The Effectiveness of Problem Based Learning Model with Realistic Mathematics Education Approach to Mathematical Communication Ability of Students at Junior High School 4 Palopo

*Ummul J[1]

[1] *Mathematics Education Master's Program, Universitas Negeri Makassar, Makassar, Indonesia*
**Corresponding author. Email:ummuljunaimil45@gmail.com*

ABSTRACT
This study aims to investigate (1) The mathematical communication ability of VIII grade students of SMP Negeri 4 Palopo before and after being taught using a problem-based learning model with a realistic mathematics education approach, (2) The effectiveness of a problem-based learning model with a realistic mathematics education approach on the mathematical communication ability of VIII grade students of SMP Negeri 4 Palopo. The type of research used is experimental research. The sample in this study was class VIIIA, totaling 30 people. The instrument used was the mathematical communication ability test. The data were analyzed using descriptive statistical and inferential statistics. The results showed that (1) the mathematical communication ability of VIII grade students of SMP Negeri 4 Palopo were in a low category before being given treatment and increased to a high category after being treated in the form of learning with a problem-based learning model with a realistic mathematics education approach. (2) the problem-based learning model with a realistic mathematics education approach effectively improves students' mathematical communication ability.

***Keywords**: Problem Based Learning, Realistic Mathematics Education, Mathematical Communication Ability.*

1. INTRODUCTION

Mathematical science is used in modeling various phenomena that occur in everyday life. Given the important role of mathematics in life, it is also important to prepare learning that is able to support the development of various competencies in the learning process. Learning mathematics requires students to be able to think logically, systematically, and critically in determining the solution to any given mathematical problem. The basic abilities that need to be developed in the mathematics learning process, namely the ability to solve problems, reason, communicate, associate ideas, and be able to present the results or solutions of the problems given in the learning process [1].

The results of observations made in one school, through an interview process with one of the teachers, said that most students in the learning process had difficulty expressing or writing answers to math problems given in the form of symbols or appropriate mathematical language. Students cannot relate or state the connection or relation between the mathematical concepts they use. In addition, in the learning process, sometimes students also feel doubtful and afraid of being wrong in expressing their ideas or ideas, so that it affects the low student learning outcomes.

Based on the above statement, communication skills are one of the important aspects that need to be developed in the mathematics learning process. Communication skills are an important aspect that students need to have in determining solutions to mathematical problems related to students' real world [2]. So it is necessary to apply an appropriate learning model to improve students' communication skills.

One of the learning models that can be applied in the mathematics learning process is the problem-based learning model. Where this model makes real problems as a starting point in carrying out mathematics learning. As stated by Sudiyasa, that problem-based learning (PBL) is a form of mathematics learning that focuses on meaningful life problems for students, the teacher's role is to present problems, ask questions and facilitate investigation and dialogue. This problem-based learning aims to help students develop thinking skills and problem-solving skills, learn authentic adult roles and become independent learners [3].

In addition to the learning model, it is also important to insert the right learning approach to support the student learning process so that the competencies to be developed can be achieved properly. In this study, a realistic approach to mathematics education was applied as a supporter of learning with a problem-based learning model. With a realistic mathematical education (rme) approach that utilizes students ' real world as part of the learning process, it will make it easier for students to understand every problem presented in learning. As found by Stemn that RME uses conceivable contextual problems as links to mathematics to support students in developing their mathematical abilities [4].

This study aims to determine (1) The mathematical communication ability of VIII grade students of SMP Negeri 4 Palopo before and after being taught using a problem-based learning model with a realistic mathematical education approach, (2) the effectiveness of a problem-based learning model with a realistic mathematical education approach on the mathematical communication ability of viii grade students of smp Negeri 4 Palopo.

2. LITERATURE REVIEW

This research contains several variables. To avoid discrepancies in perceptions of the variables discussed in this study, the researchers explain the variables in this study.

2.1. *Mathematical Communication Ability*

Mathematical communication skills are components of hard skills and soft skills of mathematics in the 2013 curriculum that need to be possessed by and developed in students who study mathematics [5]. Mathematical communication is an activity to organize, consolidate, analyze, evaluate students' mathematical thinking using mathematical language coherently and clearly to peers, teachers, and others to express mathematical ideas appropriately, both orally and in writing, to build a strong understanding of mathematics through the process of listening, presenting and discussion [6,1]. Through the communication process, students can exchange ideas about the problems posed in the learning process.

According to Hodiyanto, communication skills consist of three indicators of ability, namely (1) writing, namely explaining ideas or solutions to a problem or picture using their language; (2) Drawing, namely explaining ideas or solutions to mathematical problems in the form of pictures; (3) mathematical expressions, stating problems or everyday events in language or mathematical models [7].

Based on the definitions, it can be concluded that mathematical communication ability is the ability of students to express ideas or ideas in a mathematical situation by using symbols or mathematical models, as well as explaining the relationship or relations of these mathematical ideas both orally and in writing.

2.2. *Problem Based Learning Model*

The problem-based learning (PBL) model is a learning model that makes real problems the starting point of learning. The situation or problem becomes the starting point for understanding the principles and developing different things in general learning [8].

Trianto, suggests five main phases in learning with a problem-based learning model, namely (1) student orientation to problems, (2) organizing students to learn, (3) assisting in independent or group investigations, (4) developing and presenting results, (5) Analyzing and evaluating problem-solving [9]. With the problem-based learning model, students' abilities will be honed through group discussions. Students are required to communicate with each other and work together to solve math problems given.

In general, the problem-based learning (PBL) model is a learning model that presents real problems as a starting point for learning, which encourages students to find solutions or solutions to these

problems by utilizing students' prior knowledge to find new knowledge based on the problems presented.

2.3. *Realistic Mathematics Education* (RME)

The realistic mathematics education (RME) approach is one approach in learning mathematics. The realistic approach to mathematics education is an approach that utilizes students' real world as part of the process to rediscover the mathematical concepts they are learning. Soviawati revealed that a realistic mathematics approach is an approach that places students' reality and experience as the starting point of learning that provides opportunities to construct students' formal mathematical knowledge through real problems that exist [10].

Sunadi suggested that the realistic approach to mathematics education has six characteristics: activity, real, gradual, related, interaction, and guidance [11].

Learning using realistic mathematical education, developing a mathematical concept is started by students independently through exploration activities to provide opportunities for students to be creative and develop their minds.

Based on the definitions above, it can be concluded that the realistic mathematical education (RME) approach is a mathematical approach that utilizes the experience of the real-life of students to encourage both physical and mental activities of students in the learning process, which provides opportunities for students to find mathematical ideas/concepts being studied.

3. RESEARCH METHODOLOGY

3.1. *Location*

The research was carried out at SMP Negeri 4 Palopo, located on Andi Kambo Street, Malatunrung Village, Wara Timur District, Palopo City, South Sulawesi Province.

3.2. *Research Type and Design*

The method used in this study is a quantitative research method. This type of research is quasi-experiment; the research design used is One group Pretest–Posttest design. The design of this research can be described as follows:

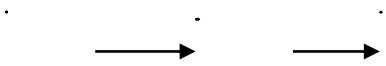

Figure 1: Research Design

Information:
O1 = Pretest before treatment
O2 = Final test (posttest) after treatment
X = Mathematics learning using a problem-based learning model with a realistic approach to mathematics education.

3.3. *Sample*

The sample in this study was all class VIIIA students of SMP Negeri 4 Palopo, with 30 students consisting of 13 boys and 17 girls.

3.4. *Research Instruments*

The data and information needed in this study were collected using instruments in pretest and posttest questions of students' mathematical communication skills. The test used in this study is a subjective test (a form of description) with the material of flat-sided three-dimensional figures.

Preparation of pretest and posttest questions based on indicators of mathematical communication skills that have been determined and validated.

3.5. *Data collection technique*

Data collection for the results of students' mathematical communication skills test was carried out in two stages. The first stage gives an initial test (pretest), and the second stage gives a final test (post-test) in the experimental class. The test aims to determine the mathematical communication skills of experimental class students before and after learning using a problem-based learning model with a realistic mathematics education approach.

4. RESULTS AND DISCUSSION

4.1. *Research result*

The results of the study consist of the effects of descriptive analysis, and the results of inferential analysis (normality test and hypothesis test) of students' mathematical communication ability in the experimental class, presented as follows:

4.1.1. The results of descriptive statistical analysis of students' mathematical communication skills for classes in the experimental class

Based on the results of descriptive statistical analysis of students' mathematical communication skills in the experimental class, they are presented in the following table 1:

Table 1. Descriptive statistics of mathematical communication skills scores

Statistics	Statistical Value	
	Pretest	*Posttest*
Sample Size	30	30
Ideal Score	100	100
Maximum Value	50	100
Minimum Value	8	58
Score Range	42	42
Average Score	28,60	80,83
Variance	133,70	135,66
Standard Deviation	11,56	11,65

If the scores of students' mathematical communication skills taught using a problem-based learning model with a realistic mathematics education approach are grouped into five categories, the frequency distribution of scores is obtained as shown in table 2 below.

Table 2. Frequency distribution and percentage of mathematical communication

Score	Category	*Pretest*		*Posttest*	
		F	Percent (%)	F	Percent (%)
$0<x\leq 54$	Very low	30	100	0	0
$55<x\leq 64$	Low	0	0	2	6,7
$65<x\leq 79$	Currently	0	0	11	36,6
$80<x\leq 89$	Tall	0	0	8	26,7
$90<x\leq 100$	Very high	0	0	9	30
Amount		30	100	30	100

Table 1 and Table 2 show that of the 30 students who were the research subjects, the average score of the mathematical communication ability pretest was 28,60 with a standard deviation of 11,56. The ideal score of 100 was in the very low category before applying the learning model problem-based learning with a realistic mathematics education approach. This means that students' initial ability in the material of flat-sided three-dimensional figures is still very low. Meanwhile, in the posttest of 30 students who were research subjects, 2 students (6,7%) were in a low category, 11 students (36,6%) were in the medium category, 8 students (26,7%) were in the high category, and 9 students (30%) are in the very high category. The average score of the mathematical communication skills of 30 students is 80,83, with a standard deviation of 11,65 of the ideal score of 100 is in the high category. Descriptively, it can be said that the students' mathematical communication skills in the experimental class became better after the implementation of problem-based learning with a realistic approach to mathematics education.

4.1.2. Normality test results of students mathematical communication ability data

Testing the normality of the data on increasing students mathematical communication skills in the experimental class using the significance value from the test of normality table in the Kolmogorov-Smirnova column.

Table 3. Normality test for increasing mathematical communication skills of experimental class students

	Kolmogorov-Smirnova		
	Statistics	df	Sig.
Communication	0,069	30	0,200

The normality test results in table 3 show that students' mathematical communication skills obtained a probability value of 0,200 for the Kolmogorov–Smirnov normality test. Values greater probability of α = 0,05 means that the data communication capabilities of students with a mathematical model of problem-based learning with a realistic mathematic education approach come from a normally distributed population.

4.1.3. The results of hypothesis testing data on students' mathematical communication abilities

Testing the average increase in students' mathematical communication skills is carried out using the test *one-sample t-test*. The hypotheses in this study are:

$$H_0: \mu_{g1} \leq 0{,}29 \text{ vs } H_1: \mu_{g1} > 0{,}29$$

H_0= There is no increase in students' mathematical communication skills after applying the

problem-based learning model with a realistic mathematics education approach.

H_1 = There is an increase in students' mathematical communication skills after applying the problem-based learning model with a realistic mathematics education approach.

μ_{g1}= ¿ Parameters of the average test scores (pretest-posttest) of students' mathematical communication skills before and after applying the problem-based learning model with a realistic mathematics education approach.

The decision-making criteria based on the probability value of the data are:

a) If the probability is ≥0,05 (p≥0,05), then it is accepted H_0
b) If the probability is‹ 0,05 (p‹ 0,05), then it is rejected H_0

The output of the test results is presented in table 4 below.

Table 4. Hypothesis testing of mathematical communication skills

	Test Value = 0,29					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Gain	17,022	29	0,000	0,45400	0,3994	0,5086

Based on table 4, one-sample t-test, it can be seen that for the results of *Sig. (2-tailed)* the increase in students' mathematical communication skills is 0,000<0,05 (0,000 is smaller than the 0,05 significance level). This means a significant difference in students' mathematical communication skills before and after applying the problem-based learning model with a realistic mathematics education approach. Then rejected H_0andH_1 accepted. So, it can be concluded that there is an increase in students' mathematical communication skills after applying the problem-based learning model with a realistic mathematics education approach.

4.2. *Discussion*

Mathematical communication skills are the ability to express ideas or solutions to a mathematical problem in images, symbols, or appropriate mathematical language. In this study, there are three indicators of mathematical communication skills, namely:

4.2.1. Explain the idea or solution to a problem or picture in the form of an appropriate description

Based on the study results, most of the students were able to explain the right solution to the given problem after being given treatment. For example, in test number two, most students can write down the known and asked elements in the question; students can find and use the right formula so that a solution that is in accordance with the purpose of the problem is obtained. In contrast to students' ability before being given treatment, some students cannot explain or determine solutions to the issues presented.

4.2.2. Explaining ideas or solutions to mathematical problems in the form of appropriate pictures

Students in the experimental class have expressed the description in an appropriate image after being taught using a problem-based learning model with a realistic mathematics education approach. For example, in test number three, most of the students could sketch a pencil case that would be made based on the shape and size described in the question. In contrast to the ability before being given treatment, most of the students could not make pictures according to the description on the test questions.

4.2.3. Expressing everyday problems or events in the language of mathematical models and their solutions.

Students in the experimental class have been able to solve the questions given. For example, in the number one test, students could make mathematical models according to the problems in the test questions. However, most of the students still made mistakes, especially in the area unit writing section, in contrast to students' ability before being given treatment where students have not been able to make the right mathematical model.

Based on the results of data analysis, it can be seen that students mathematical communication skills in learning mathematics obtained through a pretest before applying the problem-based learning model with a realistic mathematics education approach in the experimental class showed that students' communication skills in the flat-sided material for class VIII SMP 4 Palopo is in the very low category, seen from the average value of the initial ability (pretest) of students in the experimental class are 28,60. Students have difficulty communicating ideas or appropriate solutions to the given problem, even though mathematical communication skills are very important in learning mathematics. Mathematical communication is important to focus on learning mathematics because, through the communication process, students can also build understanding and explore students' mathematical ideas [1]. Thus students' mathematical communication skills need to be improved in every mathematics learning process.

The researchers applied a problem-based learning model with a realistic approach to mathematical education to improve students' mathematical communication skills. Learning with problem-based learning models requires students to be active in solving problems presented in each learning process. In addition, with a realistic approach to mathematics education that utilizes reality and the environment that students understand, students can easily understand ideas or concepts from the problems presented in learning. The realistic mathematical education (RME) approach provides opportunities for students to construct their respective understandings so that ideas or opinions that vary among students are formed. Therefore, the students can build understanding through concepts constructed on their own based on reality. Students can make procedures or modeling, and through interaction with students and teachers, they can communicate the thoughts or ideas they get [12].

The average value of students' mathematical communication skills in the material flat-sided tree dimensional figure increase after obtaining learning with a problem-based learning model with a realistic mathematics education approach, has increased as seen from the average posttest score of 80,83 with an average increase in mathematical communication skills of 0,744 is in the high category. Students' answers in each indicator of mathematical communication skills before and after applying the problem based learning model with a realistic mathematical education approach in the experimental class increased. This is reinforced by hypothesis testing conducted with the one sample t-test, it appears that the significance value of students' mathematical communication skills is 0,000, which is smaller than the significance level of 0,05, which means that there is a significant difference in students communication skills before and after being treated in the form of learning with a problem based learning with RME approach, it can be concluded that there is an effect of problem-based learning model with realistic mathematics education approach on students' mathematics communication skills. This is in accordance with [13] research, which states that mathematical communication between students who receive a problem-based learning model using a realistic mathematics education approach is better than the open-ended approach [13].

5. CONCLUSION

Based on the results of the analysis and discussion that has been carried out, it can be concluded that the mathematical communication ability of SMP Negeri 4 Palopo students before the problem-based learning model with a realistic mathematics education approach was applied were in the very low category with an average of 28,60 and a standard deviation of 11,56. After using the problem-based learning model with a realistic mathematics education approach, it's in the high category with an average of 80,83 and a standard deviation of 11,65. There is an increase in the mathematical communication skills of SMP Negeri 4 Palopo students after implementing the problem-based learning model with a realistic mathematics education approach is better than before the problem-based learning model with a realistic mathematics education approach was applied. Thus learning with a problem-based learning model with a realistic mathematical approach effectively improves students' mathematical communication ability.

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