



Improving Students' Metacognitive Awareness and Mathematical Communication Ability with Think Pair Share Learning Model

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ABSTRACT

This study aims to analyze and compare the improvement of students' metacognitive awareness and mathematical communication ability through the implementation of the Think Pair Share learning model and conventional learning. The research method used is quasi-experimental with a nonequivalent comparison group design. The population of this study consists of all students of class XI at SMK Negeri 1 Cipanas in the academic year 2024/2025. The sample includes class XI MPLB 1 (experimental group) and XI TJKT (control group), selected using purposive sampling technique. The instruments used are a mathematical communication ability test and a metacognitive awareness questionnaire with matrix material. Data analysis was conducted using normality test and Mann-Whitney U test. The results showed that there was a difference in the improvement of mathematical communication ability between students who used the Think Pair Share learning model and those who used conventional learning. However, there was no difference in the improvement of metacognitive awareness between students who used the Think Pair Share model and those who used conventional learning.

Keywords: mathematical communication ability; metacognitive awareness; think pair share

INTRODUCTION

Mathematics is one of the sciences that has an important role in the world of education and also in various disciplines that improve the quality of human thinking. According to Tampubolon (2021) mathematics is a process of finding solutions to problems faced by a person, applying shapes and sizes, applying insights about counting, and most importantly thinking within a person to apply concepts in seeing relationships. Mathematics learning should not only include various mastery of mathematical concepts, but also their implementation in real life.

The mathematical ability of students in Indonesia still needs to be improved, one of the abilities that need to be developed is the mathematical communication ability of students. Mathematical communication is one of the abilities that is very important for students to have. The low mathematical communication ability of students is an important thing to note (Andriani, 2020). In mathematical communication, students have the opportunity and are encouraged to speak, write, read, and hear a mathematical relationship, and communicate ideas mathematically (La'ia & Harefa, 2021).

Indonesian students' mathematical communication ability are still relatively low. This is in line with research conducted by Lestari (2019), Farida Sarlina & Alyani (2021), and Nugrawati (2018) that the cause of students' low mathematical communication ability is that it is difficult to understand the problems given, besides that it is also difficult to formulate and explain ideas orally or in writing. According to research conducted by

Wulandari & Astutiningtyas (2020) shows that students' mathematical communication ability in interpreting ideas in writing are still relatively low, namely with a percentage of 48.07%, therefore it is necessary to improve mathematical communication ability.

Mathematical communication ability in writing is the process of students to convey their ideas or ideas clearly and structured in writing (Wardhana & Lutfianto, 2018). This process requires deep reflection on the strategies they use, the steps taken, and the errors that may occur. This activity increases metacognitive awareness by making students more aware of how they think and solve problems. Research conducted by Mardhotillah (2021) concluded that students with high metacognition were able to fulfill all indicators of mathematical communication ability, while students with low metacognition were only able to fulfill one indicator of mathematical communication ability.

According to Khasanah (Fariz et al., 2024) metacognitive awareness is a person's awareness of his thinking process or the way he thinks. Basically everyone needs to be aware of their metacognitive abilities. Metacognition is an important indicator that helps students realize about information that has not been understood and choose effective learning strategies and how the learning process is (Damayanti et al., 2021). Research conducted by Sudiman (2022) concluded that students have difficulty understanding the problem, difficulty thinking about the plan, difficulty implementing the plan, and difficulty in reviewing the answer results. Therefore, it is necessary to increase students' metacognitive awareness.

A mature understanding of concepts to work on problems is the basic key to learning mathematics. This is because concept understanding is an important aspect in learning mathematics so that students are able to improve their ability to understand the subject matter (Apriliyana, 2023). Educational goals will be achieved by being supported by learning tools, which include learning media, teaching materials, and learning models applied by subject educators. An effective and efficient learning model can achieve maximum learning objectives (Siswondo & Agustina, 2021).

Based on the above facts, a way or model is needed to improve students' metacognitive awareness and mathematical communication ability. One of the suitable learning models to improve it is the Think Pair Share learning model. The Think Pair Share learning model is a simple, yet very useful model first developed by Frank Lyman of the University of Maryland. Students are first asked to sit in pairs, the teacher asks them a question/problem. Each student is asked to think alone first about the answer to the question/problem, then discuss their thoughts with the partner next to them to get a consensus that can represent both of their answers. After that, the teacher asks each pair to share, explain or describe the results of the consensus or answer they have agreed on with other students in the classroom (Isrok'atun & Rosmala, 2018).

The purpose of using the think pair share model in this study is because this model can give students a sense of strength and confidence in discussing material with presentations or groups. This is in line with the results of research from Zain & Ahmad (2021) which concluded that the use of the think pair share model had a good effect on students' mathematical communication ability. In addition, the think pair share model also provides an opportunity for students to understand the material by thinking for themselves first before the discussion process and then evaluating the answers during the presentation. This is in

line with Shoimin's opinion in Antafani & Purwanti (2021) that think pair share has procedures that clearly give students time to think for themselves, answer, and help each other.

In previous research, entitled “The Effect of the Think Pair Share Model on Students' Mathematical Communication Ability at SDN 61 and MIN Pekanbaru” conducted by Ariska et al (2022), it was found that the think pair share learning model had a significant effect on mathematical communication ability. Meanwhile, there is also a study entitled “Analysis of Difficulties in Understanding Mathematical Communication Problems in View of Students' Metacognition Ability” by Mardhotillah (2021) concluded that students with high metacognition were able to fulfill all indicators of mathematical communication ability while students with low metacognition were only able to fulfill one indicator of mathematical communication ability. Based on this, that Think Pair Share affects mathematical communication and metacognition affects mathematical communication. So what novelty this research is that it combines the three aspects of Think Pair Share, mathematical communication ability, and metacognitive awareness which will be an alternative in learning mathematics.

The objectives in this study are as follows: 1) to find out the difference in improving mathematical communication ability between students who apply the Think Pair Share learning model and students who use ordinary learning; 2) to determine the difference in the improvement of metacognitive awareness between students who apply the Think Pair Share learning model and students who use ordinary learning.

RESEARCH METHODS

This research uses Quasy Experimental with nonequivalent comparison group design. The population in this study were all grade XI students of SMK Negeri 1 Cipanas in the 2024-2025 academic year. From this population, two classes were taken as research samples, namely class XI TJKT which amounted to 27 students and class XI MPLB 1 which amounted to 25 students. Class XI MPLB 1 as an experimental class using the Think Pair Share learning model and class XI TJKT as a control class using ordinary learning. The sampling technique was carried out using purposive sampling technique.

The data collection technique used a description test consisting of 3 questions about matrix material to measure mathematical communication ability and a 43-item questionnaire to measure metacognitive awareness based on the Metacognitive Awareness Inventory (MAI) adapted from Schraw & Dennison (1994) in Marhaendra et al (2023). In this study, researchers used quantitative data analysis. The tests and questionnaires used will be given during the pretest and posttest. To analyze the statistics of the test results and questionnaire results, researchers used the independent sample t-test test. Before the calculation is carried out, the data used will be tested first. There are two prerequisite tests, namely normality test and homogeneity test. After that, hypothesis testing is carried out using the independent sample t-test if the conditions are met. If it is not met then use the mann-whitney u test. The significant level used is 5%. This study uses the help of SPSS Statistic 26 software application in analyzing data. The stages of this research are presented in Figure 1.

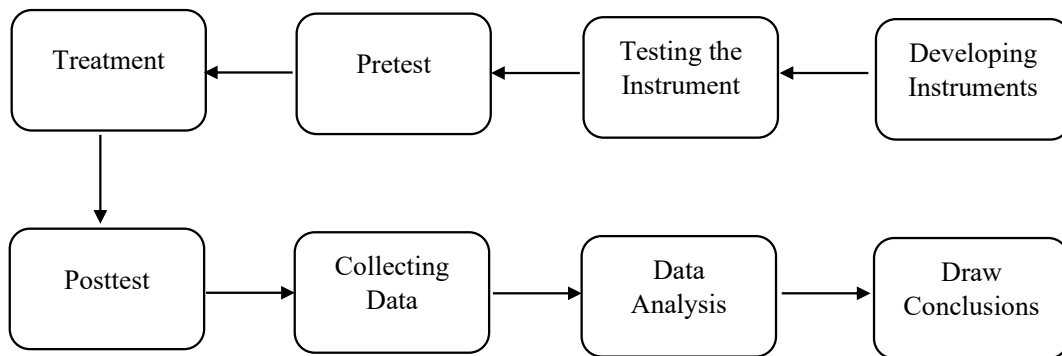


Figure 1. Research Stages

RESULTS AND DISCUSSION

Pretest of Students' Mathematical Communication Ability

To see the initial ability of students from both classes, an initial test or pretest was conducted. After that, it was analyzed using statistical tests of pretest data of experimental and control classes with normality tests, and homogeneity tests, then the equality or difference test of two independent means was carried out with the following results:

Table 1. Descriptive Statistical Data of Pretest of Mathematical Communication Ability

Statistics	Class	
	Control	Experiment
Number of Students	27	25
Min	1	1
Max	7	8
Average	4.037	3.360
Standard Deviation	1.427	1.776

Table 2. Normality Test of Pretest Data of Mathematical Communication Ability

Class	Shapiro-Wilk		
	N	Sig	Description
Experiment	25	0.020	Not Normal
Control	27	0.012	Not Normal

Based on Table 2, test the normality of pretest data for experimental and control classes in this study with the Shapiro-Wilk test of normality. The result is that the data is not normally distributed, so the homogeneity test is not carried out but the non-parametric test, namely the Mann-Whitney U test.

Table 3. Mann-Whitney U Test Pretest Data of Mathematical Communication Ability

	Mann-Whitney U	Mean Rank	
	Asymp. Sig. (2-tailed)	Control	Experiment
Pretest	0.069	30.07	22.64

Based on Table 3, the result obtained is a significance value of 0.069, meaning that the significance value of the pretest data is more than 0.05. So it can be concluded that there is no difference in the initial ability of mathematical communication of experimental class students with the initial ability of mathematical communication of control class students.

This same initial ability is because both classes have not received treatment. The similarity between the experimental class and the control class occurs because the two classes have not received different treatments or learning interventions so that the initial condition of the students is still at the same level (Sugiyono, 2019). Mathematical communication is very important because this ability is a basic part of mathematics which is very essential for mathematics and mathematics education itself (Darwanto, 2019).

Improvement of Students' Mathematical Communication Ability

The difference in the improvement of mathematical communication ability between students who apply the Think Pair Share learning model and students who use ordinary learning is obtained by analyzing the gain index data. Based on the calculation of the gain index, the following descriptive statistical data are presented in Table 4.

Table 4. Descriptive Statistical Data of Gain Index Value of Mathematical Communication Ability

Statistics	Class	
	Control	Experiment
Number of Students	27	25
Min	0.00	0.00
Max	1	1
Average	0.516	0.864
Standard Deviation	0.336	0.272

To find out the improvement of students' mathematical communication ability in experimental and control classes will be known after statistical tests which include normality, homogeneity, and similarity/difference tests of two means as follows:

Table 5. Data Normality Test of Gain Index Value of Mathematical Communication Ability

Class	Shapiro-Wilk		
	N	Sig	Description
Experiment	25	0.000	Not Normal
Control	27	0.036	Not Normal

Based on Table 5, test the normality of the experimental class and control class gain index data in this study with the Shapiro-Wilk test of normality. The result is that the data is not normally distributed, so the homogeneity test is not carried out but the non-parametric test, namely the Mann-Whitney U test.

Table 6. Mann-Whitney U Test Data of Gain Index Value of Mathematical Communication Ability

	Mann-Whitney U	Mean Rank	
	Asymp. Sig. (2-tailed)	Control	Experiment
<i>N-Gain</i>	0,000	18,44	35,20

Based on Table 6, the significance value of 0.000 is less than 0.05. So it can be concluded that there is a difference in improving mathematical communication between students who apply the Think Pair Share learning model and students who use ordinary learning. The Mean Rank value in the control class and experimental class is 18.44 and 35.20, which means that the improvement of mathematical communication ability of classes

using the Think Pair Share learning model is better than the improvement of mathematical communication ability of classes using ordinary learning models.

These findings are in line with research conducted by Agustin et al (2025) which concluded that the increase in mathematical communication of students who use the Think Pair Share learning model is higher than students who use ordinary learning. Likewise, Zain & Ahmad's research (2021) concluded that the use of the Think Pair Share model has a good effect on students' mathematical communication ability.

This different improvement in students' mathematical communication is caused by several factors. One of them is the difference in activity and learning atmosphere. It was seen that most of the experimental class students were more active in learning and confident in expressing their ideas or answers while the control class only a few people were confident in expressing their ideas or answers. In addition, experimental class students can answer mathematical communication questions more clearly and systematically because the experimental class in its learning uses the Think Pair Share learning model which requires students to focus on each learning process carried out.

Susilo (2005) states that one of the advantages of using the Think Pair Share learning model is that it helps students follow the learning process that has been designed so as to limit the disruption of their deviant thoughts and behavior because they have to discuss their thoughts with their friends. Meanwhile, most control class students did not answer the questions systematically and unclearly without expressing mathematical ideas or ideas into mathematical models or vice versa because the control class learning used ordinary learning. The learning process in the experimental class involved the Think Pair Share learning model. The use of this learning model is designed so that students are active in learning. This is in accordance with the theory of constructivism learning according to Vygotsky (in Arafah et al, 2023) that constructivism is cognitive development through social activities, group work, internships, and so on.

In the first step of the Think Pair Share learning model, namely Think, the teacher provides a problem related to matrix material and requires students to find answers to the problems given independently. This stage is also in line with the view of constructivism according to Piaget (in Sugrah, 2019), namely constructivism is a system of explanation of how students as individuals adapt and improve knowledge in themselves. When students think by finding solutions independently, they carry out a process of combination and adjustment to new information, which becomes an important basis in the development of their thinking.

The second step in the Think Pair Share learning model is Pair, the teacher asks students to pair up with a friend beside them. This stage is done so that students in pairs can exchange information with each other and complement all the answer ideas that have not been thought of at the Think stage. In addition, at the Pair stage students play an active role in learning. This is in line with Lestari's opinion (2023) that the application of the Think Pair Share cooperative learning model can increase student participation in learning.

Furthermore, in the third step, namely Share, each pair or group shares the results of their thoughts, ideas, and answers with other pairs or groups in front of the class. At this stage students can practice social ability by being good speakers and listeners, and expand understanding by listening to their friends' opinions (Lestari, 2023). So it can be concluded that the use of the Think Pair Share learning model makes a significant contribution to improving students' mathematical communication ability and is able to facilitate the development of these abilities more effectively

Students' Initial Metacognitive Awareness

To see the initial ability of students from both classes, an initial questionnaire test was conducted. After that, it was analyzed using a statistical test of the initial questionnaire data of the experimental class and control class with a normality test, and a homogeneity test, then a test of the similarity or difference of two independent means with the following results:

Table 7. Descriptive Statistics Data of Initial Questionnaire of Metacognitive Awareness

Statistics	Class	
	Control	Experiment
Number of Students	27	25
Min	100	84
Max	130	142
Average	117.1	121.6
Standard Deviation	9.341	13.393

Table 8. Normality Test of Initial Questionnaire Data on Metacognitive Awareness

Class	N	Shapiro-Wilk	
		Sig	Description
Experiment	25	0.003	Not Normal
Control	27	0.025	Not Normal

Based on Table 8, test the normality of the initial questionnaire data of the experimental class and control class in this study with the Shapiro-Wilk test of normality. The result is that the data is not normally distributed, so the homogeneity test is not carried out but the non-parametric test, namely the Mann-Whitney U test.

Table 9. Mann-Whitney U Test of Initial Metacognitive Awareness Questionnaire Data

	Mann-Whitney U	Mean Rank	
	Asymp. Sig. (2-tailed)	Control	Experiment
<i>Pretest</i>	0.059	22.69	30.62

Based on Table 9, the result obtained is a significance value of 0.059, meaning that the significance value of the initial questionnaire data is more than 0.05. So it can be concluded that there is no difference in the initial metacognitive awareness of experimental class students with the initial metacognitive awareness of control class students. This is because at the beginning of learning students have not been given any treatment. So that students' metacognitive awareness is still based on previous learning experiences.

This is in line with the results of research conducted by Heswandi (2015) that there is no difference in the initial ability of students' metacognitive awareness between the experimental class and the control class. As well as research conducted by Hamsyah (2019) explains that the initial ability of metacognitive awareness of experimental class students is the same as that of control class students. So that the two classes have the same initial ability.

Improvement of Students' Metacognitive Awareness

The difference in increasing metacognitive awareness between students who apply the Think Pair Share learning model and students who use ordinary learning is done by analyzing the gain index data. Based on the calculation of the gain index, the following descriptive statistical data are presented in Table 10.

Table 10. Descriptive Statistical Data of Metacognitive Awareness Gain Index Value

Statistics	Kelas	
	Control	Experiment
Number of Students	27	25
Min	0.01	0.00
Max	0.44	0.45
Average	0.162	0.119
Standard Deviation	0.133	0.125

To find out the increase in students' metacognitive awareness in experimental and control classes will be known after statistical tests which include normality, homogeneity, and similarity/difference tests of two means as follows:

Table 11. Normality Test of Metacognitive Awareness Gain Index Value Data

Class	Shapiro-Wilk		
	N	Sig	Description
Experiment	25	0.000	Not Normal
Control	27	0.007	Not Normal

Based on Table 11, test the normality of the experimental class and control class gain index data in this study with the Shapiro-Wilk test of normality. The result is that the data is not normally distributed, so the homogeneity test is not carried out but the non-parametric test, namely the Mann-Whitney U test.

Table 12. Mann-Whitney U Test of Metacognitive Awareness Gain Index Value Data

	Mann-Whitney U	Mean Rank	
	Asymp. Sig. (2-tailed)	Control	Experiment
<i>N-Gain</i>	0.379	28.28	24.58

Based on Table 12, the significance value is 0.379, which is more than 0.05. So it can be concluded that there is no difference in increasing metacognitive awareness between students who apply the Think Pair Share learning model and students who use ordinary learning. This means that the application of the Think Pair Share learning model has not been able to have a better effect than ordinary learning in terms of increasing students' metacognitive awareness.

One of the contributing factors is that by internal factors from the students themselves. Some students may lack motivation, have low confidence and self-esteem, or are not yet accustomed to reviewing and evaluating their own thinking processes. This is in line with Riyadi (2022) who stated that students' self-confidence in their abilities can support the process of independent learning strategies and evaluation. Andini & Azizah (2021) emphasized that students with good metacognitive awareness will understand how to control and evaluate their thinking processes which are influenced by motivation, ask, and talent. Without the internal drive to organize learning strategies and reflect on the results, the potential of the Think Pair Share learning model in increasing metacognitive awareness will not be maximized.

Increasing metacognitive awareness does not only depend on the model used, but it also requires the role of the teacher in directing students to develop students' ways of thinking, as well as a supportive learning environment. In the absence of clear guidance,

students are often unaware of their thinking process. When teachers are not clear in directing students to understand, plan, and evaluate their thinking processes, then increasing metacognitive awareness is difficult to achieve. In line with this, Fitria, Jamaluddin, & Artayasa (2020) emphasized that the role of the teacher greatly influences the increase in students' metacognitive awareness. In addition, Septian et al (2020) emphasized that learning is better if teachers reflect and evaluate after learning.

CONCLUSION

Research conducted with matrix teaching materials using the Think Pair Share model in a quasi-experimental study conducted at SMK Negeri 1 Cipanas concluded that there were differences in the improvement of mathematical communication ability of students who used the Think Pair Share learning model with students who used ordinary learning. The improvement of students' mathematical communication ability using the Think Pair Share learning model is better than the improvement of students' mathematical communication ability using ordinary learning. And there is no difference in metacognitive awareness of students who use Think Pair Share learning mode with students who use ordinary learning.

In addition, the suggestion that can be conveyed is that learning using the Think Pair Share learning model should be used as an alternative learning model that can be used by teachers in schools to improve students' mathematical communication ability, especially on matrix material and it is better for teachers to plan explicitly and systematically when using the Think Pair Share learning model.

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