The Effect of the Application of the Reciprocal Teaching Model on the Mathematical Communication Skills of Grade IX Students of Muhammadiyah 12 Middle School Makassar

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ABSTRACT
The purpose of this study was to determine whether or not there was an influence of the reciprocal teaching model on the mathematical communication skills of grade IX students of Muhammadiyah 12 Makassar Middle School. This study is a Quasi-Experimental Design study. The sample in this study was grade IX of Muhammadiyah 12 Makassar Middle School with a total of 52 students spread across two classes using the cluster random sampling method, one class as the control class and one class as the experimental class. The instrument used to collect data was a mathematical communication ability test conducted before being given treatment (pretest) and after being given treatment (posttest) as well as observation of the implementation sheet. The data analysis of this study was descriptive statistical analysis and inferential statistical analysis. Hypothesis testing used a paired t-test. The results of the study showed that both descriptively and inferentially the mathematical communication skills of students taught using the reciprocal teaching model were in the fairly high category and the mathematical communication skills taught with the reciprocal teaching model were higher than the mathematical communication skills taught with the conventional model. Thus, it is concluded that the application of the reciprocal teaching model has an effect on the mathematical communication skills of class IX students of Muhammadiyah 12 Makassar Middle School.
Keywords: Reciprocal Teaching Model, Mathematical Communication Skills, Experimental Class

INTRODUCTION

Education is a conscious and planned effort to create a learning atmosphere and learning process for students to actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble morals, and the skills needed by themselves and society.

Mathematics is a vital science in life. The need for mathematics lessons for every student, from elementary school through college, aims to equip them with the skills to think logically, analytically, systematically, critically, and creatively, as well as to develop the ability to collaborate. Mathematics is also considered a compulsory subject in schools.

Mathematical communication is a student's ability to express mathematical ideas both orally and in writing. One of the competencies students must possess is using language to understand, develop, and communicate ideas and information, as well as to interact with others (Haji, 2016).

However, in reality, communication skills in mathematics learning in junior high schools

(SMP) receive little attention from teachers. Teachers tend to emphasize arithmetic, problem-solving, and reasoning skills. Consequently, students' mathematical communication skills are weak. Students are less able to communicate their mathematical ideas clearly and correctly, both orally and in writing (Haji, 2016).

Based on the results of observations at Muhammadiyah 12 Makassar Middle School, information was obtained that in the implementation of the teaching and learning process, only the teacher was seen to be active, while the students were just silent in receiving the material presented. This was due to a lack of good communication between students and students, as well as students and teachers, resulting in low student communication.

Based on the above problems, a shift in learning from conventional to non-conventional learning is necessary. According to Firdaus (in Haji, 2006), non-conventional learning can improve students' mathematical communication skills. One such non-conventional learning model is the reciprocal teaching model, which prioritizes student activity and enthusiasm in learning.

Learning*reciprocal teaching*will increase students' enthusiasm in learning because students are required to actively discuss and explain the results of their work well so that mastery of the concepts of a mathematical topic can be achieved. Reciprocal teaching is a learning that applies four independent understanding strategies, namely summarizing the teaching material, formulating questions and solving them, re-explaining the knowledge that has been obtained and then predicting the next question from the problem presented to students (Palinscar, 1986).

Fajarwati (2010:17) defines reciprocal teaching as a learning model in which students teach material to their peers. In this model, students act as teachers, delivering material to their peers. Through this reciprocal learning model, students can develop independent learning skills, develop their own knowledge, and the teacher acts as a facilitator, mediator, and manager in the learning process.

The reciprocal teaching model is a learning model that familiarizes students with four independent understanding strategies, namely: summarizing the teaching material, formulating questions and solving them (questioning), re-explaining the knowledge they have acquired (clarifying), and predicting (predicting), (Hayati, 2012:17).

Communication is essentially a process of social interaction between humans and their

environment. Etymologically, "communication" comes from the Latin word "communicatio," which is derived from the word "communis," meaning to create togetherness or build togetherness between two or more people. The root of "communis" is "communico," meaning to share, in this case sharing a shared understanding through the exchange of messages (Vardiansyah, 2008).

Eriska (2019: 143) states that mathematical communication is a mathematical thinking skill. This ability is a crucial component of mathematics and must be developed in the learning process. Therefore, improving mathematical communication skills is crucial for students, as it is crucial for them to express mathematical ideas.

The indicators of mathematical communication skills in this study based on the reciprocal teaching learning model are as follows:

1. Expressing mathematical ideas or problems through writing.
2. Using mathematical terms, notations, and symbols in presenting mathematical ideas.
3. Able to analyze and assess mathematical thinking and strategies

RESEARCH METHODS

This type of research is quasi-experimental research. This study involved two classes, namely the experimental class and the control class. The design used was nonequivalent control group design. The implementation of this research was carried out in the class of SMP Muhammadiyah 12 Makassar. The sample in this study was class IX of SMP Muhammadiyah 12 Makassar with a total of 52 students spread across two classes with sampling using the cluster random sampling method, one class as the control class and one class as the experimental class. Data collection techniques in this study provided a mathematical communication ability test before and after the application of the reciprocal teaching model and an observation sheet of learning implementation. The data obtained were then analyzed using descriptive and inferential statistics using the t-test.

RESEARCH RESULT

The researcher used a quasi-experiment to determine whether or not the reciprocal teaching model had an effect on the mathematical communication skills of ninth-grade students of SMP Muhammadiyah 12 Makassar. The sample taken was two classes, namely IX A as the experimental class with 26 students and IX B as the control class with 26 students. In this

study, the researcher provided treatment in the form of a reciprocal teaching learning model in class IX A and a conventional learning model in class IX B. The research data consisted of a test

The initial (pretest) and final test (posttest) on the material that has been delivered, namely quadratic equations using the application of the reciprocal teaching model. The study was conducted on October 17 to October 31, 2019. The treatment was given on Monday at 3-4 and Thursday at 3-4 for class IX A, Monday at 5-6 and Thursday at 5-6 for class IX B. The description of each description of the analysis results is as follows:

a. Mathematical Communication Ability Test Results

The results of the mathematical communication ability test in this study were taken from the results of the pretest and posttest given to the experimental class, namely class IX A and the control class, namely class IX B. Where for the control class the pretest was given on October 17, 2019 at 5-6 o'clock, while the experimental class on October 17, 2019 at 3-4 o'clock, and the posttest for the control class on October 31, 2019 at 5-6 o'clock, while the experimental class on October 31, 2019 at 3-4 o'clock.

Table 1 Results of the Experimental Class Mathematical Communication Ability Test.

	Pretest	***Posttest***
Sample Size	26	26
Mean	59.61	83.30
Median	57.00	81.00
Standard Deviation	11.95	7.94
Minimum	42.	69.00
Maximum	83.00	100

Table 2 Results of the Mathematical Communication Ability Test of the Control Class

	Pretest	***Posttest***
Sample Size	26	26
Mean	52.03	72.11
Median	50.00	75.00
Standard Deviation	11.94	9.36
Minimum	30.00	52.00
Maximum	75.00	89.00

1) Mathematical Communication Ability First Indicator

From the results of processing data on mathematical communication skills for the first indicator in both the experimental and control classes, a recapitulation of data on students' mathematical communication skills was obtained as in the following table:

Table 3 Results of Mathematical Communication Ability First Indicator

Class	Average Score	Criteria
*Pretest*Experiment	61.83	Currently
*Posttest*Experiment	86.00	Tall
*Pretest*Control	55.33	Low
*Posttest*Control	71.12	Currently

2) Mathematical Communication Ability Second indicator

From the results of processing the mathematical communication ability data for the second indicator in both the experimental and control classes, a recapitulation of the students' mathematical communication ability data was obtained as in the following table:

Table 4 Results of Mathematical Communication Ability for the Second Indicator

Class	Average Score	Criteria
*Pretest*Experiment	60.23	Currently
*Posttest*Experiment	82.67	High enough
*Pretest*Control	53.18	Low
*Posttest*Control	75.93	High enough

3) Mathematical Communication Ability Third indicator

From the results of processing the mathematical communication ability data for the third indicator in both the experimental and control classes, a recapitulation of students' mathematical communication ability data was obtained as in the following table:

Table 5 Results of Mathematical Communication Skills for the Third Indicator

Class	Average Score	Criteria
*Pretest*Experiment	58.70	Currently
*Posttest*Experiment	81.06	High enough
*Pretest*Control	49.97	Low
*Posttest*Control	69.53	Currently

4) Normalized Gain of Experimental Class of Reciprocal Teaching Model

The statistical values of the normalized gain scores of students taught using the

reciprocal teaching model.

Table 6 Gain of Improvement in Mathematical Communication Skills Results of Experimental Class

Statistics	Experimental Gain
Sample Size	26
Mean	0.6045
Median	0.620
Mode	0.62
Standard Deviation	0.159
Minimum	0.29
Maximum	1.00

Table 6 Frequency Distribution and Percentage of Normalized Gain Scores of the Experimental Class

Score category	Frequency	Percentage (%)
$g < 0.30$ Low	1	3
$0.30 \leq g < 0.70$ Moderate	20	76
$g \geq 0.70$ Tall	5	19
Total	26	100

5) Normalized Gain of Conventional Model Control Class

The statistical values of the normalized gain scores of students taught using the conventional learning model are seen in Table 8.

Table 8 Gain of Improvement in Mathematical Communication Skills Results of Control Class

Statistics	Control Gain
Sample Size	26
Mean	0.4192
Median	0.43
Mode	0.57
Standard Deviation	0.133
Minimum	0.22
Maximum	0.62

Table 9 Frequency Distribution and Percentage of Normalized Gain Scores for the Control Class

Score category	Frequency	Percentage (%)
$g < 0.30$ Low	7	26
$0.30 \leq g < 0.70$ Moderate	19	73
$g \geq 0.70$ Tall	0	
Total	26	100

b. Implementation Observation Sheet

The results of observations on the implementation of reciprocal teaching learning by applying the class during the model in the experimental in the following learning process can be seen table:

Table 10 Observation Series Implementation Sheet

Meeting	Average Score	Criteria
1.	2.68	Not implemented well
2.	3.10	Well executed
3.	3.31	Well executed
Average	3.03	Well executed

B. Inferential Statistical Analysis

a. Normality Test

The calculation results obtained are as follows:

Table 11 Summary of Normality Test

No	Group	Sig	Conclusion
1	*Pretest*Experimental Class	0.200	Normal
2	*Posttest*Experimental Class	0.122	Normal
3	*Pretest*Control Class	0.084	Normal
4	*Posttest*Control Class	0.088	Normal

b. Hypothesis Testing

1. Mathematical communication skills after implementing the reciprocal teaching learning model are at least in the fairly high category.

   H_(0): μ_k≤72
   H_(1): μ_k>72
   Information :
   μ_(k)= Mathematical communication ability.
   The assessment categories for mathematical communication skills are as follows:

Table 12 Categories of Communication Skills Assessment

No	Assessment Categories	Information
1	$0 < x \leq 40$	Very Low
2	$41 < x \leq 56$	Low
3	$57 < x \leq 71$	Currently
4	$72 < x \leq 85$	High enough
5	$86 < x \leq 100$	Tall

(source: Muhammadiyah 12 Makassar Middle School)

Average ability testmathematical communication after the application of the reciprocal teaching learning model, namely the posttest value in the experimental class, was carried out using a paired t-test using SPSS version 22. The output of the test results is presented in the following table:

Table 13 Hypothesis Testing

No	**Mathematical Communication Indicators**	**Criteria**	**Achievement *mean***	**Decision H_0**
1	First	$\mu_k > 72$	Sig = 86.00	Rejected
2	Second	$\mu_k > 72$	Sig = 82.67	Rejected
3	Third	$\mu_k > 72$	Sig = 81.06	Rejected

Based on the table above, it appears that starting from the first to the third mathematical communication indicator, the significance value is >72, it can be concluded that Decision

H_(0) is rejected so that the mathematical communication ability after implementing the reciprocal teaching learning model is at least in the fairly high category.

2. The mathematical communication abilities of students taught using the reciprocal teaching model are higher than the mathematical communication abilities of students taught using the conventional model.

H_(0): μ_2≤μ_1
H_(1): μ_2>μ_1

The test results output is presented in the following table:

Table 14. Independent t test

Group Statistics

	Class	N	Mean	Standard Deviation	Std. Error Mean
Communication	Post experiment	26	83,3077	7.94868	1.55886
	Post Control	26	71,1154	9,36943	1.83750

The results of the hypothesis test show that the mathematical communication skills of students in the experimental class are higher than the mathematical communication skills of students in the control class, which means that the decision H_(0) is rejected.

3. The gain in increasing mathematical communication skills of students taught using the reciprocal teaching model is higher than the gain in increasing mathematical communication skills of students taught using the conventional model.

Statistically stated as follows:

H0 : μ_(g_(2))≤μ_(g_1)
H1 : μ_(g_(2))>μ_(g_1)

In testing the third hypothesis, a paired t-test was used to determine whether the increase in mathematical communication skills of students taught using the reciprocal teaching model was higher than the mathematical communication skills of students taught using the conventional model.

DISCUSSION

Based on the results of the data analysis presented above, it can be stated that it is related to the relevant theory in chapter II by Rifa, et al (2015) with the conclusion that

reciprocal teaching learning has an effect on students' mathematical communication skills on quadrilateral material in class VII of SMP Negeri 5 Pontianak, where the purpose of this study is to determine whether or not there is an effect of the application of the reciprocal teaching model on students' mathematical communication skills in class IX of SMP Muhammadiyah 12 Makassar.

In general, the mathematics learning of ninth-grade students at Muhammadiyah 12 Junior High School, Makassar, before implementing the reciprocal teaching model was still less active and needed improvement. This was evident in the students' low mathematical communication skills. Therefore, it is necessary to implement a learning model that will improve students' communication skills.

Regarding the implementation of learning with the application of the reciprocal teaching model, an average of 83.30 was obtained with the criteria of being implemented well in line with the results of students' communication skills which were obtained on average more than 72 with a fairly high category. With the implementation of learning well, it supports students' mathematical communication skills in each indicator, namely:

1) Expressing mathematical ideas or problems through writing before being given treatment was 61.83, after being given treatment it increased to 86.00.

2) Using mathematical terms, notations and symbols in presenting mathematical ideas before being given treatment was 60.23, after being given treatment it increased to 82.67.

3) Able to analyze and assess mathematical thinking and strategies before being given treatment was 58.70, after being given treatment it increased to 81.06.

This aligns with Firdaus's (in Haji, 2006) argument that non-conventional learning can improve students' mathematical communication skills. One such non-conventional learning model is the reciprocal teaching model, which prioritizes student activity and enthusiasm in learning.

The results of this study also show that students' mathematical communication skills with the application of the reciprocal teaching learning model are more influential than those of class students with the application of the conventional learning model (lecture).

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the application of the reciprocal teaching learning model has an effect on the mathematical communication

skills of class IX students of SMP Muhammadiyah 12 Makassar, with the following explanation:

1. Mathematical communication skills after implementing the reciprocal teaching learning model are in the fairly high category with an average (mean) of more than 72.
2. The mathematical communication ability of students taught using the reciprocal teaching model, namely (83.30), is higher than the mathematical communication ability of students taught using the conventional model, namely only 71.11.
3. The gain in improving mathematical communication of students taught using the reciprocal teaching model, namely (0.6045), is higher than the gain in improving mathematical communication skills of students taught using the conventional model, namely only (0.4192).

Based on the research results obtained, the researcher would like to provide the following suggestions:

1. Teachers can apply the reciprocal teaching learning model especially to improve students' mathematical communication skills, because in this study there was an influence of the application of reciprocal teaching on students' mathematical communication skills.
2. It is best that during the learning process, teachers try to explore the knowledge that students have, such as by training students' mathematical communication skills so that they can work together to solve problems and issues in mathematics.
3. Learning with the reciprocal teaching model is very capable of developing students' mathematical communication skills by appointing one of the students to act as a teacher where students are given the opportunity to study the material first, then students re-explain the material learned to other students, this can make students learn more independently, creatively, and more actively.
4. For future researchers, they are required to conduct research with different materials so that they can be used as comparative studies to improve the quality of national education.

BIBLIOGRAPHY

Eriska. 2019. Improving Students' Mathematical Communication Skills Through Reflective Learning in Senior High School. PGRI University. Palembang. Vol. 1

Fajarwati, Munifah Sri. 2010. Implementation of the Reciprocal Teaching Model as an Effort to Improve the Understanding of Mathematics Concepts of Class XI Accounting

Students of RSBI (Pilot International Standard School) at SMK Negeri 1 Depok. Yogyakarta: UNY.

Hayati, Mardia. 2012. Character-Based Learning Design. Pekanbaru: Al-Mujtahadah Press.

Haji, Saleh and M. Ilham Abdullah. 2016. Improving Mathematical Communication Skills Through Realistic Mathematics Learning. FKIP University. Bengkulu. Vol 5 No 1.

Palincsar, A. & Brown, A. (1984). Reciprocal teaching of comprehensive-fostering and comprehensive-monitoring activities. cognition and instruction, 2, 117-175.

Rifa, Dwi et al. 2015. The Effect of Reciprocal Teaching Learning on Students' Mathematical Communication Skills in Quadrilateral Material in Junior High School. Mathematics Education Study Program KIP Untan. Pontianak.

Rachmayani, Dwi. 2014. Implementation of Reciprocal Teaching Learning to Improve Students' Mathematical Communication Skills and Mathematics Learning Independence. Unsika Education Journal Volume 2 Number 1, 2014.

Sari, Ika. 2017. Mathematical Communication Ability Based on Differences in Learning Styles of Grade X Students of SMA NEGERI 6 Wajo on Statistics Material. Journal of the Faculty of Mathematics and Natural Sciences. Makassar State University. Volume 5 number 2, 2017.