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Achievement of Mathematical Problem-Solving Abilities of 4th Grade Students at SDN 02 Kajar through The Problem-Based Learning (PBL) Model: One-Sample T-Test Analysis

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***Abstract*:**
The mathematical problem-solving ability of IV grade students in plane geometry is still a concern that requires attention. Teachers, as educators, should apply varied learning models that can develop students' mathematical problem-solving skills. This research aims to determine whether the mathematical problem-solving abilities of IV grade students at SDN 02 Kajar in plane geometry using the Problem Based Learning (PBL) model can meet the minimum competency criteria (KKM) score or not. This study is quantitative research using a pre-experimental design method with a one-shot case study type, involving 15 fourth grade students at SDN 02 Kajar. Data collection techniques include mathematical problem-solving ability tests, observation, and interviews. The data obtained was then analyzed using the T-Test (one-sample t-test). The research results show that the achievement of mathematical problem-solving abilities through the Problem-Based Learning (PBL) model is equal to the minimum competency criteria (KKM) score, which is 75.

Keywords: Learning outcomes; mathematics; one sample t-test; minimum competency criteria

Introduction

Education is one of the most important aspects of national development. Literally, education refers to the lessons imparted by an instructor to learners. Both adults and children are expected to provide examples, offer learning, improve ethics and morals, as well as explore the knowledge of each individual. Teaching provided to learners does not only come from formal education administered by the government but, in this context, families and communities play an important role and serve as places for development that can awaken and enhance knowledge and understanding (Ujud et al., 2023).

The implementation of the Merdeka Curriculum as the official curriculum is one of the efforts to develop education in Indonesia. One of the mandatory subjects taught at various school levels is mathematics. Mathematics is very important because it aids

in daily life and helps students think logically. Consequently, teaching must be student-centered to make learning more relevant. Mathematics is defined as a subject that uses logic regarding structure, shapes, magnitudes, and relationships between concepts. Essentially, mathematics is a discipline that enhances thinking and reasoning skills, contributes to solving everyday problems, and supports the development of science and technology. This means mathematics is a subject that guides logical and critical thinking and encourages the presentation of ideas or opinions, which can then be applied to problem-solving skills (Kurniawati et al., 2023; Robbany Arham, 2022).

In mathematics, there are reasoning skills and mathematical problem-solving abilities. A problem is an issue that contains an answer, and if the question is well-formulated and systematic, it is possible to answer it correctly. Problem-solving means the process of seeking information, analyzing the situation, and recognizing the problem to produce alternatives, so actions can be taken to solve the problem and achieve a goal. From this explanation, it can be concluded that problem-solving is a way that can assist learners in solving problems, from gathering data to drawing conclusions that stimulate critical thinking. It is likely that each student has a different understanding of the material. This is because students have different ways of handling problems around them (Kusumawati et al., 2023).

The steps of mathematical problem-solving according to Polya (1973) include: a) Understanding the problem; b) Devising a plan; c) Carrying out the plan; d) Looking back. By following Polya's strategy, students are required to begin solving problems and think through the solution until it can be implemented. Therefore, problem-solving strategies are methods or procedures for solving problems, with steps designed to help students think of the correct problem-solving patterns. Thus, problem-solving strategies impact students' thinking processes in generating new ideas that assist in mathematical problem-solving.

The challenges faced by education today are complex and varied. This is based on the learning process and the weaknesses in learning assessments. Therefore, a student-centered learning model is required to develop critical thinking skills and solve real-life problems. The model used in this research is the problem-based learning (PBL) model. This learning model trains and develops the ability to solve problems oriented toward real-life problems of students to stimulate higher-level thinking skills. The problem-based learning (PBL) model is a learning model that encourages students to work in groups to solve problems and gain new knowledge by using real-life problems as a context (Aini et al., 2023). By using real-life problems, the Problem-based Learning (PBL) model allows students to acquire important knowledge and concepts from the material they have studied previously, leading to the creation of new knowledge (Darwati & Purana, 2021).

The advantages of the problem-based learning (PBL) model include: 1) An effective method for gaining a better understanding of the subject matter, 2) Challenging students' abilities and providing satisfaction in discovering new knowledge, 3) Increasing students' learning activity, 4) Helping students develop their

new knowledge and take responsibility for what they learn, and 5) Helping students broaden their knowledge and take responsibility for their learning. One weakness of the problem-based learning (PBL) model is that students will not try if they are not interested or believe the problems studied are difficult to solve, require significant preparation time, and students will not learn what they want to learn if they do not understand the problems being studied (Hotimah, 2020).

Many students at various educational levels face difficulties in learning mathematics. One of the problems in learning mathematics is that most students view mathematics as a boring and difficult subject, which causes many students not to like it. Factors contributing to difficulties in learning mathematics include internal and external factors. Internal factors include students' negative behavior during mathematics lessons, low interest and motivation to learn, and lack of sensory skills. External factors include teachers and monotonous teaching, lack of learning tools and media, an unsupportive family environment, a noisy community environment, and the generally low level of education in society (Ayu et al., 2021).

Based on the results of preliminary interviews with the 4th-grade teacher at SD Negeri 02 Kajar, Mrs. Nanik Handayani, it was found that students face problems in learning mathematics. Among the difficulties faced by the 4th-grade students at SDN 02 Kajar Kudus are challenges in applying fraction concepts, calculations, and solving problems, especially word problems. Because of these issues, the researcher intends to identify the factors contributing to the difficulties in learning mathematics among the 4th-grade students of SDN 02 Kajar Kudus.

Based on the explanation above, this study aims to examine the achievement of mathematical problem-solving abilities of 4th-grade students at SDN 02 Kajar through the Problem-based Learning (PBL) model. Therefore, the researcher is interested in using the title "Achievement of Mathematical Problem-Solving Abilities of 4th Grade Students at SDN 02 Kajar Through the Problem-Based Learning (PBL) Model: One-Sample T-Test Analysis".

Research Methods

This study uses the Research and Development (R&D) method which aims to produce a particular product and test its feasibility (Sugiyono, 2019). This study is also a study that refers to the 4D (four-D) research and development model. The 4D development model consists of 4 stages, namely the define, design , develop , and disseminate stages .

The research was conducted at SD Negeri 02 Kajar in the 4th-grade class during the second semester of the 2023/2024 academic year. This study is a quantitative research using a pre-experimental method with a one-shot case type involving 15 students from the 4th grade of SDN 02 Kajar in the even semester. This pre-experimental research design involves a single treatment, which is expected to have an impact on the post-test results.

Data collection techniques were conducted through observation, mathematical problem-solving ability tests, and interviews. The research instrument used was a written test, which is necessary for obtaining the average score of individual samples from the population. This test was administered at the end of the learning process using the Problem-Based Learning (PBL) model to measure the students' mathematical problem-solving abilities. The independent variable in this research is the Problem-Based Learning (PBL) model, while the dependent variable is the mathematical problem-solving ability of the 4th-grade students at SDN 02 Kajar, specifically in the topic of flat shapes.

During the study, the researcher used the Problem-Based Learning model to administer the treatment. The post-test results will be used to draw conclusions. The results will be analyzed on average and compared with the desired standard, with the aim of demonstrating the measurement strength and scientific value of a research design using a one-shot case study. The object of this research is the mathematical problem-solving ability of students in the Mathematics subject. Data analysis was performed using a one-sample t-test with prerequisite tests such as the normality test, to determine whether the sample mean significantly differs from the established value. The research design can be illustrated as follows:

$XX \rightarrow 0$

Explanation:

X = Treatment through the PBL model

0 = Student learning outcomes

Results and Discusssion

This study employs a pre-experimental method to make the research more directed, using the one-shot case study design. In other words, in the research design, the sample is given a treatment, followed by a test, and then the learning outcomes are observed. The treatment procedure is conducted only once, where the students are provided an explanation of the flat shapes material.

Data analysis is necessary to compare the average post-test score of the experimental class with the Minimum Mastery Criteria (KKM) score (75) for the flat shapes material, which has been set at SD Negeri 02 Kajar. This analysis uses the one-sample t-test. Quantitative data is used to analyze the students' learning outcomes, with the aim of measuring the level of student success. The formula used to determine the students' learning outcomes is as follows:

Learning outcomes = $\frac{total\ score\ obtained}{total\ possible\ score} \times 100$

Furthermore, SD Negeri 02 Kajar has set the Minimum Mastery Criteria (KKM), as shown in Table 1.

Table 1. Minimum Mastery Criteria (KKM)

Minimum Mastery Criteria	Decisions
≥ 75	Passed
< 75	Not passed

This test will determine whether the average test score significantly differs from the Minimum Mastery Criteria (KKM) score of 75. In the One Sample T-Test, prerequisite tests need to be conducted, including normality and homogeneity tests. The prerequisite test required for the One Sample T-Test is the normality test, which is carried out using the Shapiro-Wilk test for small samples. The normality test is necessary to determine whether the sample follows a normal distribution or not. It also determines whether the data meets the significance criteria of > 0.05 or not. Average abnormal return, cumulative abnormal return, and average trading volume activity are each tested for significance using the One Sample T-Test (Aprilia & Haryanto, 2017).

The hypothesis tested in the normality test is related to whether the mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar in mathematics, through the PBL model, follows a normal distribution.

Table 2. Tests of Normality

Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
Statistic	df	Sig.	Statistic	df	Sig.
.141	15	.200*	.959	15	.671

Based on the output above, the Sig. value obtained is 0.671 > 0.05, which means H0 is accepted and H1 is rejected. Therefore, it can be concluded that the average test scores for the mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar in mathematics using the PBL model follow a normal distribution. Thus, the assumption of normality for the one-sample t-test has been met.

Next, a one-sample t-test was conducted with the hypothesis being tested that the average mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar in mathematics through the PBL model is ≥ 75.

Table 3. One-Sample Statistics

	N	**Mean**	**Std. Deviation**	**Std. Error Mean**
Mathematical Problem-solving scores	15	75.6667	11.46838	2.96112

Based on the output above, the first table shows the descriptive statistics of the score variable, including the number (15), mean (75.6667), standard deviation (11.46838), and standard error of the mean (2.876). Additionally, information about the

One Sample T-Test is presented in the second table. In the decision-making process, the Sig. (2-tailed) value can be compared with the chosen α value. From the second table, it is found that the Sig. (2-tailed) value is 0.825 > 0.05, which means H0 is accepted. Therefore, it can be concluded that the achievement of mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar using the PBL model is equal to 75.

Table 4. One-Sample Test

	Test Value = 75					
	t	df	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
Mathematical Problem-solving scores	.225	14	.825	.66667	-5.6843	7.0176

The results indicate that the mathematical problem-solving ability of 4th-grade students at SD Negeri 02 Kajar who received learning through the Problem-Based Learning (PBL) model meets the Minimum Mastery Criteria (KKM). By using the One Sample T-Test, the individual learning completeness was found to be 0.825 > 0.05, meaning that H0 is accepted, which implies that the average mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar in mathematics through the PBL model is ≥ 75. These results demonstrate that the PBL model is effective in the mathematics learning process for 4th-grade students on the topic of flat shapes, as it meets the criteria individually.

The findings of this study are in line with the research conducted by Amaliyah & Santoso (2022), which states that elementary school students can acquire mathematical problem-solving skills using learning media in the form of modules within the Problem-Based Learning model. Additionally, the research by Darwati & Purana (2021) mentions that utilizing the Problem-Based Learning model can enhance students' thinking skills, problem-solving abilities, and mastery of learning materials, indicating that the PBL model is effective. The implementation of the PBL model in mathematics learning at SDN 02 Kajar has been proven to meet or exceed the established completion standards, demonstrating its effectiveness in improving students' mathematical problem-solving skills. This is because the Problem-Based Learning model helps students enhance their critical thinking skills and mastery of the subject matter.

Conclusions and Suggestions

Mathematical problem-solving is a method that can be used to help students solve problems, starting from gathering data to drawing conclusions, which can

stimulate students to think critically in the context of mathematics. When solving mathematical problem-solving test questions, the Problem-Based Learning (PBL) model can be used. The PBL model is a learning model that uses real-world problems as the starting point for students to learn and acquire essential knowledge and concepts from each lesson that students have previously learned, leading to the formation of new knowledge.

The results of the One Sample T-test above show the Sig. (2-tailed) value with the α value used. The testing criteria are that H0 is accepted if Sig. (2-tailed) > α, while H0 is rejected if Sig. (2-tailed) < α. Additionally, information about the One Sample T-Test is presented in the second table. In the decision-making process, the Sig. (2-tailed) value is compared with the α value used. From the second table, it was found that the Sig. (2-tailed) value is 0.825 > 0.05, meaning H0 is accepted. Therefore, it can be concluded that the achievement of mathematical problem-solving ability of 4th-grade students at SDN 02 Kajar using the PBL model is equal to 75.

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