(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING
Volume 7, No. 3, September 2024
P-ISSN 2621-4733
E-ISSN 2621-4741
https://dx.doi.org/10.22460/jiml.v7i3.p20613

THE IMPROVEMENT OF MATHEMATICAL COMMUNICATION ABILITY USING PROBLEM-BASED LEARNING MODEL ON JUNIOR HIGH SCHOOL STUDENTS

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ARTICLE INFO

Article history:

Received Sep 06, 2023
Revised Sep 12, 2023
Accepted Sep 13, 2023

Keywords:

Mathematical Communication Ability
Problem-Based Learning
Junior High School

ABSTRACT

Students' understanding of linear equations with one variable is still low. Of the total number of students in the class, namely 32 students, only 10 students scored above the minimum completeness criteria (KKM) while the remaining 22 scored below the KKM. This research aims to determine the improvement of mathematical communication skills by using problem-based learning better than ordinary learning. Two classes, an experimental group, and a control group, were selected for this study. The researchers tested the technique because experimental research requires both groups to have the same skill level. The researcher used a test of students' mathematical communication skills as a research tool in this study. The average N-gain score for students who apply the problem-based learning model with regular learning is 0.71 (high category), higher than students who receive regular learning. of 0.10 (low category). Then the N-gain score normality test was carried out, the results obtained were 0.023 in the experimental class and 0.216 in the control class and the results obtained were not normally distributed. Then proceed with non-parametric tests, from the results of the Mann-Whitney U-Test obtained by Asymp. Sig (1-tailed) is 0.000 < which indicates it is rejected, meaning that the increase in mathematical communication skills of experimental class students is significantly better than that of the control class. The PBL model improves students' mathematical communication by promoting critical thinking, collaborative work, and active problem-solving. It also allows students to understand the practical relevance of mathematical concepts in real-life situations.

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How to Cite:

Fitri, S. A. N., Pertiwi, C. M., (2024). The Improvement of Mathematical Communication Ability Using Problem-Based Learning Model on Junior High School Students. *JIML*, 7(3), 272-280.

INTRODUCTION

The International Trends in Mathematical Science Research (TIMSS) study was conducted to compare student achievement in math and science in different countries. In general, TIMSS aims to track the education system's performance in terms of student performance in mathematics and science. TIMSS is conducted routinely every four years, namely in 1995, 1999, 2003, 2007, 2011 and 2015. During the last four periods, Indonesia has been its TIMSS

target country. Indonesia is still far from international standards when it comes to math scores, he reports TIMSS. According to Hadi & Novaliyosi (2019), the average math scores of Indonesian students for 3 periods were still low. These results indicate that the average Indonesian student can only recognize some basic facts, but cannot yet communicate and discuss different topics, let alone apply these facts, and complex and abstract concepts in their mathematics.

Mathematics is one of the subjects taught from elementary school to college. Susanto (Rizky Ananda & Rizki Wandini, 2022) believes that mathematics can develop the ability to think, discuss, and express ideas, and plays a role in solving problems that exist in life and the world of work, apart from that this subject also supports the development of science or technology based on what was stated by Anggraeni, Muryaningsih, & Ernawati (Rizky Ananda & Rizki Wandini, 2022) Mathematics is a subject that helps to improve the quality of students, especially in terms of behavior and thinking. Mathematics learning is learning that requires students to have various mathematical abilities, one of which is the ability to think. According to Tansil Laia & Harefa (2021), Mathematics plays an important role in the current era of technological progress. Progress in science and technology is also a contribution to mathematics.

One of the mathematical skills commonly used in everyday life is mathematical communication. Mathematical communication ability is one of the important mathematical competencies possessed by students in learning mathematics, especially junior high school students. This is reflected in the objectives of learning mathematics according to the Ministry of National Education (2006) which shows that the abilities that students must have include using reasoning about models and properties, concepts, generalizing, applying mathematics, making evidence, and explaining. mathematical ideas and statements, communicating ideas and ideas using charts, diagrams, and other types of objects to clarify situations and appreciate the usefulness of mathematics in everyday life, namely curiosity and interest in learning mathematics, perseverance, and confidence in problem-solving. According to Baroody (Hendriana & Kadarisma, 2019), Mathematical communication is an asset in perfecting, exploring, and investigating mathematics, a means of social activity in exchanging thoughts and opinions, as well as the ability to hone ideas and convince others. N.C.T.M. in Nasution & Ahmad (2018) explains indicators related to mathematical communication skills, namely: (a) Expressing mathematical ideas in writing or orally; (b) Developing definitions and generalizations; (c) Presenting mathematics with understanding; (d) Explanation of math problems; (e) Appreciate the power and beauty of mathematics. In addition, Sumarmo's mathematical communication skills (Aminah et al., 2018) are 1) State problems in the form of language, symbols, and mathematical ideas; 2) Explain mathematical ideas, situations, and relationships in simple language; 3) Listen, discuss and write about mathematics; 4) Understand mathematical representations; 5) Repeat the math description in their language.

The system of linear equations in one variable (SPLSV) is part of the mathematics curriculum. In SPLSV material, the purpose of this material is to find the value of a certain variable. According to Istiqomah & Setianingsih, (Rosmawanti et al., 2020) Variables are letters that represent a value and are abstract. SPLSV material is classified as essential material because it is the first foundation for studying high-level algebra material. (Setyawan in (Rosmawanti et al., 2020)). Based on the results of a questionnaire distributed to upper-class students before conducting the research, it was found that most students did not like mathematics lessons, because they were identical to calculations, especially the material on linear equations with one variable which confused students by separating numbers from variables, from the results of the questionnaire answers. These students have difficulty understanding the concept of linear equations with one variable, even though the material on

linear equations with one variable is very important because the concept of linear equations with one variable is widely used in everyday life, such as in buying and selling, estimating calculations and so on. Apart from that, the material on linear equations in one variable is the basic material for studying the material on linear equations in two variables and systems of linear equations. The problems in the one-variable linear equation material are usually in the form of story problems, so students have to make a mathematical model from the story problem, Because students don't understand the concept of one-variable linear equations students have difficulty in making the mathematical model, then students have to solve story problems that have been created by mathematical models using solving linear equations in one variable using equivalent equations. In line with the research results of Jumiati & Zanthy (2020) showing conceptual errors, errors because the subject did not understand the concept of variables, errors because the subject did not write down examples, and errors in changing questions into mathematical models show that there are automatic, fundamental errors and operational errors that occur. and because the subject cannot write equations, problems cannot be analyzed further, and problems cannot be solved properly.

According to a pre-survey interview with one of the mathematics teachers at Al-Fatih Integrated Junior High School, students' understanding of mathematics subject matter of one-variable linear equations is still in the low category. This can be seen from the low learning outcomes of students in the material of one-variable linear equations in the previous year, namely in the 2022/2023 Academic Year. Of the number of students in the class, namely 32 students, only 10 scored above the minimum completeness criteria (KKM), while the remaining 22 scored below the KKM. The comparison of students who get scores below the KKM is more than students who get scores above the KKM. If it is associated with the criteria of classical learning completeness, then only 31.25% of students complete the test. According to Nabilah & Abadi (2019) states that what can affect student learning outcomes are internal and external factors. Internal factors are factors that exist within students, namely the lack of interest of students and also the lack of motivation of students in learning mathematics while external factors, namely factors that come from outside the students themselves can come from educators, friends, and the environment, factors from educators such as the teacher's method is monotonous or unattractive to students. this research is in line with the statement of Maisyarah et al., (2021) that one of the success factors in learning mathematics is that it depends on the teacher's ability to manage learning, the teacher must be able to create more effective learning situations and must be able to arouse enthusiasm in students, to manage learning to be more effective the teacher needs to use appropriate learning models and media to increase students' enthusiasm for learning.

Research conducted by Ningrum (2016) found that Problem-Based Learning can be used as a learning model and potential means for developing students' mathematical communication skills. This is supported by the research of Purwati & Darussyamsu, (2021) PBL affects students' mathematical communication skills. By considering not only the characteristics of PBL learning but also aspects of students' mathematical communication abilities and mathematical tendencies, it is believed that the use of the PBL learning model can improve students' mathematical communication abilities and mathematical tendencies. The PBL syntax according to Ningrum's research results (2016) includes (1) student orientation towards problems; (2) organizing student learning, including activities to interpret ideas from various points of view to outline problem-solving steps; (3) supporting group and individual research, including activities to interpret the problem from different perspectives, identify the concepts needed to solve the problem and apply those concepts to different problem contexts; do. (4) development and presentation of learning outcomes, including actions to adapt the concepts

obtained to fully solve the original problem; and (5) analysis and evaluation of the problem-solving process, including the overall problem-solving action.

The hypothesis in this study is to increase students' mathematical communication skills through problem-based learning models with ordinary learning. In the matter of one variable linear equation system in class VII Al-Fatih Integrated Junior High School To test the research hypothesis above, the statistical hypothesis in the study is as follows:

$H_0 : \eta_1 = \eta_2$ The rank of mathematical communication abilities of students taught through regular learning with the problem-based learning model is significantly the same as the increase in mathematical communication abilities of students taught using regular learning.

$H_a : \eta_1 > \eta_2$ The rank of students' mathematical communication skills taught through scientific learning with problem-based learning models is significantly better than the increase in students' mathematical communication skills taught by scientific learning.

The test criteria are as follows:

If the value $Sig.(p - value) < \propto (\propto = 0{,}05)$ so H_0 rejected

If value $Sig.(p - value) \geq \propto (\propto = 0{,}05)$ so H_0 accepted

So the researcher will conduct research with the problem formulation "Can the use of the Problem-Based Learning model improve the mathematical communication skills of junior high school students in one-variable linear equation material? Is there an interaction between the Problem-Based Learning model and the level of students (high, medium, low) to improve math communication skills?"

METHOD

This research uses a quantitative research approach. According to Sugiyono (2011:14) states that "Quantitative research methods can be interpreted as research methods that are based on the philosophy of positivism, used for research on certain populations or samples, sampling techniques are generally carried out randomly, data collection uses research instruments, data

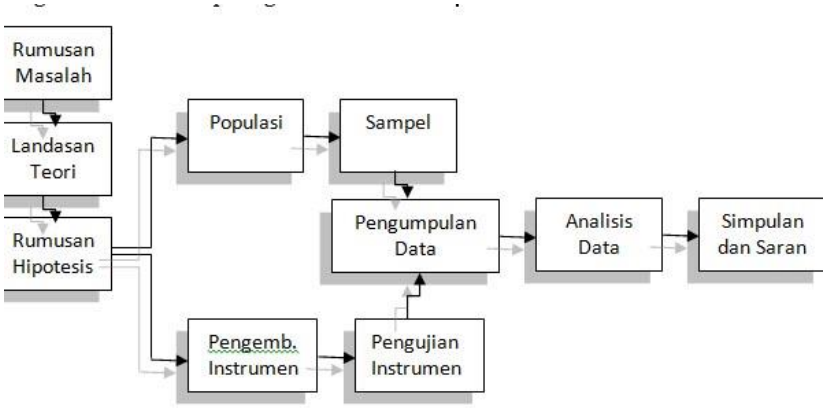

Figure 1. Quantitative research steps according to Sugiyono (2011)

analysis quantitative/statistical in nature with the aim of testing predetermined hypotheses".

The type of research used in this research is quasi-experimental research. According to Sugiyono (2011: 114), "this quasi-experimental research method has a control group, but

cannot fully function to control external variables that influence the implementation of the experiment." The design used is a nonequivalent control group design, which is almost the same as the pretest-posttest control group design, only in this design, the experimental group and control group are not chosen randomly. According to Sugiyono (2011:117), population is a generalized area consisting of objects/subjects that have certain qualities and characteristics determined by researchers to be studied and then conclusions drawn. Based on this statement, the population in this research is all class VII students of Al-Fatih Integrated Middle School for the 2022/2023 academic year with a total of 101 students from five classes. According to Sugiyono (2011:118), the sample is part of the number and characteristics of the population. Two classes will be selected for the samples in this research, namely the experimental class and the control class. The researcher took the technique because the requirement for conducting experimental research is that both classes must have the same level of ability. Purposive sampling is carried out by taking subjects not based on a specific objective. In this research, the type of test instrument used was a test of students' mathematical communication abilities. The indicators are: connecting images to mathematical ideas, memorizing mathematical ideas in your own words, and writing mathematical ideas into mathematical models.

RESULTS AND DISCUSSION

Results

Based on research that has been carried out at Al-Fatih Integrated Middle School class VII in the odd semester of the 2022/2023 Academic Year with a confusing data processing method and data collected by researchers in the form of mathematical communication ability data students in class VII A and VII B. Data obtained by giving test instruments to students in the form of pre-test and post-test. the pre-test is given to students before applying the problem-based learning model and the post-test is given after applying problem-based learning to the two-variable linear equation system material. The learning process that took place in the experimental class used problem-based learning, while the learning process in the control class used scientific. The data processing carried out in this study was assisted by SPSS version 18. The N-gain of students who applied the problem-based learning model was 0.71 (high category), higher than students who used scientific learning 0.10 (low). The following is a table that describes the descriptive pretest, posttest, and n-gain data for the mathematical communication ability test. The results of the pretest and posttest scores as well as n-gain data can be seen in the following table.

Table 1. Data on students' mathematical communication ability scores

Ability	Score	Experiment				Control			
		n	$\bar{x}$	s	%	n	$\bar{x}$	s	%
Mathematical Communication Skills	Pretest	23	6,00	1,087	37,5	19	5,26	0,653	32,89
	Posttest	23	13,04	2,637	81,52	19	6,32	1,734	39,47
	N-Gain	23	0,71	0,260		19	0,10	0,151	
Ideal Maximum Score = 16									

Based on the table above, the average pretest mathematical communication abilities of the experimental and control classes were 6 and 5.26 respectively from the ideal maximum score of 16. The pretest averages of the two classes were not much different, this shows that the students' mathematical communication abilities were not very good. very different. For

greater clarity, the table above can be made into a diagram comparing the average pretest and posttest scores as follows.

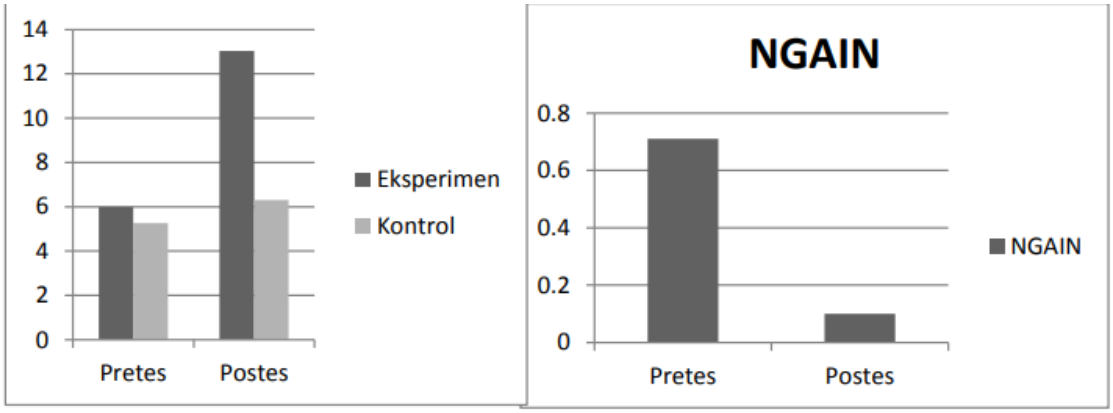

Figure 2. Average Pretest, Posttest, and N-gain Scores for Communication Skills

The following is a table of data from the Rank N-gain Comparison Test Results for Mathematical Communication Ability

Table 2. Data from Comparison Test Results Rank N-gain Mathematical Communication Ability

Statistics	Mark	Information	Conclusion
$Mann-whitney\ U$	17,000	H_0 rejected	Hypothesis accepted
$Asymp.Sig\ (1-tailed)$	0,000		

Based on the data analysis that has been carried out, the results of this research show that improving students' mathematical communication skills through the problem-based learning model is significantly better than students who receive ordinary learning. This is shown by the average N-gain score of students who apply the problem-based learning model with regular learning of 0.71 (high category), higher than students who get regular learning of 0.10 (low category). Then the N-gain score was tested for normality, the results obtained were 0.023 in the experimental class and 0.216 in the control class and the results obtained were not normally distributed. Then proceed with the non-parametric test, from the results of the Mann-Whitney U-Test obtained by Asymp. Sig (1-tailed) is 0.000 < which indicates that it is rejected, meaning that the increase in the mathematical communication skills of the experimental class students is significantly better than the control class.

Discussions

The results of this study indicate that improving students' mathematical communication skills through problem-based learning is better than students' mathematical communication skills through ordinary learning. This is relevant to research conducted by Tansil Laia & Harefa (2021) Data shows that overall the average score of students' mathematical problem-solving abilities is in a good category. Likewise, in line with the results of Ramadhan et al.'s research, (2022) there was a significant increase from the pretest value to the posttest value. Furthermore, the effect of the PBL model on the ability to understand mathematics shows a moderate average score for this criterion. With this problem-based learning model there is an increase in students' mathematical communication abilities in the experimental class due to several factors, namely in the first stage the orientation of students to problems, At this stage the teacher gives problems in real life to students related to the learning material used.

ongoing which aims to recall previously studied material. The second stage is organizing students, by dividing them into groups and giving each group of LKPD that have been provided where questions are given according to indicators of students' mathematical communication abilities. The division of this group is carried out homogeneously consisting of students with high, medium, and low abilities, which aims so that students who have high abilities can explain with their group mates who lack understanding of the material being taught. The third stage is guiding individual and group investigations, Here the teacher guides students to investigate problems on the LKPD provided by asking students to observe the problem. In the fourth stage, developing and presenting the results of the work, the teacher asks students to present the results of their discussion in front of the class. The fifth stage is analyzing and evaluating problem-solving, The teacher helps students in analyzing and evaluating problem-solving where students are asked to rebuild their thoughts and activities during the learning stages they have passed by asking students to conclude the material they have studied. Then the teacher summarizes the students' statements again to refine the students' conclusions to obtain more meaningful learning. So it can be concluded that learning outcomes can be improved using the Problem-Based learning model. In line with the results of previous research carried out by Heryati (2021) that the application of the Problem-Based learning model used by teachers can improve student learning outcomes, and based on Panjaitan et al., (2020) by using the Problem-Based learning model there is an increase in learning outcomes. Based on the explanation above, to improve student learning outcomes in one-variable linear equation material, you can use the Problem-Based learning model.

CONCLUSION

Based on the discussion that explains the use of the Problem-Based Learning (PBL) Model to improve the mathematical communication of class VII students in the One Variable Linear Equation System material, several conclusions can be drawn, namely that the application of the PBL Model can improve students' mathematical communication because this model encourages them to think critically, collaborate with classmates, and discuss actively in solving mathematical problems. The PBL model also helps students in learning the material studied in real-world situations, so that they can understand the relevance of mathematical concepts in everyday life. Students are required to think critically and creatively to solve complex problems. This can help students to develop their mathematical communication skills because they must be able to explain their ideas clearly and logically. Communication between students is also improved in the PBL model because they must discuss, express opinions, and explain their mathematical thinking to their friends. classmate. The PBL model can increase students' motivation because they are involved in more active and challenging learning. This can increase their interest in mathematics and possibly better learning outcomes.

ACKNOWLEDGMENTS

The researcher would like to thank all parties who have helped in the research process and writing this article. Particularly to the IKIP Siliwangi institution which has facilitated the writing of articles and the 4th ISAMME committee which has also provided directions, also to the schools and students involved. So that research can run well. Hopefully, this research can be a reference and useful for readers and other researchers.

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