

Improving Mathematics Problem-Solving Ability With Problem-Based Learning in V Grade Students

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Abstract:

Nowadays, the ability of students in solving problems is very important. The teacher as a facilitator must present learning that is interesting and easy to understand. One alternative that can be done is to apply a problem-based learning model. This study aims to determine whether there is a significant improvement in the mathematical problem-solving ability of fifth-grade students of Aisyiyah Metro Elementary School after problem-based learning is applied. This research was conducted using a quantitative research method with the type of experimental research and using a quasi-experimental design in the form of a non-equivalent control group design. The sample in this study was the fifth-grade students of Aisyiyah Metro Elementary School with a total of 37 students divided into 2 classes, namely the experimental and the control class. Data collection techniques in this study used three methods, namely: observation, problem-solving ability tests, and documentation. The results of the study concluded that there was a significant increase in mathematical problem-solving ability in classes using problem-based learning compared to classes using conventional learning.

Keywords:

problem-solving ability; problem-based learning; mathematics

DOI: [10.18952/aladzkapgmi.v12i1.6401](https://doi.org/10.18952/aladzkapgmi.v12i1.6401)

Received: 26 April 2022; **Accepted:** 28 June 2022; **Published:** 30 June 2022

How to cite :

Saputra, H. (2022). Improving Mathematics Problem-Solving Ability With Problem-Based Learning in V Grade Students. *Al-Adzka: Jurnal Ilmiah Pendidikan Guru Madrasah Ibtidaiyah*, 12(1), 28 – 37.



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Introduction

In learning mathematics in schools that are carried out by teachers so far, generally, teachers still use the concept of learning where the teacher is the center of knowledge. Students in their learning in class only become objects of listeners and recipients of knowledge given by the teacher. This condition causes lack of activity and motivation of students in learning. In addition, learning that is only one-way and conventional causes lack understanding of the learning material being taught. According to Wicaksono and Widiyaningrum (2020) in the research that has been done, it is stated that conventional learning is still often found in schools. Conventional learning is more teacher-centered, so it has weaknesses, including making students less actively involved in learning. Conventional methods cause students to experience boredom, and lack of learning activities, and in the end students' cognitive learning outcomes are low. According to Herlina and Reinita (2021), conventional learning tends to cause students to be passive in learning activities, one of which is in the critical thinking process, students are not actively involved so they do not develop their thinking processes. These obstacles resulted in learning in the classroom did not run optimally. To overcome these obstacles, teachers need to apply learning methods that can make students active, critical and innovative in carrying out the learning process.

Student activity is one indicator that is very influential on the learning process in the classroom. According to Sinar (2018), student activity is the most important part of teaching and learning activities. In line with that, Daryanto and Rahardjo (2018) explain that student activity in learning is the most important part because student activity can affect the knowledge and final grades that they will receive. Students must be more active in learning activities because students are subjects who plan and carry out learning. In line with this statement, Indrijati (2017) explains that the learning process must involve students to be active in constructing their knowledge. Based on these two statements, it can be said that the role of the teacher to invite students and create a more active class atmosphere when learning takes place is very important, thus students will be motivated to construct their knowledge because students are the subject of the learning.

Learning has a very important role in creating quality graduates. This means that the learning process depends on the teacher's ability to carry out learning. Learning that is carried out well will have a positive impact on the quality of learning obtained by students. However, if the learning is not optimal, it will cause students to be less than optimal in the learning process. In line with Zagoto (2019) who states that the success of education in the learning process depends on the ability of teachers to process learning which can create situations that allow students to learn. The low quality of education is caused by the ineffectiveness of the learning process. According to Jamaluddin (2019), the success of education in the learning process depends on the ability of teachers to process learning which can create situations that allow students to learn. The low quality of education is caused by the ineffectiveness of the learning process.

One of the functions of learning mathematics is to form the ability to think patterns, and reasoning skills, and think logically, systematically, and critically. In its development, the thinking ability will be used by students in solving mathematical problems and in everyday life. The importance of students in solving problems, the teacher as a facilitator must present learning that is interesting and easy to understand. One alternative that can be done is to apply a problem-based learning model which is usually better known as Problem Based Learning. Gagne (in Amir, 2009) states that problem-based learning is learning that has a high level of effectiveness in improving students' thinking processes. The same thing was

conveyed by Arifin (2011) stated that problem-based learning has an important role in critical thinking skills.

Problem-based learning is learning that stimulates students to create innovation in solving a problem. This can happen because in problem-based learning a problem or phenomenon is presented that makes students curious so that it raises the motivation to be able to solve the problem. Rahmawati et al (2015) state that problem-based learning is very effective for improving critical thinking skills and improving student learning outcomes. This is because problem-based learning trains students' thinking skills to solve given problems, find solutions, and stimulate students' interest to actively interact in the learning process.

Problem-based learning is a learning strategy that uses problems as the main reference to gain new knowledge. Problem-based learning focuses on student learning activities. Departing from this problem-based learning, students can develop new experiences and knowledge independently. Hotimah (2020) states that problem-based learning is learning that is triggered by a problem so that students learn and work cooperatively to find solutions. Furthermore, Hotimah explained that problem-based learning is learning that exposes students to a problem to be solved conceptually openly in learning.

Problem-based learning is learning that in the process includes various problems that have been designed as an effort to form students in critical thinking to acquire knowledge, solve problems, and have expertise in the learning process which will later be used as the basis for dealing with problems in their lives. Karlina (2019) states that problem-based learning is learner-centred learning by confronting students with problems in life. In problem-based learning from the start, students are faced with problems that they may encounter in the future. Meanwhile, Sudirman (2020) states that problem-based learning is presenting learning material using problems as the subject of discussion so that students will analyze and find solutions to the problem. Suprihatin (2019) suggests that learning to think is essentially learning to solve problems. It is from this that good design in implementing problem-based learning is so important to apply so that students will be motivated to think about solving problems.

Problem-based learning has advantages compared to other learning models, these advantages include; increase self-confidence in solving problems, the more knowledge gained by students, the sharper their thinking power, the sharper the thinking students, students will have various ways to solve problems independently, and can foster more curiosity in students teach everything. This is in line with the delivery of Sudarmin (2015) who revealed that one of the advantages of problem-based learning is that it can improve critical thinking skills, foster student initiative, and motivate internally to learn.

In this article, researchers focus on applying problem-based learning to students, because problem-based learning affects mathematical problem-solving abilities. Once the importance of problem-solving skills for students, therefore teachers as educators must be able to provide learning that can lead to student motivation in learning. From the problems that have been discussed above, this article will discuss how problem-based learning can improve students' mathematical problem-solving abilities.

Research Methods

Researchers used quantitative methods with experimental research in this study. The research design used was a quasi-experimental design with a non-equivalent control group design. The research design used is presented in the Figure 1.

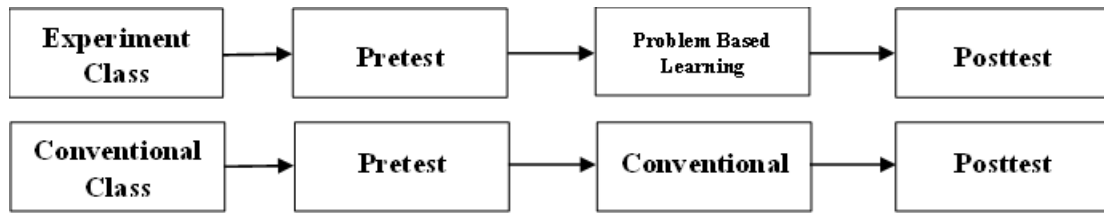


Figure 1. Research Design

In this study, the fifth-grade students of Aisyiyah Metro Elementary School were the population, then the sample consisted of 37 students who were divided into two classes, namely the experimental and control class. The data obtained from this research is in the form of quantitative data. Quantitative data was obtained from a survey conducted, quantitative data was obtained from the results of a problem-solving aptitude test and qualitative data was obtained from observation of learning in class. In this research conducted, the researcher used various data collection tools, including observation, problem-solving skills tests, and documentation. After the data was obtained, the data were analyzed using SPSS software.

Results and Discussion

Problem-based learning was applied to the experimental class and conventional learning was applied to the control class. From the research conducted, quantitative data and qualitative data were obtained, quantitative data were obtained from the results of problem-solving ability tests, and qualitative data were obtained from observations in classroom learning. Before carrying out the research, the teacher prepares problem-solving test questions. The problem-solving test questions before being used were tested for validity and reliability. After testing the validity and reliability, it was found that the problem-solving test questions were declared valid and could be used.

Before classroom learning is carried out, a pretest is carried out to measure the initial abilities of the experimental class and control class. The pretest questions consist of 5 story questions that have been previously designed according to problem-solving questions. From the pretest that was carried out at the beginning of the lesson, the data was obtained from the pretest scores of students in the experimental class and the control class. This data was analyzed using SPSS software and obtained a statistical description of the problem-solving ability scores of the pretest experimental class and control class. The statistical description of the problem-solving ability score on the pretest is described in table 1:

Table 1. Problem-Solving Ability Pretest Pretest Score Experiment and Control Class

Group	N	Mean	Stad. Dev.	Max	Min
Experiment	19	41.94	7.820	57	25
Control	18	40.72	6.359	50	26

Table 1 shows that the averages of the two classes that are the object of research are not much different (almost the same), which means that the abilities of the two classes are said to be equal. The experimental class has an average of 41.94 and the control class is 40.72. From the comparison of the two mean values, it can be seen that the test class and control class have almost the same mean value.

Normality test (to see whether the data is normally distributed or not) and homogeneity test (to see whether the data is homogeneous or not), then the data obtained must go through both tests. From the normality test, it was concluded that the results of the pre-test of problem-solving skills were normally distributed. And

the homogeneity test concluded that the problem-solving ability data from the pre-test had identical or homogeneous variants.

After carrying out the pre-test, the learning in each class was carried out according to the research plan. The experimental class students received PBL and the control classes received conventional learning. At the end of the learning process, students in each class receive a post-test. Post-test was conducted to see the difference in the problem-solving ability of the two research classes and to determine whether there was a significant difference. The description of troubleshooting skills after the test can be seen in Table 2:

Table 2. Problem-Solving Ability Post-test Score Experiment and Control Class

Group	N	Mean	Stad. Dev.	Max	Min
Experiment	19	81.42	6.085	92	70
Control	18	62.94	11.336	82	50

According to Table 2, it can be seen that the average in the experimental class is 81.42 and in the control class is 62.94. From the results that have been obtained, namely the acquisition of the average problem-solving ability of the two classes that are the object of research, it is concluded that the average value in the experimental class is higher. Thus, it can be said that the class that received PBL had a higher average score than the class that only received conventional learning.

The problem-solving assessment data obtained after the test must be tested for normality and homogeneity tests. From the normality test, it was concluded that the post-test value of problem-solving ability was normally distributed. Homogeneity test concluded that the post-test problem-solving data had identical or homogeneous variants.

Furthermore, to find out the quality of increasing the problem-solving ability score of the two classes that became the object of research, it is necessary to do an analysis using the N-gain formula on the problem-solving ability score. After analyzing the n-gain data score, a description of the data on improving problem-solving abilities is obtained in Table 3:

Table 3. Description of Troubleshooting Enhanced Data

Group	Mean N-gain	Stad. Dev.	Min	Max	Range	N
Experiment	0.675	0.118	0.39	0.83	0.44	19
Control	0.370	0.197	0.10	0.68	0.58	18

Table 3 shows the two research classes have quite a difference between 0.675 (experimental) and 0.370 (conventional). So, it can be said that of the two research classes, the experimental class has a higher score increase than the control class.

After obtaining the results of the average score of the n-gain data, then the normality test and homogeneity test were carried out using the normality test to determine whether the n-gain data for problem-solving skills were normally distributed. The homogeneity test was calculated to determine whether the data obtained were homogeneous.

Table 4. Normality Test of Data Solving Ability of Experimental and Control Class

Group		Shapiro Wilk		
		Statistic	Df	Sig
N-gain	Experiment Class	0.950	19	0.395
	Control Class	0.925	18	0.158

Based on Table 4, the post-test normality test using the Shapiro-Wilk test in the table above shows that the significance value of the experimental class pre-test data is 0.395 and the control class pre-test data is 0.158. Both classes have a significant value, which is greater than 0.05, so it can be concluded that post-test data on students' problem-solving abilities in mathematics are normally distributed.

Table 5. Data Homogeneity Test Results n-gain score Problem-Solving ability Experiment and Control Class

Aspect		Levene's Test for Equality of Variances	
		F	Sig
Ngain_score	Equal variances assumed	0.389	0.348
	Equal variances not assumed	-	-

Based on Table 5, it is known that the significance value obtained is $0.389 > 0.05$. It is concluded that the variance of the N gain_score data for the experimental class and control class data is homogeneous. The data obtained were then tested for hypotheses to determine whether the hypothesis was accepted or rejected. The hypothesis test is used with a t-test. The proposed hypothesis is as follows:

H_0 : There is no significant difference in improving the problem-solving ability of students who use PBL with those using conventional learning in class V students of Aisyiyah Metro Elementary School.

H_1 : There is a significant difference in improving the problem-solving ability of students who use PBL with those using conventional learning in class V students of Aisyiyah Metro Elementary School.

Hypothesis testing is done by using the statistical formula independent sample t-test. The statistical formula for the independent sample t-test analyzes the difference between the values of the two research classes. The results of the analytical tests carried out are presented below.

Table 6. Statistic Test

Aspect	Sig. (2-tailed)	Statistic test
Ngain_score	0.001	t-test for Equality of Means
	0.001	

Based on Table 6, the equal variance obtained from the above data analysis was assumed to be 0.001 and the non-assumed equal variance was $0.001 < 0.05$. From the results of the analysis, it can be concluded that hypothesis H_0 is rejected. In other words, there is a significant difference in improving the problem-solving ability of students who use PBL and students who use conventional learning in fifth-grade students of Aisyiyah Metro Elementary School.

Table 7. Independent Samples Test

Aspect		Sig.	Statistic Test
Ngain_score	Equal variances assumed	0.379	Levene_Tes_for_Equality_of_Variances
	Equal variances not assumed		

The data analysis in Table 7 shows that between the two research classes, it is 0.379. So $0.379 > 0.05$, then in statistical rules it can be interpreted that H_0 is accepted from the data analysis, and we can interpret that there is no significant difference between high, medium, and low qualifications.

From the research data described, it can be concluded that there is a significant difference in improving the problem-solving abilities of students who use PBL with those using conventional learning in fifth-grade students of Aisyiyah Metro Elementary School. In the process, PBL is designed to force students to solve math problems in their classroom learning, therefore students must be able to carry out problem-solving steps to help them solve problems systematically. The steps for solving the problem include understanding the problem given, planning problem-solving, taking action to solve the problem and carefully reviewing/re-analyzing the answers that have been obtained to whether the answers received are correct (Pelu, 2019). PBL familiarizes students to solve problems systematically. In addition, students learn to be thorough and confident when facing a problem. This is supported by Jayadiningrat et al (2017) and Karlina (2019) state that PBL can improve problem-solving skills, where problem-solving skills are a person's basic ability to solve a problem that involves critical, logical, and systematic thinking. The importance of improving problem-solving skills cannot be separated from its role in life, namely to develop one's ability to deal with a problem.

The significant difference between the two research classes will certainly not occur without reason, this is due to the difference in treatment between the experimental class and the control class. The experimental class uses PBL, while the control class uses conventional learning. Thus, we all know that PBL has succeeded in increasing the ability to solve mathematical problems. However, the traditional model is considered ineffective in improving mathematical problem-solving abilities.

From the research data described above, it can be concluded that there is a significant difference in improving the problem-solving abilities of students who use problem-based learning with those using conventional learning in fifth-grade students of Aisyiyah Metro Elementary School. This can happen because problem-based learning emphasizes students solving problems that have been prepared by the teacher as a class facilitator. In the problem-based learning process, especially in solving mathematical problems, students must understand and carry out problem-solving steps; Among them are understanding the given problem, planning to solve the problem, taking action to solve the problem, and seeing/re-analyzing the answers that have been obtained carefully whether the answers obtained are correct (Pelu, 2019).

Problem-based learning familiarizes students to solve problems systematically. In addition, students learn to be thorough and confident when facing a problem. This is supported by Karlina's statement (2019) which states that problem-based learning can provide opportunities for students to explore collecting and analyzing data to solve problems, and students can think critically, systematically, and logically in finding alternative problem-solving. In line with that, Jayadiningrat et al (2017) state that problem-based learning can improve problem-solving skills, where problem-solving skills are a person's basic ability to solve a problem that involves critical, logical, and systematic thinking. The importance of improving problem-solving skills

cannot be separated from its role in life, namely to develop one's ability to deal with a problem.

The significant difference between the experimental class and the control class in math problem-solving scores is certainly caused by the difference in treatment between the experimental class and the control class. Where the experimental class uses problem-based learning while the control class uses conventional learning. So that it can be said that problem-based learning has succeeded in increasing mathematical problem-solving abilities. While the conventional model is not effectively used in improving mathematical problem-solving abilities. This is in line with research conducted by Imami (2018) which states that the achievement and improvement of problem-solving abilities of students who receive Problem-Based Learning are better than the ability of students with conventional learning.

This can be seen from the achievement of the average post-test score of solving ability in the Problem-Based Learning class and the improvement seen from the pretest and posttest gain of mathematical solving ability in the Problem-Based Learning class. In line with that, the research conducted by Noya & Susanti (2021) stated that problem-based learning was feasible and better to use than direct or conventional learning. Likewise, research conducted by Dewi and Septa (2019) states that problem-based learning can improve students' mathematical problem-solving abilities and mathematical dispositions.

In learning in the experimental class that uses problem-based learning, students try to solve mathematical problems according to the problem-solving steps, in this process, each student learns how to be critical and creative in dealing with the problems given. Teachers in problem-based learning act as facilitators in charge of coordinating students to collaborate and discuss in groups to solve problems that have been prepared. After students have finished discussing in their respective groups, students present the results of problem-solving that have been obtained. When one group presents the results of problem-solving obtained, other groups can ask questions, provide input, and correct.

Problem-based learning besides being able to improve students' mathematical problem-solving abilities, can also make learning in the classroom more active, creative, and innovative so that students more easily understand the material provided. Zulfaidhah et al (2018) stated that problem-based learning, which is the most significant innovative learning, develops lifelong skills with an open, reflective, critical mindset and can increase student activity. Juarsih et al (2017) stated that in principle, in a problem-based learning model, students themselves are actively seeking answers to the problems given by the teacher. In this case, the teacher acts more as a mediator and facilitator to assist students in constructing their knowledge effectively. Problem-based learning is learning that presents students with real and open problem situations.

The results of observations on the activities of students in the experimental class showed that with problem-based learning the activities of students increased. This is because in the process students interact and discuss more with other students both in their groups to solve problems. In addition, students are taught to dare to ask each other either with other students or with the teacher when experiencing difficulties. Research conducted by Raehan et al (2020) stated that the problem-based learning model can improve the ability to master concepts and creative thinking skills of students.

In addition, there is an increase in the activity of teachers and students in learning after problem-based learning is applied. According to Paramarta (2019), problem-based learning is relatively simple learning, so it can be used by teachers as a basis for carrying out good learning activities. By using group discussions, students

actively interact in learning activities so that teachers do not dominate learning too much.

This study also obtained several advantages and disadvantages in the problem-based learning process. The advantages include; the enthusiasm of students in learning, a new learning atmosphere where students work together to solve a problem, and confidently present the results of group discussions to other groups. While the weaknesses in the problem-based learning process are; limited learning time which is not by problem-based learning which tends to take quite a long time.

Conclusion

Based on the discussion above, it can be concluded that problem-based learning can improve the mathematical problem-solving ability of fifth-grade students of Aisyiyah Metro Elementary School. From the results of the data analysis, it can be seen that there is a significant increase in mathematical problem-solving ability in classes that use problem-based learning compared to classes that use conventional learning. The use of problem-based learning can be used as an alternative in learning to improve quality and meaningful learning.

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