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Student's mathematical creative skill using interactive application media based on collaborative learning

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Abstract. Completing Linear Equation System by Elementary Row Operations is a fairly complex problem in mathematics. Someone who is faced with this problem can be measured his creative skills. The fact shows that their creative skills are still relatively low. Therefore learning based collaborative using interactive application media will be applied. This research type was a mixed method, which combines quantitative and qualitative research. The Quantitative method is used to analyze student learning outcomes, while the qualitative methods is used to analyze students' creative abilities. Respondents involved in this study consisted of three classes, consisting of two experimental classes and one control class which is each class consisting of 36 students. The objects of this research was the students of SMAN 1 Kencong Jember, who were selected three class as research samples, therefore XI MIPA 1 class as the first experimental class and XI MIPA 2 class as the second experimental class and at last XI MIPA 3 class as the control class. The research results indicated that the pre-test of three classes was homogeneous. While the post-test result shows that the average of the three classes is significantly different. This is indicated by the value of one way ANOVA ($p < 0.05$), it was found that collaborative learning using interactive application media as part of the developed tool can provide better results in terms of creative thinking abilities. Interactive application media as part of collaborative-based learning tools can provide positive stimulation to students so that students' creative thinking abilities increase. The tool developed in this study was also declared valid, practical and effective.

1. Introduction

Education is a conscious and systematic effort made by people who are entrusted with the responsibility to influence students to have the character and behaviour in accordance with the ideals of education [1]. Educational skills and technological mastery must be mastered in facing and preparing for challenges in the 21st century era. Student center learning, education based collaboration, contextual learning, and school are integrated with environment are 4 basic principles of learning in



21st century [2]. The main skills that must be have is critical thinking, creative, communication, and collaboration [3].

In modern learning, students should not only listen to lectures as in conventional learning, where students simply swallow raw and accept all the teacher's explanations without any activeness from students or teacher centered, but students must process what they hear and see into a meaningful single unit [4]. Information technology influences the development of learning media [5]. Technology based learning media is important in mathematics learning [6]. In the process of learning mathematics, media can generate desire, motivation and stimulation. The goal is to make learning communication effectively, so the planned learning aim is reached [7]. Learning activeness can be seen from active involvement between teachers and students [8].

Collaboration is the process of linking the learning context and student personality, prior experience and knowledge and learning skills [8, 9]. The process of successful collaboration is also a process of individual student interpretation of the learning situation that is part of a shared meaning [11, 12] . Collaboration has been proven to activate special learning mechanisms that cannot be triggered by working individually [13, 14] . Collaborative learning through Lesson Study and then integrated with the use of technology is an effective action to increase student creativity in the classroom.

Creative thinking can be described as the ability of students to generate many possible answers and ways to solve problems [15]. There are four criteria of think creatively proposed by Munandar: fluency, flexibility, originality and elaboration [13]. Student's creative thinking can improve with innovative method [13]. Febriyanti et al's research stated that students with TBK 1, TBK 2, TBK 3 and TBK 4 showed students in accordance with the indicators of creative thinking, and TBK 0 were students without 4 indicators of creative thinking. Hobri et al's research (2018) stated that open ended-based collaborative learning aims to help develop students' creative activities with simultaneous problem solving. The results of the study generally state that collaborative learning results in better achievement than conventional learning.

This study also refers to the application of Monsakun from [18], which contains a solution within format of mathematical stories question for elementary school level students.

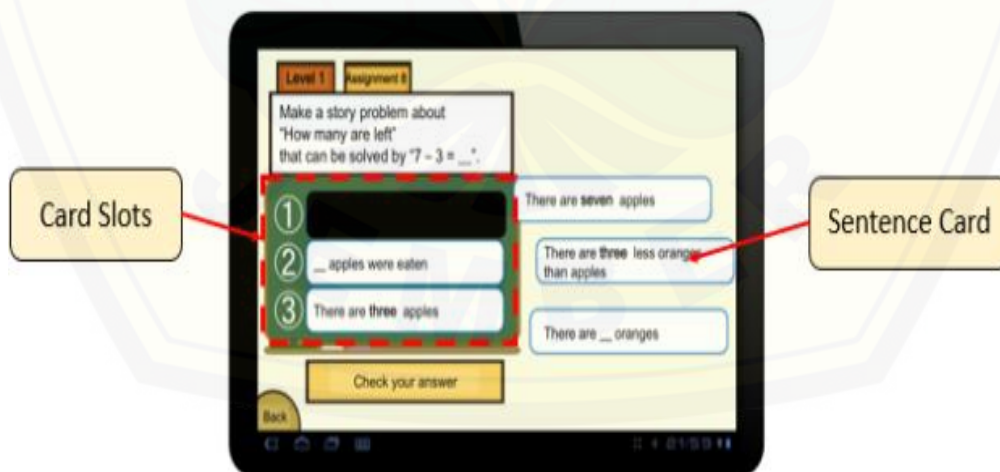


Figure 1. Display of Monsakun Application

Based on the explanation above, the development of collaborative learning tools using interactive application media is a combination that can be used in the process of learning mathematics in schools, with the hope that the process of learning mathematics in schools will improved, students can be creative and active in it.

2. Method

The method in this research is combination research or mixed methods. [16] states that the combined research method (mixed methods) is a research method that combines or merge quantitative methods with qualitative methods to be used together in a research activity, in order to obtain more comprehensive, valid, reliable and objective.

This study aims to develop collaborative learning tools using interactive application media and discover their effects on students' creative thinking abilities. Thus, this type of research is to combine 2 types of research, those are development research and experimental research. This combined research method is used to test the effectiveness of the process and the results of a particular product. The effectiveness of the process was investigated by qualitative methods and the effectiveness of the results was tested by experimentation.

Development research uses the design of the development of learning tools developed by Thiagarajan, Semmel and Semmel. Thiagarajan's model in [17] is known as 4-D (Four-D Models). This research implemented in four stages, there are the defining stage, the design stage, the development stage and the disseminate stage. Whereas in experimental research, the chosen research design is the one that most allows the researcher to control other variables that are thought to have an influence on the dependent variables.

The combination method model used is the triangulation model, which is a research method that combines qualitative and quantitative research methods by mixing the two methods equally. The method is used together, at the same time but independently to answer the problem formulation [16]. The qualitative method intended in this research is development research and the quantitative method is experimental research.

The subjects of this study were students of class XI of SMAN 1 Kencong. Sampling is done by homogeneity test. Data sources are from Mathematics teacher, validator, data taken from student creativity observation sheet, data from teacher observation sheet, student questionnaire data and student pre-post test result data.

Quantitative data analysis was performed by using data normality tests. If the data is normally distributed, then one way annova test was conducted.

This study uses three classes, which are contains two experimental classes and one control class. For the experimental class 1 were treated X1, experimental class 2 was treated X2, and the control class was not treated any or using conventional learning.

Table 1. Research design scheme

Experiment Class	O_1	X_1	O_6
Experiment Class	O_2	X_2	O_5
Control Class	O_3		O_4

Keterangan:

O_1, O_2, O_3 : Pre-test

O_4, O_5, O_6 : Post-test

X_1 : The treatment uses collaborative learning without using LKS learning tools and interactive application media

X_2 : The treatment uses collaborative learning by using LKS learning tools and Interactive Application Media

Qualitative data analysis was performed by analyzing the validity, practicality and effectiveness of the instrument. The analysis of students' creative thinking abilities was carried out using scoring in accordance with the criteria of creative thinking abilities namely fluency, flexibility, originality and elaboration.

3. Result and discussion

The results of instrument validation are based on the following tables.

1. Validity of instruments

The instrument validity criteria are based on the following table.

Table 2. Validity Table

Interval	Validity
$3.5 \leq \overline{V}_A \leq 4$	Very valid
$2,5 \leq \overline{V}_A < 3,5$	Valid
$1,5 \leq \overline{V}_A < 2,5$	Quite valid
$\overline{V}_A < 1,5$	Invalid

Processing RPP validation score obtained an average of 3.90. Processing an LKS validation score obtained an average of 3.85. Processing the THB validation score obtained an average of 3.56. From the average results of RPP, LKS and THB validation, the instrument meets the validity criteria.

2. Practicality of instruments

The instrument validity criteria are based on the following table.

Table 3. Teacher activity categories

Score	Criteria
$90\% \leq P_g$	Very active
$70\% \leq P_g < 90\%$	Active
$50\% \leq P_g < 70\%$	Quite Active
$P_g < 50\%$	Inactive

Table 4. Student activity categories

Score	Criteria
$90\% \leq P_s$	Very good
$70\% \leq P_s < 90\%$	Good
$50\% \leq P_s < 70\%$	Quite good
$P_s < 50\%$	Not good

From processing the validation score of the teacher's activity the percentage is 97.22%. This percentage is included in the very active category. From processing the validation score of student activities obtained a percentage of 96.53%. These percentages are included in the excellent category. The percentage of the results of the validation of the teacher's and student's activities shows that the instrument meets the practicality criteria.

3. Effectivity of instrument

The instrument validity criteria are based on the following table.

Tabel 5. Interpretation of validation value by experts

Score	Criteria
$90\% \leq P \leq 100\%$	Very good
$80\% \leq P < 90\%$	Good
$65\% \leq P < 80\%$	Quite good
$55\% \leq P < 65\%$	Not good

From processing the validation score of the effectiveness of LKS was obtained a percentage of 91.67%, the percentage is included in the excellent category. Processing the validation score of student responses to LKS obtained a percentage of 93.75%. These results indicate that the instrument meets the effectiveness criteria.

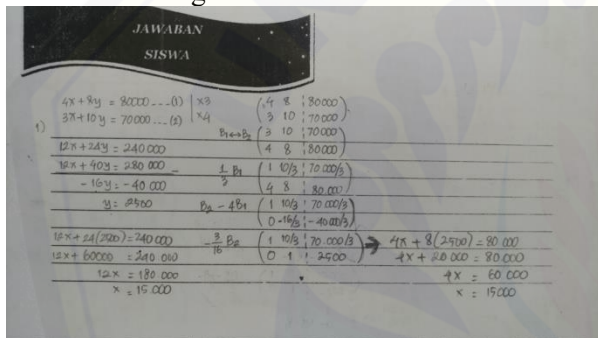
Based on the four creative criteria of students and the post-test scores will be obtained later scores which will then look for the percentage of students' creative thinking abilities:

Table 6. Criteria for students' creative thinking abilities

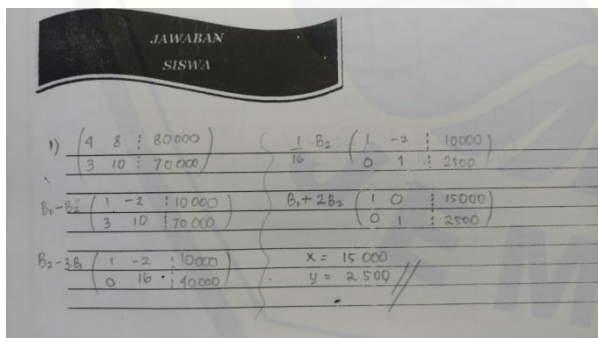
Score	Criteria
$90\% \leq NP \leq 100\%$	Very Creative
$75\% \leq NP < 85\%$	Creative
$60\% \leq NP < 75\%$	Quite Creative
$55\% \leq NP < 60\%$	Less Creative
$NP < 55\%$	Not Creative

3.1 Analysis of Student Work

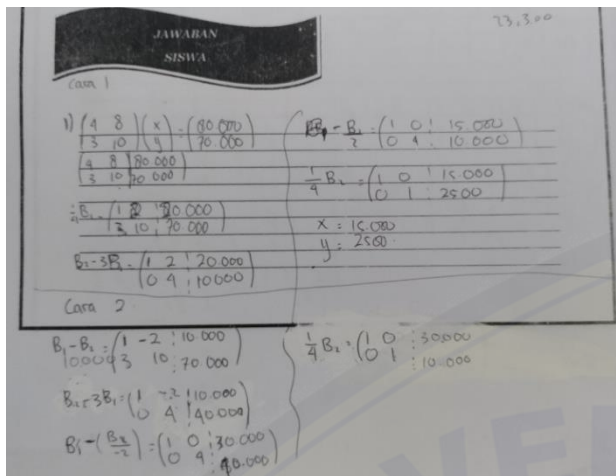
The following are the results of student work



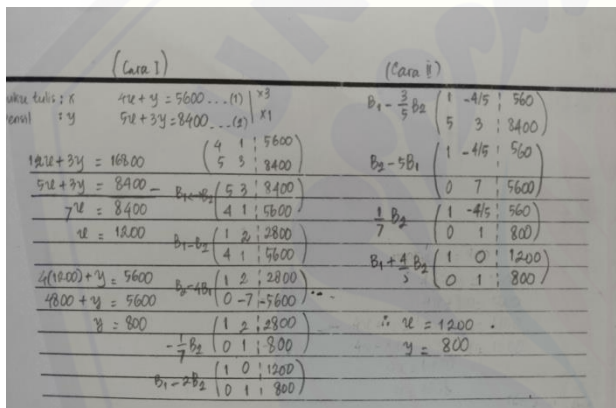
Student 1, He has developed his ability to think creatively by looking for steps to complete OBE, but the answers are still wrong.



Student 2, He has developed his creative thinking ability by finding steps to complete OBE, producing one correct answer.



Student 3, He has developed his ability to think creatively by looking for steps to complete the OBE, producing two answers, one right answer and one wrong answer.



Student 4, He has developed his creative thinking ability by looking for steps to complete OBE, producing two correct answers.

3.2 Interactive application media

This media was created as part of the development of devices to create collaborative learning that attracts students' interests, so students can be more interested, eager to follow the learning, understand the material more easily and enhance students' creative thinking abilities.

Figure 2 is an initial display that allows students to fill in their names, absentee numbers and classes. Figure 3 is a level selection page or question level starting at level 1 (questions with easy category) to level 5 (questions with difficult category). Figure 4 is a display of interactive application media level 1. At this level 1 students are only asked to write the matrix form of an SPLDV or SPLTV. This figure 5 shows level 2 which is contains questions that are above the previous level. At this level students are asked to write the matrix form of SPLDV and SPLTV and determine the solution as shown in Figure 5, but at this level students are still given the completion options as shown in Figure 6. In Figure 7 students are given exercises as before but are not given the completion options, so students are asked to analyze it themselves or find ways of solving it themselves. From here students' creative thinking skills can be further honed.

Login Siswa



Figure 2. Login Menu

Pemilihan Level



Figure 3. Option Level Feature

Pengerjaan: Level 1

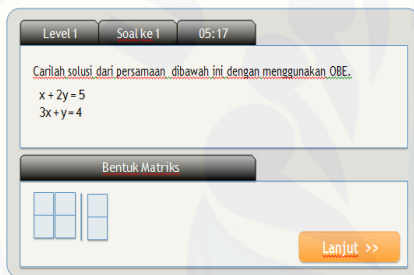


Figure 4. Example Level 1

Pengerjaan: Level 2

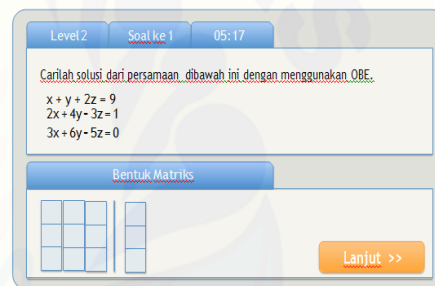


Figure 5. Example Level 2

Pengerjaan: Level 2
Ops1 → Siswa diberikan pilihan



Figure 6. Example Level 2 with option answer

Pengerjaan: Level 2

Ops2 → Siswa bebas menentukan langkah penyelesaian

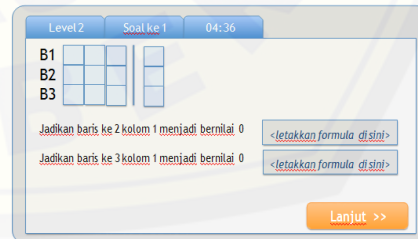


Figure 7. Example Level 2 with no option answer

3.3 Quantitative analyzing data

From students' pretest data, normality test was conducted based on Kolmogorov-Smirnov statistical values with a significance level of 5%, which obtained a significance level greater than 0.05 for 2

experimental classes and 1 control class so that it can be concluded that the data were normally distributed.

Tests of Normality

Groups	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre_Test Experiment Class 1	.122	38	.168	.959	38	.175
Experiment Class 2	.080	36	.200*	.979	36	.711
Control Class	.114	35	.200*	.965	35	.319

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Then a variant homogeneity test was conducted by using OneWay ANOVA with a significance level of 5%, obtained a significance level greater than 0.05 which means the data is homogeneous. If the homogeneity test shows that the significance level is less than 0.05, then the data is not homogeneous and a non-parametric test must be performed, namely the Mann-Whitney test.

Pre Test			
Levene Statistic	df1	df2	Sig.
1.694	2	106	.189

The One Way ANOVA test was conducted which results in a significant level of 0.507 or greater than a significant level of 5% so that it can be concluded that there is no influence on students' creative thinking abilities.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	286.031	2	143.016	.683	.507
Within Groups	22189.217	106	209.332		
Total	22475.248	108			

From the student's post test data also conducted a normality test based on Kolmogorov-Smirnov statistical values with a significance level of 5%, which obtained a significance level greater than 0.05 for 2 experimental classes and 1 control class so that it can be concluded that the data are normally distributed.

Tests of Normality

Groups		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
post test	Experiment Class 1	.143	38	.047	.946	38	.064
	Experiment Class 2	.133	36	.107	.922	36	.014
	Control Class	.132	35	.129	.947	35	.092

a. Lilliefors Significance Correction

Then a variant homogeneity test was conducted by using OneWay ANOVA with a significance level of 5%, obtained a significance level greater than 0.05 which means the data are homogeneous. If the homogeneity test shows that the significance level is less than 0.05, then the data is not homogeneous and a non-parametric test must be performed, namely the Mann-Whitney test.

Test of Homogeneity of Variances			
post test			
Levene Statistic	df1	df2	Sig.
.169	2	106	.845

Furthermore, One Way ANOVA test will be conducted which results in a significant level of 0,000 or smaller than a significant level of 5% so that it can be concluded that collaborative learning using interactive application media has an influence on students' creative thinking abilities.

ANOVA

post test					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	631.976	2	315.988	13.510	.000
Within Groups	2479.217	106	23.389		
Total	3111.193	108			

4. Conclusion

Based on the discussion and analysis of the data, it was found that collaborative learning using interactive application media as part of the developed tool can provide better results in terms of creative thinking abilities. Interactive application media as part of collaborative-based learning tools can provide positive stimulation to students so that students' creative thinking abilities increase. The tool developed in this study was also declared valid, practical and effective.

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