

COMPARISON OF STUDENTS' MATHEMATICAL COMMUNICATION ABILITY BETWEEN THINK PAIR SHARE AND NUMBERED HEAD TOGETHER COOPERATIVE LEARNING MODEL

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ABSTRACT

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Penelitian ini bertujuan untuk mengetahui perbandingan kemampuan komunikasi matematis siswa yang diajar dengan model pembelajaran kooperatif tipe Think Pair Share dan Numbered Head Together. Populasi dalam penelitian ini adalah seluruh siswa kelas X MAN 2 Model Medan. Sampel dalam penelitian ini adalah seluruh siswa kelas X-C yang terdiri dari 37 siswa sebagai kelas eksperimen I dan kelas X-H yang terdiri dari 36 siswa sebagai kelas eksperimen II, yang dipilih melalui teknik random sampling. Kelas eksperimen I diajar dengan model pembelajaran kooperatif tipe Think Pair Share, sedangkan kelas eksperimen II diajar dengan model pembelajaran kooperatif tipe Numbered Head Together. Penelitian ini merupakan penelitian quasi eksperimen dengan desain posttest only control group design. Instrumen pengumpulan data yang digunakan adalah tes kemampuan komunikasi matematika yang telah diuji validitas dan reliabilitasnya. Sebelum melakukan pengujian hipotesis dilakukan uji normalitas dengan menggunakan uji Shapiro-Wilk dan uji homogenitas dengan menggunakan uji Levene terhadap data penelitian. Hasil penelitian menunjukkan bahwa sampel berasal dari populasi yang berdistribusi normal dan homogen. Pengujian hipotesis dengan uji-t menunjukkan bahwa $t_{hitung} > t_{tabel}$ ($2,4 > 1,666$). Dengan demikian H_0 ditolak dan H_1 diterima, sehingga kemampuan komunikasi matematis siswa yang diajar dengan model pembelajaran kooperatif tipe Think Pair Share lebih baik dari pada kemampuan komunikasi matematis siswa yang diajar dengan model pembelajaran kooperatif tipe Numbered Head Together.

This study aimed to find out the comparison between students' mathematical communication ability taught by Think Pair Share and Numbered Head Together cooperative learning model. The population in the study were all students in grade X MAN 2 Model Medan. The sample were all students of class X-C with 37 students as experimental class I and class X-H with 36 students as experimental class II, which were selected through random sampling technique. The experimental class I was taught by Think Pair Share cooperative learning model while the experimental class II with Numbered Head Together cooperative learning model. This

research was quasi experimental with posttest only control group design. Data collection instrument used was mathematics communication ability test that have been tested for validity and reliability. Before testing the hypothesis, normality test was carried out using Shapiro-Wilk test and homogeneity test using Levene test on the research data. The results showed that the samples came from normal and homogeneous distributed population. Hypothesis testing with t-test show that $t_{count} > t_{table}(2,4 > 1,666)$. Thus H_0 is rejected and H_1 is accepted, so students' mathematical communication ability taught by Think Pair Share cooperative learning model is better than the students' mathematical communication ability taught by Numbered Head Together cooperative learning model.

INTRODUCTION

Education plays an important role in developing human capital. Institutions must be able to keep up with the rapid developments in science and technology. Special attention is given to the progress and development of education for improving the quality of education.¹

In the writings of Suwangsih and Tiurlina the term mathematics originated from the Greek “mathematike” which means to study. The word “mathematike” comes from the word “mathema” which means knowledge. In addition, the word “mathematike” is also related to another word that is almost the same, namely “mathein” or “mathenein” which means thinking.²

Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines, and advances human thinking. Mathematics needs to be given to all students from elementary school to high school to equip students with the ability to think logically, analytically, systematically, critically, and creatively. The objectives in learning mathematics according to the 2013 curriculum are for students to have the ability to understand mathematical concepts, develop mathematical reasoning, develop problem-solving ability, develop mathematical communication ability, and develop an attitude of appreciating the use of mathematics in life.

The main standards in mathematics learning contained in the National Council of Teachers of Mathematics (NCTM) standards (2000) are problem-solving ability, communication ability, connection ability, reasoning ability, and representation ability. These five standards have an important role in the mathematics curriculum.³

Basically, the process of learning mathematics is not just about transferring ideas from teachers to students. More than that, mathematics learning is a dynamic process, when teachers provide opportunities for students to observe and think about the ideas given. Therefore,

¹ R.R. Ginting et al., “Analisis Faktor Tidak Meratanya Pendidikan di SDN 0704 Sungai Korang,” *Jurnal Pendidikan Indonesia* 3, no. 4 (2022): 408.

² Isrok'atun and A. Rosmala, *Model-Model Pembelajaran Matematika* (Jakarta: Bumi Aksara, 2018), 3.

³ M.A. Maulyda, *Paradigma Pembelajaran Matematika Berbasis NCTM* (Malang: IRDH, 2020), 7.

mathematics learning activities are teacher-student, student-student, and student-teacher interaction activities to clarify thoughts and understanding of a mathematical idea.

Mathematical communication ability an effective way to teaching mathematical concept intelligibly to friends, teachers, and others speech or writing. Communication can help students not only in building concepts but building links between ideas and abstract language with mathematical symbols. Students also be given the opportunity to express their ideas by speaking, writing, drawing or graphing. Communication in mathematics is a fundamental skill that students and teachers must have while learning, teaching, and evaluating mathematics. Communication opens up space for students to exchange and discuss mathematics. Therefore, if students have good communication skills, their mathematics learning results will certainly be good.⁴

An important issue in mathematics education is the importance of developing students' mathematical communication skills. Research by Riyanti and Mardani shows that approximately 80% of students find it difficult to convey the learning outcomes achieved and to teach the learning outcomes achieved. From the problem already given.⁵ In line with Asmara and Afriansyah's research, also states that it appears that most students have difficulty interpreting description problems into mathematical models and many are confused in interpreting problems, students also lack the courage to convey mathematical ideas orally or in appropriate language.⁶

Based on the news that I obtained from the internet on the website, MAN 2 Medan Model is not included in the ranking of schools with the most students passing the SNBP in 2023, ranking 1 is SMAN 3 Medan, ranking 2 is SMAN 18 Medan, and ranking 3 is SMAN 3 Medan. Then for the ranking of the highest UTBK scores, MAN schools in Medan are also not included in the top 10 and are still defeated by other high schools, one of which is SMAN 1 Medan.

This is also in line with the experience of researchers when carrying out field introduction activities at school during semester 7, namely at MAN 2 Medan Model school, it was seen that when giving daily mathematics exams to students there were still many students who got low scores, so the Pamong teacher at that time advised us to hold a repeat exam or often called remedial. Therefore, related to the problems experienced by researchers at that time, researchers are interested in conducting observations at MAN 2 Model Medan.

⁴ M.W.K. Dewi and R. Nuraeni, "Kemampuan Komunikasi Matematis Siswa SMP Ditinjau dari Self-Efficacy pada Materi Perbandingan di Desa Karangpawitan," *Plusminus: Jurnal Pendidikan Matematika* 2, no. 1 (2022): 155.

⁵ R. Riyanti and D. Mardiani, "Kemampuan Komunikasi Matematis Siswa antara Model Pembelajaran Course Review Horay dan STAD," *Plusminus: Jurnal Pendidikan Matematika* 1, no. 1 (2021): 130.

⁶ R. Asmara and E.A. Afriansyah, "Perbedaan Peningkatan Kemampuan Komunikasi Matematis Siswa antara Model Eliciting Activities dan Discovery Learning," *Suska Journal of Mathematics Education* 4, no. 2 (2018): 83.

The students' average scores after taking the test showed that in experiment class I is 43,43(Appendix 14). While in experiment class II is 43.95(Appendix 14). This means that students' mathematical communication ability are still low.

Based on the results of the researchers' interviews with mathematics teachers at MAN 2 Medan Model, namely Mrs. Syifa Hayaty Rangkuti, S.Pd, it was found that the learning model that was usually applied was only a conventional learning model, then giving project-based group assignments. Learning media such as PowerPoint is also rarely used, teachers only use digital books which are explained directly to students by using a projector. The low mathematical communication ability is also a result of students' responses to mathematical communication questions generally lacking. In addition, it is caused by conventional learning models that are more teacher-centered and do not involve students being active.

Mathematical communication ability is the ability of students to convey mathematical ideas both orally and in writing. Mathematical communication ability as one of the important mathematics learning outcomes must be improved in high school students. The purpose of communication ability in learning is to make connections between mathematical ideas, to express mathematical ideas, and to explain situations or problems using symbols, tables, diagrams, or other media.⁷

Mathematical communication ability consists of oral communication and written communication. Oral communication such as discussion and explanation. Written communication such as expressing mathematical ideas through pictures/graphics, tables, equations, or in the students' own language.⁸

In addition, mathematical communication ability also need to be improved so that students are motivated to provide relevant reasons for their answers or statements and to comment on other opinions so that students are able to understand the mathematics concepts learned meaningfully. Based on the standard Principles and Standards for School Mathematics from NCTM (2000), the indicators of mathematical communication ability used are as follows.

- a. The ability to express mathematical ideas through oral, written, as well as visually depict
- b. Ability to interpret and evaluate mathematical ideas both orally and in writing
- c. The ability to use mathematical terms, symbols, and structures to model mathematical situations or problems.⁹

⁷ A. Qohar and U. Sumarmo, "Improving Mathematical Communication Ability and Self-Regulation Learning of Junior High Students by Using Reciprocal Teaching," *Indonesian Mathematical Society Journal on Mathematics Education* 4, no. 1 (2013): 61.

⁸ T.H. Nugraha and H. Pujiastuti, "Analisis Kemampuan Komunikasi Matematis Siswa Berdasarkan Perbedaan Gender," *Edumatica: Jurnal Pendidikan Matematika* 9, no. 1 (2019): 2.

⁹ Maulyda, *Paradigma Pembelajaran Matematika Berbasis NCTM*, h. 65.

To measure students' mathematical communication ability in learning mathematics can be done by giving description questions that can reveal mathematical communication ability.

Realizing the importance of mathematical communication ability, educators need to strive for learning by using learning models that can provide opportunities and encourage students to practice mathematical communication ability. Group discussion is one of the activities that can have a positive impact on students' mathematical communication ability. In this case, researchers chose two types of cooperative learning models, namely the Think Pair Share (TPS) and Numbered Head Together (NHT) learning models.

By applying the cooperative learning model of TPS and NHT types, it is expected to generate students' connection to mathematics material and make students more active, encouraging cooperation between students in learning material, so as to improve students' mathematical communication ability. However, between these two types of learning models, it will be investigated which cooperative learning model is more effective so that it can be applied in the learning process to improve students' mathematical communication ability. Therefore, of the two learning models the researcher intends to conduct research to see the difference between TPS and NHT cooperative learning models on students' mathematical communication ability.

Based on the description above, the researcher wants to conduct research with the title "Comparison of Students' Mathematical Communication Ability between Think Pair Share and Numbered Head Together Cooperative Learning Model".

RESEARCH METHODS

The location of this research was conducted at MAN 2 Model Medan which has an address on Jl. Williém Iskandar No. 7A, Kec. Medan Tembung. The research was conducted in the odd semester of the 2023/2024 school year. The type of research in this study is quasi-experimental research. Experimental research is research conducted with a scientific approach using two sets of variables. The population in this study were all students of class X MAN 2 Model Medan which amounted to 17 classes, namely class X-A to class X-Q. The sample that is used as a unit to be observed must be taken from a population and must meet certain requirements so that the sample can be representative of the population from which it was taken. The samples in this research were class X-C as many as 37 students, and class X-H as many as 36 students. So, this sample size is a large sample, because the number of samples is more than 30 students. Sampling in this research using random sampling technique, where class X-C as an experimental class I that uses Think Pair Share (TPS) learning model, and class X-H as an experimental class II that uses Numbered Head Together (NHT) learning model. The research design used in this study is a posttest only control group design, this study is an experiment carried out on two groups where

one of them is a comparison group by giving a final test to each class group. When the data is normally distributed and homogeneous, data analysis must be carried out to see students' mathematical communication ability, the data obtained and analyzed with t-test statistics at a significant level $\alpha = 0.05$, hypothesis testing in this test uses a one-way test (right side). Where the test criteria are reject H_0 accept H_1 if $t_{count} > t_{table}$ and accept H_0 reject H_1 if $t_{count} \leq t_{table}$.

RESULTS AND DISCUSSION

In the research that uses two different cooperative learning models, namely the Think Pair Share (TPS) learning model and the Numbered Head Together (NHT) learning model, the data on students' mathematical communication ability in experimental class I and experimental class II will be seen. Data on students' mathematical communication ability were obtained by giving posttest questions. The questions used are 3 essay questions. Before the questions is given, the questions have been validated by three validators and have been declared valid and feasible to use to measure students' mathematical communication ability. After the instrument is proven valid, different treatments are given to each class, then a posttest is given to see students' mathematical communication ability. From the posttest results, the data on students' mathematical communication abilities in experimental class I and experimental class II are presented briefly in the following table.

Table 1. 1. Posttest data of students' mathematical communication ability in Experiment Class I and Experiment Class II.

Statistics	Class	
	Experimental I	Eksperimental II
Number of Students (N)	37	36
Total Scores	3101.2	2817.7
Maximum Scores	100	94.4
Minimum Scores	61.1	58.3
Mean	83.81	78.26
Varians	92.0864	102.6348
Standard Deviation	9.596	10.130

Table 1.1. shows data on experimental class I and experimental class II after the learning process using the Think Pair Share (TPS) and Numbered Head Together (NHT) cooperative learning models. The range of values in experimental class I is 38.9 while in experimental class II it is 36.1. This shows that the range of the two classes is not much different. The highest student score from the two classes was in experimental class I with a score at 100. This means that the highest student mathematical communication ability is in experimental class I.

When viewed from the average score obtained by both classes, it is known that the average posttest score of students' mathematical communication ability of the experimental class I was 83.81, then the average posttest score of students' mathematical communication ability of the experimental class II was 78.26. Therefore, the average posttest score of experimental class I is higher than experimental class II with a difference of 5.55. This shows that the average score of students' mathematical communication ability of experimental class I is above the average score of students' mathematical communication ability of experimental class II.

For more details, the data obtained based on the posttest results of both classes are presented in the following bar chart by Figure 1.1.

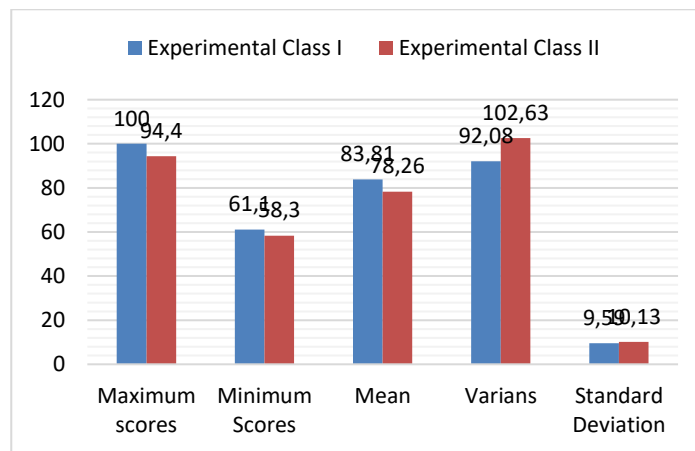


Figure 1. 1. Bar chart of posttest experimental class I and experimental class II.

Moreover, the average posttest of students' mathematical communication ability on each indicator can be seen in Figure 1.2. below.

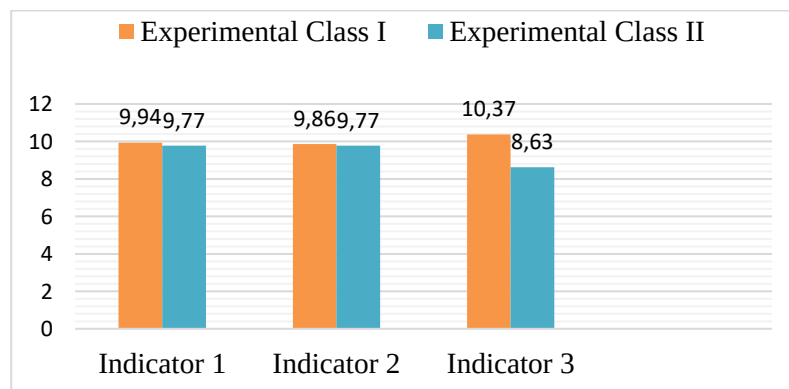


Figure 1. 2. Bar chart of the average posttest of students' mathematical communication ability on each indicator.

Based on the bar chart in Figure 1.2. above, it is known that in the experimental class I, students' mathematical communication ability in each indicator has higher average scores than the experimental class II. The indicator that has the highest average score compared to other indicators in experimental class I and experimental class II is the third indicator. For the first indicator namely the ability to express mathematical ideas through oral, written, as well as visually depict, the experimental class I had an average score of 9.94 while the experimental class II had an average score of 9.77. On the second indicator namely ability to interpret and evaluate mathematical ideas both orally and in writing, the experimental class I had an average score of 9.86 while the experimental class II had an average score of 9.77. And the third indicator namely the ability to use mathematical terms, symbols, and structures to model mathematical situations or problems, the experimental class I had an average score of 10.37 while the experimental class II had an average score of 8.63.

After knowing that the experimental class I and experimental class II are normally distributed and homogenous, hypothesis testing can then be carried out using t- test statistics. The research hypothesis are follows.

$H_0 : \mu_1 \leq \mu_2$ = Students' mathematical communication ability using the think pair share (TPS) cooperative learning model is less than or equal to students' mathematical communication ability using numbered head together (NHT) cooperative learning model.

$H_1 : \mu_1 > \mu_2$ = Students' mathematical communication ability using the think pair share (TPS) cooperative learning model is better than students' mathematical communication ability using numbered head together (NHT) cooperative learning model.

With degree of freedom ($df = n_1 + n_2 - 2$) and $\alpha = 0.05$, the basis for decision making is reject H_0 accept H_1 if $t_{count} > t_{table}$ and accept H_0 reject H_1 if $t_{count} \leq t_{table}$. In summary, the results of testing the hypothesis of mathematical communication ability are presented in Table 1.2.

Table 1. 2. The result of hypothesis test calculations

Posttest Average Score		t_{count}	t_{table}	Conclusion
Experimental Class I	Experimental Class II			
83.81	78.26	2.4	1.666	$t_{count} > t_{table}$

Based on the Table 1.2. above, it was found that $t_{count} > t_{table}$, namely $2.4 > 1.666$ then H_0 rejected and H_1 accepted (Appendix 16). Thus it can be obtained that students' mathematical communication ability using the think pair share (TPS) cooperative learning model is better than students' mathematical communication ability using numbered head together (NHT) cooperative learning model.

Before conducting the research, researchers prepared research instruments consisting of teaching modules, and student worksheets (LKPD) for both classes, namely teaching modules with the TPS and the NHT learning model. In addition to teaching modules and LKPD, researchers also prepared posttest questions in order to measure the mathematical communication ability of the two experimental classes. The research instruments namely teaching modules, LKPD, and posttest questions have been validated by two mathematics lecturers, and one mathematics teacher of MAN 2 Medan Model.

After given different treatments, researchers gave a posttest or final test to see students' mathematical communication ability after being given treatment. From the posttest conducted, the average posttest score of the experimental class I was 83.81 and the average posttest score of the experimental class II was 78.26. This means that the two research samples experienced different conditions for students' mathematical communication ability. In this case, it can be seen that experimental class I obtained a higher average posttest score than the average posttest score of experimental class II. Thus, the students' mathematical communication ability of experimental class I who used Think Pair Share cooperative learning model was higher than the students' mathematical communication ability of experimental class II who used Numbered Head Together cooperative learning model.

This is also proven by testing the hypothesis using a one-way t test (right side). After testing based on posttest data, the value of t_{count} is 2.4 and t_{table} is 1.666 so it can be seen that $t_{count} > t_{table}$, namely $2.4 > 1.666$, which means that H_0 is rejected and H_1 is accepted. So it can be concluded that the students' mathematical communication ability using the think pair share (TPS) cooperative learning model is better than students' mathematical communication ability using numbered head together (NHT) cooperative learning model.

In experimental class I which used the think pair share cooperative learning model, students were divided into several groups where each group consisted of 2 people (paired with a benchmate). Then, students were asked to work on the LKPD, students worked in pairs and helped each other and discussed the solution of the problems in the LKPD. But students are not left alone, the teacher provides assistance in the form of direction and guidance to them, such as questions, encouragement, or reminders that can guide students to be able to communicate their mathematical ideas in working on problems and discussing based on the situation given and finding solutions to the problems. After that, the teacher chose one of the pairs to present the results of their discussion and the other groups were given the opportunity to respond to the results of the discussion of the presenting group. After finishing, the teacher provides a conclusion of the material discussed at the meeting that day, at the end of the meeting the teacher tells students the material will be studied at the next meeting.

In experimental class II which used the Numbered Head Together cooperative learning model, students were divided into several groups where each group consisted of 5 people. Each group member was given a head number from 1 to 5 so that when the teacher mentioned one of the head numbers, each group member who had the same head number had to prepare to present the results of their discussion. Similar to experimental class I, in experimental class II, students are also asked to work on LKPD and discuss with their groupmates. After that, the teacher will call the head number randomly to present the results of the discussion and stand around their group friends and the same head number from the other group is given the opportunity to respond to the results of the discussion presented. The problems in the LKPD at each meeting consist of 3 questions so that in each meeting there are 3 numbers that will be called. After finishing, the teacher provides a conclusion of the material discussed at the meeting that day, at the end of the meeting the teacher tells students the material will be studied at the next meeting.

The advantage of the Think Pair Share learning model compared to Numbered Head Together is in the third stage (share) in the Think Pair Share learning model which provides opportunities for students to show their participation to other students. This share stage makes students more brave to present the results of their discussions because they appear together with their friends, different from the Numbered Head Together learning model which is required to present the results of their discussions individually to represent their respective groups. In addition, in the Numbered Head Together learning model, students will be called one by one according to their number so that not all students get the opportunity to have their number called by the teacher.

For the advantages in the Numbered Head Together learning model and the weaknesses in the Think Pair Share learning model are during the discussion stage, if both models are implemented properly, students taught with the Numbered Head Together learning model will be more active in discussing because many ideas appear and can exchange opinions, this can improve students' mathematical communication skills, while in the Think Pair Share learning model the ideas that appear are less because it only consists of two group members.

When viewed from the results of the student posttest based on indicators of students' mathematical communication ability, in the experimental class using the Think Pair Share learning model, the highest average score is the third indicator with a score of 10.37, this indicates that the Think Pair Share learning model has the most effect on improving students' mathematical communication ability for the third indicator. While in the experimental class that used the Numbered Head Together learning model, the highest average score was on the first and second indicators with an average score of 9.77 for both.

Therefore, it can be concluded that the students' mathematical communication ability using the Think Pair Share cooperative learning model is higher than using the Numbered Head Together cooperative learning model. And students who used the Think Pair Share cooperative learning model achieved each indicator of mathematical communication ability higher than students who used the Numbered Head Together cooperative learning model.

CONCLUSION

From the results of research and data processing in this research, it was concluded that the average posttest value of experimental class I using the Think Pair Share cooperative learning model was 83.81 and the average posttest value of experimental class II using the Numbered Head Together cooperative learning model was 78.26. Based on the results of hypothesis testing with one-way t test (right side) obtained $t_{count} > t_{table}$, which is $2.4 > 1.666$ the H_0 is rejected and H_1 is accepted. So, it is concluded that students' mathematical communication ability using the Think Pair Share cooperative learning model is better than students' mathematical communication ability using the Numbered Head Together cooperative learning model.

SUGGESTION

For mathematics teachers can use the Think Pair Share (TPS) cooperative learning model as an alternative learning in an effort to improve students' mathematical communication ability in the learning process so that students are easier and able to automatically understand and learn the material being taught. But the researchers did not deny that this research still had many shortcomings that needed to be improved. Therefore, for future researchers are expected to evaluate and improve this research through deeper study and pay attention to other factors that can affect research results.

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