proofs	1. Test the algorithm of the biometric image encryption security system pattern. 2. Make a function of the biometric image encryption security system pattern. 3. Test the function of the biometric image encryption security system pattern. 4. Apply inductive, deductive, and qualitative proof for the biometric image encryption security system algorithm.
Considering other combinatorial problems	1. Interpretation 2. Proposing an open problem 3. Identifying new combinatorial problems 4. Finding potential applications	1. Propose available issues related to biometric image encryption security systems. 2. Find applications of edge irregular reflexive k-labeling in other biometric image encryption security systems.

The framework of learning material process development

This study's follow-up development of learning materials can be done using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model development design. This design is effective because it begins with analysis and evaluation activities in the final stage. For massive follow-up implementation in educational units in the same area as the research area that has been carried out, an in-depth study must still be carried out with relevant policymakers.

Raiser and Mollenda [11] said that the ADDIE model development design has five stages of development. These stages are analysis, design, development, implementation, and evaluation [16]. The development carried out is the development of RBL-STEM integration learning materials. The combination of the RBL learning model with the STEM approach in its development is carried out in the context of students' combinatorial thinking skills.

The first stage of analysis is carried out by analyzing the characteristics of students, the characteristics of the material and the learning process, and the learning media to be used. Development is also carried out by considering the features of the target education units. The second stage, the design stage, is carried out by designing learning materials that integrate the RBL model into the STEM approach. Several teaching materials were prepared at this stage, including syllabus, lesson plans, worksheets, pre-test, post-test, and other assessment instruments.

The third stage is the development stage, namely conducting trials of teaching materials and instruments to check the validity, practicality, or practicability of teaching materials. Validation results include content validity, format validity, language validity, and practicality level. The fourth stage is implementation to determine the effectiveness of RBL-STEM teaching materials to improve students' combinatorial thinking skills.

The last stage is the evaluation stage. This stage is carried out in the form of reflection activities to assess whether the application of RBL model learning materials with a STEAM approach can improve students' combinatorial thinking skills. In this last evaluation stage, inferential statistics is needed to show generalization to other populations in different time and space dimensions.

DISCUSSION

The development of the RBL-STEM learning activity framework in utilizing the study of edge irregular reflexive $\boldsymbol{k}$-labeling in solving biometric image encryption problems to improve students' combinatorial thinking skills is very important and useful. Apart from being a means of getting used to thinking and acting holistically and recognizing scientific steps, the results of this study serve as guidelines in making a biometric image encryption system that is more secure and resistant to attacks in any form. This corroborates [1][10][13][14], that the five indicators of combinatorial thinking skills are maximally exceeded by paying attention to various learning support factors.

As a continuation of this research, two things can be done, namely (1) developing RBL-STEM learning materials for the addie development model and (2) analyzing the implementation of RBL STEM learning materials in the encryption process using edge irregular reflexive $\boldsymbol{k}$-labeling to improve student combinatorial thinking [4]. The Rbl-Stem Combined Learning Activity Framework Is Very Effective In Realizing The Next Generation Who Understand How To Protect Privacy And Confidentiality; Image Encryption Can Also Be Used In Applications Such As Copyright Protection, Malicious Content Filtering, And Video-Surveillance Security, Especially Images Or Biometric Data.

CONCLUSION

The results showed how the phases of RBL integrated with the STEM approach. The framework of RBL learning activities with the STEM approach is the main result of the research. The activity framework is an encryption process using edge irregular reflexive k-labeling to improve students' combinatorial thinking.

The conclusions of this study can be described as follows: (1) the learning process has illustrated how the RBL syntax integrated with the STEM approach to the process of encrypting biometric images using edge reflexive irregular k labelling to improve students' combinatorial thinking skills; (2) based on the results of the study, the process of encrypting biometric images using edge reflexive irregular k-labelling can provide insight to students in maintaining the security and privacy of biometric data, and is very important to meet security needs as well as legal obligations and applicable regulations; (3) the keystream built with edge irregular reflexive k-labelling in the biometric image encryption process is more secure and not easily hacked by unauthorized parties; and (4) the RBL learning process integrated with the STEM approach is presented in six stages.

ACKNOWLEDGEMENT

We would like to thank the members of the CGANT research group University of Jember for their assistance, Universitas PGRI Argopuro Jember for their support, and all parties who have contributed to the completion of this research

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Table Profile of Digital Literacy Skills of Vocational High School Students in Learning Mathematics

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Abstract. Digital literacy is one's knowledge of using digital media. The benefits of having digital literacy skills can make students more insightful, able to think critically and understand information well, as well as increase vocabulary mastery. This study aims to describe the profile of digital literacy skills of vocational students in learning mathematics. This type of research uses a descriptive-qualitative approach. Data collection carried out in this study was by interview techniques, documentation techniques, and literature study techniques. The results of this study indicate that students' digital literacy in learning mathematics is in the high category. Competency results data obtained as follows: (a) Internet Search Competency obtained an average score of 76.73, (b) Hypertext Direction Guide Competency obtained an average score of 79.53, (c) Information content evaluation competency obtained an average score of 52.94, and (d) Knowledge preparation competence obtained an average score of 74.27. From these results it can be said that digital literacy in the use of e-resources has an average value that is included in the high category, but there are some activities that are measured to have low scores among other activities so that improvements are needed. These improvements need to be made to the competency evaluation of information content. This is because students begin to filter filters, collect the information obtained, until later new knowledge emerges.

INTRODUCTION

In this digital era, there is a demand for quality learning that can facilitate students in their learning process as an effort to face challenges in global life. However, this was hampered by the outbreak of the Covid-19 pandemic in Indonesia, which affected students' interest in learning and learning motivation [1][2]. Therefore, educators need to utilize technology in their learning such as presenting interesting material and being able to stimulate students to be more active in learning.8

Based on Indonesian Digital Data, social media users in Indonesia in 2020 will reach 160 million people or 59% of the total population. This is a very large number. Fatmawati's research in 2019 proved that the use of social media by the public greatly influences extreme behavior [3]. This is important for the government and universities to pay attention to in an effort to develop digital literacy competencies in society.

Current education is expected to be able to develop students' abilities to think creatively, flexibly, solve problems, collaborate and innovative skills needed for success in work and life (Pacific Policy Research Center, 2010). According to Emre Cam and Kiyici [4] the technological knowledge and skills needed by each individual in using digital media to develop learning activities. Digital literacy is an important component in the field of technology, especially information systems. This capability focuses on using technology as wisely as possible to create interactive and positive communication. In addition, its application can also make people much wiser in utilizing technology. According to Hasanah, Cholily, and Effendi [5][6] digital literacy is currently the latest trend in mathematics learning. Education is currently expected to be able to develop students' abilities to think creatively, be flexible, solve problems, collaborate and innovative skills needed for success in work and life [7]. According to Emre Cam and Kiyici [4] the technological knowledge and skills needed by each individual in using digital media to develop learning activities. Digital literacy is an important component in the field of technology, especially information systems. This capability focuses on using technology as wisely as possible to create interactive and positive communication. In addition, its application can also make people much wiser in utilizing technology. According to Hasanah, Cholily, and Effendi [8]

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040043-1–040043-5; https://doi.org/10.1063/5.0241613

digital literacy is currently the latest trend in mathematics learning which can provide interesting reading literacy, provide various reference materials, communicate, and solve problems.

To achieve these expectations, it is necessary to conduct a test to measure how digital literacy skills are in learning mathematics. The results of this test will later be used as a basis for what steps can be taken in preparing graduates with good digital literacy skills [9][10]. Based on this, in this study the researcher wanted to find out how the profile of digital literacy skills of Al-Yasini Health Vocational School students in learning mathematics. Furthermore, researchers will provide recommendations for strategies to increase digital literacy skills based on the profile of abilities found and student perceptions.

RESEARCH METHODS

This research focuses on students' digital literacy skills in learning mathematics. In this study, the researcher acts as the main instrument. Researchers are also directly involved in the research process. Researchers obtained and collected data related to the application of digital literacy at Al-Yasini Health Vocational School. This research has a natural background, the data researched and produced will be presented according to what happened in the field. The results of the research are descriptive, because the data collected is not in the form of numbers but in the form of words and sentences. In this study there are limitations to the problems found in the research focus and data analysis tends to be inductive [11]. In terms of data collection, data types and data analysis techniques, this research is classified as qualitative research.

The main data of this research is in the form of verbal data from the exploration of students' digital literacy skills which are described through skill profiles and views on literacy activities during learning. The data collection was carried out by distributing questionnaires. Questionnaire. In this study a questionnaire was used to determine students' perceptions of digital literacy activities in learning. The questionnaire also provides questions about student suggestions or recommendations about digital literacy activities that they need during learning to support improving their digital literacy skills. Furthermore, the data obtained from the lift regarding digital literacy is processed by finding the average score for each digital literacy competency, then the researcher converts it into a digital literacy value for each competency measured. The digital literacy score for each competency is categorized into three digital literacy profile categories, namely high, medium and low.

DISCUSSION

This research was conducted to describe the level of digital literacy competency of Al Yasini Health Vocational High School students which was seen based on 4 competencies [12], namely 1) Internet search ability competency, 2) Hypertext direction guiding competency, 3) Information content evaluation competency, and 4) Compilation of knowledge preparation. Each competency has several activities that vocational students do. The picture is shown in Figure 1 [9].

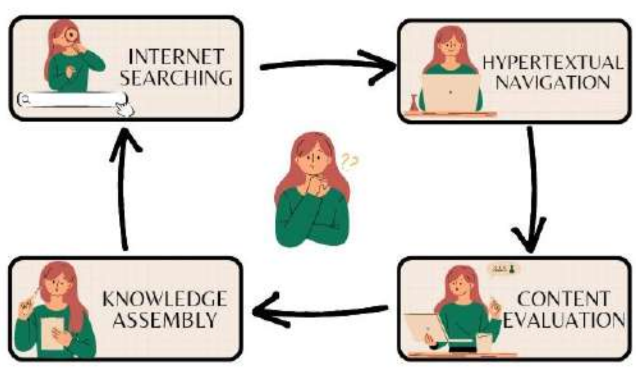

FIGURE 1. Digital literacy competency

Competency on Searching the Internet

Internet search competence includes two aspects, namely (1) being able to search for information on the internet using a search engine, and (2) being able to carry out various activities in it. According to Gilster [12] there are several student activities in using the internet, such as having an email account, managing and checking email accounts every time a message comes in, membership in a certain group on social media, reading articles on the internet, using it in doing school assignments [13]. online learning such as zoom or google meet, searching for references or teaching materials, and downloading teaching materials), as well as utilizing the internet such as streaming TV, online radio and so on. The results of measuring digital literacy activities based on internet search abilities can be seen in table 1.

TABLE 1. Digital literacy activities based on internet search ability

Measured activity	Average
Create, manage and check accounts on various online learning platforms	88,23
Read articles on the internet	54,04
Doing schoolwork	77,56
Take advantage of the internet such as streaming TV, online radio and so forth	87,09
Overall Average	76,73

Table 1 shows that students' ability to search the internet for digital media is on average in the high category. In general, students are able to create, manage and check accounts on various online learning platforms such as email, Facebook and so on. In addition, students are also able to do schoolwork, such as downloading teaching materials and uploading schoolwork on YouTube. In addition, students are also capable of utilizing the internet such as streaming TV, online radio and others. In the aspect of the ability to read articles on the internet, it is an activity with the lowest average score compared to other activities. These findings indicate that students' ability to actively participate in reading articles still needs to be improved and honed so that students have the ability to read about learning by utilizing digital platforms.

Competence About Hypertext Navigation

Skills in reading and understanding the navigation (guide) of a hypertext in a web browser. This competency includes four components, including: (1). Knowledge of hypertext and hyperlinks and how they work, (2) Knowledge of how the web works, (3). Ability to understand the characteristics of web pages.

TABLE 2. Digital literacy activities based on the Hypertext direction Guidance competency

Measured activity	Average
know the function and use of hypertext (direction link)	71,23
know about how the web works	74,04
able to understand the characteristics of web pages (http, html, url)	87,56
know the types of e-resources	85,29
Overall Average	79,53

Table 2 shows that students' abilities in digital media hypertext guides are on average in the high category. Students are said to be able to know the functions and uses of hypertext (direction links), know about how the web works, are able to understand the characteristics of web pages (http, html, url), and know the types of e-resources.

Competence About Evaluation of Information Content

One's ability to think critically and provide an assessment of what is found online is accompanied by the ability to identify the validity and completeness of information referenced by hypertext links. This competency includes five components [14], including: (a) The ability to distinguish between display and information content, namely the user's perception in understanding the appearance of a visited web page, (b). The ability to analyze background information on the internet, namely the awareness to explore more about sources and makers of information, and (c). Ability to analyze a web page.

TABLE 3. Digital literacy activities based on information content evaluation competencies

Measured activity	Average
differentiate between display and content of information visited in e-resources	71,23
explore more about the sources and creators of the information	74,04
Analyze the web pages visited	77,56
Overall Average	52,94

Table 3 shows that students' abilities in evaluating digital media information content on average are in the low category

Competence About Knowledge Assembly

The ability to organize knowledge, build a collection of information obtained from various sources with the ability to collect and evaluate facts and opinions properly and without prejudice. This competency includes three components [14], namely: (a). Students' ability to analyze the background information obtained, (b). The ability to cross-check or re-check the information obtained, (c). Ability to compile sources of information obtained on the internet.

TABLE 4. Digital literacy activities based on knowledge assembly

Measured activity	Average
complete tasks by searching for information on search engines (blogs, social networking, forums, news)	71,23
able to evaluate the information presented on the internet critically to determine the relevant information as needed	64,04
hold discussions with other people in an effort to solve problems related to the assignments obtained	87,56
Overall Average	74,27

Table 4 shows that students' abilities in compiling digital media knowledge are on average in the high category. After knowing the average of each internet search sub-variable, hypertext direction guide, evaluating information content, and compiling knowledge, then the total value will be calculated using the grand mean formula. Based on the results of the overall calculation of the number of sub-variables used, an average total value of 3.95 is obtained. It can be concluded that this figure is categorized as high.

Even though all the sub-variables and activities that are measured about digital literacy in the use of e-resources have an average value that is included in the high category, there are some activities that are measured that have a low value among other activities so that there is a need for improvement. These improvements need to be made to the competency evaluation of information content. This is because students begin to filter filters, collect the information obtained, until later new knowledge emerges.

CONCLUSION

Based on the research conducted, it was obtained an overview of the digital literacy profile of students who took part in mathematics learning in the high category. Competency results data obtained as follows: (a) Internet Search Competency obtained an average score of 76.73, (b) Hypertext Direction Guide Competency obtained an average score of 79.53, (c) Information content evaluation competency obtained an average score of 52.94, and (d) Knowledge preparation competence obtained an average score of 74.27. These results indicate that in general students are able to use and manage digital learning platforms well. However, the development and provision of digital literacy to students needs to be continuously developed in learning and other activities in schools, especially in the competency evaluation of advanced digital media information content as a provision for students to face an all-digital era.

ACKNOWLEDGEMENTS

We thank the head of the research and community service unit (bp2m) pgri wiranegara university for facilitating this research.

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The Profile of Mathematical Literacy Skills of Prospective Mathematics Teachers in Graph Theory

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Abstract. The main objective of this research was to provide a comprehensive picture of the mathematical literacy skills possessed by prospective mathematics teachers, especially in graph theory. This research uses a descriptive qualitative research design. The location of this research was Wisnuwardhana University. The research focused on a group of fifth-semester students specifically selected by using a purposive sample method. Data collection strategies included non-test methodologies such as project assignments and interview procedures. Data analysis techniques included multiple methods, such as data reduction, display, and conclusion drawing. The research findings showed that the project assignment facilitated the development of several key prospective teacher students skills, namely: (1) students were able to identify and articulate authentic difficulties in the context of problem-solving; (2) they demonstrated proficiency in using mathematical concepts and techniques to address these problems; (3) students demonstrated competence in analyzing and understanding the solutions generated through problem-solving; (4) they displayed the capacity to assess and appraise the effectiveness of these solutions critically. By assessing students' proficiency in mathematical literacy, we can establish future educational strategies that foster their capacity to adapt to the evolving world and changing times.

INTRODUCTION

Literacy in math is a skill that everyone needs to have (1–5). This is because understanding the importance of mathematical literacy in society enables individuals to develop informed and rational decision-making skills essential for active and thoughtful participation as responsible citizens in the modern era (6,7). Therefore, it is advisable for individuals who hope to become mathematics teachers to improve their proficiency in mathematical literacy. This can help students see how mathematics is used in a variety of contexts, including everyday decision-making (8,9). This study captured students' mathematical literacy skills in graph courses. Graph theory is a field that has made significant advances in mathematics (10–13). Graph theory can help with the internet, computers, transportation, AI, GPS, etc. In this study, the profile of mathematical literacy skills will be captured based on the indicators in the following table.

TABLE 1. Indicator of Mathematical Literacy Skill

No	Indicators	Description
1	Formulate	Formulate real problems in problem solving
2	Use/Employ	Use mathematics in problem solving
3	Interpret	Interpret solutions in problem solving
4	Evaluate	Evaluate solutions in problem solving

A project task consisting of 3 problems was given to see the ability of mathematical literacy, such as the Chinese postman problem, which is finding the whole Eulerian circuit for each weight and finding the Eulerian circuit with the least weight; Travelling Salesman Problem that is Find the whole Hamiltonian circuit for each weight and find the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040044-1–040044-5; https://doi.org/10.1063/5.0242209
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

Hamiltonian circuit with the least amount of weight; Graph Coloring which is the procedure of assignment of colors to each vertex of a graph G such that no adjacent vertices get same color.

METHODS

This research uses a descriptive qualitative research design. The location of this research was Wisnuwardhana University. The research focused on a group of fifth-semester students specifically selected by using a purposive sample method. Data collection strategies included non-test methodologies such as project assignments and interview procedures. Data analysis techniques included multiple methods, such as data reduction, display, and conclusion drawing as shown in Figure 1 [14,15].

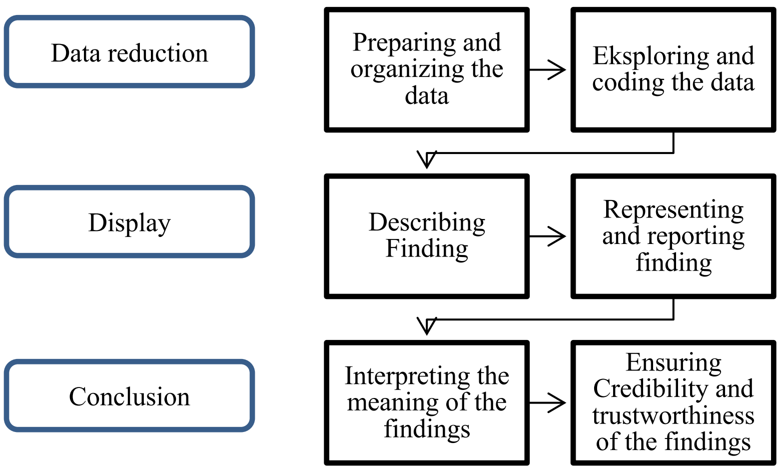

FIGURE 1.: *Steps of qualitative analysis*

RESULT AND DISCUSSION

Through the results of student projects, we see their mathematical literacy skills. The first is the Chinese postman problem.

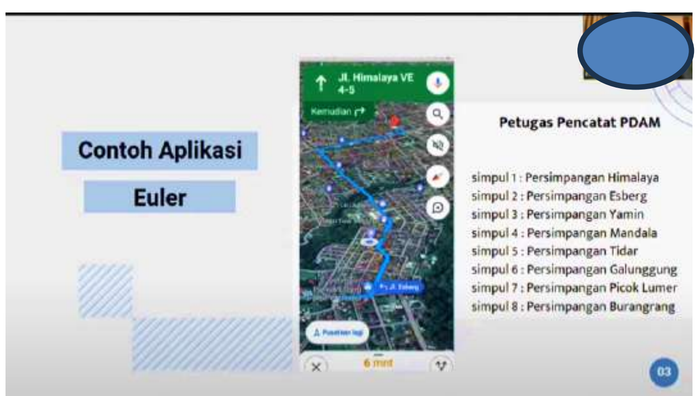

FIGURE 2.: *Application of The Chinese Postman Problem*

From the picture above, it appears that formulate real problems in problem solving. From the picture above, students can formulate real problems in problem-solving. Students take the PDAM Water Recorder Officer problem; namely, to save time and distance, PDAM water loggers need to take the shortest path possible. Then, students use mathematics in problem-solving, as shown in the following figure.

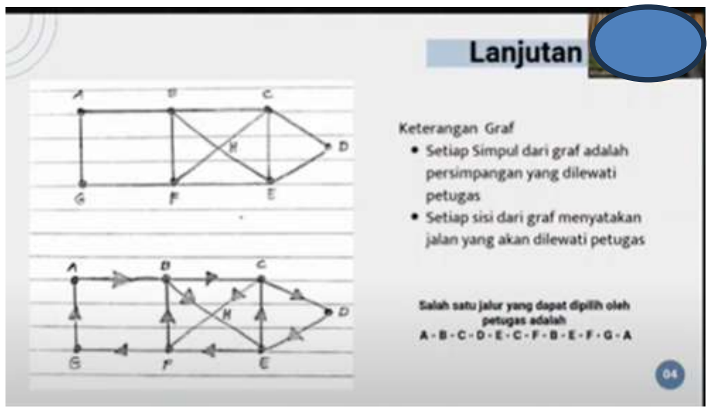

FIGURE 3.: *The solution to the PDAM Registrar's problem*

Figure 3 appears that students employ mathematics. It is shown that the student can draw a graph that represents the problem of the PDAM recording officer. After that, in Figure 3, it also appears that students interpret the solution by finding the Euler circuit of the graph they have previously drawn. Furthermore, they have evaluated solutions in problem-solving, as shown in Figure 3, where they determine the shortest Euler circuit as a solution to the PDAM recording officer's problem.

The second problem is application from travelling salesman problem as shown in the following figure.

FIGURE 4.: *Application of The Travelling Salesman Problem*

From the Figure 4, it appears that, students can formulate real problems in problem-solving. Students take the Egg Trader problem; namely, helping the egg trader find the shortest way for sales to save time and distance. Then, students also use mathematics in problem-solving, as shown in the following figure.

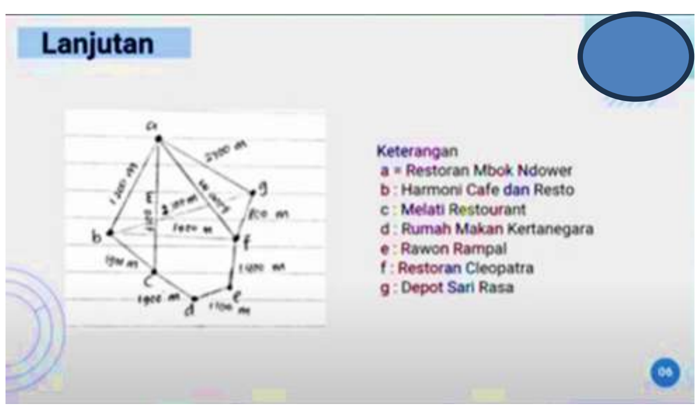

FIGURE 5.: *Use Mathematics in Egg Trader Problem*

It can be seen from Figure 5 that the student's use of mathematics is to draw a graph that corresponds to the egg trader problem; the vertices represent restaurants, and the sides are roads. They then interpreted the problem-solving by finding all available Hamilton circuits, as shown in Figure 5. After that, they evaluate problem-solving by determining the shortest Hamilton circuit to solve the egg sales problem, as shown in Figure 6.

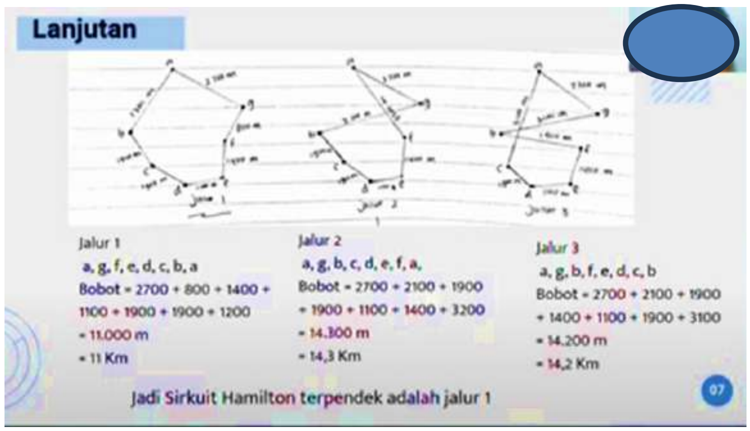

FIGURE 6.: *The solution to the Egg Trader Problem*

The third problem is application from Graph Coloring as shown in the following figure.

FIGURE 7.: *Application of The Graph Coloring*

From the Figure 7, it appears that students can formulate real problems in problem-solving. Students take the chemicals problem; namely, to help figure out where to put chemicals that can catch fire. Then, students use mathematics in problem-solving, as shown in the following figure.

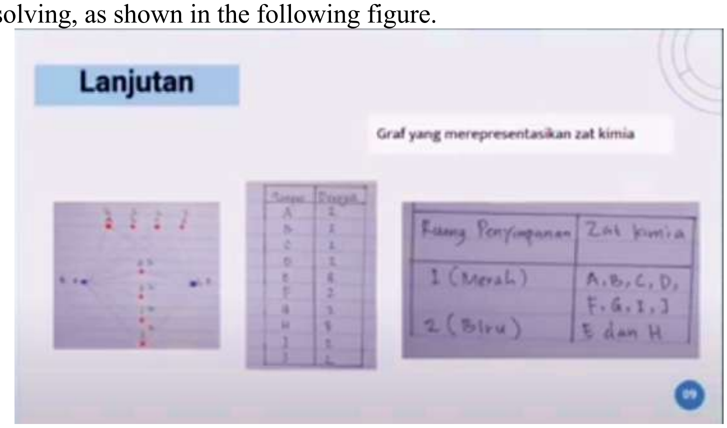

FIGURE 8.: *The solution to the Chemical Problem*

From the Figure 8, it appears that students do mathematics. It is shown that the student can draw a graph that represents the problem of the chemical problem. After that, in Figure 8, it also appears that students interpret the solution by coloring the graph they have previously drawn. Furthermore, they have evaluated solutions in problem-solving, as shown in Figure 8, where they Furthermore, they have evaluated solutions in problem-solving, as shown in Figure 8, where they determine which nodes of the same color can be put in the same place. Hence, students can sort out which chemicals should not be stored together.

CONCLUSION

Based on the study's results, students' mathematical literacy skills can be seen through project assignments. From the result and discussion, it appears that (1) students were able to identify and articulate authentic difficulties in the context of problem-solving (Formulate real problems in problem-solving); (2) they demonstrated proficiency in using mathematical concepts and techniques to address these problems (Use mathematics in problem-solving); (3) students demonstrated competence in analyzing and understanding the solutions generated through problem-solving (Interpret solutions in problem-solving); (4) they displayed the capacity to assess and appraise the effectiveness of these solutions critically (Evaluate solutions in problem-solving).

ACKNOWLEDGMENTS

This study was made possible with help from the Department of Mathematics Education, DRTPM, and LPPM Wisnuwardhana University Malang. The author would like to thank these groups.

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Biology Teachers and Lecturers Perceptions of the Independent Curriculum at High Schools and Universities

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Abstract. This research aims to describe the implementation of the independent curriculum in high schools and universities in DKI Jakarta. This research uses descriptive method and conducted in five high schools and two universities in DKI Jakarta. The population in this study were 11 biology teachers in high schools, and 11 lecturers at universities. The sampling technique was carried out through purposive sampling. The sample chosen in this study was in accordance with the willingness of respondents based on the population, namely 5 biology teachers in five high schools and 11 lecturers in two universities in Jakarta. The instruments used questionnaires with indicators for implementing independent curriculum, 21st century skills, local wisdom and ethnoscience, implementing learning strategies, and project-based learning. The data analysis technique uses the Guttman scale and narrative approach and is assisted by the SPSS 21 application. The research results show that teachers and lecturers have implemented the independent curriculum in learning, but still have not implemented it. In general, teachers and lecturers have used the project-based learning model (PjBL). However, the PjBL model is not always used in learning, and lecturers still encounter obstacles in implementing project-based learning. This is also shown in project work, which takes a long time. teachers and lecturers have never applied local Betawi wisdom in lectures, and some of them find it difficult to develop 21st century skills. So, it can be concluded that teachers and lecturers understanding regarding curriculum changes are good; it's just that the integration of local wisdom in teacher and lecturer learning is still not able to integrate it.

INTRODUCTION

The curriculum will continue to change and the changes are always influenced by the underlying factors. The curriculum can change if there is a new paradigm regarding the learning process so that a curriculum that is appropriate and relevant to changes in society is formed. Basically, curriculum changes have good and bad impacts on the quality of education, good impacts on students can learn by following the development of increasingly advanced times. Teachers and lecturers must have quality so that they are able to facilitate students in learning and students are able to understand and use the teacher as a facilitator [1]. The bad impact for the world of education in Indonesia is that the quality of education decreases and changes in the curriculum that are too fast result in new problems such as a decrease in students' academic scores, this is because students are not able to adjust to the changing conditions of learning in the curriculum system. The positive and negative sides of this curriculum change naturally occur because there are

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040045-1–040045-8; https://doi.org/10.1063/5.0246870
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

new things that are happening, the unpreparedness of educators, parents and students needs to be a common concern for the smooth running of the educational process [2]. If that's done, then basically changing the curriculum is not a problem, it's just that habituation and a change in way of thinking are needed.

The independent curriculum, through the Pancasila student profile, is a new order that is important to understand and implement as a solution to various kinds of challenges and changes at this time. The concept of implementing an independent curriculum is very important to understand together. The learning process in the independent curriculum is a form of student-oriented learning. Independence in learning gives freedom and autonomy to educational institutions and is free from bureaucratization and students are given the freedom to choose the fields they like. The implementation of the independent curriculum in schools provides an opportunity for students to develop 21st century skills, namely creativity, innovation, and make individuals who are independent and have positive character [3].

Problem solving, creative, critical thinking, and innovative skills are skills in the 21st century. 21st century skills consist of communication skills, critical thinking and problem solving, as well as being creative and innovative. These skills need to be implemented by teachers, educational biology lecturers and students in learning so that the quality of learning increases [4]. This independent curriculum is based on project-based learning guided by the Pancasila student profile. Character is the main pillar to be nurtured, because the influence of this character has implications for the strength and sovereignty of the State to be more advanced and qualified and have a positive impact on the world. This new paradigm must be supported and implemented in schools and learning, so as to produce the expected outputs and outcomes as expected by national education goals [5].

Research on government policies, especially in the field of curriculum, is very important to study. Many researchers have discussed studies regarding curriculum implementation and changes, such as the new paradigm in the prototype curriculum [6], the application of the curriculum during a pandemic [7], an analysis of the implementation of the independent learning curriculum at the Nusa Bangsa University biology study program [8], independent learning curriculum innovation in the era of 5.0 society [9]. Although research on implementation and curriculum has been carried out by many researchers in Indonesia. However, there is still little that discusses the implementation of the independent curriculum in schools and how to apply the essence of the curriculum to biology learning. For this reason, this study aims to describe teachers' and lectures perceptions of the independent curriculum in driving schools and universities in DKI Jakarta.

METHODOLOGY

The method used in this research is descriptive method, which examines problems in the form of facts from the population. According to Sugiyono [10] the descriptive method is a method used to analyze by describing and describing the data that has been collected as it is. This study aims to describe teachers' perceptions of the independent curriculum in DKI Jakarta driving schools and universities. The population in this study was 11 high schools teachers and 11 educational biology lectures universities in DKI.

Sampling was done by purposive sampling based on the willingness of respondents. Biology teachers and educational biology lecturers were selected as samples according to the research objectives so that they could represent the research objectives. Purposive sampling is a sampling technique that has been considered and determined according to Sugiyono [10]. The sample chosen was in accordance with the willingness of respondents based on the population, namely 5 biology teachers in five high schools and 11 lecturers in two universities in Jakarta.

In obtaining data regarding the integration of ethnoscience in learning, the researcher used the Interview/Interview technique which was conducted in an open interview so that it did not limit the explanations or opinions of the informants. Open interviews were conducted to take indicators of the implementation of the independent curriculum, local wisdom, 21st century skills, learning strategies, and PjBL. The questionnaire is part of data acquisition by using a questionnaire sheet which is filled in by teachers and Lecturers.

The data analysis technique used in this study uses the Guttman Scale. The Guttman scale is a cumulative measurement scale that only measures one dimension of a multi-dimensional variable. This scale produces a firm answer, namely "yes-no"and narrative approach and is assisted by the SPSS 21 application.

TABLE 1. Guttman Scale

No.	Skor	Explaination
1.	2	YES
2.	1	NO

RESULT AND DISCUSSION

Independent Curriculum Implementation

The government's effort to achieve the expected educational goals is to make changes to the educational curriculum. To date, the government has implemented approximately eight forms of curriculum, namely the 1968 Curriculum, the 1975 Curriculum, the 1984 Curriculum, the 1994 Curriculum, the 2004 Curriculum, or Competency-Based Curriculum, the Education Unit Level Curriculum (KTSP), the 2013 Curriculum, and the Independent Curriculum [2].Changes and developments in the curriculum are dynamics in education; the curriculum in Indonesia continues to undergo changes along with changes and developments over time and knowledge.

An analysis of teachers' and lecturers' understanding of biology learning was carried out to analyze understanding related to the independent learning curriculum, project-based learning model, local Betawi wisdom, integration of local wisdom in learning, and 21st century skills.

1) Teacher's and lecturers' understanding of the independent curriculum

There were three questions asked in the questionnaire, including: implementation of the independent curriculum. The results of the analysis showed that 77.8% of teachers and lecturers had implemented the independent curriculum in learning, and 22.2% had not implemented it. Furthermore, the results of the analysis show that 83.3% of teachers and lecturers understand the concept of an independent curriculum, while 16.7% do not understand the concept of an independent curriculum. Then, in the evaluation of the independent curriculum, the results of the analysis showed that 66.7% of teachers and lecturers carried out evaluations in accordance with the independent curriculum, while the others had not carried out evaluations in accordance with the independent curriculum. From the results of this analysis, it can be explained that, in general, teachers and lecturers understand the independent curriculum.

The independent curriculum is a curriculum with diverse intracurricular learning where the content is optimal so that students are expected to have enough time to explore concepts and strengthen competencies (11). (12) that in changing the curriculum, teachers play a role in implementing the existing curriculum and act as aligning the curriculum with the characteristics of students and their needs. teachers and lecturers already understand the concept of the independent curriculum. Supported through research conducted by (13) (14).

2) Learning strategies used by teachers and lecturers

In this aspect, the focus of the question is the project-based learning model that has been implemented by lecturers. The analysis data can be shown in Table 2.

TABLE 2. Data on Teacher's and Lecturers' Understanding of Learning Strategies

No.	Questions	Yes answer percentage	No answer percentage	Undecided answer percentage
1.	Is the learning model used project-based (PjBL)?	77,8%	16,7%	5,6%
2.	Do you always use project-based learning during lectures	27,8%	72,2%	-
3.	Is the PjBL implemented based on multidisciplinarity?	66,7%	33,3%	-
4.	Do you have any obstacles in implementing project-based learning?	44,4%	55,6%	-
5.	Does project-based learning take a long time?	83,3%	11,1%	5,6%
6.	Can all biology materials be turned into projects?	50%	50%	-
7.	Can students complete the project well?	72,2%	27,8%	-

Based on the table above, it is known that in general, in the implementation of teachers and lectures, lecturers have used a project-based learning model (PjBL). However, the PjBL model is not always used by teachers and lecturers, then there are still obstacles faced by lecturers in implementing project-based learning. This is also shown in the project work that takes a long time.

The independent curriculum is the newest curriculum, which has the concept that students and teachers are able to contribute and learn freely on a project basis based on real environmental conditions. So independent literacy is needed because education is prepared to be able to anticipate various kinds of problems in society (15) (16). Therefore, understanding the concept of the independent curriculum is necessary for good learning and implementation of the independent curriculum.

3) Integrated learning of local wisdom

In this aspect, the focus of the question is the lecturers' understanding of Betawi local wisdom. The results show that 33.3% of teachers and lecturers understand Betawi local wisdom and 66.7% do not understand it. The data obtained can be described in the form of a picture below.

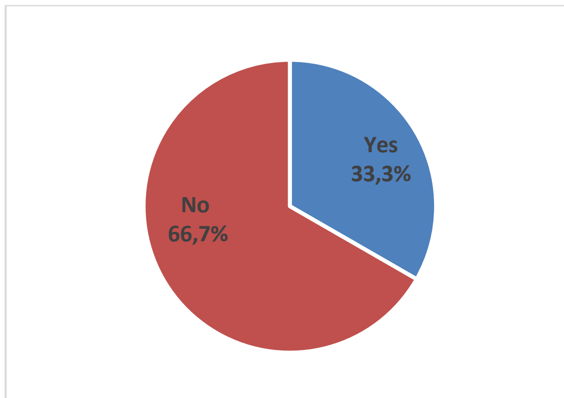

FIGURE 1. Understanding Teachers and Lecturers of local wisdom of Betawi culture

Betawi culture itself is a culture that exists in the people of DKI Jakarta; of course, the theme of local wisdom in the independent curriculum refers to the culture around the school environment. As a driving school in the Jakarta area, the local wisdom that needs to be applied is Betawi culture. Looking at the image of the data above, 33.3% of teachers understand Betawi culture because many teachers have Betawi backgrounds. It has been strengthened through research (17) (18) (19) that Betawi culture has the potential to be an alternative to biology learning.

The next question focused on teacher's and lecturers' understanding of the values of Betawi local wisdom. The results show that 38.9% of lecturers understand the values of Betawi local wisdom, but as many as 61.1% of lecturers do not understand it. The results obtained can be described in Figure 2.

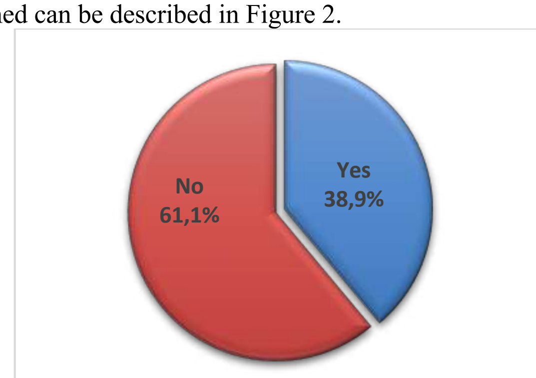

FIGURE 2. Understanding Teachers and Lecturers of value local wisdom of Betawi culture

Local wisdom is considered very effective in providing life values and a system of truth in the form of awareness that is easily absorbed by students. Because it is supported by the community environment. Based on data from 5 teachers, only 1 teacher applied or integrated local wisdom into science learning. In applying local wisdom in learning, there are three strategies (20), namely:

1. General learning, the teacher integrates cultural values into the group system or becomes the basis for learning syntax activities
2. Embedded learning, teachers integrate cultural values into learning materials or content on certain topics.
3. Mixed learning, teachers integrate culture by combining content and learning approaches.

Furthermore, an analysis was conducted related to the understanding of lecturers in the application of Betawi local wisdom in lectures. The results obtained showed that 94.4% of teachers and lecturers said it was important to implement it, and 5.6% were hesitant to implement it. This result is in contrast to previous data in which lecturers said local wisdom was important to apply. However, almost all lecturers never implement it. The results of the urgency of implementing local wisdom can be shown in Figure 3.

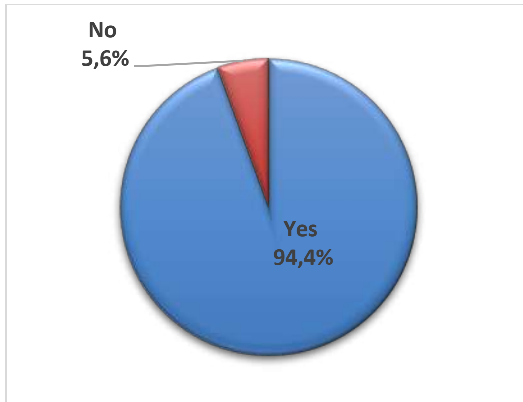

FIGURE 3. The Urgency of Applying Betawi Local Wisdom

The existence of local wisdom in learning can be a filter for various global aspects that enter various aspects of people's lives. Local wisdom can encourage teachers and students to create creative and innovative learning. Local wisdom is very useful in preserving culture and students' independence in interacting with the environment. In line with research results (21) that teachers show high enthusiasm and interest in learning local wisdom.

4) Teacher's and Lecturers' understanding of ethnoscience-based learning

Ethnoscience is a learning approach that bridges culture and science. Lately, this has become a hot issue in independent curriculum-based learning, this is because the expected output of students not only has 21st century skills, but also has character in accordance with the nation's identity. The following presents the teacher's and lecturers' understanding of ethnoscience-based learning.

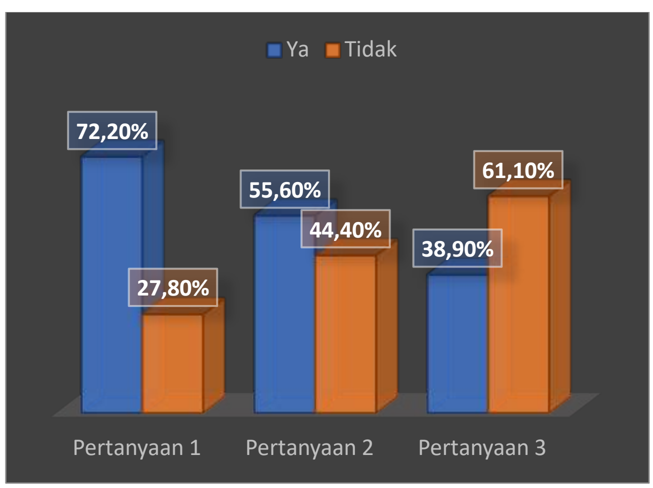

FIGURE 4. Teacher's and Lecturers' Understanding of Ethnoscience-Based Learning

Description:
Question 1 Do teachers and lecturers understand the concept of ethnoscience?
Question 2 Do teachers and lecturers understand the position of ethnoscience in learning strategies?
Question 3: Do teachers and lecturers apply ethnoscience in learning?

Ethnoscience is a new term for biology teachers in learning. Referring to the table above, some teachers do not understand this term. However, there are teachers who know the meaning of the term ethnoscience and express that the meaning of the term ethnoscience is "science connected with culture". According to the data results, 738.9% of teachers understand the concept of ethnoscience. This result is also strengthened by research conducted by (14) (22) that biology teachers do not have adequate knowledge about ethnoscience.

In addition to the above strategies, there are four learning strategies for integrating ethnoscience (23), namely:

1. Trailored teaching strategy
2. Culturally responsive teaching (CRT)
3. Culturally responsive transformative teaching (CRTT)
4. ESD-based pedagogical approaches

5) Teacher's and Lecturers' understanding of 21st Century skills

In the independent curriculum, students are expected to master 21st century skills so that learning is needed that can facilitate students to develop 21st century skills. Teachers and lecturers as facilitators and mentors should understand the concept of 21st century skills and how to evaluate them. The results obtained show that all lecturers understand 21st century skills. However, as many as 55.6% find it difficult to develop 21st century skills. The following data are presented in Figure 5.

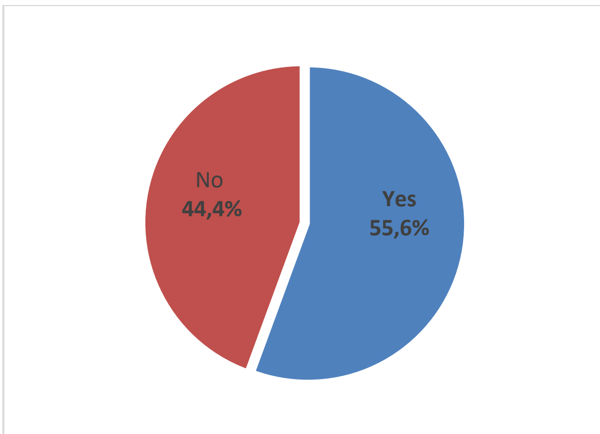

FIGURE 5. Teachers and Lecturers Struggle to Develop 21st Century Skills

21st-century skills are important for students to master. These skills will help students to be able to face challenges and problems. For this reason, teachers and lecturers need to use various learning strategies (24) (25). Referring to the picture above, teachers and lecturers experience difficulties in developing students' 21st century skills. 21st century learning skills are important skills that must be mastered by students in this century and in the future. Even though there are difficulties in developing it, teachers try to develop it through learning. According to research results (26) education in this century is very important for students to master 21st century skills to support learning and use in life by utilizing technology and information media.

CONCLUSION

Curriculum changes from time to time is finding the ideal curriculum. Every change that goes through the curriculum is inseparable from the factors of the government, society, and developments in science and technology. In essence, curriculum changes are to improve the quality of education in a better direction. With this curriculum change, the learning process also changes so that the curriculum changes are in line with national education goals.

Curriculum changes make teachers must be prepared to face them by increasing the level of professionalism by acting as implementers of the new curriculum in schools and adjusting students.

Through the results of the research that has been done, it can be concluded that the teacher's and lecture's perception of the independent curriculum is positive and gets very good appreciation from the teachers and lectures. This can be seen through the results of questionnaires and interviews, namely, teachers and lectures have understood curriculum changes, changes to the 2013 curriculum towards an independent curriculum, teachers and lectures have understood the importance of local wisdom, but have not been able to implement local wisdom into biology learning. The project-based learning model is in accordance with the main focus in the independent curriculum. Teachers and lectures carry out assessments in various ways, there are formative and summative assessments and assessments can be carried out through given project assignments, but the teacher and lectures has not implemented a diagnostic test. In line with the concept of an independent curriculum which gives freedom to teachers and students to innovate and think creatively.

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Students' Cognitive Conflict Process in Solving Plane Geometry Problems: Quadrilateral

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Abstract. This study aims to describe what stages students go through in the process of cognitive conflict in solving plane geometry problems in quadrilaterals form. The data were collected through observations of words or sentences, leading to the derivation of qualitative outputs. The process of cognitive conflict is based on discrepant events sourced from the students themselves. Thus, in this case there are two students who are used as research subjects. The screening begins with giving two problems about quadrilateral problems where students are asked to answer by choosing the appropriate plane shape and giving an explanation and then there is an intervention to see the cognitive conflict. The results showed that the data discrepant event in the process of cognitive conflict can be present several times and can also only once. The process of cognitive conflict students in solving the problems given in this study begins with the in-conflict stage, post-conflict stage, and ends with the final stage. Discrepant event it appears due to errors in applying prior knowledge characterized by confusion and anxiety when solving problems.

INTRODUCTION

One of the problems found related to mathematics understanding is the contradictions in students' understanding of a particular concept in mathematics. The conflict between the understanding of mathematical concepts is a problem in the cognitive process. If these understandings do not integrate with each other in the thinking process of students or even contradict each other, it can cause mental imbalance in the thinking process. Not integrating or contradicting these understandings is a condition called cognitive conflict. Cognitive conflict was a perceptual condition where people considered the differences between the mental structure and its environment (external information). It was also emphasized as the differences between the components of one's cognitive structure, including conceptions, beliefs, sub-structures, etc [1].

Cognitive conflict is the difference that students experience between new information or ideas and existing mental factors, such as knowledge, perceptions, behaviors, and attitudes [2], [3], [4]. For example, conflicts often arise during mathematics instruction when students have preconceptions about solving problems that require different solution methods [5]. Additionally, cognitive conflict constitutes an interactive, inspiring, interesting, and stimulating learning strategy for students [1]. In mathematics education, this conflict plays an essential role in understanding mathematical concepts [3], [6]–[11].

Cognitive conflict is a condition of awareness of the occurrence of opposition, incompatibility of previous knowledge structures owned by students with new knowledge structures, or discrepancies between knowledge structures owned by students, or discrepancies between what students already believe with new information, thus triggering the emergence of questions or statements. This awareness is characterized by feelings of surprise, tension, panic, lazy thinking, frustration, and or the urge to seek resolution of the conflict that occurs. One example of cognitive conflict will be described below. This example is quoted from [3] which shows a learner who experiences cognitive conflict. The learner in [3] has a belief that the set of prime numbers is closed to the multiplication operation. Furthermore, in the process of solving the problem, the learner found a new fact that $2 \times 3 = 6, 3 \times 5 = 15, 7 \times 11 = 77$, while 2, 3, 5, 7, and 11 are prime numbers but 6, 15, and 77 are not prime numbers. This new fact shows that the

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040046-1–040046-9; https://doi.org/10.1063/5.0242913
Published under an exclusive license by AIP Publishing. 978-0-7354-5088-2/$30.00

set of prime numbers is not closed to the multiplication operation. This new fact contradicts what he previously believed about the closed nature of prime numbers to the multiplication operation. The learner's awareness of this new contradictory fact is shown by the reluctance to think further about the contradiction, expressed verbally by the learner, "*I'm getting lazy again*", then becomes frustrated, expressed verbally by the learner, "*I don't know how to say it, I don't know how to say it, it's frustrating*".

Based on the results of a review of previous studies, it can be said that cognitive conflict is an important part in the process of conceptual change. Based on the results of research by [12] said that in the learning process, cognitive conflict can bring conceptual change in students' better understanding of changes in the use of information used in solving problems. There have been many previous researchers who utilize cognitive conflict as a tool to change the misconceptions of students in the learning process, among others [8], [13], [14], [15]. These researchers applied cognitive conflict in science learning to change students' conceptions of certain materials in science. Some other studies also used cognitive conflict as a teaching strategy [16], [17].

Various facts about cognitive conflict have been found by several researchers before. The first fact, the application of cognitive conflict in learning has a significant impact on changing the conception of learners [18]. This fact is based on the results of his research that by providing information that contradicts the students' ideas (wrong) during learning, can help students correct their misconceptions about related topics. The second fact is that the application of cognitive conflict in learning has no effect on changing learners' conceptions [19]. They argue that although learners' ideas may encounter conflicting information through an instruction in learning, learners often do not realize the conflict. Sometimes, the information provided is contradictory and can even have a negative impact on learners. The third fact is that the change in the conception of learners in learning using cognitive conflict is "learner-depending", which depends on the learners [3]. The third fact stated by [3] means that cognitive conflict can affect one learner but not necessarily affect other learners. The fourth fact is when errors occur due to misconceptions, this is the right time to explore cognitive conflict and help learners resolve cognitive conflict. And the fifth fact is the inconsistency of ideas learners potentially cause cognitive conflict [3].

These studies show that the emergence of student cognitive conflict is in a learning setting. The emergence of cognitive conflict is due to the presence of conflicting information or data that comes from outside the structure of thinking of students. The presence of conflicting information or data in this paper hereinafter referred to as discrepant event. The interesting thing is how the structure of cognitive conflict process when the presence of this discrepant event comes from students?

So, we use geometry, especially quadrilaterals as media. where the instruments we use are the result of research on the development of instruments to explore students' cognitive conflicts. because, this basic thing is that many students still do not know the relationship between the shapes of the quadrilateral. we can see from the picture on the side. each shape has its own relationship based on its properties. and the students only know the properties but not the relationship between the shapes. so that in distinguishing between ordinary shapes find it difficult. This is also helped by using how to define a shape. Definition is an expression that limits a concept.

METHODOLOGY

Study Design

In this study, a qualitative approach was used due to the production of comprehensive descriptions [20], [21], [22]. The approach was also used to frame data about the subject's in-depth perception, through observation (attentiveness), empathic understanding (empathetic understanding), and grouping preconceptions (bracketing preconceptions), regarding the topic evaluated. Furthermore, the data analysis method was inductive because the experimental activities used field facts to determine the process of cognitive conflicts. In this case, direct observations were critically carried out directly, accompanied by the collection of data from various sources, including interview transcripts and field notes, as well as the review and interpretation of relevant information. This inductive data analysis was subsequently conducted by constructing patterns, categories, or themes into more abstract information units, to provide a holistic account of the analyzed problem.

Participants

This research was conducted in Mathematics Education Study Program for first-semester students at Makassar State University, Indonesia. The subject selection criteria are (1) consideration of the subject under study has studied Flat Build Geometry, (2) understanding the concept of material, (3) Experiencing Cognitive Conflict.

How to obtain research subjects, first of all students are given Cognitive Conflict-based Questions (CCQ) where the questions contain the main questions and intervention questions. The main question serves to see the extent of understanding of the concept of students and the intervention question serves to stimulate the occurrence of cognitive conflict while seeing the understanding of the concept of students. Giving the questions separately by giving the main problem and given time to solve then giving the next problem, namely the intervention problem and given time to solve and so on. Once obtained students who understand the concept and provide psychological signs of cognitive conflict then given an interview to explore or reveal cognitive conflict experienced by these students this is also the provision of intervention. Then obtained 2 research subjects with different types of cognitive conflicts in various problems. After that then given what scaffolding in accordance with the type of conflict experienced by the subject.

Data Collection and Analysis

The expert is the main instrument acting as a planner, which directly handles experimental subjects, obtains data, performs information processing, analyzes outputs, concludes, and reports analytical results. This was shown by the researcher giving questions to the participants first, then analyzing the results of the problem solving, then conducting more in-depth interviews based on the results of the problem solving. Based on identifying a cognitive conflict, the thing that needs to be observed when students have solved the given problem is the intervention of the expert. This analysis was carried out before meeting several characteristics cognitive conflict process.

Interviews are also needed to clarify invisible elements when the subject solves the problem. This depends on the discrepancy between the expressed and written elements. So that, for the validity of the data using the triangulation method. Therefore, any indications should be explored by subsequently tracing and confirming the existence of an error in constructing the concept. The identification process was also carried out through a think-aloud approach, to determine the indications of cognitive conflicts. From the results, only two selected participants experienced a cognitive conflict based on an error in solve the problems. This was accompanied by in-depth interviews, to ensure the dispute levels of the participants before identifying the occurrence of the cognitive conflicts.

RESULTS

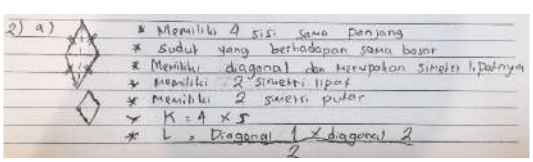
Based on the results, only two selected participants experienced cognitive conflicts in solving the problems. The two selected participants represent students who experience cognitive conflict who have the same characteristics based on errors in solve the problems consisting of 1 male student and 1 female student.

Understanding the concept of rhombus

Based on written data, a description of students' understanding of the concept of rhombus was obtained. It was found that almost all students answered correctly for the main question on understanding the concept of rhombus. The following is data on students' understanding of the main question on understanding the concept of rhombus in CCQ.

TABLE 1. Subject's Answer on CCQ Number 1

1. Write down the properties of a rhombus and draw a rhombus!

Data Exposure	Interpretation
 (a)	This subject has answered correctly by writing down the properties of a rhombus and drawing a rhombus, so this subject can be said to understand the concept of a rhombus on the properties of a rhombus.

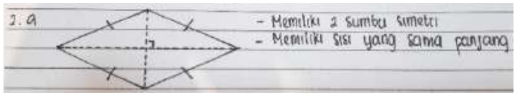
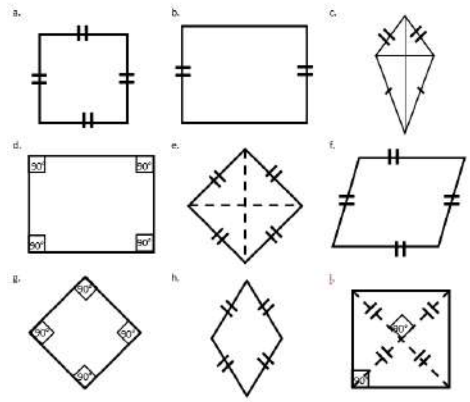
 (b)	This subject has answered correctly by writing down the properties of a rhombus and describing a rhombus, so this subject can be said to understand the concept of a rhombus in the properties of a rhombus

FIGURE 1. Answer on CCQ Number 1 (a) Subject 1, (b) Subject 2

At the time of giving intervention questions to subjects, almost all subjects began to show signs of cognitive conflict. Some seemed confused, some seemed surprised and began to hesitate to determine the correct answer. And the reasons that subjects give were various. The following is the data presentation

TABLE 2. Subject's Answer on CCQ Number 2

2. Which of the following is a rhombus based on its properties? Give the reason!



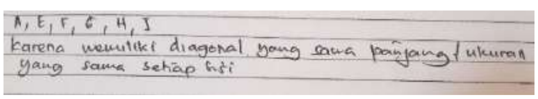
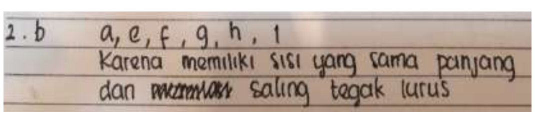
Data Exposure	Interpretation
 (a)	This subject answered correctly, namely choosing pictures a, e, f, g, h, i, and gave reasons because they have diagonals and the length of each side is the same. Even so this subject at the time of answering he seemed hesitant and confused to answer. He felt surprised when given the intervention question
 (b)	This subject answered correctly, namely choosing pictures a, e, f, g, h, i. and gave reasons because they have the same side length and the diagonals are perpendicular to each other. Even so this subject also seemed hesitant and confused to answer. He felt surprised when given the intervention question

FIGURE 2. Answer on CCQ Number 2 (a) Subject 1, (b) Subject 2

Some gave the reason because it has a diagonal if it does not have it, it is no longer a rhombus. Some also answered that they only chose the rhombus they usually saw, because it contradicted their understanding, namely the picture they usually saw even though it was the same shape, but the position of the picture did not match their understanding, they said it was not a rhombus. Another answered that he chose a rhombus whose image is in the form of a parallelogram but although the diagonals are there, they are not perpendicular because the image is almost the same as what they are used to understanding. Even though the picture is not a rhombus.

Based on interview data, the provision of further intervention obtained a description of the type of cognitive conflict that occurs in subjects understanding based on signs or subject responses as follows.

TABLE 3. Subjects Interview Data

Data Exposure	Interpretation
W 02 - 04: According to your answer, are you sure that the rhombus image is based on its properties, namely e, f, g, h, i? ENI 02 - 04: Yes, sir, I am sure. Because the four sides are equal and there are diagonals. W 02 - 05: Look at picture a, does it not include that? Then picture f, g, h has no diagonal, why does it include a rhombus? ENI 02 - 05: The square picture is the picture a, not a rhombus. That f, g, h looks like a rhombus sir because the slope of the picture is not like picture a. but like a square it is e, g, i sir. like I feel hesitant to answer actually does it look like a square (while scratching his head) ... W 02 - 07: What do you think, are the properties of a square the same as the properties of a rhombus. Try to explain! ENI 02 - 07: I think it's the same, sir. that's the example of the picture you previously gave like a square all the pictures of the rhombus. (while shaking her head) ... W 02 - 09: Are you sure about your answer? So how do you respond to these problems? ENI 02 - 09: hmm I'm sure sir (while bowing my head for a moment). And I think it's interesting sir because I just got this problem, even though it sounds easy but when I want to work it's quite difficult because I'm confused about which picture is a rhombus. Hehe.	This student showed signs of cognitive conflict, namely he felt confused, hesitant, surprised, there is interest, and think a little longer. - This student felt surprised after the picture was compared with other pictures so that the student seemed hesitant to answer it with signs of scratching his head and gave a rather surprised response. - the student felt interested to know the problem because this problem was new to him. It looked easy but complicated to answer - the student felt confused about his answer because it was different from the picture he usually saw or got - the student thought a little longer to overcome the confusion he experienced
W 02 - 04: What according to your answer, are you sure that what is included in the rhombus image based on its properties, namely a, e, f, g, h, i? SCR 02 - 04: hmm. I am sure sir. because it fulfills the properties of a rhombus. But like a square all the pictures ... W 02 - 08: What do you think, are the properties of a square the same as the properties of a rhombus. Try to explain! SCR 02 - 08: I think it's the same but the difference is that the rhombus has a diagonal line. W 02 - 09: What about picture a? Even though pictures a, g, h do not have diagonal lines? SCR 02 - 09: If I'm not mistaken, if you add a diagonal line, it's the same as a rhombus. Moreover, if the figures g and h are not given a line, the rhombus sir. ... W 02 - 11: Are you sure about your answer? And how do you respond to these problems? SCR 02 - 11: hmm not too sure sir (while scratching his head). Because the pictures are similar. And I think it's good sir even though it looks easy because of the rhombus picture but when you want to work it's quite difficult because it makes you confused which picture is right. Hehe.	This student showed signs of cognitive conflict, namely he felt confused, hesitant, surprised, there is interest, and think a little longer. - This student felt surprised after the picture was compared with other pictures so that the student seemed hesitant to answer it with signs of scratching his head and the student felt doubtful about the answer he gave because the picture given was almost the same but different from the understanding he had. - The student felt interested to know the problem because this problem was new to him. It looks easy but difficult to answer - the student feels confused with his answer because the pictures are almost all the same, so he is confused about choosing the right answer - the student thought a little longer to overcome the confusion he experienced. Although she felt unsure of her answer.

So based on the data that has been presented above, the subject is experiencing a type of cognitive conflict that is reassessing and trying to overcome the conflict, because it has passed the stages of the previous type of cognitive conflict. The signs of cognitive conflict given are, students think a little longer to overcome the confusion they experienced. Students try to give rational answers even though sometimes there is inconsistency or lack of confidence in their answers.

The next question is given in the form of further intervention when given a picture of a square, where the square is added a diagonal line and rotated 45 degrees and asks the subject whether the picture is a square or a rhombus? Like **Figures 3**. When they saw this, they looked confused because to state that it was a square or a rhombus was very difficult because basically the picture was a square but only added a few and viewed from the other side which was rotated to look not like a square anymore and turned into a rhombus. This makes the subject experience cognitive conflict. where the discrepant event appears in the form of a square concept contradicts the concept of rhombus. where in this case the concept he understands is contrary to what they see.

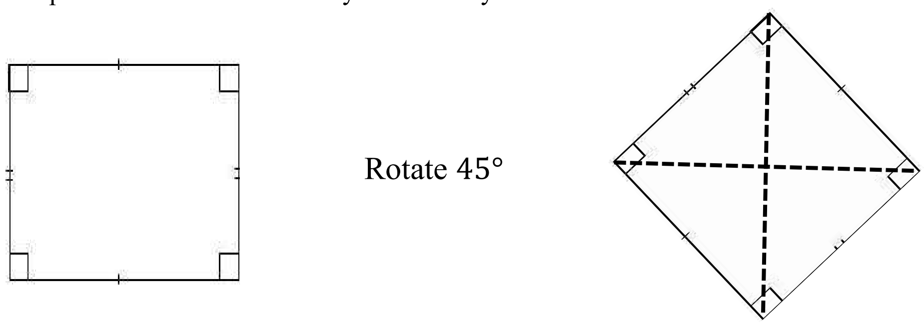


FIGURE 3. Intervention Problems to see Cognitive Conflict Process

Cognitive Conflict Process

Five stages in the process of cognitive conflict subjects in solving mathematical problems consist of (1) preliminary stage, (2) pre-conflict stage, (3) in-conflict stage, (4) post-conflict stage, and (5) the final stage. Preliminary stage is the stage when subjects begin to identify the problem until they believe the concept used in solving the problem and believe the answer. Pre-conflict stage is a stage that begins with subjects' efforts to prove their beliefs and ends when they find conflicting data. In-conflict stage is a stage that begins when subjects realize and acknowledge the presence of conflicting data so that conflict occurs, then interest or anxiety arises when they realize the presence of conflicting data.

Post-conflict stage is the stage when subjects rethink the conflict that occurs, whether the conflict that occurs will be resolved or left without resolution. if subjects decide to leave the conflict that occurs without resolution, then the process of cognitive conflict will end more quickly (ended at that time) but if subjects decide to resolve the conflict that occurs, then the process in the post-conflict stage still continues until shortly before subjects find the resolution of cognitive conflict. Final stage is the stage when subjects successfully find a resolution to their cognitive conflict, realize the mistakes that lead to conflict, change the structure of their knowledge, and solve the mathematical problems being solved. The two subjects in this study experienced all five stages.

DISCUSSION

The findings in this study emphasize the process of cognitive conflict that discrepant event comes from the students themselves. Three main findings in this study consist of (1) stages of cognitive conflict process of students in solving math problems, (2) the model of cognitive conflict process of students in solving math problems. Both findings are described below.

Stages of Cognitive Conflict Process

Cognitive conflict process in this study consists of 5 stages, namely the preliminary stage, pre-conflict stage, in-conflict stage, post-conflict stage, and the final stage. Stage cognitive conflict process can be modeled as in **Figure 4**.

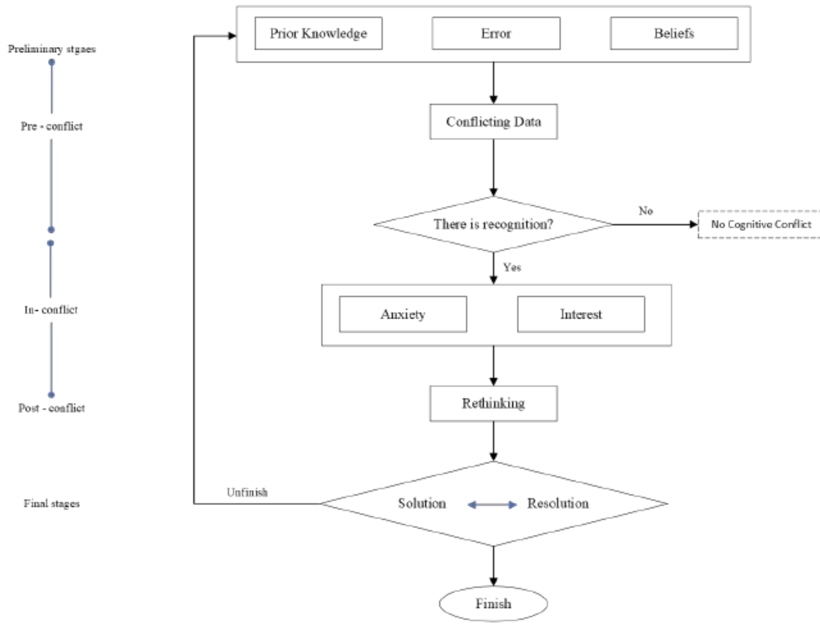


FIGURE 4. Cognitive Conflict Process Model

Figure 4. shows that the process of cognitive conflict in this study begins with the preliminary stage, followed by the stage of pre-conflict, in-conflict, post-conflict, and ends with the final stage. Stages of cognitive conflict process is developed based on the results of this study, with reference to the cognitive conflict process model that has been proposed by [1] and based on a review of previous studies. In previous research, [1] put forward a cognitive conflict process model consisting of three stages, namely preliminary stage. conflict stage, and resolution stage. Preliminary stage in the process of cognitive conflict is a stage where students have confidence in the previous concept owned, which is used to solve the problem, and then believe the answer given.

Meanwhile, in [8] stated that the preliminary stage is a stage where a learner who already has confidence in his/her previous concept accepts information that contradicts his/her concept as the real concept. Conflicting information/data that resulted in anomalous situations in previous studies, such as those conducted by [1], [3], [23] came from outside the individual experiencing conflict. While in the process of cognitive conflict in this study, conflicting data is self-discovered and recognized by individuals who experience conflict. [24], [25], and [4] discuss about cognitive conflict which anomalous situation is presented by students themselves when the students solve math problems. The presence of conflicting data found by students in this study, included in the pre-conflict stage. Similar to previous studies, when conflicting data is not recognized its presence, it can be said that there is no cognitive conflict. This pre-conflict stage is also a stage where students acknowledge or reject the presence of conflicting data. When students recognize the data can be known whether students feel anxious or actually feel challenged to face the existence of conflict. Since the student recognizes the existence of conflict, the student has entered the stage of the in-conflict stage in this study. Furthermore, students reassess the conflict that occurs, whether to be resolved or abandoned. This stage is referred to as the post-conflict stage. Furthermore, what kind of conflict resolution and problem solutions, as well as how students react to cognitive conflicts that occur, are included in the final stage.

Discrepant Event Model (DEM)

Recurrence of the post-conflict stage to the preliminary stage is also shown by S2 on the cognitive conflict process model DEM. In addition to the omission, there is also a loop from the final stage to the preliminary stage on the DEM model The description of the DEM cognitive conflict process model can be seen in **Figure 5**.

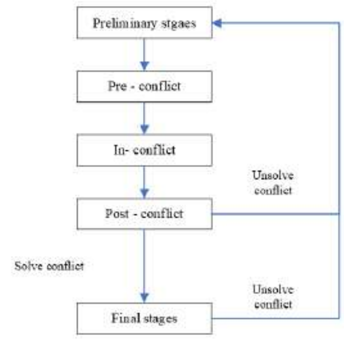


FIGURE 5. Cognitive Conflict Process Model DME

Begins with the preliminary stage, which is followed by the pre-conflict stage. in-conflict stage, post-conflict stage, and the final stage (conflict resolution). Because this subject S2 solves CCQ by sorting some cases, cognitive conflict also occurs in the process of solving CCQ on the cases of the results of the selection. So that after finding a resolution and completing one case (in the process of solving CCQ), the subject returned to the preliminary stage to solve the next case to complete CCQ. When the subject could not find a resolution of cognitive conflict in one case, the subject then left the case and completed the next case. The existence of the loop is in line with the theory put forward by [1] regarding the loop from the resolution stage to the preliminary stage in the cognitive conflict process model as previously described.

CONCLUSION

The process of cognitive conflict students in solving math problems shown by the subjects in this study begins with the preliminary stage, followed by the pre-conflict stage, in-conflict stage, post-conflict stage, and ends with the final stage. The preliminary stage is the stage when students identify and understand the problem. The pre-conflict stage is the stage when students begin to plan and use their prior knowledge to solve the problem. At this pre-conflict stage, there are data that contradict students' understanding or contradict students' thinking when solving problems. The in-conflict stage is the stage when students recognize the presence of conflicting data. The post-conflict stage is the stage when students will reassess whether this conflict will be resolved or abandoned. The Final Stage is the stage when students decide to resolve their conflict.

The process of cognitive conflict students in solving math problems can occur only once and can also be repeated. Meanwhile, conflicting data (discrepant event) in the process of cognitive conflict can be present several times and can also be only one time. Based on the frequency of cognitive conflict and recurrence of the presence of conflicting data, as well as from the results of data analysis obtained in this study, there are three models of cognitive conflict process based on the appearance of discrepant event.

ACKNOWLEDGMENTS

The authors would like to thank all research participants, especially Universitas Negeri Makassar and Universitas Patompo, which has provided many experimental experiences. The author also thanks Universitas Negeri Makassar for helping to coordinate the selection of experimental subjects. This analysis is part of the development research funded by Universitas Negeri Makassar with PNBP funds.

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Ethnomathematics and Computational Thinking in Mathematics Learning: Bibliometric Review

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Abstract. In this study focused on learning mathematics, the objective is to delineate the connection between computational thinking and ethnomathematics. Employing the dimensions database, our research method centers on bibliometric analysis, examining 435 reputable articles. Our findings indicate a global presence of publications on the link between computational thinking and ethnomathematics across continents, with prominent contributions from the United Kingdom, the US, and Indonesia. This suggests a concerted effort in these nations to develop contextually-oriented mathematics learning strategies, underlining the importance of international cooperation in shaping innovative math education approaches. Incorporating ethnomathematics and computational thinking into curricula and teaching practices stands to benefit from our study's insights. The research sheds light on the dissemination and evolution of knowledge on these topics in diverse mathematical learning environments globally. A key conclusion is that computational thinking and ethnomathematics synergize effectively in learning mathematics. Ethnomathematics enriches understanding by integrating cultural and contextual factors, while computational thinking emphasizes problem-solving and logic. Despite these valuable insights, it is imperative to acknowledge study limitations. The data's dynamic nature, susceptible to rapid changes, requires caution in generalizing findings over time. Recognizing this caveat ensures a nuanced interpretation and enhances the study's credibility. This research significantly contributes to the synthesis of computational thinking and ethnomathematics, offering a pathway for more relevant and meaningful mathematics instruction in an ever-evolving educational landscape.

INTRODUCTION

Mathematics is a branch of knowledge that supports many other sciences, for example, science, chemistry, biology, engineering, and the technology industry [1,2]. Mathematics has a fundamental role in human cognitive development [3]. Mathematics is used to investigate the order of the universe. Therefore, mathematics is very close to nature. Modern science develops as if mathematics has no relevance to everyday life, thus developing mathematics as a science that is complicated and difficult to understand [4]. Mathematics is an abstract language that brings thoughts into reality, and as a light thrown over the darkness in this world [5]. Mathematics, as a universal language, captures the patterns of nature [6]. Its usefulness in explaining the world is undeniable. The fusion of mathematics and reality indicates a deep harmony in the universe. The language of mathematics develops with the patterns and structures learned [7].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040047-1–040047-10; https://doi.org/10.1063/5.0242373

Ethnomathematics is said to be a higher level of mathematics within the scope of education [8]. Where ethnomathematics combines nature, science and mathematics in one harmonious concept. Ethnomathematics is literally derived from the words "ethnos" and "mathematics" [7]. The term "ethno" comes from the Greek word "ethnos", which can mean "human group", "ethnicity", or "nation" [9]. In the context of ethnomathematics, the term "ethno" refers to research or teaching that focuses on how to study, understand, and apply mathematical concepts from a variety of human or ethniological contexts. While mathematics is a scientific discipline that studies numbers, changes in patterns, counts, structures and geometry. Ethnomathematics can be defined as the study or understanding of how different human or ethnic groups use and understand mathematical concepts in their culture, as well as the way they interact with mathematics in everyday life, traditional systems, and different ways of thinking. D'Ambrosio was a Brazilian mathematician who was instrumental in developing ethnomathematical concepts [10]. He has proposed an ethnomathematical view that involves an understanding of mathematics in a cultural context as well as a more inclusive mathematics education [11]. Ethnomathematics has succeeded in changing the relationship of mathematics with the conditions of the reality of society that has been distanced because formal mathematics education is taught in a rigid, often not contextualized and far from the reality conditions of society [12]. In ethnomathematics learning is associated with culture, customs, language, traditional games, buildings and even local specialties. This seems to erode the distance that exists between mathematics and the reality of life.

Computational thinking is a research topic that is being hotly discussed in the development of the world of education. Computational thinking is a vital approach to thinking in a modern world that is increasingly dependent on technology and data processing [13,14]. Computational thinking is also defined as a way of thinking that is inspired by the way computers process information, and has significant relevance in learning mathematics and various disciplines. The importance of computational thinking in mathematics learning includes two things. First, this approach gives students a deeper understanding of mathematics by showing how mathematical concepts are used in solving real problems. This makes learning maths more relevant and engaging. Second, computational thinking trains students in problem-solving skills that are important in a variety of contexts. This involves the ability to decompose problems into smaller subproblems, identify patterns, abstract unnecessary details, design algorithms, and evaluate solutions. In addition, computational thinking promotes creativity and critical thinking. Students are taught to think logically, analyze data, and make evidence-based decisions. Thus, this approach prepares students with relevant and competent skills to face the challenges of information technology and data analysis in the future. In mathematics learning, the integration of computational thinking can be done through the use of computational mathematics software, mathematical modeling, and solving real problems involving mathematical concepts to improve students' mathematical understanding [15].

Ethnomathematics and computational thinking are two fields that have a relationship in the context of learning mathematics. Although the two have different focuses, they can complement each other and improve students' understanding of mathematics. Ethnomathematics explores the ways in which different cultures utilize mathematics in everyday life, linking mathematics to cultural reality [16,17]. On the other hand, computational thinking is a thinking approach that can be applied to solve mathematical problems in a structured and algorithmic way [12]. The combination of cultural understanding of ethnomathematics with problem-solving abilities of computational thinking can enrich students' understanding of mathematics and help them see how mathematics plays a role in a variety of cultural contexts, while developing strong problem-solving skills. Thus, the two can work together to promote more contextual and relevant mathematics learning.

Learning mathematics that combines ethnomathematics and computational thinking can encourage collaboration between students [18]. They can work together on projects that combine an understanding of mathematics in their culture with computational problem solving. This can improve students' social and collaborative skills. In addition, Indonesia is a country that is very rich in cultural, ethnic, and linguistic diversity. With over 300 different ethnic and linguistic groups, the country offers a wide range of opportunities to integrate ethnomathematical learning [17]. While computational thinking as an approach that is becoming a trend in the world of education will be a creative collaboration in improving students' skills. With this collaboration, mathematics will be seen as a universal language that can be used to explain and model phenomena in cultures that develop in society.

In recent years, many researchers have begun to be interested in the topics of ethnomathematics and computational thinking in mathematics learning [19,20]. Combining ethnomathematics and computational thinking in mathematics learning aims to improve students' relevance, understanding, and skills. It enables students to see mathematics in their cultural context, develop algorithmic problem solving, enhance creativity, and appreciate cultural diversity. This combination prepares students for the modern world related to technology and promotes collaboration and critical thinking. In addition, it advances inclusive education and creates a deeper link between mathematics and everyday life. The combination of ethnomathematics and computational thinking creates a rich and relevant learning experience for students. Through bibliometric analysis, we saw how the trends on the topic have been in the last 5 years. The purpose of this study is to identify studies that represent research trends related to ethnomathematics and computational thinking in mathematics learning and visualize them. By conducting research and analysis of the latest data, significant changes in the approach to teaching mathematics can be identified [21]. The goal is to seek out fresh ideas that can improve the relevance and accessibility of math instruction. In this process, it is also important to maintain the richness of Indonesian culture. This can be achieved by collaborating with other subject areas that have a significant impact, so that mathematics is not only seen as a universal subject, but also as an important part of Indonesia's cultural heritage [22].

METHODS

Study Design

In this study, the research method used was descriptive bibliometric analysis. Bibliometric analysis is a logical way to handle deciphering and estimating patterns, examples and effects of logical exploration in the form of writing accessible in data sets such as journals, articles and books [23]. Statistics, graphs, and modeling are used in this approach to determine the most influential research, the influence of authors or institutions, and research trends [24]. Scientists, librarians, and policymakers all benefit from the ability to measure research impact, identify recent developments in specific scientific fields, and plan future research using bibliometric analysis. It is also useful for evaluating research that supports strategy and decision-making across disciplines. The use of tools such as, VosViewer, and Microsoft Excel allows comprehensive analysis of academic contributions and trends in the field. With regards to this exploration, the logical methodology applied is enlightening subjective examination. The means of this investigation incorporate recognizing and choosing pertinent bibliometric information sources, gathering information, for example, distribution title, creator, year of distribution, establishment, and so on. Then, the information is gathered in view of suitable subjects or classifications, and the items in logical distributions are clarified top to bottom for recognize designs, applied systems, research techniques and principal discoveries. The aftereffects of the examination will be deciphered with regards to the exploration, giving inside and out knowledge into the subject under study and its importance. With this methodology, this examination would give a more profound comprehension of scholastic commitments and patterns in logical writing connected with the exploration point. In this bibliometric analysis, there were 4 stages that must be passed, namely, identification, screening, eligibity and conclusion [21].

Data Collection Method

In bibliometric analysis there were many data sources that can be used to harvest publications for example, dimensions, google scholar, scopus or publismed [25]. In this study, researchers use dimensions as a data source to find publications related to research topics. The reason for choosing database dimensions is because there was still a lack of publications related to research topics in other data sources. Dimensions have more data so that they can be analyzed more widely. 435 data were obtained from dimensions by entering the keyword "ethnomatematics and computational thinking" with publication criteria in the form of articles, chapters, proceedings and books in the 2019-2023 range.

The dataset of 435 sections has gone through a progression of thorough strides in bibliometric examination. The primary stage is the recognizable proof stage, which is the underlying step where specialists look for or input predefined catchphrases into a data set to get to investigate results connected with a particular field. At this stage, 1987 important information connected with the subject of ethnomathematics and computational reasoning in math learning were acquired. Next is the subsequent stage, which is the screening stage. During screening, scientists lay out measures as indicated by their particular necessities. For this situation, the model was set to incorporate distributions from the beyond 5 years, bringing about 473 information sections. The third stage is the qualification stage, where information is surveyed for its appropriateness founded exclusively on the distributers of instructive diaries. In this stage, 435 information passages remained. These 435 information sections then continue to the last stage, which is the incorporation stage. In this stage, the got information will be dissected utilizing different strong applications. For a more point by point portrayal of these stages, kindly allude to Figure 1.

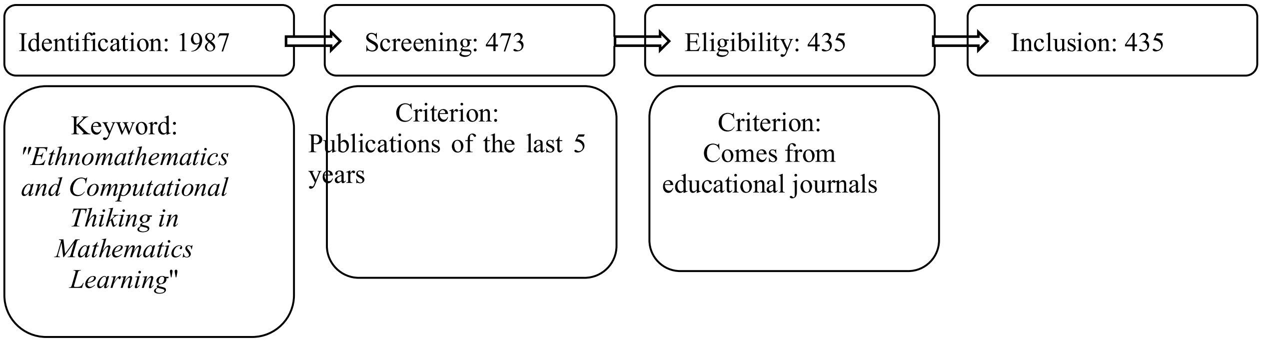

FIGURE 1. Data Collection Stages

The decision to use data for the past 5 years was driven by a variety of factors. Data from the last 5 years is often more relevant and accurate as it reflects the latest situations and trends, harnesses technological advancements for more efficient data collection and analysis, and supports more precise decision-making in an ever-changing world. The data obtained from the dimensions database is further analyzed with the help of the vosviewer application. Vosviewer is used to analyze and visualize data obtained through biographical pair analysis [26]. Through this analysis, the distribution of countries, bibliographic pairs of authors, bibliographic pairs of journals and distribution of documents will be obtained. Furthermore, from Vos viewer can also be seen visualization of keyword trends related to research topics while publication trend graphs are displayed with the help of Microsoft Excel applications.

RESEARCH AND DISCUSSION

Publication Trends 2019-2023

The appropriation of distributions throughout recent years, as displayed in Figure 2, territories from 2019 to 2023. The information got shows that a sum of 435 distributions are spread across these years.

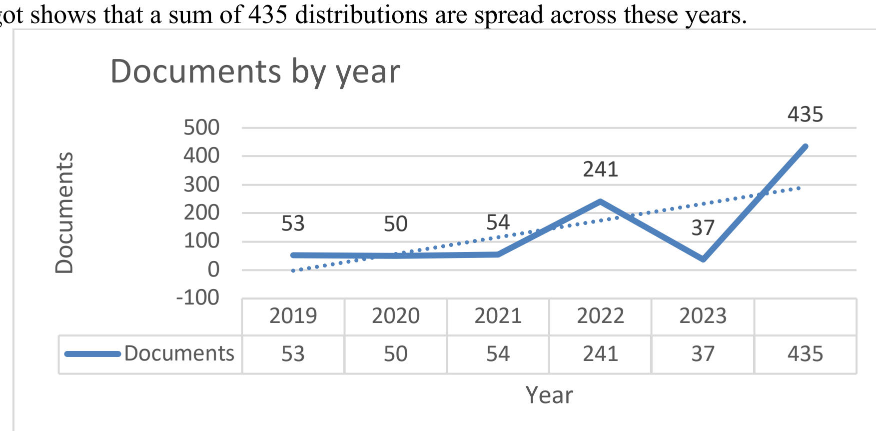

FIGURE 2. Publication Graphics

Figure 1 is a graphic image of publications over the last 5 years. The publication graph on ethnomathematical research and computational thinking in mathematics learning shows an interesting pattern during the period 2019 to 2023. There are several points of analysis that can be drawn from the chart presented in figure 2. Attention to this topic is likely to see a significant spike in 2023 with 241 publications, which is much higher than in previous years. This could indicate that the topic is increasingly relevant and of interest to researchers. The year 2020 saw a lower number of publications, which may have been affected by the impact of the COVID-19 pandemic. Limited access to resources and changes in research focus might lead to a temporary decline in publications [27]. The years 2019 to 2022 have a relatively consistent number of publications at around 50-54. This may reflect stability in research interest in this topic over the period. There is significant variability between 2022 and 2023, which may be triggered by changes in major research projects or special initiatives undertaken in 2023. Publications include articles, book chapters, conference proceedings, and books, showing the diverse sources of information and research platforms used by researchers in discussing these topics. Overall, these graphs reflect the growing interest in ethnomathematical research and computational thinking in mathematics learning, as well as responses to certain developments that affect the number of publications.

Global Collaboration Pattern

In light of the consequences of the examination utilizing VOSviewer application, we got a perception of the worldwide joint effort design as displayed in Figure 3.

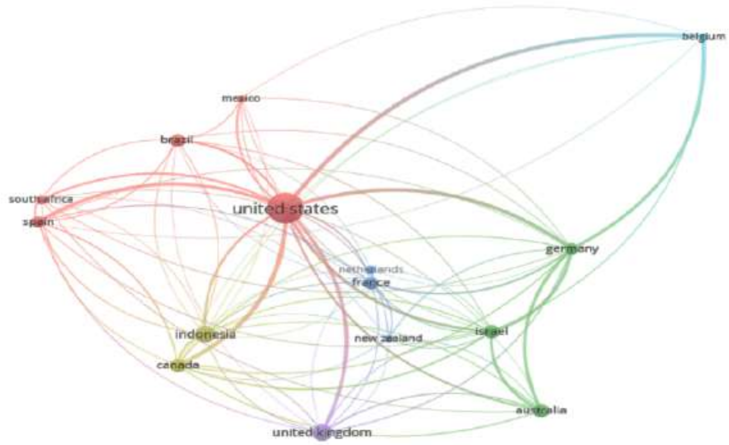

FIGURE 3. Global collaboration pattern visualization

The figure above shows the relationship between several countries and their publications on the topics of ethnomathematics and computational thinking in mathematics learning. The countries shown are countries with at least 5 publications and citations. The United States, United Kingdom, and Indonesia have the highest number of publications on this topic, indicating the high interest and contribution of these countries in ethnomathematical research and computational thinking in mathematics education. Canada, Spain, South Africa, Mexico, Belgium, Germany, France, the Netherlands, Australia, New Zealand, Israel and Brazil are other countries involved in publications on this topic, but the number of their publications varies. This indicates the diverse interest of different countries in combining ethnomathematics and computational thinking in the context of mathematics learning. It is possible that collaboration and knowledge exchange take place between countries with similar interests. For example, European countries such as France, Germany, Belgium, the Netherlands, and Spain may have strong cooperation in this area. This shared interest in the topic could also be related to global trends in mathematics education that emphasize relevance, problem-solving, and computational thinking. Factors such as investment in research, higher education, and strong academic communities in these countries may affect their publication rates [28]. The visualization reflects the complexity of global networks in ethnomathematical research and computational thinking in mathematics learning. This suggests that this topic has not only received attention at the national level, but also involves cooperation and exchange of ideas between countries contributing to a better understanding of this approach in a global context. A global exchange of ideas can lead to positive direction for research on this topic [29].

Authors Collaboration Relationship

In Figure 4, we present a representation of the connections among authors who teamed up on research connected with this subject. Various varieties are utilized to address coordinated effort among authors.

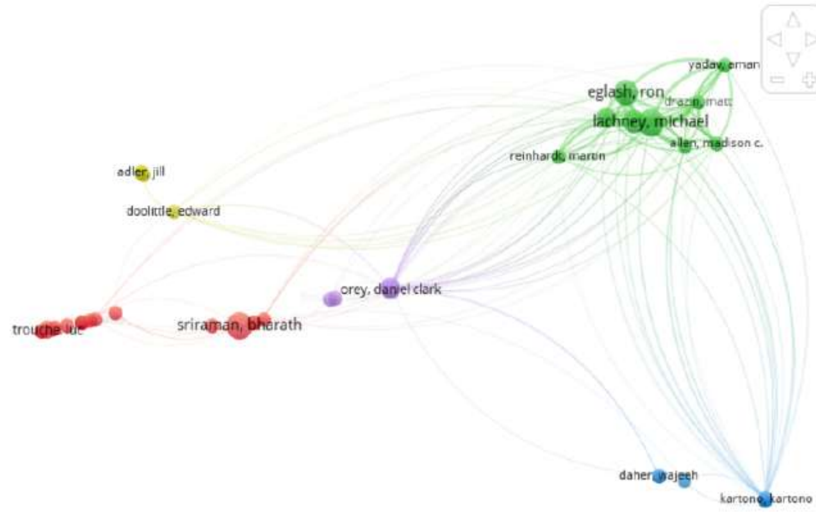

FIGURE 4 Authors Collaboration Relationship

Images of author networks in ethnomathematical research and computational thinking in mathematics learning show patterns of collaboration between authors. The largest green circle represents a group of writers who have many collaborative relationships. This indicates that there is a strong research group that often collaborates on research related to this topic. This close collaboration may be due to similar research interests or cooperation in large research projects. Other, smaller color circles represent groups of writers who have more limited collaborative relationships. This suggests that there are some writers who may collaborate in teams or have more focused involvement in a particular topic.

On the green circle one of the influential writers is Lachney, Michael. In Lachney's recent years, Michael has had a lot of research on related tobics. Ethnocomputing and computational thinking are topics that are widely discussed [30]. No wonder Lachney, Michael became one of many writers involved in active collaboration.

Density Visualization Keyword Reseacrh

The exploration is centered around the subjects of ethnomathematics and computational reasoning in math learning, as depicted in Figure 5. By setting a minimum threshold of 5 times for those keywords, the visualization displayed resembles what is shown in Figure 5.

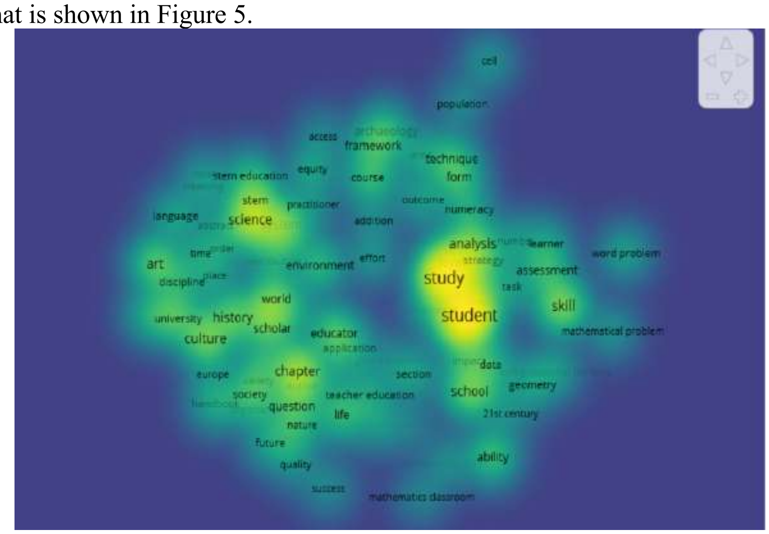

FIGURE 5. Keyword Research

The image above is an image of keyword distribution displayed in density visualization in the vosviewer application. Density visualization is a method for visualizing the distribution or density of data in a particular context, often used to understand the distribution of information within an area or domain [25]. From this image, density visualization can be used to illustrate the distribution and frequency of using certain keywords in the distribution of keywords with ethnomathematical topics and computational thinking in mathematics learning. There are several keywords with high density, namely study, student, STEAM, art, and history. This can be seen from the yellow circle which is clearer than other keywords. The density of keywords in the visualization carries significant meaning related to the mathematics learning approach that focuses on ethnomathematics and computational thinking. The keyword "study" indicates that this approach emphasizes research, in-depth understanding of concepts, and comprehensive learning in the realm of mathematics. "Student" indicates that the program is aimed at students or university students, emphasizing its relevance in learning for that group.

Then, the existence of the word "STEAM" with high density illustrates that in mathematics learning, this approach combines aspects of science, technology, engineering, art, and mathematics. The integration of these disciplines demonstrates the importance of understanding mathematics in a broader and multidisciplinary context, creating opportunities to develop creativity and innovative thinking. Furthermore, the keyword "art" highlights the central role of art in this learning of mathematics. This illustrates that aspects of creativity, expression, and interpretation of art have significant relevance in the understanding of mathematical concepts, which can result in more interesting and meaningful learning approaches. Lastly, the density of the keyword "history" emphasizes the importance of understanding the history of mathematics, especially in the context of ethnomathematics. This shows that this mathematics learning program appreciates the origins and development of mathematics in various cultures, providing a deeper understanding of how mathematics has developed and is used by societies around the world.

Overall, this visualization illustrates a holistic and multidisciplinary approach to mathematics learning, focusing on in-depth study, student participation, STEAM integration, the role of art, and understanding the history of mathematics. This approach aims to create a rich and immersive learning environment in an effort to understand mathematics in a variety of cultural and practical contexts.

Novelty Keyword Research

Lastly, an analysis of events using keywords was conducted to uncover novelty in the field of ethnomathematics and computational thinking in mathematics learning. Consequently, the novelty visualization of keyword relationships, as generated by the VOSviewer application, is presented in Figure 6.

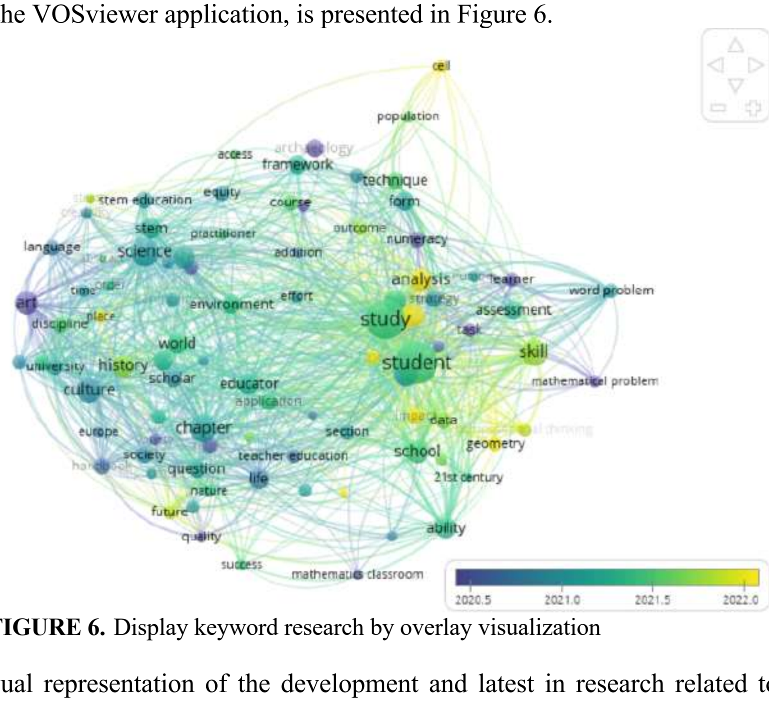

FIGURE 6. Display keyword research by overlay visualization

The picture above is a visual representation of the development and latest in research related to the topic of ethnomathematics and computational thinking in mathematics learning. In this image, the colors used reflect the time period of publication and show the extent to which a keyword is considered the latest keyword in the context of research on ethnomathematics and computational thinking in mathematics learning. In the image, dark blue represents a keyword that first appeared in research in 2020. This indicates the initiation of a research focus on this topic that year. Green indicates keywords that are starting to become a concern in research in 2021. This could indicate an expansion or progression in the study beyond the previous year. Yellow is the brightest color in this visualization, indicating keywords that were introduced or became particularly important in research over the past year. This indicates more recent research and a major focus in current research on the topics of ethnomathematics and computational thinking in mathematics learning. The use of these colors provides a clear visual view of how the focus of research in this topic has evolved over the years. The lighter the color, the more important and new those keywords are in recent research. This can help mathematics education researchers and practitioners to see the latest trends and developments in the understanding of ethnomathematics and computational thinking and encourage the development of better learning approaches in this context.

The keywords noted in yellow, namely "analysis," "place," "strategy," "geometry," and "cell," have strong relevance in this context. The keyword "analysis" refers to the ability to critically parse and understand data or information related to ethnomathematics and computational thinking in mathematics learning. This may indicate that research in 2022 is more focused on an in-depth analysis of this topic, perhaps by digging deeper and in more detail. The keyword "place" can relate to how mathematical concepts and computational thinking are applied and relevant in specific places or environments. This may indicate that the study may have considered geographical or cultural aspects in mathematics learning. The keyword "strategy" highlights the approach used in learning mathematics related to ethnomathematics and computational thinking. There is likely an emphasis on developing effective strategies for integrating aspects of ethnomathematics and computational thinking in the mathematics curriculum. The keyword "geometry" shows the role of geometry in this study. This can refer to how aspects of geometry are used in an ethnomathematical context or in support of understanding computational thinking in mathematics. A unique feature highlighted in the keyword "cell", this keyword may indicate micro aspects or details analyzed in the context of this study. This could mean that more recent research focuses more on more detailed analyses or on smaller elements that influence ethnomathematics and computational thinking.

The novelty suggestion that can be gleaned from this keyword is an increase in understanding of how ethnomathematics and computational thinking can be applied in mathematics learning. More in-depth analysis, development of more effective strategies, application of geometry, and understanding of micro-details as indicated by the keyword "cell" can provide valuable new insights in developing better mathematics curriculum and learning approaches. The emphasis on "place" can also result in more contextual research, illustrating how mathematics learning can be adapted to the local environment and culture, which is important in ethnomathematical contexts.

CONCLUSION

The results of this study provide an interesting overview of the development of research related to ethnomathematical topics and computational thinking in mathematics learning. Based on the data analyzed, there are several key findings that can be concluded. First, 2023 is the year with the highest number of publications on this topic. This shows that interest and research in ethnomathematics and computational thinking in mathematics learning continues to grow, with 2023 being the peak of research activity. Second, there was a decline in publications in 2020. This can be caused by various factors, such as the influence of the COVID-19 pandemic which may affect research productivity in that year. However, this decline was later followed by significant growth in the following years, indicating that interest in this topic is recovering and increasing. Third, by setting the publication threshold to 5, it was found that the United States, United Kingdom, and Indonesia had the highest number of publications on the topic of ethnomathematics and computational thinking in mathematics learning. This reflects the significant contributions of these countries in research related to this topic. Fourth, content analysis showed that there are some keywords with "high density," such as "study," "student," "STEAM," "art," and "history." This indicates that these elements have an important role to play in the context of mathematics learning that focuses on ethnomathematics and computational thinking. Fifth, color visualization highlights the keywords "analysis," "place," "strategy," "geometry," and "cell" in yellow, indicating that these keywords are the most recent and important in recent research. Overall, this study shows that the topics of ethnomathematics and computational thinking in mathematics learning continue to grow and get significant attention from various countries. The potential for development and renewal in approaches to learning mathematics taking these elements into account still seems to be great. Novelty suggestions include increased understanding of the application of ethnomathematics and computational thinking in mathematics learning through in-depth analysis, development of effective strategies, application of geometry, and understanding of micro details. It is also important to contextualize mathematics learning with the local environment and culture in ethnomathematics.

ACKNOWLEDGMENTS

Our deepest gratitude is conveyed to all parties who have participated in the process of completing this research. There are countless individuals and groups who have provided tireless support, and although we cannot name them individually, your contributions and assistance have been meaningful to the success of this research. May the kindness and hard work of all of us continue to be an inspiration for greater achievements in the future. Thank you for all the effort and encouragement that has been given.

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Phenomenon-Based Learning Method to Enhance Students' Skills in Entrepreneurship Course

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Abstract. The new phenomenon-based learning model is seen as an alternative pedagogical approach to create a positive learning environment for students to evaluate and explore real-life problems holistically. Phenomenon-based learning shifts the focus from understanding the world to understanding and acting concerning the world, in which every circumstance can be chiefly observed and scientifically utilized to provide optimal information for students. Currently, entrepreneurship education expects students to be able to venture into business by absorbing the existing phenomenon on how to develop a business. This motivates and excites students to engage in the course. This research method is a literature review exploring various references to phenomenon-based learning. The research objective is to establish the benefits of phenomenon-based learning in developing entrepreneurship courses, thereby achieving the learning objectives successfully. The research findings state that entrepreneurship education can be further enhanced through phenomenon-based learning because this method connects experiential learning holistically, and enables students to develop business plans based on the exploration of various phenomena in their surrounding environment.

INTRODUCTION

Poverty and unemployment are daunting challenges for school graduates, especially, for those from higher education institutions. This issue is also a primary concern of the government. The Central Bureau of Statistics (BPS) reported that the unemployment rate in Indonesia until February 2023 was 7.99 million people. This decreased from February 2022 by 410 thousand people, as it was initially 8.40 million people in February 2022. The number of people who gained employment increased by 3.02 million people from February 2022 to February 2023. Meanwhile, the unemployment rate decreased by 4.88%, which is equivalent to 0.41 million people. However, despite these improvements, the unemployment rate in Indonesia remains relatively high.

To address unemployment, one of the government's approaches is to support the entrepreneurship education movement. This maneuver has been introduced to various institutions; including primary, secondary, and higher education institutions; as well as government and private organizations. The entrepreneurial culture can enhance the work motivation of the society, which in turn will be able to create innovative, tested, independent, and up-to-date entrepreneurial opportunities. Entrepreneurship education in higher education has been facilitated by the Ministry of Education and Culture (Dikti) since 1997 through various activities such as entrepreneurship development programs for students, including Entrepreneurship Learning (KWU), Entrepreneurship Internship (MKU), Business Work Lectures (KKU), Business Consultation and Job Placement (KBPK), and New Entrepreneur Incubator (INWUB). Entrepreneurship education typically consists of modules and activities related to shaping entrepreneurial mindset and behavior, developing speaking skills, building relationships, and designing business plans based on market needs and profitability. Therefore, universities nowadays accommodate and facilitate this course for all their students [1]

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040048-1–040048-5; https://doi.org/10.1063/5.0242431
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The government regulation that is urgently needed to be implemented is to embody entrepreneurial cultural behavior in society. This was initiated in 1995 and has steadily continued to grow until the present day. To enhance the activities of the program, the regulation has currently been instructed by the President of the Republic of Indonesia. Through the forming cultural behavior movement, it is expected that entrepreneurship becomes an integral part of the work ethic of the community, which will ultimately foster the creation of new professional; resilient, tested, and independent entrepreneurs. Entrepreneurship education in higher education institutions has already been incorporated and programmed by the Ministry of Education and Culture (Dikti) two years after the government regulation on entrepreneurship programs had been launched to the public.

Entrepreneurship education is integrated into the curriculum at the junior high, senior high, and tertiary levels. Entrepreneurship education aims to equip students and university students with knowledge, skills, and the configuration of an entrepreneurial mindset from an early age, so that they will be able to become competent young entrepreneurs in their respective fields as adults. According to Mohammad Saroni [2, p. 45], entrepreneurship education is a learning activity that focuses on equipping students with the ability to develop their entrepreneurial potential. Similarly, Agus Wibowo [3, p. 30] states that entrepreneurship education is an effort to instill an entrepreneurial mindset through educational institutions and other training and development centers.

Entrepreneurship education shapes the entrepreneurial spirit and instills entrepreneurial competencies and values. Providing entrepreneurship education to students is highly beneficial [4] as one of the contributing factors to the development of entrepreneurship in Indonesia lies in the role of government institutions and educational institutions that actively participate in its implementation.

The highly considered learning model that is suitable for achieving entrepreneurial learning outcomes is the phenomenon-based learning model (PBL). The term "phenomenon" is often used to refer to things that emerge around us or observable and exploratory experiences. One learning theory that supports the PBL model is constructivism, which emphasizes the process of constructing an understanding of instructional materials during the learning process. Based on this viewpoint, PBL is a learning model that encourages students to actively construct new concepts, understanding, and ideas based on various realities encountered. Therefore, the teaching methods are selectively chosen and implemented to motivate students in organizing their own experiences into meaningful knowledge [5].

Thus, this paper identifies how the phenomenon-based method fosters teaching and learning in entrepreneurship courses to achieve the established learning outcomes. Through the aim of its course which can provide and equip the students with entrepreneurial mindset and experiences, phenomenon-based learning is believed as one of the most suitable solutions. Entrepreneurship education using various methods has been extensively researched by other scholars, such as the development of entrepreneurship through games-based learning [6]. Other studies have focused on the implementation of PBL to enhance critical thinking [7], [8], as well as on improving conceptual understanding in physics learning through PBL [5], [9]. However, there is a lack of research on the application of phenomenon-based learning (PBL) or the implementation of PBL in entrepreneurship education conducted by other researchers. Hence, this study aims to contribute new insights to the field and further enrich the surrounding discourse of the phenomenon-based learning implementation in entrepreneurship education.

RESEARCH METHODOLOGY

This study employs a qualitative descriptive method, involving the exploration of relevant literature or articles that discusses the phenomenon-based learning method. Data collection is conducted by analyzing document abstracts. The data analysis follows three stages as typically outlined by Milles and Huberman [10] data reduction, data display, and conclusion drawing.

CONCEPTUAL FRAMEWORK

Phenomenon-Based Learning Model

This learning model has been incorporated into the latest curriculum reform in Finland in 2016 for primary education [11]. The phenomenon-based approach is related to constructivist learning [12]. The starting point of phenomenon-based teaching is constructivism, wherein learners are viewed as active knowledge builders, information is seen as the result of problem-solving and constructed from "small pieces" into a holistic coherence aligned with the objectives. When phenomenon-based learning occurs in a collaborative setting (learners working in teams), it supports sociocultural and sociocognitive learning theories, in which information is not solely viewed as an internal individual element; but rather formed within a social context. In the curriculum, the phenomenon-based approach particularly supports inquiry-based learning, problem-based learning, project-based learning, and portfolio compilation in educational institutions, as well as their practical implementation [13].

Phenomenon-based learning begins with the observation of a phenomenon from various perspectives. Silander [12] argues that phenomenon-based learning consists of five dimensions: holism, authenticity, contextualization, problem-based inquiry learning, and the learning process.

1. The holistic aspect refers to the multidisciplinary nature of phenomenon-based learning, which focuses on a systematic and comprehensive exploration of current and real-world events.
2. The authenticity aspect implies the use of methods, tools, and materials which are necessary for factual situations to address constraints that is relevant to students’ lives and significance in society. In this aspect, theories and information have direct utility value. While experts and professionals from various fields are included in the learning community, learners are encouraged to participate in authentic expert culture and practices. Thus, the authentic learning environment is considered to be the real world, rather than the traditional classroom.
3. The contextualization aspect refers to phenomenon-based learning as a systemic entity, which is significant in the context and its natural setting. In this sense, a phenomenon cannot be predetermined but remains somewhat fuzzy and ambiguous as it is brought forth by students who observe its broader context.
4. Through problem-based inquiry learning, students pose their questions and collaboratively construct knowledge during the learning process, which is seen as deliberate hypothesis development and theory building. Learning tasks facilitate learning and guide students to become aware of their learning (know-how).
5. In its advanced stages, students themselves plan the learning process by creating their own tasks and learning tools. Scaffolding is needed for students to move beyond what they currently [13].

Phenomenon-Based Teaching and Learning through Phenomenological Pedagogy, simultaneously, phenomenon-based teaching is embedded within a problem-solving environment, where teachers begin by posing questions or problems, and students "jointly construct answers to the questions or problems posed about phenomena that are interesting to them" [12]. Instructional goals are negotiated rather than imposed, and evaluation serves as a self-analysis tool. The teaching activity is learner-centered with theories that should be learned by students connected to practical situations and phenomena.

To comprehensively study phenomena, team teaching that is involving subject-specific teachers is considered an important approach [13]. In the learning process, teachers are viewed as facilitators of learning tasks, who utilize their expertise; not only to convey facts but also, more importantly, to encourage and guide students in facing problems identified by the students themselves [13].

The phenomenon-Based Learning Model has several syntaxes, including:

1. Orient students to the phenomenon.
2. Organize students for learning.
3. Conduct experiments in groups.
4. Present the experiment results.
5. Analyze and evaluate the presented phenomenon description [8].

The PBF model is grounded in constructivist learning theory, which emphasizes the process of students’ constructing an understanding of the subject matter. The learning process based on this theory is a model that encourages students to be active and creative in developing new concepts, understanding, and ideas based on discovered events [14]. Therefore, the instructional model must be carefully designed and effectively implemented to cultivate students' motivation in transforming their own experiences into meaningful knowledge [5].

Entrepreneurship

To achieve these goals, all students are required to take General Basic Courses (MKDU). Some of the MKDU courses have been mandated by Law No. 12 of 2012, such as Religion, Pancasila (the state ideology), Citizenship, and Indonesian Language. To perfectly accomplish the educational outcomes of MKDU, it is supplemented with English language courses, Entrepreneurship, and other personality development courses; both integrated and non-integrated. The Entrepreneurship course is aimed at shaping entrepreneurial personality or, at the very least, increasing students' knowledge of the ins and outs of the business; including both soft and hard skills, so that, they can seize opportunities in their surroundings to establish their ventures after graduation or even while still in college. Furthermore, the government will formulate a more detailed education plan, along with teaching materials that can be utilized by lecturers in higher education institutions. The development of these learning plans and teaching materials is funded by the Directorate of Learning and Student Affairs under the Directorate General of Higher Education. The formulated materials will be uploaded to the Dikti website to serve as an accessible learning resource to everyone, including students.

According to McClelland in Hery Maulana [15], one aspect that indicates a country's development is when the number of entrepreneurs in that country reaches at least 2% of its population. Currently, the number of entrepreneurs in Indonesia is only around 400 thousand or less than 1% of Indonesia's population of approximately 270 million. This situation contrasts with the United States, where the percentage of entrepreneurs is 11.5% of its population, and our neighboring country; Singapore, where 7.2% of its citizens work as entrepreneurs. The abundance of entrepreneurs in a country leads to significant economic growth.

Higher education institutions should serve as a barometer for the development of entrepreneurial character and the cultivation of independence among their students. This actually can be achieved through: 1. Fostering performance habituation that encourages the emergence of creative ideas in thinking and action, as well as fostering independent learning through exercises, individual assignments, problem-solving, decision-making techniques, and identifying opportunities. 2. Incorporating honesty and integrity in communicating and acting within various educational activities, as a foundation for building entrepreneurial character among students. 3. Sharing of education practitioners' knowledge and providing support for the learning process that has been implemented. The strategies will be able to yield both entrepreneurial and independent personalities in the students, hence, they can plan, execute, and are willing to take risks, to create new businesses, and opportunities. That entrepreneurial growth process leads to entrepreneurship, which is defined as a mental attitude, perspective, ideas, and patterns of thinking and behavior that individuals have towards their responsibilities, always oriented towards customer satisfaction or any actions that add value to their tasks and responsibilities [16, p. 35].

Discussion

Entrepreneurship education sets several learning outcomes, which include the ability of students to analyze business development and current entrepreneurship trends, as well as the ability to formulate business plans in the form of PKM-K proposals and to create product prototypes. The government's objective in incorporating this course is indeed to prepare students to become young entrepreneurs who can be self-reliant and create job opportunities for themselves and others. However, it is not easy for students to generate business opportunities that they will later develop, as they may lack an entrepreneurial mindset and come from families without such experience.

For that matter, the phenomenon-based learning model can address the difficulties faced by students. This is because the phenomenon-based learning model is fundamentally based on constructivist theories, whichever, learning strategies emphasize group activities that prioritize students' involvement over instructor-led activities as engaging in laboratory activities, field experiences, case studies, problem-solving, discussions, brainstorming, and simulations [17]. In this regard, students can collaboratively explore the field, and discover various experiences of others in planning and developing their businesses. They can then discuss these experiences within their groups and simulate them in front of their classmates. Additionally, phenomenon-based learning is also related to problem-based learning (PBL), which is essentially a part of contextual learning; a method that enables students to applicate their comprehended knowledge and skills to solve problems in real-life situations. It is aligned with the certainty that the natural phenomena observed are real-life problems related to entrepreneurship. Thus, students apprehend that they will face some problems and are demanded to have the capability in making various anticipations. Furthermore, this approach is also associated with an inductive approach, which is begun by presenting specific conditions, then followed by inferring facts, principles, or rules. The learning process starts by presenting specific examples and then formulating generalizations based on them [18]. The implementation of this inductive approach begins by presenting facts, principles, and rules discovered in the field, particularly those which are related to entrepreneurship. From various facts, principles, and rules presented by various groups during the learning process, students can formulate these facts, principles, and rules in a general manner.

Thus, this learning model encourages students to actively construct their knowledge by analyzing phenomena and events to enhance their conceptual understanding. In line with Tomayahu's opinion [19], phenomenon-based learning is supported by the observation of occurring phenomena. This learning approach directly involves students in observing the phenomena and subsequently engaging in discussions related to those phenomena. Furthermore, phenomenon-based learning emphasizes conceptual discoveries by students.

CONCLUSION

Based on the presentation, phenomenon-based learning is considered as one of the latest learning models, even Finland has recently been integrating this model into its elementary education curriculum since 2016. Concerning the more significant entrepreneurship education, the learning outcomes expect students to have business plans and to be able to establish their business activities, which relate to factual business environments.

The phenomenon-based learning model, which connects the real world to the learning process, will enable students to excavate the phenomena or events within society. The situation happens because the various experiences that are possessed by the students will enrich the learning process. Furthermore, phenomenon-based learning is complemented by constructivist theory, problem-based learning, and inductive learning.

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E-IM3 Learning Model for Developing Junior High School Students' Decision-Making Ability in Solving Number Pattern Problems

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Abstract. The existence of the new normal and changes in the curriculum have caused teachers to innovate in implementing effective learning so that students are able to solve higher order thinking skills (HOTS) type questions in accordance with the essential skills of the 21st century, namely decision making. One of the innovative learning models that is expected to improve students' decision-making abilities is the e-IM3 learning model. The e-IM3 learning model is an acronym for electronic (e-) with IM3 steps, namely Identifying (I) problems, Membangun (M) is building ideas, Mengklarifikasi (M) is clarifying ideas, and Menilai (M) is assessing the reasonableness of ideas. This research aims to reveal that e-IM3 learning is able to develop students' decision-making abilities in solving number sequence problems. This research includes descriptive qualitative research under research subjects 32 grade VIII students at Junior High School in Madiun. Students carry out 4 steps of learning activities, namely identifying problems on student worksheets, building ideas by solving problems, clarifying ideas by presenting answers and assessing the reasonableness of ideas through students' oral explanations. The research results showed that there were 2 correct student decisions in solving questions on the worksheets, namely: (1) using sequential addition with a fixed difference. (2) using the concept $Un = a + (n-1)b$, where a is the duration on the first day and b is the difference so that the correct results are obtained. However, in the process there were students who were not careful enough so that the answers were not correct. Other results show that most of the scores obtained by students after implementing E-IM3 learning model increased, which shows that students' decision-making abilities in solving number sequence problems are developing. This e-IM3 learning model can be used to develop students' decision-making abilities in other mathematics materials.

INTRODUCTION

Education is given to students as an effort to direct students to develop according to their age, interests, talents and abilities. Education is a conscious and planned effort to create a learning atmosphere and learning process [1]. This is intended so that students are able to play an active role in developing their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals, and the skills needed by themselves, society, nation and state. Apart from that, education can also be used as a benchmark for a country to determine whether or not the country is able to provide welfare, protect and ensure that people's needs are met [2]. Considering the importance of education, the government has guaranteed the education of its citizens that every citizen has the right to receive education regardless of origin, social, economic status or physical condition.

After the Covid-19 pandemic, the education system in Indonesia changed, being replaced by online learning [3], [4]. Online learning is a learning activity that requires an internet network with connectivity, accessibility, flexibility, and the ability to create various types of learning interactions [5]. Apart from that, the existence of the new normal, namely the implementation of normal life after Covid-19 [6] and changes in the curriculum, mean that teaching staff have to think extra to apply it in effective learning. The reason is that students are required to be able to reason about the problems given before then thinking about how to solve them. This is in line with Scott's (2015) statement that essential abilities and skills in the 21st century are thinking activities which include: the use of skills related to thinking

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040049-1–040049-11; https://doi.org/10.1063/5.0241565

and reflection, thinking habits (analysis, interpretation, precision and accuracy, problem solving, reasoning) and the use of expert thinking (detailed knowledge and metacognition) to support decision making [7]. Koh, et. al. (2015) reinforces that the demands for essential skills in the 21st century are closely related to high-level thinking abilities, one of which is decision making abilities [8][9].

In the midst of the increasing demands and targets of the education system, there are students who are adapting to new habits. The reason is that students have just returned to offline learning activities where learning activities are carried out outside the network using learning media [10] after undergoing online education for approximately two years. This certainly has a big impact on students' level of understanding of the learning material. Based on a survey, class VIII students at Junior High School in Madiun had difficulty understanding number sequence material. This is because the questions given are HOTS (Higher Order Thinking Skill) type questions, namely high-level thinking skills consisting of analysis, evaluation and creation which are part of cognitive abilities [11]. Apart from that, Heong (2011) also added that questions with the HOTS type can measure two abilities, namely critical and creative thinking so that students must be able to understand the material and solve problems related to daily events, one of which is number sequence material [12].

Number patterns or sequences are one of the inductive reasoning materials that are often found in mathematics. A number sequence is a collection of numbers that have a sequence and are arranged according to a certain pattern [13]. A number sequence is a list of numbers from left to right that has a certain pattern where each member of the number sequence is called a number term [14][15]. Number sequences are also one of the materials studied by class VIII students at the Junior High School level [16]. Number lines are one of the difficult materials for students. Students still experience difficulties in number pattern material, especially in the process of determining the formula for the given number sequence problem [13]. This is supported by the statement that many students after studying mathematics cannot understand even simple material, many of the concepts they understand are not precise enough so that mathematics is considered complicated [18]. Of the two problems given, students were only able to work on one problem and not all students were able to solve the problem correctly. Therefore, it is necessary to develop learning by innovating learning models. The learning model that is expected to be used to develop decision making skills is the e-IM3 learning model. The e-IM3 learning model is an acronym formed from electronic learning with steps consisting of identifying problems, building ideas, clarifying ideas, and assessing the reasonableness of ideas [19]. The application of this learning model is carried out to develop students' decision-making abilities in solving number sequence problems. In mathematics learning, research related to decision-making skills has been carried out by several researchers but they have only examined decision-making abilities qualitatively [20]–[22] and there is still no innovation used to improve these abilities. Thus, this research is important to carry out because it can provide information on the application of the e-IM3 learning model to improve first school students' decision-making abilities in solving number pattern problems.

METHOD

Research Type and Subject

The method used in this research is descriptive qualitative which can be used to describe the results of implementing the e-IM3 learning model in developing students' decision-making abilities [23]. The results of implementing the e-IM3 learning model are focused on student learning outcomes in solving number pattern problems. Then we saw how students' decision-making abilities are in solving problems with number pattern material based on the steps of the IM3 learning model, including: Identifying problems, Building Ideas, Clarifying Ideas, and Assessing the Reasonableness of Ideas. The subjects of this research were 32 Junior High School students in Madiun, East Java, Indonesia in grade VIII. The procedure for this research is described in the Figure 1 as follows.

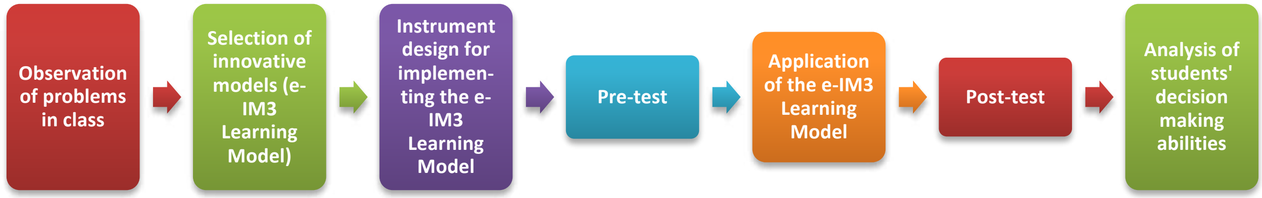


Figure 1. Research Procedure

Data Collection and Analysis

This research data was taken from observations of the implementation of the E-IM3 learning model, giving individual assignments on student worksheets. The instruments used in this research were observation sheets, individual assignments used to determine pretest and posttest scores. The individual assignment given is in the form of a problem, namely "*Koko wants to take part in the official school selection. To train his stamina, he takes the time to jog every day. On the first day, he jogged for 7 minutes. He targets to increase the duration of jogging by 3 minutes consistently the next day. He jogged for 10 minutes on the second day and 13 minutes on the third day, and so on. How many minutes does Koko jog last on the 30th day?*". This problem has been validated by experts and senior mathematics teachers and the results show that the problem is valid so it can be used as a research instrument.

Data analysis was carried out in the stages of reducing observation data on the application of the E-IM3 learning model, reducing data resulting from individual work assignments. Next, was presented the data and drawed conclusions. Meanwhile, data validation was carried out using method triangulation, namely by comparing observation data collection methods, individual assignments [24], [25].

RESULT AND DISCUSSION

Result

The application of the E-IM3 learning model was carried out in grade VIII of Junior High School in Madiun on number patterns/sequences. This learning step or phase consists of identifying problems, building ideas, clarifying ideas, and assessing the reasonableness of ideas that are integrated with the use of electronic technology. These learning steps can be seen visually in Figure 2.

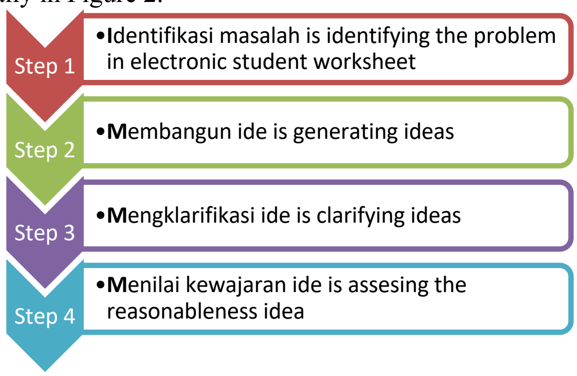


Figure 2. E-IM3 Learning model steps

The implementation of e-IM3 learning is carried out in groups. The 32 students were divided into 6 groups with each group consisting of 5-6 students. At the problem identification stage, students in group discussions identify problems presented on the electronic student worksheet as shown in Figure 3.

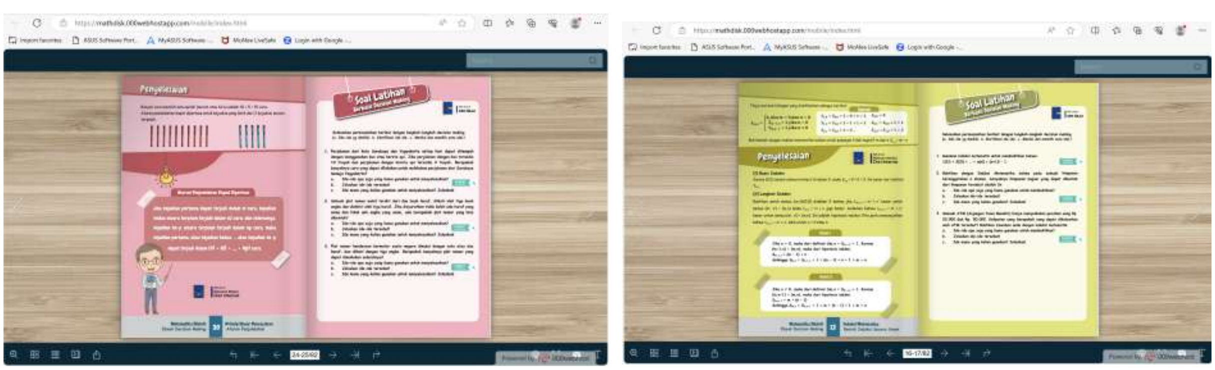


Figure 3. Electronic Worksheet

At this stage, students understand the problem given, understand what is known and are asked about the problem. At the idea building stage, students discuss and provide their ideas in the form of ways that can be used to solve problems on the electronic student worksheet. At the stage of clarifying ideas, each group presents its solution in front of the class and the teacher asks questions regarding the reasons for using this solution method. At the stage of assessing the reasonableness of an idea, the teacher asks the group why they chose that method and how students can use this method to get the answer. From these group activities, 32 students were given individual assignments with an average score after implementation (posttest) of 83.91. These results showed a significant increase because the average score before implementation (pretest) was 60.47 which can be seen in Figure 4.

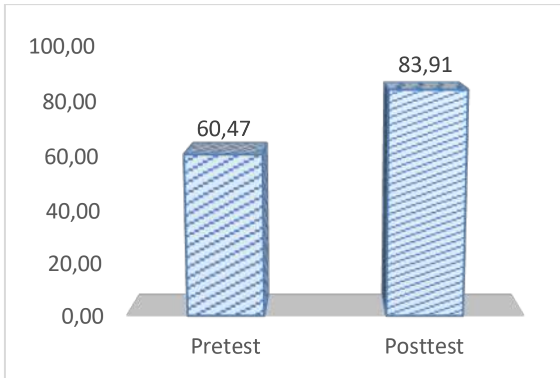
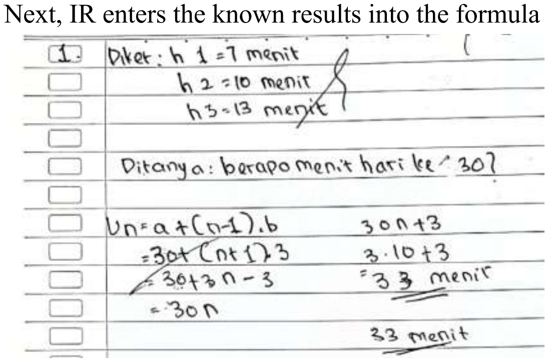


Figure 4. Average pretest and posttest scores

Next, the following describes the answers of 6 students taken from representatives of each group. The selection of these 6 students was carried out randomly to find out in more depth the students' answers in completing individual assignments based on their learning in each group. IR from group 1, AP from group 2, GA from group 3, DP from group 4, PR from group 5, RY from group.

1. IR from group 1

   IR identifies problems by writing down what is known about the problem in the LKPD starting from knowing and asking. From Figure 4, it can be seen that IR builds ideas by writing the 1st day which is 7 minutes, the 2nd day which is 10 minutes and the 3rd day 13 minutes. Then IR, write down how many minutes on the third day. Next, IR enters the known results into the formula $Un = a + (n - 1)b$, so that the results are 33 minutes.



Translation:
Given: h1 = 7 minutes
h2 = 10 minutes
h3 = 13 minutes
Asked: how many minutes is the 30th day?

$$Un = a + (n - 1)b \qquad 30n + 3$$
$$= 30 + (n - 1)3 \qquad 3.10 + 3$$
$$= 30 + 3n - 3 \qquad = 33\ minutes$$
$$= 30n \qquad 33\ minutes$$

Figure 5. IR Solution

   IR then presented the results of his work in front of the class. He clarified the idea by explaining that using the formula $Un = a + (n - 1)b$ could solve the problem with results obtained in 33 minutes. After presenting the answers, the teacher assesses the reasonableness of the idea by asking questions to the IR.

T : *What is your reason for using the formula $Un = a + (n - 1)b$ to solve this problem?*
IR : *My reason is because I see the time structure in the form of minutes and days sequentially.*
T : *So, what's the next step?*

IR : *I then entered the numbers by applying the formula* $Un = a + (n-1)b$
T : *Are you confident in entering the numbers you have identified?*
IR : *Not sure.*
T : *Why?*
IR : *I made a slight error in entering the numbers.*

From the results of assessing the reasonableness of the idea, IR was correct in using the concept $Un = a + (n-1)b$, but he was wrong in operating the numbers obtained in the problem.

2. AP from group 2

In solving problems, AP does not show identification of problems in his work. AP uses a method of adding numbers sequentially with a certain pattern. In Figure 5, it can be seen that AP solves the problem by adding up the numbers in the minutes on days 1, 2, 3 up to day 30.

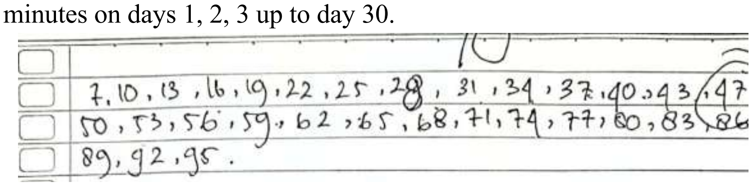


Figure 6. AP Solution

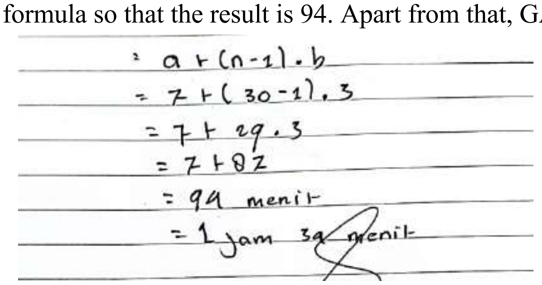
AP clarified the idea by presenting the results of the answer and explaining that he added up the minutes from day 1 to day 30 sequentially. From one number to the next, he adds 3. To assess the reasonableness of the idea, the teacher asks questions to confirm and find out the method used by AP as follows.

T : *How do you solve this problem?*
AP : *I first looked at the numbers in the minutes*
T : *So what's next?*
AP : *I calculated from minute 7 to minute 10 and minute 10 to 13 what the difference was.*
T : *Then, how?*
AP : *Because what was asked was the 30th day. I added it up by adding 3 repeatedly up to 30 times so I got a result of 95.*
T : *Are you sure about the repeated addition?*
AP : *Looks like yes*

In theory, AP is correct in solving the problem by adding up the minutes from 7, 10, 13 to 30. However, AP is not careful in adding up. It can be seen that 43 added to 3 should be 46 but AP wrote 47 so the results obtained are still wrong.

3. GA from group 3

In identifying the problem, GA immediately wrote the formula $Un = a + (n-1)b$ by entering the numbers he had obtained from the problem. In Figure 6, GA applies the formula $Un = a + (n-1)b$ and operates the formula so that the result is 94. Apart from that, GA also converts it into hours.



Translation:
$= a + (n-1)b$
$= 7 + (30-1)3$
$= 7 + 29.3$
$= 7 + 87$
$= 94\ minutes$
$= 1\ hour\ 34\ minutes$

Figure 7. GA Solution

GA clarified the idea by presenting the process and results of the work by explaining that he wrote a, which is 7, n is 30 and b, which is 3. In working on this problem, GA applied the ditributive concept of multiplication to subtraction. To assess the reasonableness of the idea, namely to find out the reasons for using the formula, the teacher asks the following questions.

T : *Why do you use the formula $Un = a + (n-1)b$?*
GA : *I first noticed that there was a pattern in the number sequence*
T : *What pattern?*
GA : *First, the 1st day lasts 7 minutes, the 2nd day 10 minutes and the 3rd day 10 minutes*
T : *Then, how to determine the values of a and b?*
GA : *The value of a is the first term from day 1 and b I got from subtracting 10 from 7 which is 3.*
T : *How many results did you get?*
GA : *94 minutes. I changed it to 1 hour*
T : *Are the results appropriate?*
GA : *Well that's that then*

From the transcript above, in theory and application the formula is correct. GA also explains the work process in sequence.

4. DP from group 4

DP identifies problems by sequentially adding up the numbers from the minute to the 30th day. In Figure 7, DP builds an idea by adding up the minutes on day 1, namely 7 with 3. Next, the results obtained are again added to 3 and so on to obtain a result of 94. DP then clarifies the idea by explaining the work process, namely by adding up the minutes on Every day Koko jogs with 3 which is obtained from the difference in minutes on the 1st and 2nd days so that DP gets a pattern.

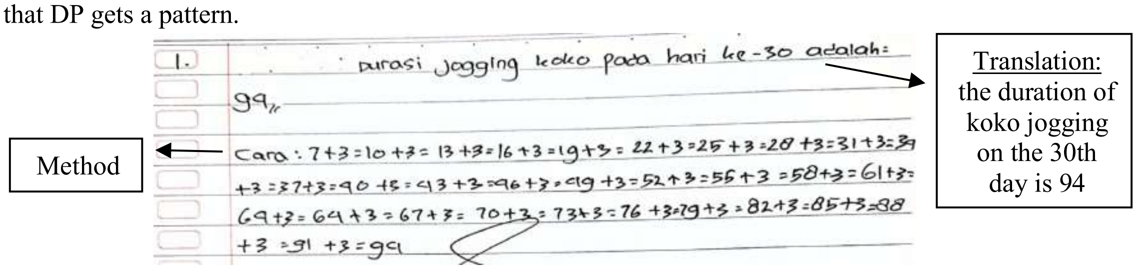


Figure 8. DP Solution

DP assessed the reasonableness of his idea by providing reasons why he used this method which can be seen from the following.

T : *How do you solve this problem?*
DP : *First, I calculated the difference between day 1 and day 2.*
T : *So what's next?*
DP : *First, the 1st day lasts 7 minutes, the 2nd day 10 minutes and the 3rd day 10 minutes*
T : *So, the next step?*
DP : *Because what I was looking for was the duration of jogging on the 30th day, I added them up sequentially and I always added 3 to the result.*
T : *How many results did you get?*
DP : *94 minutes.*
T : *Are the results correct?*
DP : *Yes, I'm sure I calculated correctly.*

In terms of the form of work, DP succeeded in solving the problem correctly even though he did not use the number sequence formula. He knows the pattern so he just adds up horizontally.

5. PR from group 5

Homework identifies problems by adding up the jogging duration up to the 30th day. Homework adds up sequentially and concludes at the end of the solution. In Figure 8, PR builds ideas by first looking for jogging duration patterns, namely by subtracting the jogging duration on day 2 and day 1. Homeworker clarified the idea by presenting the answer that after carrying out the process in sequential addition, he obtained a result of 103 minutes. To assess the reasonableness of the idea, to find out how and why homework uses this method, the teacher asks the following questions.

P : *What method did you use to solve this problem?*
DP : *I first looked for additional duration from day 1 and day 2.*
P : *Keep going?*
DP : *After finding 3, I then added it and I counted up to 30 times because 30 days.*
P : *Did you get the desired results?*
DP : *Yes, the result is 103 minutes*
P : *Are you sure?*
DP : *Yes, so on the 30th day the duration is 103 minutes*

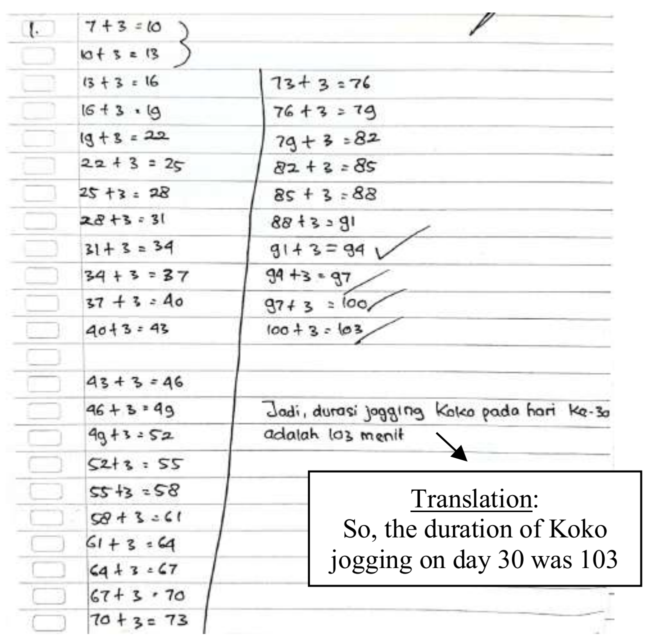
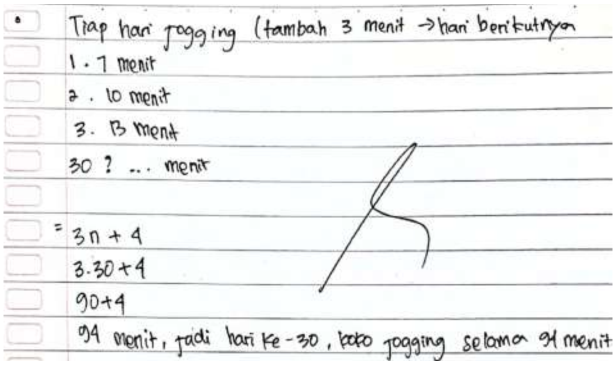


Figure 9. PR Solution

In the process of work, PR has done the right thing. However, PR was not careful in determining the 30th day so the results obtained were wrong.

6. RY from group 6

RY identified the problem by observing the difference in duration from day to day so he could write down adding 3 minutes the next day. In developing ideas, RY wrote down the days and minutes required and wrote down what was asked. Next, RY applies the formula $Un = a + (n - 1)b$ as shown in figure 10.


Tiap hari jogging (tambah 3 menit → hari berikutnya
1. 7 menit
2. 10 menit
3. 13 ment
30 ? ... menit
= 3n + 4
3.30+4
90+4
94 menit, jadi hari ke-30, koko jogging selama 94 menit

Translation:
Tiap hari joging (tambah 3 menit → hari berikutnya
1 = 7 minutes
2 = 10 minutes
3 = 13 minutes
30? … minutes
$= 3n + 4$
= 3.30 + 4
= 90 + 4
94 minutes, So on the 30th day, Koko jogged for 94 minutes.

Figure 10. RY Solution

RY clarified the idea by presenting that to solve this problem, he first determined the additional minutes per day. Then, he used a formula $Un = a + (n-1)b$ and operate it until it is obtained $Un = 3.n + 4$ thus finding a result of 94 minutes. RY assessed the reasonableness of the idea by choosing the method of execution which can be seen in the following.

T : *Why did you use this method to solve this problem?*
RY : *Because I see the addition of minutes each day is always constant, namely 3.*
T : *So, what next?*
RY : *Then, I used the concept of* $Un = a + (n-1)b$. *However, I operated the Un first.*
T : *Yes. After that?*
RY : *I replaced a with 7 then because of the addition of 3 it became b, which is different. I operate by multiplying to find* $Un = 3.n + 4$ *with* $n = 30$ *days*
T : *How many results did you get?*
RY : *94 minutes.*
T : *Are you sure about these results?*
RY : *Yes So, on the 30th day the duration of jogging is 94 minutes*

From these results, RY has succeeded in solving the problem by applying the concept $Un = a + (n-1)b$ to the number sequence so that the expected results are correct.

Disscusion

Based on the application of the E-IM3 learning model and the results of the analysis of student work, it showed that teachers and students can carried out each learning step which includes: identifying problems, building ideas, clarifying ideas, and assessing the reasonableness of ideas. At the problem identification stage, there are students who write down the results of their identification by writing down what they know and what is asked in the question. However, there are also some students who do not write down their identification results even though they actually also identify the problem. The identification carried out by students by writing down what they know and asking questions is in line with Polya's problem solving steps, where students carry out identification by understanding the problem first [26], [27]. For students who did not write problem identification in their work, they actually also identify it because this is the first step that must be taken in implementing the e-IM3 learning model. Students identify this problem by looking at the problems presented on the electronic student worksheet. The use of e-worksheets is because the application of the e-IM3 learning model also requires the integration of technology in the learning process. This is in line with the TPACK concept where teachers were currently required to master knowledge that is not only knowledge and pedagogy but also technology [28], [29].

At the idea building stage, students tend to use ideas that have been taught by the teacher, but there are also students who use other ideas that they did not get from the teacher. Students use manual concepts by adding sequentially by adding a fixed difference. From the results of clarification and assessing the reasonableness of ideas, it was found that there were students who calculated correctly but there were also students who were less careful in carrying out calculations. Students with this condition mean they are able to build ideas but are not yet able to convert their ideas into mathematical concepts. This is in line with Ruseffendi's research that students are less precise in answering questions because they are not able to connect concepts with the principles of the material being studied, and students are not able to change questions into mathematical language [30]. Students who are able to develop ideas but are less precise in answering are students who have errors in calculation operations or errors in the skill stage of the calculation operation process [31]. On the other hand, there are not only errors in calculating operations, but there are other errors, one of which is that students forget or don't even know the formula that should be used so that students end up calculating manually [32]. Therefore, it can be concluded that students with the two conditions above are able to build ideas but are not yet able to apply these ideas in accordance with the concept of the material being studied.

Students use the concept of a number sequence by entering the first term and difference and operating it in the formula $Un = a + (n-1)b$. From the stage of clarifying ideas and assessing the reasonableness of ideas, it was found that students were correct in using the Un formula, students did not understand the concept of $Un = a + (n-1)b$ so they were less precise in using the Un formula, and students who had used the Un formula but were not correct when entering the numbers used. Students with these conditions are able to carry out the stages of E-IM3 learning and errors occur if students are not careful in understanding the question in question. Students experience problems because they misunderstand the language of the questions, students' inability to understand the language in the questions will cause students to fail to get the correct answer and even use the formula incorrectly [18]. There are also types of errors in determining the formula to answer a problem [33], [34]. In line with the research results which stated that students were able to determine the first and nth terms according to the problem, while there were students who were found to have written the nth term of an arithmetic sequence incorrectly, causing students to be unable to get the correct answer [35]. Therefore, it can be concluded that students who can use the Un concept correctly and thoroughly are able to get correct results.

CONCLUSION

Based on the explanation above, E-IM3 learning was able to develop the ability to solve number sequence problems. The E-IM3 learning stages start with students identifying problems when students understand the problems on students' worksheets. The idea building stage is when students begin to solve the problems contained in the student worksheet. The stage of clarifying ideas when students make presentations, and the last stage of assessing the reasonableness of ideas with questions from the teacher, namely how to use this method. From the individual task representatives for each group, the results showed that there were 2 types of settlement decisions, namely the first by adding sequentially by adding a fixed difference. Second, by using the concept of a number sequence by entering the first term and the difference then operating it in the formula $Un = a + (n-1)b$. From these two methods, several students were able to carry out the stages of E-IM3 learning. Students have also been able to identify problems even though at the stage of clarifying ideas students were less careful so they did not get the right results. Apart from that, the scores obtained before and after the application of E-IM3 learning have increased so that the application of the E-1M3 learning model can develop the ability to solve number sequence/pattern problems in grade VIII students at Junior High School in Madiun.

ACKNOWLEDGMENTS

Our gratitude goes to Universitas PGRI Madiun, the Faculty of Teacher Training and Education, the Mathematics Education Study Program and Junior High School 7 Madiun, East Java, Indonesia for giving permission to conduct the research by lesson study.

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Design of Arithmetic Learning Tools Based on Discovery Learning to Support Student's Conjecturing Ability

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Abstract. This study proposes the integration of a student-centered learning model, namely the discovery learning model, as an effort to support and improve students' conjecture skills. In this model, a series of steps was involved, including providing stimuli, identifying problems, collecting data, processing data, verifying, and drawing conclusions. This study aims to design an arithmetic learning tool based on discovery learning to support students' conjecturing abilities in solving problems related to sequences and series. The development method used referred to the Plomp model, which consisted of preliminary research, prototyping, and evaluation stages. However, this research focused on the prototyping stage. Based on expert validation results, it was shown that the developed learning tool was suitable for use in arithmetic learning on sequences and series topics in junior high school. The research results showed that students' response to this teaching material was well. Thus, this discovery learning-based arithmetic learning tool has the potential to support and enhance students' conjecturing abilities in solving problems related to sequences and series. Therefore, it is important to actively involve teachers and students in further implementation stages, as well as conduct further research to measure the effectiveness of this discovery learning-based learning tools in supporting students' conjecture skills on the topic of sequence and series.

INTRODUCTION

Improving quality education is the key to creating an educated and thriving society [1]. An effective educational process plays a major role in shaping meaningful experiences for each learner [2]. More than just transferring knowledge, quality education empowers students to understand and apply the concepts acquired in a real-world context. One of the crucial elements of effective education is the quality of learning tools and methods used in the education process [3]. Education is considered quality when the learning process is effective, providing meaningful experiences for students. Quality education is realized through systematic planning, good materials, efficient governance, and teaching by competent educators [4,5].

Mathematics is a subject at every level of education that plays an important role in solving daily problems [6,7]. It holds a central role in developing analytical and logical thinking skills. Students are expected not only to memorize facts and formulas when facing mathematical challenges but also to propose conjectures or hypotheses. Conjecture refers to an assumption or supposition made by learners when they attempt to solve mathematical problems [8]. Conjectures are often based on existing facts or logical reasoning but have yet to be confirmed [9]. This means that learners propose a hypothesis or opinion about the solution to a problem, but do not yet have concrete evidence to support it. This ability reflects the level of cognitive maturity and the ability of students to conduct deeper analysis of mathematical situations or problems [10].

The 2nd International Conference of Mathematics Education, Learning, and Application
AIP Conf. Proc. 3148, 040050-1–040050-8; https://doi.org/10.1063/5.0241595

According to Jeannotte [11], the importance of conjecturing ability in mathematics learning is universally emphasized in national standards. For instance, in the United States, students at all levels are expected to make conjectures, explore the truth of these conjectures by analyzing cases and counterexamples, and present their conclusions to others. One of the main goals of the curriculum in England is to provide opportunities for all learners to provide mathematical reasoning by following lines of inquiry, relating conjectures and generalizations, developing arguments, justifications, or proofs using mathematical language [12]. Despite its importance, there is a significant gap in students' abilities to make conjectures and formally prove them. Previous research has highlighted that students often face difficulties in formulating conjectures in specific mathematical problems [13].

Educators can provide them with the freedom to construct their own knowledge to support students' conjecturing abilities. This requires a learner-centered approach, namely discovery learning [14–16]. The reason for choosing this learning model is to give students the opportunity to actively learn and be able to discover formulas or concepts from the material being studied. This learning concept places the educator as a facilitator. Educators guide students when needed. Students are encouraged to think and analyze on their own so that they can "discover" general principles based on the provided material or data [17]. Through the discovery learning model, the learning that takes place becomes more meaningful, and participants are less likely to forget the information they acquire, as it comes from their own process of discovery [14]. Throughout the process of discovering solutions to a problem, students will develop the skill of conjecturing.

Previous studies have shown that the discovery learning model has been proven effective in enhancing students' conjecturing skills. Kartika, et al. [18] and Putri, et al. [19] found that mathematics worksheets based on the discovery learning model are valid and effective tools for improving their students' thinking skills. Similar findings were also revealed by Muhayati et al. [20] as well as Aliyawinata et al. [21], demonstrating that this model is capable of enhancing thinking skills and learning outcomes of students. One of the thinking skills studied is conjecturing. The results of a study conducted by Sutarto [22] showed that it is very important to describe the process of conjecturing in solving general pattern generalization problems so that educators can accurately understand the conjecturing process undertaken by students. Subsequently, educators can assist students in formulating, refining, and exploring conjectures.

The ability to make conjectures is an important part of the mathematical thinking process [23–25]. It involves learners in forming assumptions and arguments based on existing facts. This ability has broad implications in mathematics education, as emphasized in the national education standards of various countries. Through the discovery learning approach, learners are given the freedom to construct their own knowledge [26,27]. Educators play the role of facilitators, guiding learners in the process of discovery. Consequently, the learning process becomes more meaningful, and learners are more engaged in understanding mathematical concepts. On the other hand, students' ability to solve mathematical problems still shows a low level of proficiency. Aliah and Bernard [28] highlight that many students struggle, especially in executing mathematical procedures. Additionally, learning tools often come from the internet, not always aligning with the characteristics of the students.

This study aims to design mathematics teaching materials based on discovery learning to support the conjecturing abilities of junior high school students. These teaching materials contribute to helping teachers effectively deliver arithmetic content and engage students in making conjectures. Previous research has developed mathematics learning tools based on discovery learning that are responsive to sequences and series [29]. Although some arithmetic learning tools based on discovery learning have been developed, there is still a need for further development and refinement of these materials. The novelty of this research lies in the innovative effort to develop arithmetic learning tools that support conjecturing abilities. These teaching materials are specifically designed to enhance the conjecturing abilities of 8th-grade junior high school students in the topic of sequences and series.

METHOD

This research method adopts the Plomp model, which consists of preliminary research, prototyping, and evaluation stages [30,31]. The main objective of this research is to design arithmetic learning tools that support junior high school students' conjecturing ability. The initial investigation phase was conducted to determine the basic problems needed to develop learning tools. At this stage, theoretical analysis of supporting learning tools, curriculum analysis, student analysis, and teaching material analysis were carried out by collecting and analyzing supporting information to plan further activities. In the design phase, the design and systematics of learning tools that will be used in learning are designed. In addition, the instruments needed in the study were also designed including validity instruments, practicality instruments, and effectiveness instruments for learning tools. Learning tools that have been prepared according to the design in the design phase are called prototype 1. This prototype will be validated and tested in the next phase. Prototype 1 produced in the realization phase was prepared by the research team and then validated by validators consisting of two mathematics lecturers who are experts in the field of learning and preparation of learning tools. Based on the results of the validation, if it still requires revision, the researchers rearranged prototype 1 to prototype i. Furthermore, prototype i which has been declared feasible can be used for testing. By conducting trials, it is expected to obtain input, suggestions and improvements to the learning tools that have been prepared. However, this research focuses on the design stage of learning tools. This stage includes the hypothetical preparation of learning devices. The last stage is evaluation, which includes testing the practicality of learning devices. This research only focuses on designing arithmetic learning tools that support conjecturing ability. The research procedure is described in Figure 1.

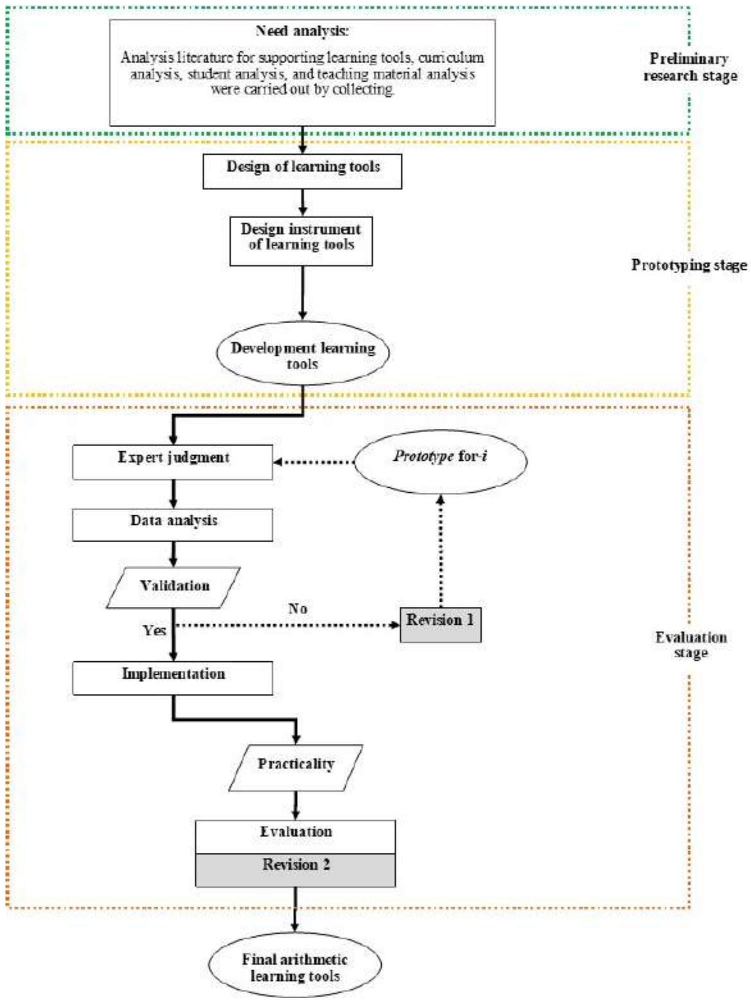

FIGURE 1. Stages of Plomp model in developing learning tools.

The implementation of product trials was carried out on grade 8 students at SMPN 2 Paciran with a total of 28 students. The instruments of this research are validation sheet, student activity observation sheet, learning observation sheet, student response questionnaire and teacher response questionnaire. The data analysis technique used was validity and practicality data analysis. Data analysis of validity was carried out on teaching material products, data analysis of practicality was carried out on observation sheet data, teacher and student responses.

The validity test of arithmetic learning learning tools was carried out by validators who are competent in the field of learning and preparation of learning tools. Furthermore, the validators were asked to provide general assessments and suggestions related to the learning tools developed. The level of validity of learning tools as a result of development research is identified by the validity score ($\bar{x}_v$). The criteria for making validity decisions in learning tools [32] with some modifications, can be seen in Table 1.

TABLE 1. Validity criteria of learning tools

Score	Criteria
$3{,}5 \leq \overline{x}_v \leq 4$	Very Valid
$2{,}5 \leq \overline{x}_v < 3{,}5$	Valid
$1{,}5 \leq \overline{x}_v < 2{,}5$	Less Valid
$1 \leq \overline{x}_v < 1{,}5$	Not Valid

The level of practicality of teaching materials as a result of this development research is identified by the implementation of learning and the percentage score of practicality ($\overline{x}_f$). The criteria for making practicality decisions in teaching materials based on the results of the percentage score [33] with some modifications, can be seen in Table 2.

TABLE 2. Practicality criteria of learning tools

Score (%)	Criteria
$90 \leq \overline{x}_f \leq 100$	Very Good
$80 \leq \overline{x}_f < 90$	Well
$70 \leq \overline{x}_f < 80$	Pretty Good
$40 \leq \overline{x}_f < 70$	Not Good
$0 \leq \overline{x}_f < 40$	Very Poor

RESULT AND DISCUSSION

The result of this research was the design of discovery learning-based mathematics teaching materials to support the conjecture ability of junior high school students. The teaching materials developed were in the form of teaching modules. This research aims to design arithmetic teaching materials based on discovery learning to support the conjecture ability of junior high school students, especially in the material of rows and series.

The development of this teaching material adopts the Plomp model design. The Plomp model has 5 (five) stages [31], including the initial investigation phase, design phase, realization phase, assessment phase then implementation phase. However, this study only carried out up to the assessment phase because the aim was to produce teaching materials that were valid and practical to implement.

Description of Initial Investigation Phase

Based on the observation, the learning model applied by teachers at SMPN 2 Paciran is a conventional learning model. This means that learning is teacher-centered, where students only listen to the teacher's explanation with the lecture method through displayed projector. This resulted in a lack of enthusiasm among students in learning. As a consequence, students' understanding of the taught concepts became insufficient.

After conducting a literature review to explore theories that can be used, the researcher managed to find a learning model that is in accordance with the independent curriculum (kurikulum merdeka) and is able to encourage students to become more independent and active in finding concepts from the material they learn. The proposed learning model is discovery learning. Furthermore, researchers analyzed the curriculum implemented at SMPN 2 Paciran. Based on the observation, the curriculum used is Merdeka curriculum. In addition, the researcher also analyzed the characteristics of students in terms of knowledge and understanding of arithmetic concepts. The results of an interview with one of the mathematics teachers at SMPN 2 Paciran showed that students' understanding of arithmetic sequences and series material was still low. This is evident from several symptoms, such as most students have difficulty in solving math problems that are different from the examples given, they have difficulty in determining the steps for solving problems related to arithmetic sequences and series, some students only memorize formulas, but have difficulty in applying them in problems. The impact of this problem is that students' math learning outcomes are still below average and have not been completed.

Next, researchers analyzed the material by comparing the current content with the material to be developed. At this stage, adjustments were made by adding or subtracting materials as needed. This process considers various aspects, especially the content of the material and the use of language, with the aim of creating more suitable materials. The materials developed will be compiled based on the subject syllabus applicable at SMPN 2 Paciran. Researchers also set indicators of conjecturing ability for students. These indicators are used to measure students' conjecturing ability related to the material of sequences and series. Then, these indicators include the ability to observe cases, organize cases, look for and predict patterns, formulate conjectures, validate conjectures, and generalize conjectures. With these indicators, researchers can conduct a more detailed evaluation of students' conjecturing ability.

Learning Tools Design Phase

In the design phase of this research, the main focus was on creating the initial product design in the form of a teaching module. The teaching module was structured based on discovery learning, which was then integrated with indicators of students' conjecturing abilities, especially related to the topic of sequences and arithmetic series. The indicators of students' conjecturing abilities included: the ability to observe cases, organize cases, seek and predict patterns. In addition to the product development process, this phase also involved creating research instruments, including validation sheets, observation sheets, and response sheets for both teachers and students.

The development of this teaching material began with a study of the sequences and series content that aligns with the independent curriculum and the discovery learning-based teaching model. The steps involved include providing stimuli, formulating problems, collecting data, processing data, verifying, and generalizing. As a whole, this discovery learning-based teaching material is divided into several sections: the cover section, the supporting section (including foreword, table of contents, usage instructions, required competencies, concept maps, bibliography, author information), and the content section which contains the material on sequences and series.

Realization Phase of Learning Tools

In this phase, the teaching module is structured according to the design in the design phase, which is then referred to as Prototype 1. This prototype will be validated and tested in the next phase. The teaching module developed aligns with the indicators of conjecturing skills that will be achieved by the students. The module contains steps tailored to the syntax of discovery learning integrated with students' conjecturing abilities. The module includes blank boxes, empty tables, and points provided to facilitate students in expressing their ideas, thus helping to stimulate or enhance their conjecturing skills. The teaching module is designed to be engaging, taking into consideration arithmetic learning activities so that students do not get bored when working on tasks within it. Figure 2 shows the cover display of the developed teaching module.

FIGURE 2. Teaching Module Cover

The Validation Stage of Learning Tools

In this phase, the first prototype that has been created is then validated by experts before being tested. All the instruments developed are subsequently subjected to validation by two validators. These validators are mathematics education lectures who are experts in the field of teaching and instructional material development. The assessments from the experts or the validation results serve as the basis for revisions and improvements to the instructional tools. Therefore, the resulting instructional tools are deemed suitable for use in the teaching and learning activities.

Based on the validation analysis results from experts regarding the developed teaching module, the average validity score is 3,64 as shown in Table 3. The aspects assessed include: subject matter relevance, formulation of indicators and objectives, appropriateness of content, alignment of learning activities with the discovery learning model, systematic organization of content integrated with students' conjecturing abilities, selection of learning resources, allocation of time, and language usage.

TABLE 3. Teaching Module Validity Score Results

Aspect	Validator 1	Validator 2	x_v	$\overline{x}_v$
Subject Identity	3	4	3,5	
Formulation of Indicators and Objectives	4	4	4	
Material Suitability	3	4	3,5	
Suitability of Learning Activities with Discovery learning Model	4	3	3,5	3,64
Systematic preparation of material with the Discovery learning model	3	4	3,5	
integrated with students' conjecturing ability.	3	4	3,5	
Selection of Learning Resources	4	4	4	
Time Allocation	4	3	3,5	

The advice from the validator was that in developing the teaching module, it was crucial to pay attention to its connection with the discovery learning model. This implies that the process of exploration or conjecture made by students when using the teaching module should be linked to the discovery learning model. Therefore, the developed teaching module can support students in enhancing their conjecturing abilities.

TABLE 4. Summary of Validation Results

The Validated Tools	$\overline{x}_f$	Criteria
Lesson Plan	3,44	Valid
Teaching Module	3,64	Very Valid
Observation Sheet	3,22	Valid
Student response questionnaire	3,42	Valid
Teacher response questionnaire	3,28	Valid

Based on the data in Table 4, it can be concluded that the average assessment from the experts is in the "valid" category with some revisions. This indicates that the learning tools, response questionnaires, and observation sheets are suitable for testing in arithmetic learning on the topic of sequences and series in junior high schools.

Practicality Test of the Learning Tools

After being revised based on input and suggestions from experts, this module was then implemented with 8th-grade students at SMPN 2 Paciran. This pilot study was conducted to evaluate the practicality of the developed learning tools. The focus of observation in this pilot study was on the students' activities and the teacher's ability to manage the learning process with the help of the learning tools. After the series of lessons was completed, both students and teachers were asked to fill out response questionnaires as a measure to assess their feedback on the applied learning tools. This pilot study was conducted for a total of 3 sessions.

The data from the field trial were then analyzed to assess the practicality of the developed learning tools, which would be taken into consideration in revising the prototype into the final tool. Data regarding the practicality of this teaching material was obtained from response questionnaires from both students and teachers, which were analyzed to evaluate the practicality level of the prepared material. The student response questionnaires were administered to 28 students after they had completed the entire sequence of lessons using the arithmetic teaching material based on discovery learning, focusing on the topic of sequences and series in terms of conjecturing abilities.

TABLE 5. Summary of Response Questionnaire Results

Response Questionnaire	$\overline{x}_v$	Criteria
Students	93,97%	Very Good
Teacher	88,25%	Well

Based on the data in Table 5, the average percentage of student responses to the learning activities using the teaching material is 93,97%. Therefore, it can be concluded that the practicality criteria for student responses have been met. Similarly, the teacher's response to the learning activities using the teaching material scored 88,25% with a category of practical. Thus, it can be concluded that the practicality criteria for teacher responses have been achieved. Based on both practicality components, namely the student response questionnaire and the teacher response questionnaire, the analysis results for both show positive feedback towards the teaching material used.

TABLE 6. Results of Educator Activity in Managing Learning

Stages	Mean	Average (%)	Criteria
Intoduction	3,67	91,75%	Very Good
Main Activity	3,43	85,75%	Well
Closing Activity	3,50	85,50%	Well
Classroom Management	3,49	87,25%	Well

Based on the observation sheet and the analysis of teacher's ability in managing the arithmetic learning in Table 6, the average score of the teacher's ability in all aspects falls into the "well" category. This means that the teacher's ability to manage arithmetic learning based on the discovery learning model is good and meets one of the practicality components. Therefore, the developed teaching material meets the practicality criteria, and there is no need for further adjustments or revisions to the teaching material. This aligns with the findings of Mahayukti et al. [34] that both educators and students assessed the mathematics teaching material using the discovery learning model positively. The implementation of arithmetic learning with the discovery learning model has also been shown to improve students' mathematics learning outcomes [20,35]. With this teaching model, students can use and develop their basic knowledge, making it easier for them to remember the learning material as they discover concepts and draw conclusions [35]. The results of other studies indicate that students engaged in discovery learning tend to have a deeper understanding of the taught mathematical concepts.

The discovery learning approach allows students to become active agents in the learning process. They not only receive information but also engage in seeking and constructing their own knowledge. This helps in building self-confidence and enhancing students' conjecturing abilities. Based on field observations, mathematics teaching materials based on discovery learning can help improve students' conjecturing abilities in several ways:

1. encourages students to be active in the learning process,
2. provides hands-on experience,
3. encourage discussion and exchange of opinions, and
4. reinforcing students' existing arithmetic concepts.

Through the trial of discovery learning-based learning tools, students are encouraged to actively investigate mathematical concepts independently. They are also encouraged to learn to question and propose hypotheses regarding possible solutions. Students do not solely rely on information from the teacher, but also learn to solve problems using their own approach. This helps them build confidence in their mathematical thinking skills. This will train students in formulating their own hypotheses or conjectures about a mathematical concept, which is one aspect of conjecturing ability. Additionally, this teaching material also emphasizes the use of activities and direct experiences in delivering the content. By working directly with real examples, students will find it easier to understand mathematical concepts. Some studies also suggest that discovery-based learning tools can be implemented through discussion methods [35–38]. Through discussions with their peers, students can exchange opinions and test the validity of their conjectures or hypotheses, which will help improving their conjecturing abilities. Discovery learning-based teaching materials can help students strengthen their self-concept. With a strong self-concept, students will be more willing to put forward their conjectures or hypotheses about a mathematical concept [39,40]. Thus, the development of learning tools based on discovery learning for the topic of arithmetic sequences and series in 8th grade opens up new opportunities in cultivating students' conjecturing abilities.

CONCLUSION

The result of prototyping in the development phase consists of the components of the learning tools, which include the lesson plan and the arithmetic learning module based on discovery learning. Based on the validation analysis by experts, each instrument falls into the valid category for the lesson plan and highly valid for the teaching module. Thus, the developed learning tools meet the validity criteria. Furthermore, the analysis of practicality components, namely teacher response and student response, yielded an average percentage of 88,25% for teacher response, categorized as "well," and an average percentage of 93,97% for student response, categorized as "very good." Hence, the developed teaching materials meet the practicality criteria. Based on field observations, the mathematics learning tools based on discovery learning can help sharpen students' conjecturing abilities by encouraging them to be active in the learning process, providing direct experiences, fostering discussions and exchanges of opinions, and reinforcing existing arithmetic concepts within the students. This study suggests that the development of arithmetic learning tools based on discovery learning has the potential to support and enhance their conjecturing abilities. Implementation and further research are needed to develop valid, practical, and effective arithmetic learning tools based on discovery learning to support students' conjecturing abilities.

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