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The Effect of Think Pair Share Learning Model with the Help of Geogebra Software on Students' Mathematical Communication Skills

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Abstract: The background of this study was the lack of mathematical communication skills of students. Researchers chose the think pair share of cooperative learning model with the help of GeoGebra software to overcome this students' lack of mathematical communication skills. The purpose of this study was to determine the implementation and whether there was an influence of the think pair share of the cooperative learning model with the help of GeoGebra software on students' mathematical communication skills. This research was a type of quasi-experimental research and the design used was the pretest-posttest control group design. The population of this study was 320 students of the eighth grade at MTs Negeri 1 Purbalingga. The research sample was 40 students of VIII A as a control class and 39 students of VIII B as an experimental class. Based on the analysis of observation sheet data, an average value of 3.38 was obtained and was located at intervals of $3.25 \leq x \leq 4.00$ which was classified as very good. Based on the results of the t-test against the post-test results that had been done, the value of Sig. $0.000 < 0.05$ which showed that there was an average difference in mathematical communication skills between the experimental class and the control class. This study concludes that the implementation of the think pair share learning model with the help of GeoGebra software is very good, it can affect the improvement of students' mathematical communication skills.
Keywords: Geogebra Software; Mathematical Communication Skills; Think Pair Share.

A. Introduction

Mathematics is one of the sciences that underlies the development of modern technology and is able to develop a human mindset so that it has a role in improving the quality of human resources. With mathematics, humans have a mindset that makes sense and are able to communicate a series of symbols and ideas to others (Hendriana, 2019:4).

In KTSP (2006) which has been refined in the 2013 Curriculum, mathematics learning in schools has the aim that students are able to: 1) understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms flexibly, accurately, efficiently, and precisely in problem solving, 2) use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements, 3) solve problems, 4) communicate ideas with symbols, diagrams, or other media to clarify circumstances or problems, 5) have an attitude of appreciating the usefulness of mathematics in life, have curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving, and 6) use simple and modern teaching aids to carry out mathematical activities (Hendriana, 2019:7).

The objectives of mathematics learning listed in the 2013 curriculum above, there are two important points, namely mathematics learning aims to make students able to communicate

ideas with symbols, tables, diagrams, or other media to clarify situations or problems and use simple and modern teaching aids to carry out mathematical activities. This shows that mathematical communication skills are one of the essential basic mathematical skills that must be possessed by high school students (Hendriana, 2018:59). Through a good mathematical communication process, students can use it to convey their ideas or ideas both verbally and in writing with symbols, images, algebraic expressions, graphs, or diagrams in explaining problems or circumstances from the information obtained. Students who have low mathematical communication skills, can certainly have difficulty in conveying their ideas both verbally and in mathematical writing.

The high and low mathematical abilities possessed by students cannot be separated from the process of learning mathematics. The current trend of the learning process is still centered on teachers with a lecture or storytelling learning model. Students are less actively involved in the learning process, so the level of student comprehension of the subject matter is low (Nurfuadi, 2020:143).

The mathematical communication skills of each individual will have an influence on the learning process and outcomes. Mathematics learning requires mathematical communication so that students can construct and communicate mathematical knowledge and mathematical problem solving, organize and combine mathematical ways of thinking, and use mathematical language to express and represent ideas correctly (Hendriana, 2018:60). Therefore, students' mathematical communication skills need special attention to be further developed in mathematics learning.

Indicators of mathematical communication according to the Ontario Ministry of Education quoted by Heris Hendriana, et al., include: a) Written text, which explains the model of the situation or problem using its own language either orally, in writing, graphs, concrete or algebra; explain and make mathematical questions from the material that has been studied; listening, discussing, and rewriting mathematics; determine the relationship between models, constructing arguments, and summing up arguments; b) Drawing, which describes a model of a mathematical situation or problem into visual form (drawing, table, or diagram); and c) Mathematical expressions, which express mathematics or express a model of a mathematical situation or problem into mathematical language or symbols.

Based on observations of mathematics learning at MTs Negeri 1 Purbalingga, it was found that mathematics learning sometimes uses conventional learning models, such as lecture methods, questions and answers and practice questions together. So that the learning is still teacher-centered and does not seem too student-centered. This causes students to act passively. Such a learning model makes students' mathematical skills less honed, especially students' mathematical communication skills. The lack of mathematical communication skills of students can be seen in the student learning process on relation and function material and circle material, where students have difficulty in explaining problem models using their own language and presenting them into visual form (pictures, tables, or diagrams). Students still need help in the form of direction from the teacher to communicate the problem model into language or mathematical symbols or vice versa. In addition, students also provide less feedback on the presentation of problems given by the teacher, because they are less able to construct arguments on the problem.

To overcome these problems, a learning design is needed that is able to familiarize students to construct their thoughts both with teachers, friends, and mathematical material. One way that can be done to improve students' mathematical communication skills is to use the right learning model, one of which is by group discussion (Abdi, 2018:100). Group discussions can provide opportunities for students to construct their knowledge so that they can understand the concepts taught easily and students are able to communicate mathematical ideas in verbal and written form. To support group discussions can be used by applying a cooperative learning model.

The cooperative learning model is a learning model that allows students to cooperate and interact with fellow students in structured tasks (Ertikanto, 2016:185). This cooperative learning model has several types that can be used for alternative learning models in the classroom. Some cooperative learning models are able to attract students' attention and make them quite active in learning mathematics. In addition, a cooperative learning model that can encourage students to play an active role in class and can improve students' mathematical communication skills is the Think Pair Share type cooperative learning model (Ansari, 2016:91).

This is in line with research conducted by Ika Marantika, et al which states that the mathematical communication skills of students who follow think pair share learning are higher than the mathematical communication skills of students who follow conventional learning (Marantika, 2020:20). On the other hand, research conducted by Davi Apriadi resulted in the conclusion that the cooperative learning model and conventional learning model provide the same results when given to students with high or low learning activities (Apriandi, 2012:14). Based on the two studies that obtained different results, in this study the author will design research using a cooperative learning model of think pair share type.

The think pair share learning model is one of the cooperative learning models which in its application is aimed at influencing student interaction patterns and providing opportunities for them to convey their participation to fellow students and teachers. This model introduces the idea of 'wait or think time'. The interaction process in cooperative learning requires students to communicate directly with other students, give each other information or knowledge and exchange ideas, and practice defending their opinions if they are worth defending (Ertikanto, 2016:186).

Based on the mathematics learning objectives listed in the 2013 curriculum, one of the other important points is to use simple and modern teaching aids to carry out mathematical activities. Therefore, the learning process of think pair share in this research will use geogebra software as a modern teaching aid. Geogebra software is designed as a learning medium used to support mathematics learning activities (Syahbana, 2016:2). Its display is maximally able to help the representation of mathematical concepts in multimode. This software can be installed on a computer or can be accessed online by anyone and can be used at any time (Syahbana, 2016:2). Therefore, this software is very useful for teachers and students to support mathematics learning activities related to geometry, algebra, calculus, linear programs and statistics. There are many menus and tools available in this software. So that with guidance and direction from the teacher, students will be able to easily use and understand mathematics subject matter.

From the statements above, this study will explain how the implementation of the think pair share cooperative learning model with the help of geogebra software to improve students' mathematical communication skills and whether there is an influence of the think pair share cooperative learning model with the help of geogebra software on students' mathematical communication skills. Based on the problems described above, researchers are interested in conducting an experimental study entitled "The Effect of the Think Pair Share Cooperative Learning Model with the Help of Geogebra Software on the Mathematical Communication Skills of Class VIII MTs Negeri 1 Purbalingga Students".

B. Methods

This research is a type of quasi-experimental research (quasy experimental design) and the design used is the pretest-posttest control group design involving experimental classes and control classes.

Table 1. Research Design

Subject	Initial Test	Treatment	Final Test
Experimental Class	$X_{1(1)}$	A	$Y_{1(1)}$
Control Class	$X_{1(2)}$	B	$Y_{1(2)}$

Information:

$X_{1(1)}$: Initial test for experimental class
$X_{1(2)}$: Initial test for control class
$Y_{1(1)}$: Final test for experimental class
$Y_{1(2)}$: Final test for control class
A : Using the think pair share cooperative learning model with Geogebra Software Help
B : Using conventional learning models

The population in this study is all grade VIII MTs Negeri 1 Purbalingga students who are enrolled in the even semester of the 2022/2023 academic year. There are 8 classes in total and the total number of students is 320 students. Then, the sample in this study will be taken using purposive sampling techniques, Based on the sampling, it was obtained that the experimental class was class VIII B with a total of 39 students, while the class that became the control class was VIII A with a total of 40 students.

The data collection method uses observation and tests. In this study, researchers will implement the think pair share cooperative learning model with the help of geogebra software. Then, researchers will be observed and assessed by observers in the application of this learning model in the classroom. The observer that the researcher chose was one of the mathematics teachers of MTs Negeri 1 Purbalingga and one of the 8th semester students of the mathematics tadris study program UIN SAIZU. The research instrument is in the form of an observation sheet. The test that the researcher will give is in the form of a description test that will be given at the beginning of the study (pre-test) and the end of learning (post-test) in each research class. This method researchers use to measure the mathematical communication skills of grade VIII students at MTs Negeri 1 Purbalingga. Research instruments in the form of pre-test and post-

test that have been tested and tested for validity and reliability. Validity uses the validity of content that is validated directly by experts, namely Muhammad 'Azmi Nuha, M.Pd as a supervisor and lecturer of Tadris Mathematics UIN Prof. K.H. Saifuddin Zuhri Purwokerto and Maresesa Ulfah Nurikasari, S.Pd as a teacher of mathematics subjects MTs Negeri 1 Purbalingga. The average scores for pre-test and post-test were 3.50 and 3.66 and included in the very valid criteria.

The next validity test is the validity of the item using the Pearson Product Moment correlation with significance = 5%, namely rcalculate rtabel then the instrument is valid, while if rcalculate < rtabel then the instrument is invalid. This pre-test and post-test were tested on 40 students, with the help of SPSS 23 for windows, there were 5 valid questions, with r rtable = 0.312. After that, reliability tests were carried out with Alpha Cronbach with the decision criterion being that if the Alpha Croncbach coefficient (r) > 0.60 then it can be said that the instrument is reliable. The results of the pre-test reliability test were 0.731 > 0.60 and 0.643 > 0.60 for the results of the post-test reliability test. So that the instrument is reliable. Based on the validity and reliability test, only 3 out of 5 questions were used with criteria that met each indicator of mathematical communication ability.

After the research process and generating data, the next step is to analyze the data. To analyze the observation sheet, the following scoring guidelines are used.

Table 2 Observation Sheet Scoring Guidelines

Scoring Coefficient	Correlation	Activity Interpretation
$3{,}25 \leq x \leq 4$	Excellent	Carry out activities in accordance with the RPP
$2.5 \leq x < 3.25$	Good	Carry out activities almost in accordance with the RPP
$1.75 \leq x < 2.5$	Enough	Doing activities worse than RPP
$1 \leq x < 1{,}75$	Not enough	Not carrying out activities in accordance with the RPP

And to analyze each pre-test and post-test results using 3 kinds of tests, namely the normality test (Kolmogorov-Smirnov test), homogeneity test (Levene test), and t test. The normality test is used to determine whether the data comes from a normal population, with the test criterion being if the significance level of p-value < $\alpha = 0.05$, then the data is not normally distributed. Meanwhile, if the significance level of p-value $\geq \alpha = 0.05$, then the data is normally distributed (Anwar, 2009:88). Furthermore, the homogeneity test is used to find out whether the variance of data from the analyzed sample is homogeneous or not. The test criteria used are Sig. $\geq$ 0.05, so the data is homogeneous. Meanwhile, if Sig. < 0.05, then the data is inhomogeneous (heterogeneous) (Subando, 2019:36). And the t-test is used to find out the significant difference between the experimental class and the control class. This t-test is done by comparing the calculated values of sig. with a value of 0.05. In this study, for the t test will use the help of SPSS 23 for windows. The test hypothesis carried out is as follows:

H0 is accepted if the calculated value < ttable or the sig value. (2-tailed) > α

H1 is accepted if the calculated value > ttable or the sig value. (2-tailed) < α

If there is an acceptance of H0, it can be concluded that there is no significant effect. Meanwhile, if there is a rejection of H0, it can be concluded that there is an influence of the think pair share cooperative learning model with the help of geogebra software on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

C. Results and Discussion

The study was conducted from May 15, 2023, to May 27, 2023. The learning process is carried out in 4 meetings and 2 meetings for pre-test and post-test. The experimental class uses a think pair share cooperative learning model with the help of geogebra software. While the control class uses a conventional learning model. The learning material is relatively the same, namely discussing the surface area of the prism, the surface area of the pyramid, the volume of the prism, and the volume of the pyramid. In this result and discussion, data analysis is assisted by using SPSS 23.0 for windows.

1. Data Analysis of Think Pair Share Cooperative Learning Model Implementation with the help of Geogebra Software

   After observation by observer 1, namely Mr. Ghofur Riyanto as a mathematics teacher and Destiana Herawati as observer 2 who is a student of Tadris Mathematics UIN SAIZU. The results of observations using observation sheets are as follows:

Table 3 Implementation observations

	Observer	Total Score	Value
1	Observer 1	42	3,23
2	Observer 2	46	3,53
3	Score Average	44	3,38

In accordance with the scoring guideline criteria, an average value of 3.38 was obtained and was located at intervals of $3.25 \leq x \leq 4.00$ which was classified as very good. Thus, based on these observations, it can be concluded that the implementation of the think pair share cooperative learning model with the help of geogebra software is carried out very well.

2. Data Analysis of the Effect of Think Pair Share Cooperative Learning Model with the help of Geogebra Software on Mathematical Communication Skills

   The following are the results of pre-test and post-test data analysis after treatment in experimental and control classes:

a. Pre-Test Data Analysis

   Pre-test data of the experimental class and the control class were obtained before the two classes were given treatment by the researcher. Both classes still get the same treatment from math teachers in learning to build flat side spaces (cubes and blocks). The following are the pre-test results of mathematical communication skills of experimental and control class students:

Table 4 Pre-Test Value Data of Experimental Class and Control Class

		E	C
1	Higest Score	65,2	69,6
2	Lowest Score	39,1	43,5
3	Score Average	51,3	52,9

b. Results and Discussion of Pre-Test Normality Test

The normality test uses the Kolmogorov-Smirnov test with the test criteria used is if the significance level of the p-value < α = 0.05, then H_0 is accepted. Meanwhile, if the significance level of *p-value* ≥ *α* = 0.05, then H_0 is rejected. The results of the pre-test normality test are as follows:

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreTest	.098	79	.059	.979	79	.224
a. Lilliefors Significance Correction						

Figure 1. Pre-Test Normality Test Output

Based on the data above, it was found that the significance value of the p-value was 0.059 ≥ 0.05. From the test criteria that have been set, namely the significance of the p-value ≥ α = 0.05, with the decision H_0 rejected, the data is normally distributed. So it can be concluded that the pre-test data is already normally distributed.

c. Results and Discussion of Homogeneity Test & Pre-Test t Test

The homogeneity test uses the levene test, with the test criteria being Sig. ≥ 0.05, then the data is homogeneous. Meanwhile, if Sig. < 0.05, then the data is inhomogeneous (heterogeneous). And for the t test using an independent sample t test. The output of homogeneity test and t test using the help of SPSS 23.0 for windows, as follows:

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
Pre Test	Equal variances assumed	1.616	.207	1.726	77	.088	5.0685	2.9363	.7785	10.9155

	Equal variances not assumed			1.724	75.685	.089	5.0685	2.9403	.7881	10.9251

Figure 2. Pre-Test t-Test Output

Based on the SPSS output above, it was found that the Sig. value in the levene test was 0.207 ≥ 0.05. So it can be concluded that the pre-test data of the two classes are homogeneous. And the independent sample t test obtained the calculated value of Sig. which is 0.088. Based on the test criteria, the calculated value of Sig. is compared with a value of 0.05. The value of Sig. 0.088 > 0.05, then H_0 is accepted. So it can be concluded that there is no difference in mathematical communication skills between the experimental class and the control class.

d. Post-Test Data Analysis

Post-test data of the experimental class and the control class were obtained after both classes were given treatment by the researcher. The experimental class received treatment using the think pair share cooperative learning model with the help of geogebra software. Meanwhile, the control class received treatment using conventional learning models. The following are the post-test results of mathematical communication skills of class VIII A students as a control class and class VIII B as an experimental class.

Table 5 Post-Test Value Data of Experimental Class and Control Class

		E	C
1	Higest Score	95,7	87,0
2	Lowest Score	60,9	43,5
3	Score Average	80,5	65,9

e. Results and Discussion of Post-Test Normality Test

The results of the post-test normality test are as follows:

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Post Test	.071	79	.200*	.984	79	.426
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Figure 3. Post-Test Normality Test Output

Based on the data above, it was found that the significance value of the p-value was 0.200 ≥ 0.05. From the test criteria that have been set, namely the significance of the p-value ≥ α = 0.05, with the decision H_0 rejected, the data is normally distributed. So it can be concluded that the pre-test data is already normally distributed.

f. Results and Discussion of Homogeneity Test & t Test Post-Test

This t test is performed by comparing sig values. with a value of 0.05. H_0 is accepted if the tcount value < ttable or the sig. (2-tailed) value > α. And H_1 is accepted if the tcount value is > ttable or the sig. (2-tailed) value < α. If there is an acceptance of H_0, it can be concluded that there is no difference in the average mathematical communication ability between the experimental class and the control class. Meanwhile, if there is a rejection of H_0, it can be concluded that there is an average difference in mathematical communication skills between the experimental class and the control class. The output of homogeneity test and t test using the help of SPSS 23.0 for windows, as follows:

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
Post Test	Equal variances assumed	3.589	.062	6.423	77	.000	14.6276	2.2773	10.0929	19.1622
	Equal variances not assumed			6.451	70.160	.000	14.6276	2.2675	10.1054	19.1497

Figure 4. Post-Test t Test Output

Based on the SPSS output above, it is found that the Sig. value is 0.062 ≥ 0.05. So it can be concluded that the post-test data of the two classes are homogeneous. And Based on the table above, the independent sample t test obtained the calculated value of Sig. which is 0.000. Based on the test criteria, the calculated value of Sig. is compared with a value of 0.05. The value of Sig. 0.000 < 0.05, with the H_1 decision accepted, it can be concluded that there is an average difference in mathematical communication skills between the experimental class and the control class. In other words, it can be concluded that there is an influence of the think pair share cooperative learning model on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

D. Conclusion

1. The implementation of the think pair share *cooperative learning model* with the help of *geogebra software* is very well applied as a variation of the mathematics learning model in schools. In addition, variations of this learning model can also improve students' mathematical communication skills. This can be proven by the results of observation sheets that are in accordance with the *syntax of* the think pair share *learning model* with

the help of *geogebra software* with an average value of 3.38 and located at intervals of $3.25 \leq x \leq 4.00$ which are classified as very good criteria.

2. There is an influence of *the think pair share* cooperative learning model with the help of *geogebra software* on students' mathematical communication skills. This can be seen from the results of the *independent sample t test* (t-test) which obtained a Sig. (2-tailed) value of $0.000 < 0.05$, then H1 is accepted which means that there is an average difference in mathematical communication skills between the experimental class and the control class. The average *post-test* of mathematical communication skills of experimental class students was 80.5, while the *average post-test* of the control class was 65.9. From these results, it proves that the average mathematical communication ability of experimental class students is higher than that of the control class. Thus, there is an influence of the *think pair share cooperative learning model* with the help of *geogebra software* on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

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