

Research Article

Improving students' mathematical problem-solving ability through the think pair share cooperative learning model: A study of the quantitative experimental

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ABSTRACT

This study aims to see the improvement of students' mathematical problem solving ability through the application of Think Pair Share type cooperative learning model. Mathematical problem solving is the ability to identify the elements known, asked, and the sufficiency of the elements needed, able to make or compile mathematical models, can choose and develop solution strategies, able to explain and re-examine the answers obtained. This research uses a quantitative approach with a quasi experimental design and a nonequivalent control group design. The sample selection technique is using purposive sampling technique. The population in this study were all students of SMP Negeri 1 Juli class, while the samples were two classes, namely class VII2 as the experimental class and class VII3 as the control class. The data collection technique in this study used a mathematical problem-solving ability test. Data analysis carried out for the mathematical problem-solving ability test using non-parametric tests because the data is not normally distributed, the data is processed using SPSS 18 software and the results of non-parametric tests obtained a significant value of $0.000 < \text{significant level } \alpha = 0.05$ then according to the hypothesis criteria If the significance value < 0.05 then H_0 is rejected and H_a is accepted. So, it can be concluded that the mathematical problem-solving ability of students who get the application of the Think Pair Share type cooperative learning model is better than students who get the scientific learning model.

Keywords: mathematics-learning; mathematical problem-solving ability; think pair share; quantitative experimental

1. INTRODUCTION

The National Council of Teachers of Mathematics (NCTM, 2000: 67) states that there are five abilities that students must have in learning mathematics, namely mathematical problem solving, mathematical reasoning, mathematical communication, mathematical connection and mathematical representation. According to Polya (Lambertus, 2011) problem solving is an attempt to find a way out of a difficulty and achieve a goal that cannot be achieved immediately. Gunantara (2014) states that problem solving is the ability or potential that students have in solving problems and applying them in everyday life. According to Kusumawati (Mawaddah, 2015) mathematical problem solving is the ability to identify the elements known, asked, and the sufficiency of the elements needed, able to make or compile mathematical models, can choose and develop solution strategies, able to explain and re-examine the answers obtained.

Based on some of the above opinions, the researcher concludes that problem solving ability is a person's effort to find a way out in solving problems by identifying the necessary elements, compiling models, developing solution strategies and applying them in everyday life. In addition, problem solving is so important that it is the general purpose of teaching mathematics, even as the heart of mathematics, meaning that problem solving ability is the basic ability that a person must have in learning mathematics (Fauziah, 2010). Judging from these objectives, problem solving is quite important in the learning process of mathematics. The importance of problem solving skills is not in line with the reality, students' mathematical problem solving skills are still relatively low. This is evidenced by the results of research conducted by Putra (2014) on junior high school students which showed that the average mathematical problem solving ability in the experimental class was 0.20 with a low improvement classification and for the control class it was 0.15 with a low improvement clarification. This shows that the increase in mathematical problem solving ability in both classes is still relatively low.

This is also in line with the results of interviews and observations that researchers conducted at SMP Negeri 1 Juli with Mrs Siti Aisyah S.Pd (mathematics teacher) class VII showed that students' mathematical problem solving skills are still very low, because students do not understand mathematical concepts, do not pay attention to what the teacher explains and can be seen from the number of students who do not understand how to solve problems in mathematics, most students

consider mathematics a difficult lesson because the material is difficult to understand and not interesting. Students have difficulty when given practice problems related to everyday life even though the supporting material to solve these problems has been taught by the teacher. Students do not identify known elements, compose problems, and solve answers. So that students do not solve problems properly and correctly. To be clear, based on the problems given by researchers at SMP Negeri 1 Juli, the level of problem solving ability is still low.

Problem:

Nailul bought 8 watermelons. He paid 2 hundred thousand notes and got change for Rp. 20,000. how much is the price of each watermelon? (a) From the information make known and asked from the problem, (b) Make a mathematical model to determine the price of each watermelon, (c) if Nailul buys 5 watermelons how much does he have to pay, (d) check again.

Jawaban

a. Diketahui :

8 buah semangka
2 Lembar uang seratus ribu kembalian 20.000

Dit :

Harga pembelian tiap buah semangka
Harga membeli 5 buah semangka

b. Harga pembelian tiap buah semangka
= 8 buah semangka : $2 \times 100.000 - 20.000$
= 8 buah semangka : 180.000
= 10.000

c. Harga 5 buah semangka
 5×10.000
= 50.000

d. Benar, pembelian 5 buah semangka adalah 50.000

Errors in drafting

Error in solving the problem

Does not check his/her answer again

Figure 1. One student's answer

Based on Figure 1. shows the less-than optimal problem-solving ability because there are student answers that are incomplete and correct, from the above problems there are 4 stages of solving a problem, namely understanding the problem, composing a solution, solving the problem and finally checking back. Based on student answers at the stage of understanding the problem, students are able to know what is known and what is asked in the problem, then at the hold planning the solution students also do not understand how to solve, students should first find the total amount and then find the amount of each watermelon and make it in a mathematical model so that it makes students mistaken in solving the problem. And in the final stage students do not recheck the answer to make sure the answer they have given is correct and in accordance with the problem. Therefore, to overcome these problems, it is necessary to develop a learning model related to problem solving skills, one of which is a cooperative learning model. In addition to helping students understand difficult concepts, cooperative learning models can also be useful in helping students solve problems as well as fostering students' cooperation skills in their groups and training students in understanding the material presented.

The cooperative learning model for learning improvement that is in accordance with the problem is the Think Pair Share model. The Think Pair Share cooperative learning model is a type of cooperative learning designed to influence students' interaction patterns, this activity encourages students to get used to thinking first independently, then working in pairs (Warsono & Hariyanto, 2012). With the Think Pair Share of cooperative learning model, students are given time to think individually and then grouped in pairs to work together and build knowledge, after which each group is given time to present the results of the discussion. Based on the background of the problems described above, the research was conducted with the title "Improving students' mathematical problem-solving ability through the think pair share cooperative learning model: A study of the quantitative experimental"

2. RESEARCH METHOD

The approach used in this research is a quantitative research approach. According to Sugiyono (2016: 8), quantitative research can be interpreted as a research method based on researching certain populations or samples, collecting data using research instruments, quantitative/statistical data analysis with the aim of testing predetermined hypotheses. The type of research used in this research is quasi experimental design (pseudo experiment) with data analysis techniques processed from data obtained from research results in the form of numbers and analysed using statistical formulas.

According to Sugiyono (2016: 72), quasi experimental design has a control class, but cannot function fully to control outside variables that affect the implementation of the experiment, quasi experimental design is used because in reality it is difficult to get a control class used for research.

Based on the study objectives, namely to determine the improvement of students' mathematical problem-solving ability through the implementation of the Think Pair Share learning model. Researchers treated the experimental class with the Think Pair Share type cooperative learning model which was carried out in the odd semester of the 2022/2023 academic year. Meanwhile, the control class used a scientific learning model. The design used is nonequivalent control group design, as stated by Sugiyono (2016: 79), as follows:

Table 1. Research design

Groups	Pre-test	Treatment	Post-test
Experiment	O1	X	O2
Control	O3	-	O4

(Sources: Sugiyono 2017:79)

Description:

- O1 : Pre-test for Experiment class
- O2 : Post-test for Experiment class
- X : Implementation of the Think Pair Share
- O3 : Pre-test for Control class
- O4 : Post-test for Control class

This study was conducted at SMP Negeri 1 Juli in Bireuen Regency. The researcher chose this location as a place to conduct study with the following considerations: The location of SMP Negeri 1 Juli on the side of Jl. Bireuen-Takengon KM. 4 Juli, Bireuen and located in Paloh Village which makes researchers easy to reach. This school is open to the possibility of carrying out research using the Think Pair Share learning model. This study was conducted in the odd semester of the 2022/2023 school year.

The population in this study were all students of SMP Negeri 1 Juli in the 2022/2023 academic year consisting of 5 classes, namely VII1, VII2, VII3, VII4, and VII5. Researchers used purposive sampling technique, which is a sampling technique by way of consideration. In purposive-sampling, the sample members selected are samples that have homogeneous characteristics taken into consideration from the time of implementation and classes that make it possible to carry out research. The sample is part of the overall object owned by the population (Sugiyono, 2016: 81). The samples in this study were two classes of students from five VII classes. The samples were class VII2 as the experimental class and class VII3 as the control class. In this study, the test type instrument was a test of students' mathematical problem-solving ability. The tests that researchers use are tests given to students before and after the learning process (pre-test and post-test) which aims to determine the existence of an increase in students' mathematical problem-solving skills through the application of the Think Pair Share type cooperative learning model consisting of 7 questions in the form of descriptions concerning social arithmetic material with a time allocation of 90 minutes. Then 5 questions will be used in the pre-test and post-test questions in learning. As for obtaining accurate data, the test is used. Tests that meet good criteria, namely test validity, reliability, differentiating power, and which have a minimum difficulty level of moderate.

3. RESULTS AND DISCUSSION

3.1 Results

This study is quantitative in which data is obtained in the form of numbers which are then analyzed using SPSS 18. Data The results of this study are analyzed to determine the increase in students' mathematical problem-solving capabilities through the application of the Think Pair Share Cooperative Learning Model. Researchers have conducted research at SMP Negeri 1 Juli in the odd semester on July 12-31 July in the school year 2022/2023. In this study involving two classes, namely class VII2 is an experimental class where the class was given pre-test questions after that was given treatment using the Think Pair Share cooperative learning model and then given a post-test question, with a total of 20 students. Whereas class VII3 is a control class given pre-test after that gets learning that uses scientific learning and then given a post-test, and also the students totaling 20 people. The results of data that have been collected and obtained by researchers are data on students' mathematical problem-solving capabilities and obtained from test instruments, namely pre-test and post-test. Pre-test data and post-test both classes, namely the experimental class and the control class, the N-Gain test, normality test, homogeneity and hypothesis test (T-test) will be carried out using SPSS 18.

The following is a table that uses pre-test descriptive data, post-test, and N-gain for students' mathematical problem-solving capabilities tests. The pre-test and post-test scores are as follows:

Table 2. Data Score of the Mathematical Problem-Solving Ability in Experimental Class

Value	Experimental class				
	N	Xmin	Xmax	\bar{x}	s
Pre-test	20	0	48	25,4	14,641
Post-test	20	48	80	61,2	10,155
N-Gain	20	0,53	1,00	0,6	0,125

Maximum Score = 80

Table 3. Data Score of the Mathematical Problem-Solving Ability in Control Class

Value	Control Class				
	N	Xmin	Xmax	\bar{x}	s
Pre-test	20	0	60	32,0	18,896
Post-test	20	32	72	49,4	12,800
N-Gain	20	0,22	0,6	0,37	0,120

Maximum Score = 80

Based on **Table 2** and **Table 3**, an average pre-test of students' mathematical problem-solving capabilities is obtained in the experimental class 25.40 and in the control class 32.00 from the ideal maximum score of 80. The second average pre-test is not relatively the same, this shows that the ability of students' mathematical solving in both classes before learning is not the same relative. The difference that can be concluded based on the average pre-test score is that the ability to solve students' mathematical problems in the experimental class is no better than the ability to solve students' mathematical problems in the control class. It is clear that the pre-test results of the experimental class $25.40 < 32.00$ which is the result of the control class pre-test. After being given learning using cooperative learning type Think Pair Share in the experimental class and scientific learning in the control class, a post-test test is carried out. The results of the students' mathematical problem-solving abilities are different. The difference in the average post-test score of the two classes is the ability to solve the mathematical problem of experimental class students increased to 61.20 and the ability to solve students' mathematical problems in the control class increased to 49.40. Seen after post-test in both classes the ability to solve mathematical problems of students in the experimental class is better than the ability to solve students' mathematical problems in the control class. This can be seen in the following rod diagram to be more-clear in comparing the average pre-test and post-test scores, along with the average score of students' mathematical problem-solving capabilities in pre-test and post-test.

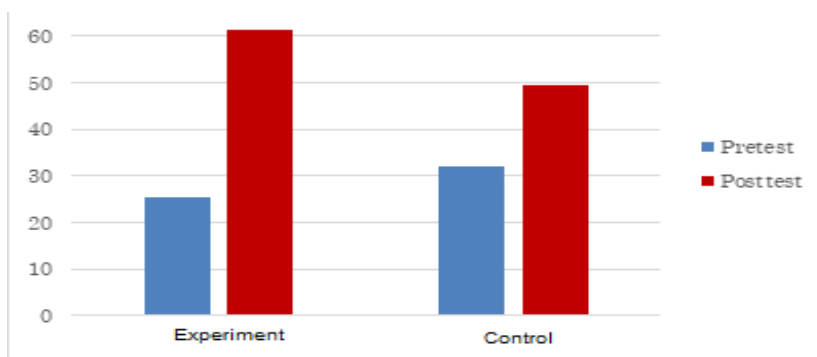


Figure 2. Pre-test score diagram and post-test ability to solve mathematical problems

The N-Gain results aim to see whether the ability to solve the mathematical problem of students taught through the application of the Think Pair Share Cooperative Learning Model is better than scientific learning, and can see an increase in students' mathematical problem-solving skills through the following image diagram.

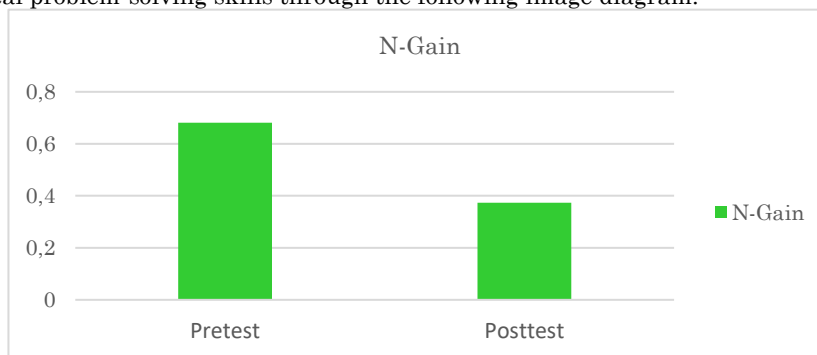


Figure 3. N-Gain Diagram The ability to solve mathematical problems

Based on **Figure 3**, states that the average N-Gain experimental class has an average of 0.6 (medium category), while the control class has an average of 0.37 (medium category). The results of this study indicate that the ability to solve students' mathematical problems increases. The ability to solve students' mathematical problems through the application of the Think Pair Share type cooperative learning model is better than the ability to solve students' mathematical problems through scientific learning on social arithmetic material. So that the application of the Think Pair Share Cooperative Learning Model is more effective to improve mathematical problem-solving capabilities.

Hypothesis test

Before the hypothesis test is carried out, prerequisites testing which includes the normality test and homogeneity test. The following is described the results of testing normality and homogeneity of the data score of the mathematical connection of students who are processed with SPSS 18 software.

N-Gain normality test

Normality test N-Gain score aims to see whether the test data obtained from the pre-test and post-test values are normally distributed or not. If the data is normally distributed, it can be continued with the homogeneity test. While the test data is not normal, then followed by a non-parametric test. This study uses the Shapiro-Wilk technique because the sample in this study is less than 30. where the significant value is greater than 0.05, the data is normal distributed. The formulation of the hypothesis used is:

- Ho: The sample comes from a normally distributed population
- Ha: Samples come from an abnormal population

- If the value of sig (p-value) < α ($\alpha = 0.05$) then Ho is rejected
- If the value of sig (p-value) $\geq \alpha$ ($\alpha = 0.05$) then Ho is accepted

The following are the results of the calculation of the data normality test for the experimental class and the control class using SPSS 18 software presented in **Table 4**.

Table 4. Normality Test Results Data

Groups	Shapiro-Wilk		
	Statistic	Df	Sig.
Experiment	0,881	20	0,019
Control	0,887	20	0,023

The normality test results for the N-Gain score of students' mathematical problem-solving capabilities in the experimental class have a significant value of 0.019 and the control class obtained a significant value of 0.023 then the results of the two classes < 0.05. So that the experimental class data and control classes are abnormal. This is because the significant results of the experimental class and the control class < 0.05 then Ho is rejected and HA is accepted. So that the N-Gain Score Data the ability to solve students' mathematical problems in the experimental class and the control class is not normally distributed, so it is not necessary to find homogeneity.

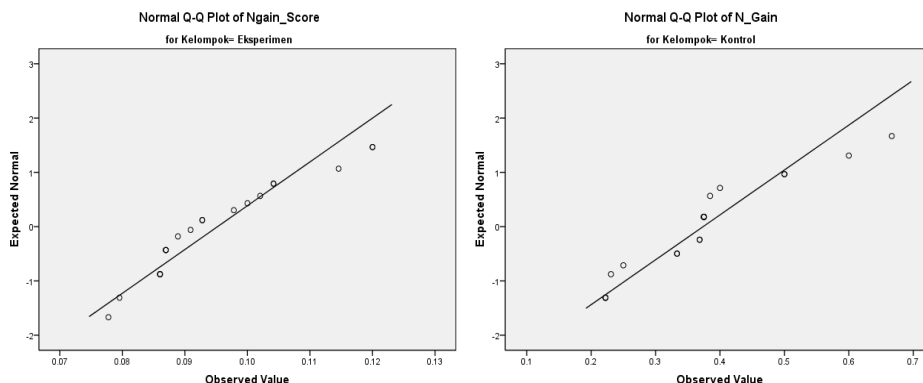


Figure 4. Graph of Normality Test Results N-Gain Experimental Class and Control Class

Based on **Figure 4**, shows that points or data spread randomly to the diagonal line. If the residual is not normally distributed, the points that describe the data will stay away or spread and do not follow the diagonal line. In this figure shows that the points or data spread randomly to the diagonal line, this proves that the results of the data in the experimental class are not normally distributed. Because both data are not normally distributed, the testing used for collecting hypotheses is to use a non -parametric test.

Non-parametric test the ability to solve students' mathematical problems

Based on the results of the previous normality test, it is concluded that the N-Gain Experimental class score and the control class are abnormal, so as to prove that the N-Gain score of the mathematical problem-solving capabilities of the experimental class students is better than the control class, the average comparison test is carried out The average N-Gain score using a non-parametric test (Mann-Whitney U-Test). The examiner is based on the following hypothesis:

The following is a table of t-test results as follows:

Table 5. Data on the Comparison Test Results N-Gain Rank Ability to Solution Ability

Statistics	Value	Description	Conclusion
Mann-whitney U	15,500	Ho rejected	Hypothesis is accepted
Asymp. Sig (1-tailed)	0,000		

Based on the results of the Mann-Whitney U-Test in **Table 5**, the ASYMP value was obtained. Sig. (1-tailed) $0,000 < \alpha = 0.005$. This shows that Ho is rejected, meaning that the increase in the problem-solving ability of experimental class students is significantly better than the control class students, thus it is proven that the hypothesis that states the ability to solve the mathematical problem of students who obtain the application of the Think Pair Share learning model more both from students who get a scientific learning model.

3.2 Discussions

The results showed that there was an increase in student mathematical problem solving through the application of the Think Pair Share cooperative learning model in the experimental class with the hypothesis value of 0,000, because in the learning model the teacher distributed students into pairs of groups to facilitate students to resolve each other Problems simultaneously, so students can connect the thoughts with one another. So, it can be concluded that there is an increase in student mathematical problem solving through the application of the Think Pair Share cooperative learning model. The following are students' answers with indicators of students' mathematical problem-solving abilities:

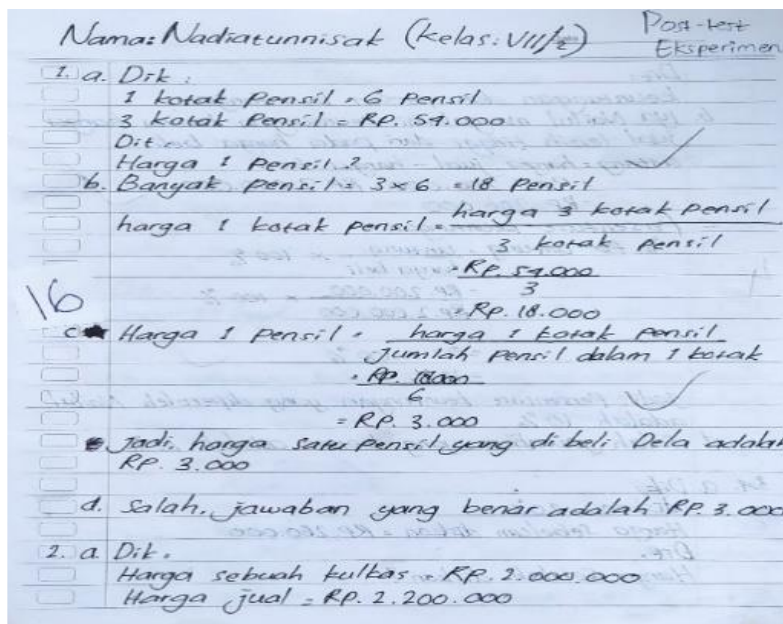


Figure 5. Answers to experimental class students

Based on the answers students can be seen that students are able to understand what problems are known and asked from the problem, where students are able to reason and separate the parts known in the questions and the parts asked from the problem, and are able to write known and asked correctly and completely and completely. The ability of students to plan problems is enough to understand, because at the stage of understanding what is known and asked is correct, then in the next solution is the stage of planning the student problem is calmer and seems to understand the solution, where the strategy in planning the problem is correct students solve the problem correctly so that Students are able to state that the results of the completion of the questions and answers to the questions that are done with the correct stages.

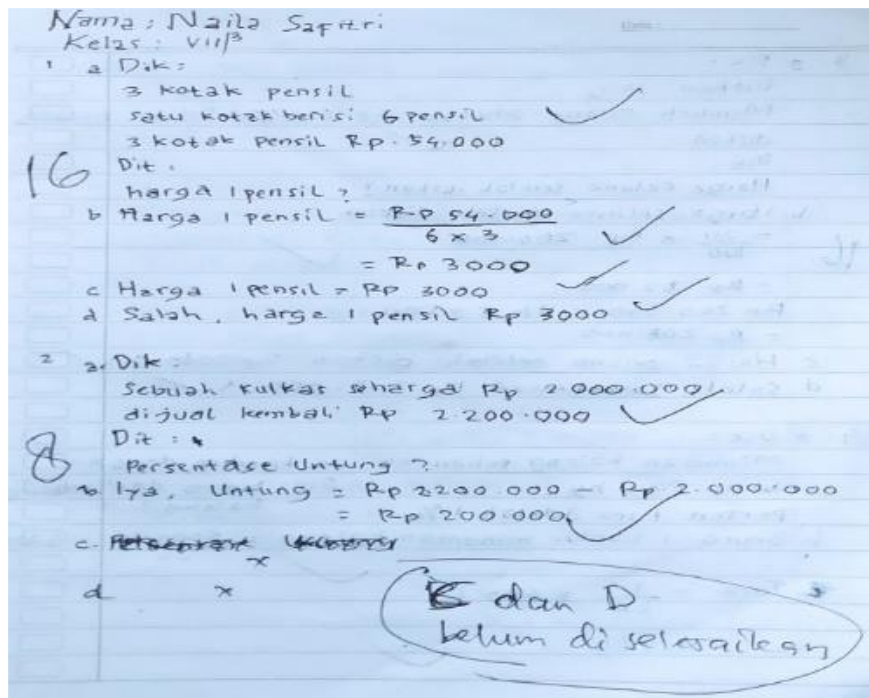


Figure 6. Answers to the Control Class Students

Based on answers students can be seen that students are able to understand the problem, write known and asked correctly and have been able to plan problems. However, at the stage of solving problems students cannot solve them, proven students' answers have graffiti. So that at the stage of re-examining students are unable to express the results of the answer. So, it can be concluded that in the experimental class using the Think Pair Share learning model is better than the control class with scientific learning.

4. CONCLUSION

Based on the results of research data obtained and analyzed as well as hypothesis testing, it can be concluded that improving the ability to solve mathematical problems students who get the application of the Think Pair Share Cooperative Learning Model is better than students who obtain a scientific learning model. Then the researcher concluded that the application of the Think Pair Share (TPS) learning model increased on the ability to solve students' mathematical problems.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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