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Research Article

The Research-based Learning-STEM Learning Activity Framework: The use of Software J-Batik in Designing the Indonesian Batik Motifs as Traditional Cultural Heritage to Improve Students Historical Literacy

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Abstract: Objective: This research was intended to develop the RBL (research-based learning) model of teaching activities framework integrated with the STEM approach, namely designing the Indonesian Batik motifs as Traditional Cultural Heritage to improve the student historical literacy. Methods:The method used was narrative qualitative on developing the research-based learning activities framework integrated with the STEM approach. Findings: The results were listed on a table of stages 1-6, in which each stage unraveled the learning activities in designing Batik motifs using JBatik Software under implementation Research Based Learning Model of teaching with STEM approach. Conclusion: The main result of these research is about activity framework of RBL model of teaching integrated with STEM approach: the STEM activity in designing batik motifs using JBatik Software to increase student historical literacy in the form of stages 1-6 and their learning activities. The development of the test instrument framework related to student historical literacy also included in this research activity.

Keywords: Batik design, Historical literacy, Jbatik Software, RBL-STEM, Traditional cloth heritage.

INTRODUCTION

The United Nations Educational from Scientific and Cultural Organization (UNESCO) gave international recognition: to Indonesian Batik as a Humanitarian Heritage for Oral and Intangible Culture (Masterpieces of the Oral and Intangible Heritage of Humanity) on October 2, 2009 (Lusianti, L. P., & Rani, F. 2012). Through Presidential Decree No. 33 of 2009, the government has set October 2 as National Batik Day. As a cultural heritage, Batik has been known for a long time in various regions in Indonesia. Batik is not only growing and developing in Java. Some archaeologists and historians believe that the batik tradition is native to areas such as Toraja, Flores, Halmahera, and Papua. Therefore, Indonesian batik motifs are known to be diverse. The most popular Batik motif such as "Tujuh Rupa" (Pekalongan), "Sogan" (Solo), "Gentongan" (Madura),"Parang Kusumo (Solo), "Lasem" (Rembang), Batik Tubo (,Ternate), "Mega Mendung" (Cirebon), "Keratin" (Yogyakarta), "Simbut" (Banten) , "Kawung" (Central Java), "Pring sepur" (East Java), "Priyangan" (Tasik), or "Machete" (Java).
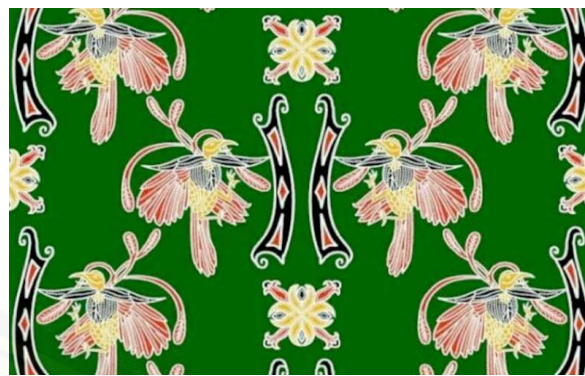

(a) Parang Kusumo (Solo)　　　　(b) Mega Mendung (Cirebon)

(c) Batik Lasem (Rembang) (d) Batik Tubo (Ternate)

Figure 1: The batik motifs of Indonesian traditional cultural Heritage

Batik motifs in Indonesia are even claimed to reach thousands. Bandung Fe Institute and Sobat Budaya have collected data on batik motifs from Indonesia several years ago (Moersid, A. F. 2013). As a result, around 6,849 batik motifs have been documented. UNESCO is certainly not without reason in giving recognition to Batik as a human and cultural heritage. They saw that the technique, symbolism, and culture in the manufacture of hand-dyed Batik on cotton and silk had blended into the lives of the Indonesian people. The tradition of Batik itself is carried out from generation to generation (Musman, A., & Arini, A. B. 2011). Batik by Indonesians in various regions from childhood to adulthood. In addition, since childhood, babies have been carried in batik cloth, and when they die, they are usually covered with Batik.

UNESCO recognition makes Batik increasingly recognized in the world. The image of Batik is getting uplifted, Batik is no longer seen as traditional clothing or clothing that is formal, old, and stiff. Furthermore, Batik is now loved by everyone, from children to adults. By carrying out the status as a world cultural heritage, of course, it is the responsibility of all parties to continue to maintain and advance Indonesian Batik, including in the world of education (Nurainun, H. &Rasyimah. 2008). The nation's culture is preserved. Besides that, batik production also contributes to a sustainable economy in rural, urban, and even national areas. Furthermore, in line with the development of technology, the process of batik painting has developed rapidly, starting from written Batik, semi-modern writing, and modern written Batik assisted by application software. Then developing student history literacy without being assisted by the Internet of Things (IoT) will be complex.

Learning about Batik is related to Batik as a traditional cultural Heritage and related to a brief history of Batik. One of the aspects of Batik design is characteristic of batik motifs arising from the history from the origin of the place (Sari, *et al.,* 2019). History education is not just learning and teaching stories about the past but more than that, "history education must be able to bring students out of the minimum value, they must be brought to a higher standard, namely to the terminology of historical literacy" (Perfetti, C. A. *et al.,* 1994). Historical literacy also can be defined in the traditional sense of a person being able to read and write history (Johansson, E. 2009) (Aronowitz, S. & Giroux, H. A. 2017)). In this respect, the goal of historical literacy is to enable students to read historical texts critically, to write thoughtfully, and engage in meaningful discussions about the past see Downey and Long (Downey, M. T., & Long, K. A. 2015). Historical literacy in Batik is very important, especially regarded to Indonesian batik motifs in learning activities. The integration of designing the Indonesian batik motifs in the learning process will be quite complex if students are taught to design Batik conventionally (Anggo, M. 2011). The use of a computer, especially Software of computer, is technology in designing Batik is needed to introduce design and develop the Indonesian batik motifs in the classroom. Historical literacy is a minimal skill that must be possessed by the community related to understanding history, the use of history, techniques to explore historical truths, and the embodiment of history in everyday life. Society needs historical literacy to enable us to tell others, instill history in others, and, more importantly, be able to internalize in ourselves, what can be taken from the history of a nation, wrote Lee (Lee, P. 2019).

The challenge of education in the 21st century is to prepare students thinking skills needed to face the industrial revolution 4.0 (Anderson, L. W., & Krathwohl, D. R. 2001). The four main skills in 21th century, namely 4C (creative-innovative, critical thinking skills, communication skills, and collaboration skills) is needed in this era (Sholihah, U. 2016). The 4 C skill is also developed by integration of STEM aspect in teaching and learning activities. STEM (Science, Technology, Engineering, and Mathematics) is an approach to the learning activity. Thus STEM approach is urgently needed to implement in the learning process (Gita, R. S. D. *et al.,* 2021). The integration of RBL model of teaching and STEM approach will be the combination effectively implemented in the classroom

to improve students' historical literacy in designing the Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development (Kustiyah, I. E. 2017).

The main objectives of this research are as follows: (1) describe the framework of the activities of RBL model of teaching integrated with STEM approach in designing the Indonesian Batik motifs as traditional cultural Heritage to improve students' Historical Literacy, (2) describing the framework for the development process of learning materials on RBL model of teaching integrated with STEM approach in designing Batik motifs as cultural Heritage (4) describes how learning materials of RBL model of teaching with STEM approach can improve the historical literacy in designing Batik motifs as Cultural Heritage by using JBatik Software.

The main objectives of this research are as follows: (1) describe the framework of the activities of RBL model of teaching integrated with STEM approach in designing the Indonesian Batik motifs as traditional cultural Heritage to improve student's Historical Literacy, (2) describing the framework for the development process of learning materials on RBL model of teaching integrated with STEM approach in designing Batik motifs as cultural Heritage (4) describes how learning materials of RBL model of

teaching with STEM approach can improve the historical literacy in designing Batik motifs as cultural Heritage.

METHOD:

This type of research is a qualitative method. The research starts from collecting some literatures and reviews. From the results of the literature review, we develop frameworks related to four research objectives above. The framework for the process of developing the RBL-STEM learning activities, referred to ADDIE model of the research and development, namely Analyze, Design, Development, Implementation, and Evaluation (Branch 2009).

RESULT AND DISCUSSION:

In the following, we will present a framework for integrating the RBL learning model into the STEM approach to improve students' historical literacy in designing the Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development (Kussudiardja, B. 1993). The framework is developed based on the RBL syntax depicted in Figure 2 (Blackmore, P., & Fraser, M. 2007). What does it look like? We develop the integration of RBL-STEM education in the following stages:
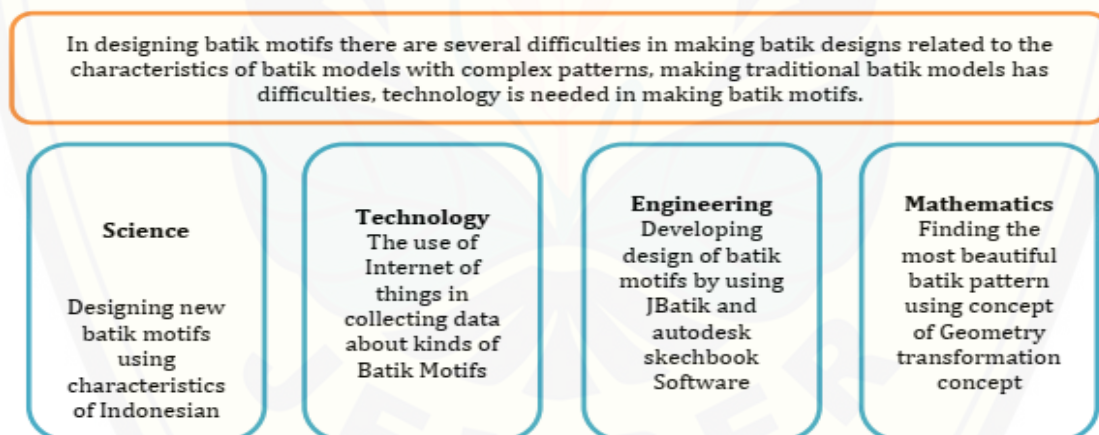
Figure 2: The STEM problem in developing the design of Batik as a Traditional Heritage

- **Problem Posing:**
  Posing a basic problem related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development (SCIENCE).

- **Obtain Breakthrough:**
  Developing breakthroughs related to the design Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik (ENGINEERING).

- **Data Information Collection:**
  Collecting data related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural

economic development through the internet (TECHNOLOGY).

- **Data Analysis:**
  Analyzing data related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development (ENGINEERING).

- **Generalization:**
  Finding the most beautiful and symmetrical Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik (MATHEMATICS).

- **Discussion:**

Presenting the results of students' Indonesian batik design as traditional cultural Heritage and sustainable rural economic development (RBL Report).

Figure 3: The framework of RBL-STEM in developing the batik Design

✓ *Student's Learning Outcome and Objective:*

o **Learning Outcomes:**

Students can develop the design of Batik related to characteristics from each place using JBatik Software.

o **Learning Objectives:**

This RBL-STEM learning will enable students to develop knowledge and skills in the following fields of Science, Technology, Engineering, and Mathematics.

o **Sciences - Students are Expected to:**

- Posing the basic problem related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development.
- Determine the brief history of the Batik motifs
- Analyse the decoration business strategy for gaining the maximum profit of business to support rural economic development.

o **Technology - Students are Expected to:**
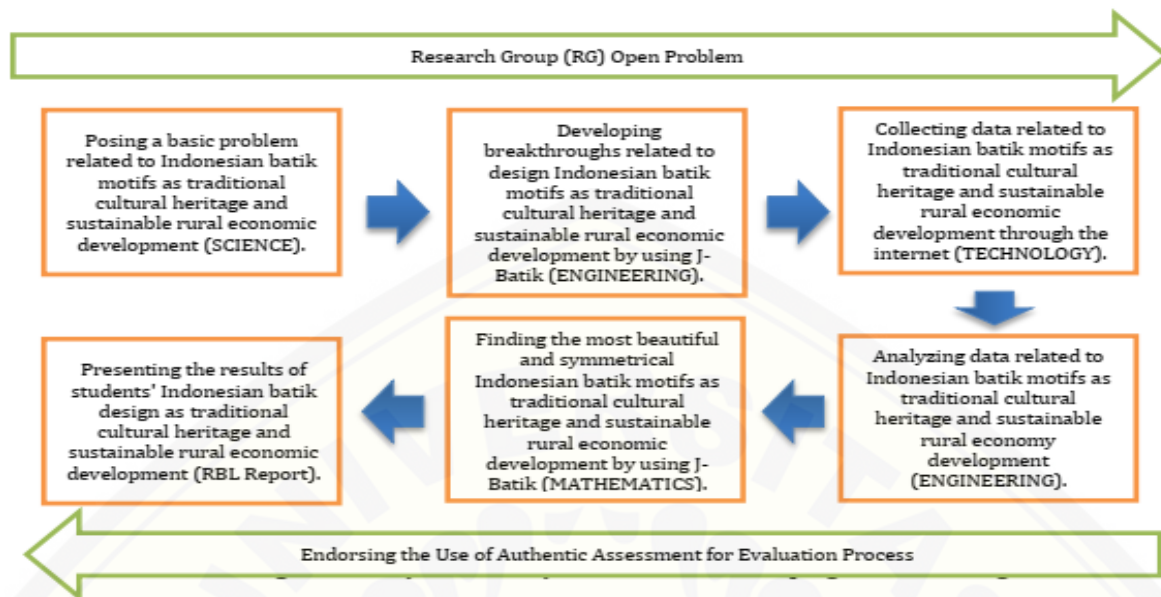
- Collecting data related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development through the internet.
- Use a researchgate site to find recent studies related to design of Batik motif.
- Use the Youtube channel to find out the tutorial for making Batik design using Software.

o **Engineering - Students are Expected to:**

- Developing breakthroughs related to design Indonesian batik motifs as traditional cultural

Heritage and sustainable rural economic development by using J-Batik SketchBook Software.

- Utilize the Geogebra Software for developing some various type of Batik design.
- Utilize the JBatik Software for developing some various type of Batik design.
- Utilize the Autodesk SketchBook Software for developing some various type of Batik design.

o **Mathematics - Students are Expected to:**

- Finding the most beautiful and symmetrical Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik
- Use Matlab atau Excel software to develop a programming to calculate the number of block paving for special color required.

❖ **The Element of Science Problem:**

The science aspect is about understanding motif Batik from several place in Indonesia and Posing a basic problem related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development, The basic problem of Batik in Indonesia is about design of Batik related to culture of several place in Indonesia. Figure 3 explain about some information of Batik motif from Bali, Yogyakarta, Betawi, and Solo. The option of motif batik is related to Color, characteristics of culture.

(a) Batik Bali
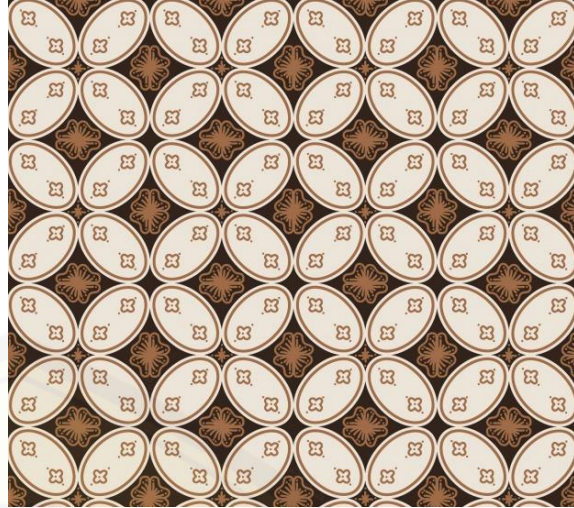
(b) Batik Kawung

(c) Batik Betawi

(d) Batik Sidoluhur

Figure 4: Motif Batik from Bali, Yogyakarta, Betawi, and Solo

Batik Bali also popular as Batik from God island, Motifs of Batik Bali insprired from animal such turtle, flamingo, and deer, Commonly the color of Batik from Bali using bright color as dominant, blue, yellow and purple. Batik kawung is the oldest Batik from Yogyakarta, The motif of batik kawung is the representation of kawung fruit or Aren arrange in geometrical structure. The philosophy of kawung Batik is about self control and hati bersih. Batik Betawi is from Jakarta with characteristic of bright color integrated with unique motif form Betawi ondel-ondel, pucuk rebung, nusa kelapa, and gambang kromong. Usually, this Batik is used during Abang None festival activities and at Jakarta cultural exhibitions. The Sidoluhur motif is generally worn by the bride on the wedding night. 'Sido' in Javanese, means to be or to be.

While 'sublime', means honorable and dignified. This is what makes Sidoluhur Batik a form of prayer from the wearer to always be physically and mentally healthy, and become a person of honor and dignity.

❖ **The Element of Technology:**
Collecting the information for internet is one of the part in STEM activity in designing Batik motif. The teacher will lead student to find brief history of Batik and some motif of Batik from several place in Indonesia related to culture from each region. The information not only from website but also from youtube and other platform information from internet. The searching about information of Batik from researcgate and sciendirect also one of the best choice to understanding the research about design Batik.
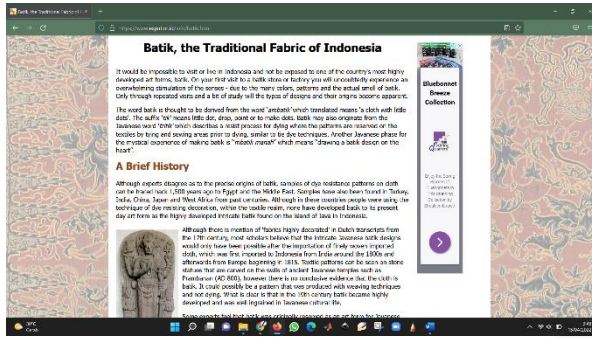
(a) The brief History of Batik
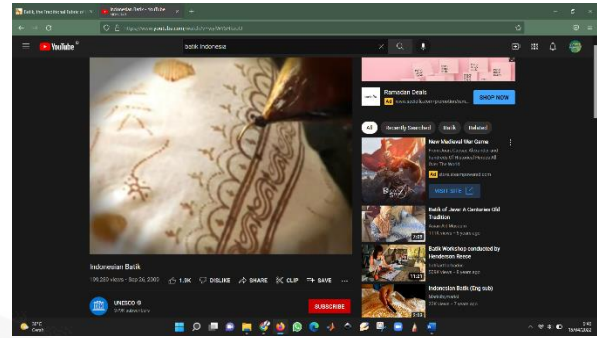
(b) Information of Batik from Youtube
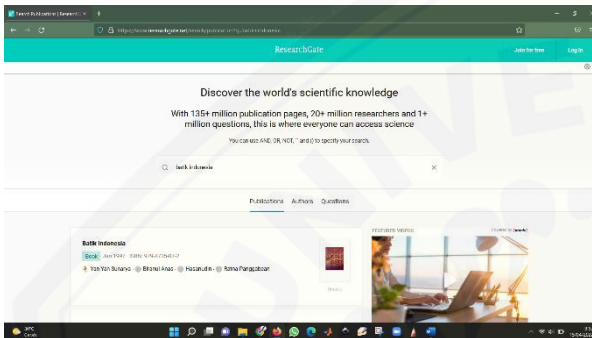
(c) Information of Batik

(d) Batik research from science direct

Figure 5: The integration of technology in STEM activity Batik design

The Element of Engineering. The engineering design process in Batik production is related to drawing motifs of Batik using Software. There is some software to design Batik, for example: Geogebra, Autodesk Sketchbook, and JBatik. The teacher should explain about the characteristic of Software to drawing batik motif, if the student prefer design batik in smartphone the choose of Software is Geogebra, JBatikand Autodesk Sketchbook.
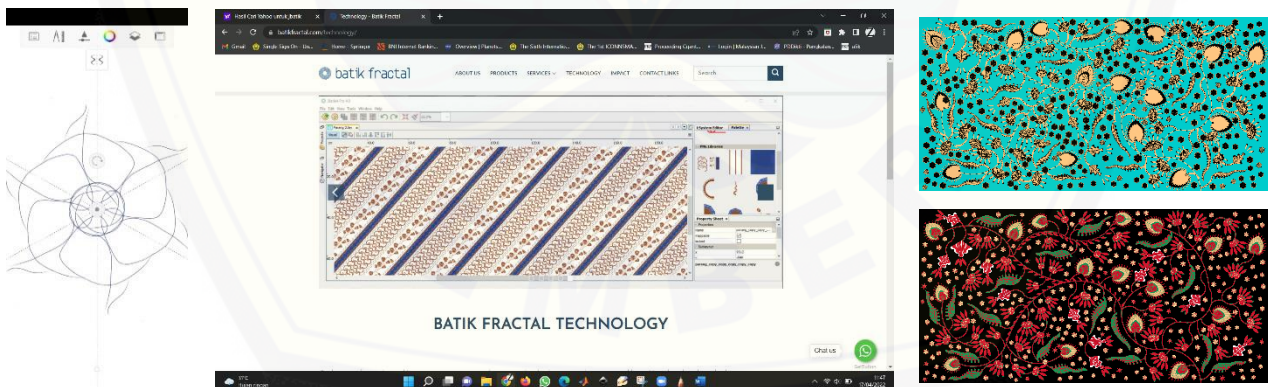
Figure 6. The illustration of Batik Design using Software Autodesk Sketchbook and JBatik

❖ **The Element of Mathematics Problem:**

The Mathematics aspect is useful in STEM activity batik design to Finding the most beautiful and symmetrical Indonesian batik motifs as traditional cultural Heritage by using the transformation in geometry concept. The concept of transformation includes translation, rotation, reflection and dilatation.

In Euclidean geometry, a translation is a geometric transformation that moves every point of a figure, shape or space by the same distance in a given direction. A translation can also be interpreted as the addition of a constant vector to every point, or as shifting the origin of the coordinate system.

Translation Process of Batik Motif	The Result of Batik Design

Horizontal and vertical translation
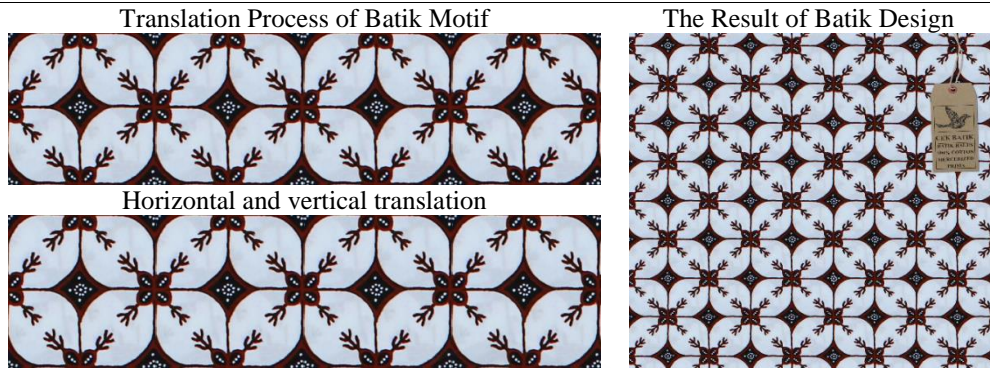
Figure 7: Translation process of Matik Motif

Rotation Process of Batik Motif	The Result of Batik Design
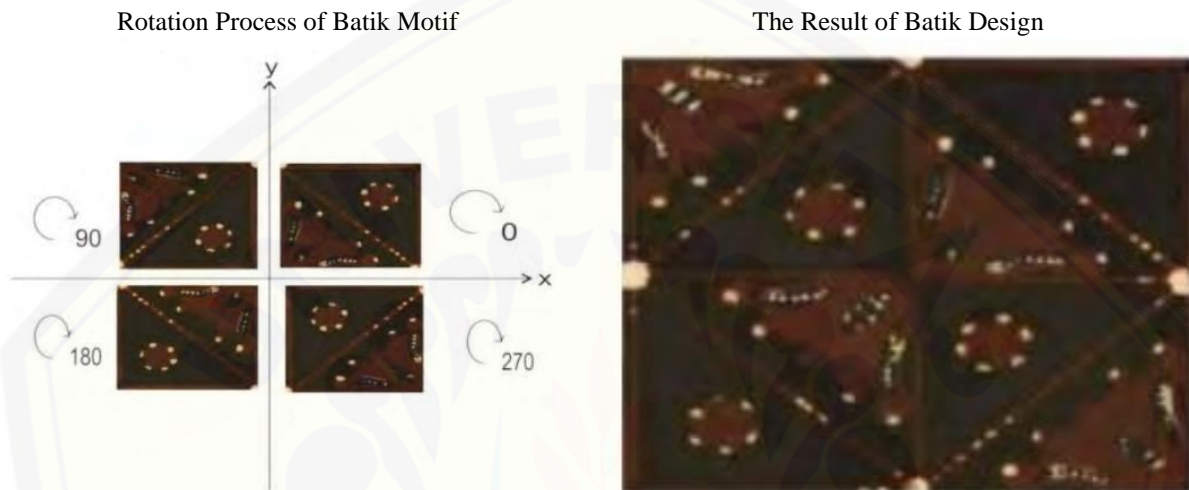
Figure 8: A rotation is a geometric transformation for Batik Design (Risdiyanti, I., & Prahmana, R. C. I. 2020)

Rotation means the circular movement of an object around a centre. It is possible to rotate different shapes by an angle around the centre point. Mathematically, a rotation means a map. All the rotations around a fixed point that make a group under a structure are called the rotation group of a unique space. The rotations around X, Y and Z axes are known as the principal rotations. The rotations around any axis can be performed by taking the rotation around the X-axis, followed by the Y-axis and then finally the z-axis.

A reflection is a geometric transformation for Batik Design (Risdiyanti, I., & Prahmana, R. C. I. 2020). A reflection in geometry is a mirror image of a function or object over a given line in the plane. The most frequently used lines are the y-axis, the x-axis, and the line, though any straight line will technically work. A reflection reverses the object's orientation relative to the given line. The final figure will be an equal distance from the line as the preimage but on the opposite side. If the original figure is close to the line, the reflected figure will also be close to the line.

Reflection Process of Batik Motif	The Result of Batik Design

Figure 9: The Implementation of Reflection Concept in designing batik Motif

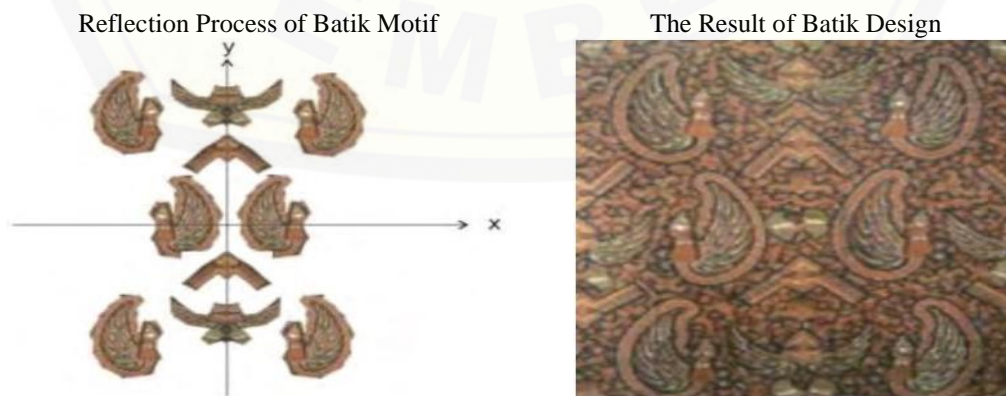A dilatation is a geometric transformation for Batik Design (Risdiyanti, I., & Prahmana, R. C. I. 2020). Dilation changes the size of the shape without changing the shape. when we enlarge a picture or use a copy machine to reduce a map, we are making dilations. enlarge means to make a shape bigger. Dilation reduce means to make a shape smaller. the scale factor tells how much something is enlarged or reduced.

Dilation Process of Batik Motif   The Result of Batik Design

Figure 10: Dilatation Process in designing batik Motif

❖ **RBL-STEM Learning Activities in Designing Batik Motif Indonesia as Traditional Cultural Heritage:**

In this part, we will discuss and focus to the six stages of RBL-STEM activities model of teaching. The six stages describe the student activity doing a research in designing Batik Motif integrated with learning activities. The first stage is (SCIENCE) focus on Posing a basic problem related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development. We will ask the student to think about how to create and develop an Indonesian batif motifs as traditional cultural Heritage. For more details see Table 1.

➢ The first stage in Science stage proposes the new Batik motifs. The lecturer and student discuss about the brief history of Batik and the relation with sustainable rural economic development. This stage focus on discussion about basic problem how to develop of batik motifs related to characteristics from each region in Indonesia. Producing Batik to improve the economic level of a region.

Table 1: The RBL-STEM Learning activities in Science aspect

Stage one	Learning Activities
(1) Posing a basic problem related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development.	- The lecturer asks to the student about the kinds of Batik Motif from several place in Indonesia. - The lecturer shows the student about kinds of Batik motifs from several place in Indonesia including the characterictics from each place. - The lecture explain the relation between Batik as traditional cultural Heritage and sustainable rural economic development. - The student start group discussion about how to making new batik motifs as traditional cultural Heritage and the impact to rural economic development.

➢ The second stage is Technology stage, student collecting some data and information from internet related to Indonesian batik motifs and how to making batif motifs, some of research about batik motifs, and videos from Youtube how to making batik motifs using Software. The details will be explained clearly in Table 2.

Table 2: The RBL-STEM Learning activities in Technology aspect

Stage two	Learning Activities
(2) Collecting data related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development through the internet.	- The lestuter guided to Collecting data and information related to Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development through the internet. - The lecturer explain how to using researchgate site to find recent studies related to design of Batik motif. - The student use the Youtube channel to find out the tutorial for making Batik design using Software.

- The third stage is engineering stage, after technology stages the student understand about a lot of batik motifs, recent study and research about Batik and relation of Batik with sustainable rural economic development, now the student try to design batik motif using Software. The details of engineering stages will explain in Table 3.

Table 3: The RBL-STEM Learning activities in Engineering aspect

Stage three	Learning Activities
(3) Developing breakthroughs related to design Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik.	- The lecturer explain about JBatik software and how to use JBatik software in designing Batik motifs - The student developing breakthroughs related to design Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik Software. - The lecture and student check design of new batik motifs create using JBatik. - The student start group discussion about new batik motifs from JBatik as traditional cultural Heritage and the impact to rural economic development.

- The fourth stage is Mathematics stages, in this stage the student check the result of Batik Motifs from JBatik software and discuss with lecture about beautiful pattern and symmetrical shape. The details of Mathematics stage explained in Table 4.

Table 4: The RBL-STEM Learning activities in Mathematics aspect

Stage four	Learning Activities
(4) Finding the most beautiful and symmetrical Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik	- Finding the most beautiful and symmetrical Indonesian batik motifs as traditional cultural Heritage and sustainable rural economic development by using J-Batik - Use Matlab atau Excel software to develop a programming to calculate the number pattern for special color required.

- The fifth stage is presenting the result as RBL report related to the use of JBatik as Software in designcand develop the new Batik design related to characteristics from each region. The student will participate in focus group discussion about topics Batik, sustainable economics development, and Historical Literacy. Form more detail see Table 5.

Table 5: Stage of RBL-STEM learning activities

Stage five	Learning Activities
(5) Presenting the results of students' Indonesian batik design as traditional cultural Heritage and sustainable rural economic development (RBL Report).	· Student develop a research report the use of JBatik as Software. · Student perform a presentation to conduct FGD (focus group discussion) about design of Batik from each group. · The lecture observe, evaluates, and clarifies the result of Batik motifs from student and making suggestion about improvement of Batik motifs. · Lecture make observation on student Historical Literacy skills using observation sheets.

❖ **Student' Historical Literacy Assessment Instrument Framework**
The framework for assessing Student' Historical Literacy ability instrument seen on Table 6 below.

Table 6: Student Historical Literacy assessment instrument framework

Indicator	Sub-Indicator	Test Material
Recognizing the events of the past	Recognizing the importance of historical events	Explaining why the relation between Batik and Historical event is importance.
	Understanding historical events for the provision for future life	Explaining the historical event of Batik for the provision for future life
	Understanding historical Heritage	Explaining the Batik as Historical Heritage
Understanding the narratives of the past	Understand the story form of continuity over time,	Explaining the brief history of Batik as historical hetitage
	Understand the narrative and use it wisely for future life	Explaining the History of Batik in narrative and descriptive.
Showing the research skills	Collect, analyze, use evidence (artifacts, documents, pictures), historical events, and narratives	Collecting some of Batik motifs related to charactretistics of local wisdom and historical aspect

	Able to develop exploration skills to enrich historical findings	Exploring and designing the Batik motif and connecting with historical aspect
	Find strategies to preserve historical events, relics, and narratives	Making a Batik exhibition from student project in making batik motifs.
Implementing the language of history	Understand the language of history	Explaining the characteristic of Batik as one of language history of Indonesian culture.
	Use historical terminology in understanding historical language	Sharing the brief history of Batik as one of language history of Indonesian culture.
Analyzing the historical concept	Understand historical concepts such as to cause and motivation.	Explaining the historical concept and characteristic of Batik as motivation
	Understand the concept of history, historical Heritage, and historical narrative	Explaining the Batik as Historical Heritage
Utilizing of the ICT to explore thedocuments of history	Using ICT in conducting historical searches	Exploring the information from internet related to History of Batik in Indonesia.
	Using, understanding, and evaluating historical sources using the Internet of Things	Exploring the research and development of Batik as Indonesian cultural Heritage and relation with sudent historical literacy.s

✓ ***The framework of learning Material Process Development:***

The development stage of learning materials using ADDIE model which developed by Raiser and Mollenda including (Analysis, Design, Development, Implementation, and Evaluation) . The first stages is Analysis stages, the activity in this stages is related to analysis of learning materials, characteristics of student and lesson plans that will be used. The second stages is design stage, in this stage the lecturer integration RBL model of teaching with STEM approach and choose the methods, tips and tricks, arrange the learning materials, lesson plans, student worksheet, pretest and postest instrument, and historical literacy instrument that will be used. The third stage is development stage is testing the instrument and teaching materials to check the validity and practicality. The validation process is related to validation in content, format, language and practicality level of instrument. The fourth stage is implementation stage, the main activity of this stage is testing the instrument in classroom and determine the effectiveness of implementation RBL model of teahing with STEM approach in improving student historical literacy in designing Batif Motifs using JBatik Software. The last stage is evaluation stage, main activity in this stage is evaluation and reflection of implementation RBL model of teaching integrated with STEM approach can improve students Historical literacy in designing Batik.

The framework of RBL-STEM in designing designing Batif Motifs by using JBatik Software is very useful to learn. These results serves as guidelines for conducting further research in Batik design. There are at least two more further research activities for future researchers, namely: (1) developing RBL-STEM learning materials with the ADDIE development model, (2) Analyzing the implementation of RBL-STEM learning materials in increasing student historical literacy in designing Batif Motifs by using JBatik Software. The combination between RBL model of teaching and -STEM approach as learning activity framework is very effective in realizing student historical literacy when applied in the learning classroom,

CONCLUSION:

The results of this study is description about how the implementation of RBL model of teaching syntax integrates with the STEM approach for the in STEM activity designing of Batik motifs to improve the students' historical literacy. The main result of these research is about activity framework of RBL model of teaching integrated with STEM approach: the STEM activity in designing batik motifs using JBatik Software to increase student historical literacy in the form of stages 1-6 and their learning activities. The development of the test instrument framework related to student historical literacy also included in this research activity. According to the results of this study, conducting further research related to learning materials development and analysis the implementation of RBL-STEM can be easily carried out by others researchers in teaching and learning activities.

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