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## The Mathematics Learning using Geogebra Software to Improve Students' Creative Thinking Ability

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## The Mathematics Learning using Geogebra Software to Improve Students' Creative Thinking Ability

Pinta Romaito, Islamiani Safitri, Hotna sarida, Hairun Nisah, Uswatun, Hasanah, Dede Apriani, Siska Afsari, Olivia Dwichanda, Yossy lucky

Program Studi Pendidikan Matematika, Universitas Labuhanbatu

E-mail: <sup>2</sup>[islamiani.safitri@gmail.com](mailto:islamiani.safitri@gmail.com) , <sup>1</sup>[pintasagala12@gmail.com](mailto:pintasagala12@gmail.com)

**Abstract.** Creative thinking in mathematics learning is a form of thinking that has received less attention in formal education until now. Creative thinking can be improved through special modifications in mathematics learning, one of which is by using Geogebra Software. This study aims to determine students' creative thinking skills in mathematics learning with Geogebra software. This research uses quantitative methods with Quasy Experimental Design. The subjects of this study were students of class <sup>12</sup>II SMP N 1 Pulau Rakyat with a population of 184 students. The samples in this study were class VIII-3 as the experimental class and class VIII-5 as the control class. The data analysis technique used the normality test with the Shapiro-Wilk test and the homogeneity test with the Levene test. Followed by testing the hypothesis that is using the independent sample t-test t-test. Based on the results of the analysis and discussion of the research data, it is found that the creative thinking ability of students whose learning process uses mathematics learning with Geogebra Software is higher than those using conventional learning models. Students with mathematics learning treatment with Geogebra Software have better creative thinking skills than students with learning treatment using conventional learning models.

### 1. Introduction

Creative thinking is the basic use of thought processes to find possible answers to a problem. Creative thinking is a form of thinking that until now still lacks attention in formal education, students are only trained in memory knowledge and logical thinking ability, or reasoning. Creative thinking ability is an ability that describes aspects of fluency, flexibility<sup>12</sup> and originality, as well as the ability to elaborate (develop, enrich, or detail) an <sup>12</sup> (elaboration). The level of creative thinking is: (1) Very creative that students can show fluency, flexibility, and novelty in solving math problems. (2) Creative students <sup>12</sup> show novelty and fluency in solving math problems. (3) Creative enough that students can show novelty or flexibility in solving math problems. (4) Less Creative, students can only show fluency in solving math problems. (5) Not Creative i.e. Students cannot show all three indicators of creative thinking in solving math problems[1].

Based on the results of interviews with teachers of mathematics subjects grade VIII SMP N 1 Pulau Rakyat it is known that mathematics learning in the classroom has developed creative thinking skills, only it has not been implemented optimally. The majority of math learning used by teachers in the classroom still uses conventional models. Since long time ago this model has been used as an oral communication tool between teachers and students in the learning and learning process. <sup>5</sup> is model is not always bad when the application is well prepared, supported by tools and media, and pay attention



to the limits of its use. But conventional models are still less attentive and give students less opportunities to develop their mindset especially in math lessons that use many formulas. So students are still fixated by the formula itself and have not been able to create new ideas in mathematics learning. This results in students' creative thinking ability is still not developing optimally.

Understanding the above problems, one of the improvement efforts that can be done is to collaborate the learning model with ICT. ICT-based mathematics learning is used during the learning process by using tutorial software to deliver GeoGebra materials and software for props. GeoGebra software is one of the software that can be used to support mathematics learning. GeoGebra is a software with basic ideas of geometry, algebra, and calculus that can be used for learning and teaching at elementary, junior high, high school, and university level[2]. This is done on the grounds that students are familiar with the use of computers, computers are able to visualize most of the math material, the curriculum demands the use of computers in math learning, and the appearance of computers is more interesting than the whiteboard.

The results of the study[3] showed that judging from students' learning achievements, creative thinking, and self-efficacy, namely (1) effective Cabri-assisted geometry learning, (2) geogebra-assisted geometry learning effectively, (3) there are differences in the effectiveness of GeoGebra and Cabri-assisted geometry learning, (4) Geogebra-assisted geometry learning is more effective than Cabri-assisted geometry learning. Furthermore, in a piece of research it was also stated that geometry learning using learning tools with the IDEAL approach assisted by GeoGebra is effectively reviewed from the achievements and motivation of students' learning[4].

The goal to be achieved in this research is to find out if students' creative thinking ability can be improved by learning mathematics using Geogebra Software.

## 2. Research Method and Results

### 10 2.1 Research Methods

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The method in this research is quantitative with quasi experimental design which is a form of experimental design that has a control group, but cannot function fully to control other variables that influence the implementation of the experiment. The research paradigm used is Pretest-Posttest Experiment Control Group Design. This design is two groups that are each randomly selected, then given a pretest to find out the initial state is the difference between the experimental group and the control group[5].

This research was conducted in the even semester of the 2019/2020 school year at SMPN 1 Pulau Rakyat, Asahan Regency, North Sumatra. The population in this study is all students of grade VIII SMP N 1 Pulau Rakyat with a total of 184 students. Sampling technique used is Cluster random sampling which is sampling technique that is done randomly regardless of strata in that population. The draw is done by giving an ordinal number to each class and then selected randomly. The first sequence number was taken for the experiment class and the second sequence number was taken for the control class, so the samples obtained were grade VIII-3 (totaling 30 students) as an experimental class and grade VIII-3 (totaling 30 students) as a control class.

The research instrument used is a blurb test to measure students' creative thinking abilities. Tests are given to students after treatment is carried out in experimental classes and control classes. The validity of the test using Product moment and its reliability is analyzed using alpha cronbach formula. Data analysis techniques in this study include normality testing and variance homogeneity test which is then continued with hypothesis test. Hypothetical test in this study using statistics t-independent sample t-test.

2.2 Research Results

2.2.1 Description of Data Pretest Experiment and Control Class. Before the learning process is carried out in both classes, a pretest is held to obtain the initial data. The initial test score data of mathematical creative thinking ability can be presented in the table below:

Table1. Description of Experiment and Control Class Pretest Score Data.

Group	X <sub>max</sub>	X <sub>min</sub>	Central Tendency Size			Group Variance Size	
			$\bar{x}$	Mo	Ma	R	S
Experiment	90	61	77	81	76	69	8,32
Control	90	61	77	81	81	54	7,38

Based on the pretest table above it can be seen the maximum value in the experiment class and control class is 90, while the minimum value for the experiment and control class is 61. The central tendency size indicates an average mean for the experiment class and control class of 77, while for the middle grade of the experiment class is 76 and the control class is 81, and the mode in the experiment class and control class is 81. The variance size of the group covering the range or range for the experiment class was 69 and for the control class was 54. The standard deviation in the experiment class was 8.32 and the control class was 7.38. Based on the above exposure, it can be concluded that the initial ability of students in the experimental class as well as in the control class is the same.

2.2.1.1 Test Normality In Experimental Classes

Normality tests are used to determine whether both samples are of normal distribution or not. The normality test used in this study was Shapiro-Wilk with a significant level of 5%. Data normality test was conducted on each group, namely the experimental group and control group. The normality test results of the pretest data can be seen in the following table:

Table 2. Results of Pretest Data Normality Test In Experimental Class.

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST_RESULTS	.173	33	.014	.948	33	.113

a. Lilliefors Significance Correction

Based on the table above it can be found that the significance value of 0.113 >  $\alpha = 0.05$  so that H0 is accepted. This can be interpreted that the pretest data in the experimental class that gets the treatment of learning by learning mathematics with Geogebra Software comes from a normal distributed population.

2.2.1.2 Test Normality In Control Classes

The results of the normality test of mathematical creative thinking ability score performed by the control class students can be seen in the following table:

Table3. Data of Pretest Normality Test Results In Control Class.

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST_RESULTS	.173	30	.023	.941	30	.097

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk <sup>2</sup>		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST_RESULTS	.173	30	.023	.941	30	.097

a. Lilliefors Significance Correction

Based on table 3 it is known that the value of visible significance is  $0.097 > \alpha = 0.05$  so that  $H_0$  is received. This means pretests in control classes derived from normal distributed populations.

### 2.2.1.3 Data Pretest Homogeneity Test

Homogeneity tests are used to determine whether both classes have relatively the same characteristics or not, in addition the homogeneity test serves to determine the t-test. The homogeneity test used in this study was the Levene test. Summary of pretest homogeneity test results can be seen in the following table:

Table 4. Data Pretest Homogeneity Test Results.

Test of Homogeneity of Variance <sup>13</sup>						
		Levene Statistic	df1	df2	Sig.	
RESULTS	Based on Mean	3.393	1	58	.071	
	Based on Median	3.376	1	58	.071	
	Based on Median and with adjusted df	3.376	1	57.558	.071	
	Based on trimmed mean	3.410	1	58	.070	

Based on table 4, the significance value is  $0.071 > \alpha = 0.05$  until  $H_0$  is received. This means that students' pretest data in control classes and experiment classes is homogeneous.

### 2.2.2 Description of Data Posttest Experiment and Control Class

After the learning process is carried out in 6th classes, posttest is carried out. Data posttest value of mathematical creative thinking ability can be presented in the table below:

Table 5. Description of Experiment and Control Class Posttest Score Data.

Group	$X_{max}$	$X_{min}$	Central Tendency Size <sup>16</sup>			Group Variance Size	
			$\bar{x}$	Mo	Ma	R	S
Experiment	94	61	75	67	73	61	7.78
Control	88	55	68	61	67	66	8.12

Based on the table above, it can be seen that the highest score in the experiment class is 94 and the control class is 88, while the lowest score for the experiment class is 61 and the control class is 55. The central tendency size include an average (mean) for experimentation of 75 and a control class of 68, while for the middle grade of the experiment class is 73 and the control class is 67 while the mode in the experiment class is 67 and the control class is 61. The variance size of the group covering the range or range for the experiment class was 61 and the control class was 66. The standard deviation of the experiment class is 7.78 and the control class is 8.12. Based on these results, it can be concluded

that students' creative thinking ability in the experimental class is higher than the creative thinking ability of students in the control class.

### 2.2.3 Data Analysis Requirements Testing

#### 2.2.3.1 Experiment Class Posttest Data Normality Test

Normality tests are used to determine whether or not both samples are distributed normally. The normality test used in this study was shapiro-wilk with a significant level of 5%. Normality test is done on bound variable data that is mathematical creative thinking ability. The normality test of mathematical creative thinking ability data was conducted on each group, namely the experimental group and the control group. The results of the normality test of mathematical creative thinking ability scores performed by students of the experimental class can be seen in the following table:

**Table 6.** Results of The Normality Test of Creative Thinking Ability Experimental Class.

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
POSTEST_EXPERIMENT	.115	30	.200*	.967	30	.456

a. Lilliefors Significance Correction

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

Based on the analysis above it is known that the significance value is  $0.456 > \alpha = 0.05$  so that  $H_0$  is accepted. This means that the posttest data of students' creative thinking ability in experimental classes who get the treatment of math learning with Geogebra Software comes from a normal distributed population.

#### 2.2.3.2 Data Normality Test Posttest Control Class

The results of the normality test score of mathematical creative thinking ability in the control class can be seen in the following table:

**Table 7.** Normality Test Results of Creative Thinking Ability Control Class.

	Tests of Normality					
	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
POSTTEST	.123	30	.200*	.948	30	.148

a. Lilliefors Significance Correction

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

Based on table 7, it appears that the significance value is  $0.148 > \alpha = 0.05$  so that  $H_0$  is accepted. This means that the posttest data on students' creative thinking skills in control classes that get conventional learning treatment comes from a normal distributed population.

#### 2.2.3.3 Data Homogeneity Test posttest Creative Thinking Ability

Homogeneity tests are used to determine whether both classes have relatively the same characteristics or not, in addition the homogeneity test serves to determine the t-test. Homogeneity test is done on bound variable data that is mathematical creative thinking ability. The homogeneity test carried out in this study with the Levene test. Summary of homogeneity test results of posttest creative thinking ability score can be seen in the following table:

**Table 8.** Data of Homogeneity Test Results Posttest Creative Thinking Ability.

		Levene Statistic	df1	df2	Sig.
Math_Learning_Resul ts	Based on Mean	.377	1	60	.541
	Based on Median	.288	1	60	.593
	Based on Median and with adjusted df	.288	1	57.773	.593
	Based on trimmed mean	.356	1	60	.553

Based on the analysis above obtained the significance value taitu  $0.541 > \alpha = 0.05$  until H0 received. This means that the posttest data on students' creative thinking abilities and experimental classes is homogeneous.

2.2.3.4 Data Analysis of Creative Thinking Ability

After the posttest data collected can be analyzed data used to test the hypothesis. Hypothetical testing uses two average similarity tests. The analysis formula used is a parametric t-test formula. The reason why t-test is used is to find out if students' creative thinking ability using geogebra software is higher than the creative thinking ability of students using conventional learning models. If it is not higher then it can be concluded that the student has the same or flat ability. Here are the hypothetical test results:

**Table 9.** Hypothetical Test Table Creative Thinking Ability Score.

		Independent Samples Test									
		Levene's Test for Equality of Variances				t-test for Equality of Means					
								95% Confidence Interval of the Difference			
		F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
MAT	Equal variances assumed	.026	.872	3.044	58	.004	6.200	2.037	2.123	10.277	
H_LE											
ARNI											
NG_R	Equal variances not assumed			3.044	57.964	.004	6.200	2.037	2.123	10.277	
ESUL											
TS											

Based on the hypothesis test final test or posttest of mathematical creative thinking ability on flat side space building material can be seen that  $t_{hitung} \leq t_{tabel}$ ,  $t_{hitung} = 0.004$  this means at the level of significance  $\alpha = 0.05$  is  $H_0$  accepted and  $H_a$  rejected. The results of the hypothesis test prove that the creative thinking ability of students who use mathematics learning with geogebra software is higher than the creative thinking ability of students who use conventional learning models.

### 3.5. Discussion

This research discussion aims to find out if the creative thinking ability of students whose learning process uses Geogebra Software is higher than that using conventional learning models. Geogebra Software learning process is a computer application that can display variations of three-dimensional shapes, provide facilities to explore, perform achievements, and solve problems quite interactively. Learning with Geogebra Software emphasizes students to be actively involved, able to express their ideas as freely as possible during the learning process.

Based on the results of analysis of final test score data or posttest creative thinking ability of experimental class and control class,  $t_{hitung}$  hypothesis obtained by 0.004 while the significance level  $\alpha = 0.05$ , because  $t_{hitung} \leq t_{tabel}$  that showed that  $H_0$  was accepted and  $H_a$  was rejected. It is concluded that students' creative thinking ability using Geogebra Software is higher than students' creative thinking ability using conventional learning models.

This is supported by the findings in the field that during the learning process on the flat side room building material with Geogebra software learning, students look more enthusiastic and more active in following the learning process. This is seen during the learning process. Researchers stimulated by providing an overview related to the build of a flat-sided space displayed with Geogebra software. Researchers give problems that must be solved by each group, in this process students exchange ideas or work together to solve the problems given. This is in line with the results [6] which show that students are more motivated in learning so that the learning results obtained have increased after learning with Geogebra Software.

In addition, students also try to find solutions to problems provided by teachers with group discussions. On several occasions, students also ask questions related to material that is considered difficult to understand. In this activity, there was a significant change in students' creative thinking ability in solving math problems with the help of Geogebra software. These results are also supported by previous research conducted by Rizky Rahman which shows the positive and significant influence of learning on the learning process assisted by Geogebra Software on students' creative thinking ability [7]. This is in accordance with the results of research on Geogebra-assisted Discovery Learning Model which has the conclusion that geogebra-assisted discovery learning model is effective to improve students' problem solving skills [8].

Unlike conventional classes, in this class geogebra software is not used so it seems that students are not as special in following the teaching and learning process. Students tend to be passive and rely only on friends in their group to work on the questions given by the teacher.

### 3. Conclusion

Based on the results of analysis and discussion of research data, it can be concluded that students' creative thinking ability with learning using Geogebra Software is higher than the creative thinking ability of students using conventional learning models. Students with learning treatment using geogebra software have better creative thinking skills compared to students with learning treatment using conventional learning models.

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