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THE INFLUENCE OF THE APPLICATION OF THE THINK PAIR SHARE (TPS) COOPERATIVE LEARNING MODEL ON STUDENTS' REASONING ABILITY AND MATHEMATICAL ABSTRACT ABILITY

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Abstract:
This study aims to determine how the effect applying the think pair share learning method has on the reasoning and mathematical abstraction abilities of class X students of SMA Negeri 9 Makassar. This study used a quantitative approach with the type of experimental research using a quasi-experimental research design with a non-equivalent control group design. The population in this study were all 290 class X students of SMAN 9 Makassar. The sample in this research was an experimental class of 36 people and a control class of 36 people. The instrument in this study was a test to measure reasoning abilities and mathematical abstraction in the form of a pretest and posttest. The data analysis technique used is descriptive statistical analysis and inferential statistical analysis, namely the multivariate analysis of variance (manova) test. The results of this study indicate that: (1) The average results of students' mathematical reasoning abilities in the experimental class and the control class increased. (2) The average results of students' mathematical abstraction abilities in the experimental class and the control class increased. (3) There is an influence of the TPS type cooperative learning model's application on the reasoning and mathematical abstraction abilities of SMA Negeri 9 Makassar class X students. (4) There is an effect of applying the TPS type cooperative learning model to the mathematical reasoning abilities of SMA Negeri 9 Makassar class X students. (5) There is an effect of applying the TPS type cooperative learning model to the mathematical abstraction abilities of SMA Negeri 9 Makassar class X students.

Keywords: Abstraction Ability, Reasoning Ability, Think Pair Share

PENGARUH PENERAPAN MODEL PEMBELAJARAN KOOPERATIF THINK PAIR SHARE (TPS) TERHADAP KEMAMPUAN PENALARAN SISWA DAN KEMAMPUAN ABSTRAK MATEMATIS

Abstrak:
Penelitian ini bertujuan untuk mengetahui bagaimana pengaruh penerapan metode pembelajaran think pair share terhadap kemampuan penalaran dan abstraksi matematis siswa kelas X SMA Negeri 9 Makassar. Penelitian ini menggunakan

pendekatan kuantitatif dengan jenis penelitian eksperimen menggunakan desain penelitian kuasi-eksperimen dengan desain kelompok kontrol non-ekuivalen. Populasi dalam penelitian ini adalah seluruh 290 siswa kelas X SMAN 9 Makassar. Sampel dalam penelitian ini adalah kelas eksperimen sebanyak 36 orang dan kelas kontrol sebanyak 36 orang. Instrumen dalam penelitian ini adalah tes untuk mengukur kemampuan penalaran dan abstraksi matematis berupa pretest dan posttest. Teknik analisis data yang digunakan adalah analisis statistik deskriptif dan analisis statistik inferensial, yaitu uji analisis varians multivariat (manova). Hasil penelitian ini menunjukkan bahwa: (1) Hasil rata-rata kemampuan penalaran matematis siswa pada kelas eksperimen dan kelas kontrol meningkat. (2) Hasil rata-rata kemampuan abstraksi matematis siswa pada kelas eksperimen dan kelas kontrol meningkat. (3) Terdapat pengaruh penerapan model pembelajaran kooperatif tipe TPS terhadap kemampuan penalaran dan abstraksi matematis siswa SMA Negeri 9 Makassar kelas X. (4) Terdapat pengaruh penerapan model pembelajaran kooperatif tipe TPS terhadap kemampuan penalaran matematis siswa SMA Negeri 9 Makassar kelas X. (5) Terdapat pengaruh penerapan model pembelajaran kooperatif tipe TPS terhadap kemampuan abstraksi matematis siswa SMA Negeri 9 Makassar kelas X.

Kata Kunci: Kemampuan Abstraksi, Kemampuan Penalaran, Think Pair Share

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INTRODUCTION

Education is a planned effort to create an atmosphere of teaching and learning so that students become active in developing their potential to have religious spiritual strength, self-development, personality, intelligence, noble character, and skills needed for themselves, society, nation, and State (Ismail, 2012). So that education can be interpreted as a business or human activity to foster his personality in accordance with the values in society and culture.

Mathematics is formed as a result of human thought related to ideas, processes, and reasoning. Mathematics is the study of patterns and relationships, ways of thinking with organizational strategy, analysis and synthesis, language, and tools for solving abstract and practical problems, and mathematics is formed from human experience in the world empirically and then that experience is processed in the world of ratios, processed by analysis with reasoning in the cognitive structure so that until mathematical concepts are formed that are easily understood by others and can be manipulated precisely, then mathematical language or mathematical notation is used with global value (Nurwijayanti, 2019). Mathematical material and mathematical reasoning are two things that cannot be separated, namely mathematical material is understood through reasoning and reasoning is understood and trained through learning mathematical material (Nita & Surya, 2017). Based on this explanation, it can be concluded that the mastery of mathematical material cannot be separated from the arrangement of one's reasoning.

Mathematical reasoning ability is the ability to direct the mind to produce a statement in reaching a conclusion when solving a problem (Konita, Asikin, & Asih, 2019). Reasoning ability is one of the things that students must have in learning mathematics. Not only because mathematics is a science that is obtained by reasoning, but also because one of the objectives of learning mathematics is for students to be able to use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements (Febriyanti, Marethi, & Jaenudin, 2017). Mathematical reasoning abilities are needed by students both in the process of understanding the mathematical material itself and in everyday life. In learning mathematics, reasoning abilities play a role both in understanding concepts and in solving problems.

The ability that is fundamental and supports carrying out cognitive processes that study mathematical concepts in solving problems is said to be the ability of abstraction (Warsito & Saleh, 2019). In addition to mathematical reasoning abilities, abilities that must be possessed by students in learning mathematics are abstraction abilities. Abstract terms often appear in the language of mathematics and mathematics education. In Indonesian, the abstract is defined as something that is intangible or something that is not shaped (Nurhasanaha & Sumekar, 2019).

Mathematical abstract ability is the ability to find solutions to mathematical problems without the real presence of the problem object (Azizah, 2016). Abstraction ability (abstract thinking) in mathematics is very important because it is an ability that can describe problems in mathematics so students can visualize and manipulate an object that is virtual in learning (Nurhikmayati, 2017). Abstraction ability in mathematics is very important because it is an ability to describe mathematical concepts in a mathematical problem in er words abstraction can build a model of a problem situation.

The abstraction and mathematical reasoning abilities of students in Indonesia are still relatively low. This can be seen from the results of a survey conducted by the Trends in International Mathematics and Science Study (TIMSS) in 2015 which showed that the percentage of passing students' mathematical ability in Indonesia for reasoning was 17%. The percentage is far below the international average passing percentage, namely reasoning 30%. This percentage shows that the mathematical reasoning of students in Indonesia is still low. This shows that the ability of mathematics in Indonesia to solve complex problems, which involve high-level thinking processes, such as critical thinking and creative thinking is still relatively low.

Preliminary observations made by researchers at SMA Negeri 9 Makassar, it turns out that students' mathematical reasoning and abstraction skills in mathematics are still lacking. Most of the students had difficulties in conveying mathematical ideas both orally and in writing, students had difficulties in expressing everyday events in mathematical language, and some students were not systematic when working on problems. This can be seen from the student's math scores in the 2018/2019 school year with an average grade X semester 1 student math score of more than 50% which is still below the standard value.

One of the causes of students' lack of reasoning and abstraction abilities is that the learning methods used are less innovative, this is what researchers see in the learning process still using direct learning models. Direct learning, namely the teacher presents material using the lecture method. This less varied learning process can result in a lack of understanding obtained by students so that their learning outcomes are also less than optimal.

The development of students' mathematical reasoning and abstraction abilities is related to the learning method applied. The development of reasoning abilities requires learning that accommodates thinking processes, reasoning processes, students' critical attitudes, and generalizing problems (Febriyanti, Marethi, & Jaenudin, 2017). One of the learning methods that can improve students' mathematical reasoning and abstraction abilities is the think pair share (TPS) learning model. TPS is a learning method that gives students plenty of time to think and respond and help each other (Subkhi, 2018). In TPS learning students will also discuss in pairs according to the groups that have been previously formed, it is at this discussion stage that can make students more active in exchanging ideas with their partners. TPS also has three stages of activity in its application. First, think, at this stage students are allowed to think about something independently. The two pairs (pairs), at this stage students, are paired and allowed to discuss what they thought before. The third is share, at this stage students share the results of their work with their friends in pairs (Fidrayani & Fauzia, 2017). With this approach, students are, expected to be actively involved in the learning process, and be able to solve problems because students interact and work together in groups, while the teacher acts as a guide and facilitator.

Based on research conducted by Natalliasari (2015) with the research title "Use of the TPS Type Cooperative Learning Model to Improve the Mathematical Reasoning and Problem-Solving Ability of MTs students" states that the use of the TPS type cooperative learning model is better than the conventional model because students' TPS models can be more effective and can work together with their friends. Based on the results of this study, the mathematical reasoning abilities of students who received learning using the Think Pair Share cooperative model were better than students who received conventional learning.

Another research conducted by Zaskia (2016) with the research title "Improving Middle School Students' Mathematical Abstraction Abilities Through Think Pair Share (TPS) Cooperative Learning" states that there is an increase in abstraction abilities among students taught by the TPS type cooperative learning model compared to conventional learning models. Based on the results of this study, the use of the TPS type cooperative learning model can improve students' mathematical abstraction abilities.

So based on some of these relevant explanations and research, the researcher will conduct a different study, namely the effect of applying the think pair share (TPS) cooperative learning model on the reasoning abilities and mathematical abstraction abilities of class X students of SMA Negeri 9 Makassar.

RESEARCH METHODS

The type of research used is quantitative research with a quasi-experimental design, namely a non-equivalent control group design with the following research design.

Table 1. Research Design

O_1	X_1 (Experimental class)	O_2
O_3	X_2 (Control class)	O_4

The population in this study were all 290 class X students of SMAN 9 Makassar. The sample in this research was an experimental class of 36 people and a control class of 36 people, which were determined through a random sampling technique. Data collection was carried out using tests in the form of pretest and posttest questions to measure students' reasoning abilities and mathematical abstraction abilities. The research instrument consisted of 3 reasoning ability essay questions and 3 mathematical abstraction ability essay questions which were arranged based on indicators of the basic competencies of the material being taught. reasoning instruments were developed concerning several indicators, namely: 1) Presenting mathematical statements orally, in writing, pictures, diagram and; 2) Submitting allegations; 3) Performing mathematical manipulation; 4) Arranging evidence, providing reasons or evidence for the correctness of the solution; 5) Draw conclusions from statements; 6) Checking the validity of an argument; and 7) Finding patterns or properties of mathematical phenomena to make generalizations (Ariati & Juandi, 2022). While the abstraction ability instrument was developed by referring to several indicators, namely: 1) Integration and problem formulation; 2) Transformation of problems into symbols; MakingMake generalizations; 4) Formation of mathematical concepts related to other concepts; 5) Formation of further mathematical objects; 6) Formalization of mathematical objects; and 7) the process of manipulating symbols (Yusepa, 2016).

The data analysis used is descriptive statistical analysis and inferential statistical analysis. Descriptive statistical analysis consists of calculating the range, calculating the number of class intervals, calculating class intervals, calculating the mean, the percentage of the average value, calculating the standard deviation, and categorizing. As for the inferential statistical data, the prerequisite tests for normality and homogeneity were carried out and the hypothesis test used was the multivariate analysis of variance (manova) test.

RESULTS AND DISCUSSION

In this study, learning was carried out for four meetings for each experimental class and control class after being given a pretest. The learning process in the experimental class used Think Pair Share learning while the control class used the cooperative learning model with the learning material of the Two-Variable Linear Equation System (SPLDV).

Data on students' reasoning abilities and mathematical abstraction abilities were obtained by applying the TPS learning model and those who did not apply the TPS model. The data was analyzed so that descriptive statistics and inferential statistics were obtained as follows:

Table 2. Pretest Categories of Reasoning Ability in Experimental Class and Control Class.

Mastery level	**Category**	**Experiment Class Pretest**		**Control Class Pretest**	
		F	%	***F***	%
80 < score ≤ 100	Very Good	0	0	0	0
60 < score ≤ 80	Good	12	33,3	5	13,6
40 < score ≤ 60	Enough	15	41,7	15	41,7
20 < score ≤ 40	Not Enough	9	25	16	44,4
0 ≤ score ≤ 20	Very Less	0	0	0	0
Amount		36	100	36	100

Based on table 2, we can see that the reasoning ability pretest category of the experimental class is 0 students (0%) are in the very less category, 9 students (25%) are in the less category, 15 students (41.7%) are in the sufficient category, 12 students (33.3%) are in a good category, 0 students (0%) are in the very good category. While the pretest category of reasoning abilities in the control class, 0 students (0%) was in the very less category, 16 students (44.4%) were in the less category, 15 students (41.7%) were in the sufficient category, 5 students (13 .9%) are in a good category, 0 students (0%) are in the very good category. So it can be concluded that the largest percentage in the experimental class pretest is in the sufficient category while the largest percentage in the control class pretest is in the less.

Table 3. Posttest Categories of Reasoning Ability in Experimental Class and Control Class.

Mastery level	**Category**	**Experiment Class Pretest**		**Control Class Pretest**	
		F	%	***F***	%
80 < score ≤ 100	Very Good	27	75	4	11,1
60 < score ≤ 80	Good	9	25	26	72,2
40 < score ≤ 60	Enough	0	0	6	16,7
20 < score ≤ 40	Not Enough	0	0	0	0
0 ≤ score ≤ 20	Very Less	0	0	0	0
Amount		36	100	36	100

Based on table 3, we can see that the posttest category of reasoning abilities of the experimental class is 0 students (%) are in the very less category, 0 students (0%) are in the less category, 0 students (0%) are in the sufficient category, 9 students (25%) are in a good category, 27 students (75%) are in the very good category. Whereas in the control class, 0 students (0%) were in the very less category, 0 students (0%) were in the less category, 6 students (16.7%) were in the sufficient category, 26 students (72.2%) were in a good category, 4 students (11.1%) are in the very good category. So it can be concluded that the largest percentage in the experimental class posttest is in the very good category while the largest percentage in the control class posttest is in a good category.

Table 4. Pretest Categories of Abstraction Ability in the Experiment Class and Control Class

Mastery level	**Category**	**Experiment Class Pretest**		**Control Class Pretest**	
		F	%	***F***	%
80 < score ≤ 100	Very Good	0	0	0	0
60 < score ≤ 80	Good	2	5,5	1	2,8
40 < score ≤ 60	Enough	19	52,8	16	44,4
20 < score ≤ 40	Not Enough	15	41,7	19	52,8
0 ≤ score ≤ 20	Very Less	0	0	0	0
Amount		36	100	36	100

Based on table 4, we can see that the category of mathematical abstraction abilities during the pretest, namely 0 students (0%) were in the very poor category, 15 students (41.7%) were in the less category, 19 students (52.8%) were in the sufficient category, 2 students (5.5%) are in a good category, 0 students (0%) are in the very good category. Whereas in the control class, 0 students (0%) were in the very less category, 19 students (52.8%) were in the less category, 16 students (44.4%) were in the sufficient category, 1 student (2.8%) is in a good category, 0 students (0%) are in the very good category. So it can be concluded that the largest percentage in the experimental class pretest is in the sufficient category while the largest percentage in the control class pretest is in the less.

Table 5. Posttest Categories of Abstraction Ability in the Experiment Class and Control Class

Mastery level	**Category**	**Experiment Class Pretest**		**Control Class Pretest**	
		F	%	***F***	%
80 < score ≤ 100	Very Good	18	50	2	5,6
60 < score ≤ 80	Good	16	44,4	25	69,6
40 < score ≤ 60	Enough	2	5,6	9	25
20 < score ≤ 40	Not Enough	0	0	0	0
0 ≤ score ≤ 20	Very Less	0	0	0	0
Amount		36	100	36	100

Based on table 5, we can see that the category of mathematical abstraction abilities at the time of the posttest, namely 0 students (0%) are in the very poor category, 0 students (0%) are in the less category, 2 students (5.6%) are in the poor category. sufficient, 16 students (44.4%) are in the good category, and 18 students (50%) are in the very good category. Whereas in the control class, 0 students (0%) were in the very less category, 0 students (0%) were in the less category, 9 students (25%) were in the sufficient category, and 25 students (69.6%) were in the moderate category. good, 2 students (5.6%) are in the very good category. So it can be concluded that the largest percentage in the experimental class posttest is in the very good category while the largest percentage in the control class posttest is in a good category.

Furthermore, hypothesis testing is carried out, which is preceded by conducting prerequisite tests, namely the normality test and homogeneity test. The normality test is used to determine whether the data is normally distributed. The normality test is carried out using the SPSS 21 application, provided that the sig. Levene's test of equality of error variances is greater than the specified sig value (> 0.05), so the sample data has a normally distributed variance. If the sig value of Levene's test table of equality of error variances is less than the specified sig value (<0.05), then the sample data is not normally distributed.

Table 6. Data Normality Test Results

	Statistic	*Df*	*Sig.*
Experimental Reasoning Pretest	.180	36	.011
Control Reasoning Pretest	.212	36	.010
Posttest Reasoning Experiments	.154	36	.031
Control Reasoning Posttest	.183	36	.060
Experimental Abstraction Pretest	.236	36	.010
Control Abstraction Pretest	.156	36	.026
Posttest Abstraction Experiment	.174	36	.080
Posttest Abstraction Control	.175	36	.070

The results of the SPSS calculation of significant pretest and posttest reasoning and abstraction abilities in the experimental class and control class obtained a sig value. > 0.05, it can be concluded that it comes from a normally distributed population.

Next, namely the homogeneity test, the homogeneity test was carried out to find out whether the sample studied came from a homogeneous or non-homogeneous population. Homogeneity testing is carried out using the SPSS 21 application, with the condition that if the sig. Levene's test of equality of error variances is greater than the specified sig value (> 0.05), so all sample data groups have the same or homogeneous variance. If the sig value of Levene's test table of equality of error variances is less than the specified sig value (<0.05), then all sample data groups have unequal variances or are not homogeneous.

Table 7. Data Homogeneity Test

	F	**df1**	**df2**	**Sig.**
Reasoning Ability	.032	1	70	.859
Abstraction Ability	.258	1	70	.613

The results of the homogeneity test of the research variables obtained significant values for reasoning and abstraction abilities were 0.859 and 0.613, so from the results of significant price calculations the data for reasoning abilities and abstractions was greater than 0.05 (sig > 0.05) it could be concluded that the data after this study also has a homogeneous variance. Next, a hypothesis test was carried out.

The results of the homogeneity test of the research variables obtained significant values of reasoning and abstraction abilities were 0.859 and 0.613 so from the results of significant price calculations the data of reasoning abilities and abstractions were greater than 0.05 (sig > 0.05) it could be concluded that the data after this study also has a homogeneous variance. Next, a hypothesis test was carried out.

Test the hypothesis in this study to find out (1). Is there any effect of applying the Think Pair Share (TPS) cooperative learning model to the reasoning abilities and mathematical abstraction abilities of class X students of SMA Negeri 9 Makassar? (2). Is there any effect of applying the Think Pair Share (TPS) cooperative learning model to the mathematical reasoning abilities of SMA Negeri 9 Makassar class X students? (3). Is there any effect of applying the Think Pair Share (TPS) cooperative learning model to the mathematical abstraction abilities of SMA Negeri 9 Makassar class X students? To answer this hypothesis, a data hypothesis test was carried out using SPSS 21 with the Multivariate Analysis of Variance (MANOVA) test so that the following results were obtained:

Table 8. *Multivariate Tests*

	Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Hotelling's Trace	73.498	2535.697[b]	2.000	69.000	.000
Class	Hotelling's Trace	.609	21.014[b]	2.000	69.000	.000

The results of the Multivariate Analysis Of Variance (manova) hypothesis test obtained sig values for both classes according to Hotelling's trace with F values of 21.014 and a significance of 0.000. So because the F table obtained from db 2.34 at a significance level of 5% is 3.28. So the value of F count > F table (21.014 > 3.28) and the significance value is less than 0.05 ($p = 0.000 < 0.05$) it can be concluded that H_0 is rejected so that the result has the effect of applying the Think Pair Share (TPS) cooperative learning model on students' ability reasoning and mathematical abstraction abilities of class X students of SMA Negeri 9 Makassar.

Table 9. *Univariate Tests*

Class	F	Sig.
Reasoning	40.210	0.0001
Abstraction	16.935	0.0001

The results of the hypothesis test obtained the sig value of the reasoning class obtained an F value of 40.210 and a significance of 0.0001. So because the F table obtained from db 2.34 at a significance level of 5% is 3.28. So the value of F count > F table (40.210 > 3.28) and the significance value is less than 0.05 (p = 0.000 <0.05) it can be concluded that H_0 is rejected so that the result has the effect of applying the Think Pair Share (TPS) cooperative learning model on students' ability mathematical reasoning of class X SMA Negeri 9 Makassar. While the results of the hypothesis test obtained the sig value of the abstraction class obtained an F value of 16.935 and a significance of 0.0001. So because the F table obtained from db 2.34 at a significance level of 5% is 3.28. So the value of F count > F table (16.935 > 3.28) and the significance value is less than 0.05 (p = 0.0001 <0.05) it can be concluded that H_0 is rejected so that the result has the effect of applying the Think Pair Share (TPS) type of cooperative learning model on the ability mathematical abstraction of class X SMA Negeri 9 Makassar.

Based on previous observations, the application of think pair share learning in the experimental class and cooperative setting learning in the control class can both improve reasoning abilities and abstraction abilities. However, the level of increased reasoning ability and abstraction ability is better in the experimental class with the think pair share learning method. The reason that there is an effect of the application of the TPS learning model on students' mathematical reasoning and abstraction abilities is that in the learning process the TPS model only involves two people in one group so that the discussion is more focused. In addition, students are able to solve problems with their own words and thoughts, each group of students tries to find out the answers to the questions given so that all students become active, and students individually can develop their thoughts because of the time to think (think time) so that answer quality can be improved. Whereas the cooperative setting learning model has a large number of members, causing only a few students to work, especially active students, so that less active students just stay silent and wait for the results of the active members. This is in line with research conducted by Chianson, O'kwu, and Kurumeh (2015) which shows the positive effect of TPS on student learning outcomes. In another study, Jannah, Paridjo, and Utami (2019) show that TPS is better for learning mathematics.

Based on the results of the SPSS test, it can be concluded that there is an influence of the application of the think pair share (TPS) cooperative learning model on students' reasoning abilities and mathematical abstraction abilities. This is evidenced in the output of the multivariate test on the effect section of the good class according to Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root, all F values are 21.014 and a significance of 0.000. So because the F table obtained from db 2.34 at a significance level of 5% is 3.28. So the calculated F value > F table (21.014 > 3.28) and the significance value is less than 0.05 (p = 0.000 <0.05). So it can be concluded that there is an influence of the application of the Think Pair Share (TPS) cooperative learning model on the reasoning abilities and mathematical abstraction abilities of class X students of SMA Negeri 9 Makassar.

CONCLUSION

Based on the results of the research and discussion, the following conclusions are obtained regarding the effect of applying the TPS type cooperative learning model on the reasoning abilities and mathematical abstraction abilities of class X SMA Negeri 9 Makassar both partially and simultaneously.

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