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Application of The Problem-Based Learning Model to Improve Students' Mathematical Problem-Solving Abilities in Elementary School

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***Abstract*:**
This study aims to analyze the application of the Problem Based Learning (PBL) model on students' mathematical problem-solving abilities in elementary school. This type of research uses a quantitative method with a quasi-experimental design. The instrument used to collect data was an objective essay test. This study involved two groups: a control group using the conventional method and an experimental group using PBL. The research results were analyzed using the Independent Sample T-test with the help of SPSS software. The analysis results showed a significant difference in mathematical problem-solving ability between students using PBL and those using the conventional method. The average score of the experimental group was higher than that of the conventional group. Thus, the implementation of PBL influences the improvement of students' mathematical problem-solving abilities. This study recommends the use of PBL in elementary school mathematics learning to enhance students' learning outcomes and analytical skills.

Keywords: Problem Based Learning (PBL), Mathematical Problem Solving Ability, Independent Sample t-test, Learning Outcomes.

Introduction

The introduction section contains the background, research context, and the results of the library study. Provide an introduction to the substance of the manuscript according to the topics and reasons of both theoretical and practical, behind the writing of the script. Contains explicitly with a brief and clear direction, intent, purpose, novelty, and usefulness of the manuscript. A brief description of what other researchers have done/discovered before. Then the description of the problem is to be examined. Antacids on other research related to results, and it is better to postpone in Discussion.

Education plays a very strategic role in improving the progress of national and state life, because only thru education can various knowledge be better conveyed to the younger generation, a prerequisite for building a more advanced country and nation compared to previous generations (Kristin, 2016). Education is so important for

improving the quality of human resources that the government is consciously and continuously improving the quality of education. The government's commitment is manifested in the transformation of the Unit Education Curriculum (KTSP) into the Basic Education Curriculum at all levels (2013), including basic, secondary, and higher education. In the 2013 curriculum, students are introduced to thematic learning (Permendikbud No. 65 2013), which is learning that encompasses several learning areas to gain experience and connect it to specific topics (Dixon and Collins in Karli, 2012:53).

Learning is the interaction between teachers and students aimed at achieving national education. Although learning is not a process of transferring knowledge from a teacher to students, the understanding of learning is an activity where a teacher provides students with the widest possible opportunity to discover their new ideas, concepts, and thoughts based on their own knowledge. In this case, it means students are directly involved in the learning process. Students do not act passively, but rather actively discover new ideas based on their concepts, ideas, and information under the guidance of the teacher. The teacher acts as a mentor and guides students to learn new things. Therefore, learning itself, including mathematics, needs to be well-packaged so that students can immediately feel the acquisition of new knowledge.

The use of learning models requires simplification of the learning process and variation within the learning process, so that it can be adapted to students' needs and achieve the desired results. The 2013 curriculum proposes a problem-based learning model for mathematics instruction because it can provide students with direct experience in problem-solving activities. For example, the Discovery Learning and Problem-Based Learning (PBL) models are suitable for teaching according to the 2013 curriculum. Although both are problem-based, they have different meanings and syntax. The problem-based learning (PBL) model is a learning model that uses problems as the basis for learning (Mulyasa, 2014:145). Meanwhile, the Discovery learning model is a type of learning where students build their own knowledge by conducting experiments and discovering principles from the results (Joolingen in Rohim, F., Susanto, H., 2012:2).

Problem-based learning (PBL) is a learning model that can improve students' mathematical problem-solving abilities. Problem-based learning (PBL) is a participatory-centered learning model where students actively participate in presenting and solving problems related to the content and context being studied. The syntax of the problem-based learning model is: (1) orientation to the problem; (2) organizing educational activities; (3) data collection guidelines; (4) developing and presenting the information received; (5) analyzing and evaluating the problem-solving process. Each step of the problem-based learning model requires reinforcement to facilitate teachers in carrying out learning activities, thus necessitating a learning environment that also helps students identify problems and analyze the problem-solving process well. (Amaliyah & Santoso, 2022).

Mathematics is a precise science. All groups must study this topic. Mathematics is a subject that can enhance thinking and reasoning abilities, and participation in solving everyday problems. It is also a fundamental science that plays an important role in the development of science and technology. According to NCTM (2000), some of the skill standards that must be achieved in mathematics include mathematical reasoning, mathematical representation, mathematical communication, connecting mathematical ideas, and problem-solving. (Kusumawati et al., 2023).

Mathematics is a subject included in school curriculum from elementary school thru upper grades. This means students can think logically, analytically, systematically, and critically. One of the problems is the low academic achievement of students, who face the biggest challenges with each grade promotion. In other words, the subjects of mathematics and the material that fifth-grade students find difficult to calculate and apply the perimeter formula. One way to boost students' learning enthusiasm and sense of belonging in the learning process is to change learning models that are no longer engaging for students by: For example, students learn thru lectures and question-and-answer sessions, but eventually, they get bored and feel less capable. Most students consider mathematics to be the most difficult and challenging subject. Currently, many students are afraid to study mathematics. This is due to monotonous learning. And this activity continues to be carried out in several educational institutions, including the fifth-grade students of SDN 1 Mejobo. This finding has implications for the academic achievement of fifth-grade students at SDN 1 Mejobo, who have low mathematics academic achievement. Therefore, changes need to be made to make the learning process enjoyable and engaging for students.

In mathematics learning, there is one indicator mentioned by the NCTM, namely mathematical problem-solving ability. According to (Hodiyanto, 2017), a question/problem is an issue for which students do not immediately know the answer/problem-solving strategy, while problem-solving is defined by NCTM (2000:52). This means students who solve a problem whose answer was not previously known. Students must know the information to find a solution to the problem. Additionally, they develop mathematical understanding thru this process. Problem-solving in mathematics learning can make students learn actively and effectively thru exploration, experimentation, observation, and discovery (BIN FRANS RESI et al., 2024). According to Sumarmo (2014:18), problem-solving skills are activities that involve: (1) gathering sufficient information to solve a problem; (2) creating a mathematical model of a daily situation or problem and solving it; (3) selecting and applying mathematical/non-mathematical problem-solving methods; (4) explaining or interpreting results according to the original problem and verifying the accuracy of the results or answers. Because of its non-routine problem-solving nature, this skill is classified as a high-level mathematical hardskill. According to (Amaliyah & Santoso, 2022), a learning model using Problem Based Learning with the help of modules can improve students' mathematical problem-solving abilities. The use of module learning

media in the Problem Based Learning method can support the development of mathematical problem-solving abilities. According to (Aini et al., 2023), Problem Based Learning (PBL) is a teaching model that involves students in specific situations to develop problem-solving skills and new knowledge related to a particular problem. Cooperative learning known as Problem Based Learning (PBL) is not effective in reducing the role of the teacher as an educator. In this problem-based learning approach, the teacher's role is more as a facilitator, guide, and motivator for students (Nashan et al., 2019). Once the teaching process begins, this is what introduces the collaborative model of teachers acting as facilitators, connecting students with deeper learning. In this learning process, the teacher provides students with the ease to ask questions and give feedback so that the teaching remains on track with the objectives.

NCTM (2000) states that the standard mathematical thinking skills are (1) Recognizing and using relationships between mathematical ideas; (2) understanding how mathematical ideas relate to each other; (3) Recognizing mathematics and applying it to other subjects . According to (Sumarmo, 2010) activities that are classified as mathematical connections include: (1) looking for relationships between different concepts and procedures (2) understanding relationships between mathematical subjects (3) applying mathematics in other fields or in everyday life (4) understanding the representation of an appropriate concept (5) looking for relationships between one procedure and another in the relevant presentation, and (6) applying relationships between mathematical subjects and non-mathematical subjects. This can be classified as low-level or high-level mathematical thinking skills depending on the complexity of the relationships presented. In addition to problem-solving abilities that are usually measured by teachers are learning achievements.

Based on observations at SDN 1 MEJOBO, fifth-grade students showed low learning outcomes. One factor contributing to low student learning outcomes is the learning strategies or models used by teachers, whose teaching is still conventional. Based on the description above, our researchers conducted a study entitled "The Effect of Problem-Based Learning (PBL) on Students' Mathematical Problem-Solving Ability in Elementary Schools." To address this problem, innovation or change is needed in learning, especially mathematics. In this case, the selection of a problem-based learning (PBL) model is a key factor in improving students' problem-solving abilities in mathematics.

The aim is to see whether there will be a difference in the average learning outcomes using the problem-based learning model with classes that use conventional learning models because class V often uses conventional learning.

Research Methods

The type of research in this study is quantitative. The research was conducted on two groups: one group received instruction, and the other group did not. In this study, the researcher used the Independent Sample T-test to determine if there was a

difference between the two groups, with a sample size of 22 respondents. From that sample, 11 samples had not yet received problem-based learning (A), and 11 samples had already received problem-based learning (B). The data used is secondary data. The data collection technique used is the documentary technique, and the analysis tool is the Independent Sample t-test. The hypothesis is accepted if the p-value is less than or equal to the alpha-value (0.05).

Results and Discussions

The following are the test results using SPSS software.

Table 1. Descriptive Analysis Results

Statistics			
		Group A	**Group B**
N	Valid	11	11
	Missing	11	11
Mean		78.9091	85.3636
Standard Deviation		8.63081	9.55272
Minimum		58.00	62.00
Maximum		85.00	95.00

Based on Table 1 above, it is known that there are 22 respondents, consisting of 11 respondents from group A and 11 respondents from group B. Where group A is a group representing students who do not have mathematical problem solving abilities and Group B is a group representing students with mathematical problem solving abilities using problem based learning (PBL). It is known that the average of group B is greater than group A, group A has an average of 78.90 while group B has an average value of 85.36. The standard deviation of group A is 8.63 and group B is 9.55, which means that the standard deviation of group B is greater than group A. The minimum value in group A is 58 and the maximum value of group A is 93. While the minimum value of group B is 62 and the maximum value of group B is 95.

Table 2. Results of Data Normality Analysis

Tests of Normality							
	GROUP	**Kolmogorov-Smirnov a**			**Shapiro-Wilk**		
		Statistics	**df**	**Sig.**	**Statistics**	**df**	**Sig.**
Academic Achievement Results	Not Accepting PBL Learning	.278	11	.018	.845	11	.037
	Embracing PBL Learning	.196	11	.200 *	.862	11	.061
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Before conducting the Independent t-test, the researcher conducted a normality test on the research data to determine the use of the appropriate testing method. Then, the data is said to be normal if the significance value > alpha value = 0.05. The 22 respondents are classified as a small sample because it is less than 30 samples, so the Shapiro-Wilk test was used for testing. The significance value obtained in the first group = 0.037 and in the second group = 0.61. Within these values, there are abnormal data, so the researcher performed a data correction method first.

Table 3. Results of Independent t-test Analysis

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference
Academic Achievement Results	Equal variances assumed	.050	.826	-1,663	20	.112	-6.45455	3.88172
	Equal variances not assumed			-1,663	19,797	.112	-6.45455	3.88172

Based on Table 3, it can be seen that the independent t-test analysis produced a significance value of 0.112, meaning it is greater than the alpha value of 0.05. This indicates that the hypothesis that states "There is a difference in academic outcomes between students who have mathematical problem-solving abilities and students who do not have mathematical problem-solving abilities" is accepted. This means that there is a difference in academic outcomes between students who have mathematical problem-solving abilities and students who do not have mathematical problem-solving abilities.

The study concluded that the Problem-Based Learning (PBL) method had an impact on student learning outcomes. This is in line with research on Problem-Based Learning (PBL) conducted by Ferdiansyah & Rukhviyanti (2024). With the title "The Effect of Problem Based Learning (PBL) Model on Student Learning Outcomes," the study concluded that the Problem Based Learning (PBL) model can improve student learning outcomes, increasing from the lowest 5% to the highest 96%. In the study, the average student learning outcomes before using problem based learning (PBL) were was 57.14 and after using the problem based learning method there was an increase to 79.09.

In research conducted by (Pratiwi et al., 2023) with the title "Implementation of Problem Based Learning (PBL) Model Learning to Improve Student Activities and

Learning Outcomes" concluded that in the results of the study, stage I before applying the Problem Based Learning (PBL) method, the average class value was 78 with a learning completion of 68.75%, while in cycle II after applying the Problem Based Learning method, the average class value was 83.03 with a learning completion of 93.75%, so, by applying the Problem Based Learning (PBL) method, learning outcomes can be significantly improved.

In a study conducted by (Nashan et al., 2019) it was concluded that the average mathematical ability of students using the PBL method was the same as the average mathematical ability of students using the PBL method of 75.

Then, according to research by (Kurniawan et al., 2019) who observed high, medium, and low ability students, it was found that students understood the problem, meaning that students responded to the problem by writing down known information and data in their own sentences. Students were also able to find solutions to problems, and this indicator was the highest based on the research results. Students did not know how to perform calculations systematically and did not pay attention to the area and perimeter of flat shapes. The recheck indicator was the indicator with the lowest percentage, students were less able to maximize the answer items and paid less attention to units of length. Therefore, the results obtained from student responses were weaker. Teachers at SD N 1 Mejobo also discussed the students because they had difficulty understanding mathematical problem-solving learning. Based on research conducted at SD N 1 Mejobo, Kudus Regency, data on the percentage of each indicator analyzed for errors made and obtained an average problem-solving ability that was classified as moderate. To further maximize results, teachers must emphasize the concept of units, implement problem-based learning and provide many contextual questions, so that mathematics learning is meaningful and not routine so that students are accustomed to facing difficult questions. So it becomes a challenge for teachers to improve the mathematical solving skills of each of their students.

Conclusions and Suggestions

Based on the above research, it was found that there are differences in learning outcomes between students who have mathematical problem-solving abilities and students who do not have mathematical problem-solving abilities in the application of the Problem Based Learning learning model. Students who have mathematical problem-solving abilities tend to have high learning achievements and good achievements, so it becomes a challenge for teachers to improve students' mathematical problem-solving abilities.

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