THE IMPLEMENTATION OF PROBLEM-BASED LEARNING MODEL TO IMPROVE MATHEMATICS LEARNING OUTCOMES ON SOLID FIGURES MATERIAL FOR FIFTH-GRADE STUDENTS

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ABSTRACT

This study was motivated by the low Mathematics achievement of fifth-grade students at SDN 3 Mataram. From the sample data of students' Mathematics scores, 51.35% (19 out of 37 students) scored below the minimum competency standard (KKM) of 70, with a class average score of 68.37. The research aimed to determine whether the application of the Problem-Based Learning (PBL) model could improve Mathematics learning outcomes on geometry topics for fifth-grade students at SDN 3 Mataram during the 2022/2023 academic year. The classroom action research was conducted in two cycles, with each cycle consisting of the stages of planning, implementing actions, observation, evaluation, and reflection. Data collection methods included learning outcome tests and observation. In Cycle I, the average student learning outcome was 69.19, with a mastery percentage of 71.87%. The teacher activity score in implementing the PBL model was 35, categorized as good, and the student activity score was 34, categorized as active. In Cycle II, there was an improvement: the average student learning outcome increased to 71.48, with a mastery percentage of 84.37%. The teacher activity score rose to 43, categorized as very good, and the student activity score increased to 46, categorized as very active. The findings indicate that the application of the Problem-Based Learning model can effectively enhance Mathematics learning outcomes on geometry topics for fifth-grade students. The implications of this study suggest that PBL can be a valuable instructional approach to address low Mathematics achievement and foster active learning. Educators are encouraged to integrate PBL in their teaching strategies, particularly for challenging mathematical concepts, to improve both student engagement and learning outcomes.

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1. INTRODUCTION

In Indonesia's National Education System Law No. 20 of 2003, it is stated that education is a conscious and planned effort to create a learning environment and learning process in which students actively develop their potential. This enables them to acquire spiritual strength, self-control, noble character, and skills needed for themselves, society, the nation, and the state. Furthermore, the national education goals are outlined as developing students' potential to become individuals who are faithful and pious to Almighty God, have noble character, are healthy, knowledgeable, capable, creative, independent, and responsible democratic citizens.

To achieve these goals, one of the educational efforts is incorporating mathematics learning into the curriculum content or curriculum standards for each educational level. In relation to mathematics learning, the curriculum content standards for Mathematics in elementary schools (SD/MI) cover the scope of

Mathematics material and the competencies expected in Mathematics learning at the primary education level, specifically from grades I to VI (elementary school level).The scope of mathematics learning includes fundamental topics such as whole numbers and basic fractions, simple geometry and measurements, as well as introductory statistics. The competencies expected from students encompass both cognitive and affective aspects. These include demonstrating positive attitudes towards mathematics, such as logical thinking, precision, honesty, responsibility, and perseverance in problem-solving, reflecting the implementation of inquiry and exploration habits in mathematics. Furthermore, students are expected to develop curiosity, continuous enthusiasm for learning, confidence, and an interest in mathematics, which are nurtured through their learning experiences.

In terms of specific competencies, students should understand addition and subtraction of whole numbers, classify objects based on their shapes, comprehend the effects of addition and subtraction on collections of objects, identify wholes and parts in daily life, use pictures or photographs to represent information and answer related questions, and employ concrete models in problem-solving. Based on these objectives, mathematics education fundamentally aims to enable students to understand numerical concepts and operations, apply accurate procedures, and utilize reasoning to solve mathematical problems effectively. Mathematics is essential for students to make sense of the world around them, address real-life contextual problems, and engage with their surroundings more meaningfully.

However, in practice, numerous challenges hinder the attainment of these objectives, particularly the issue of low mathematics learning outcomes among students. This issue is a critical problem observed in many schools and requires immediate attention. Low learning outcomes are often associated with subjects that demand high levels of critical thinking and analytical skills, such as mathematics. Addressing this issue is imperative to improve students' mathematical proficiency and their ability to apply mathematical concepts in everyday life.

Masalah rendahnya hasil belajar Matematika juga terjadi di kelas V SDN 3 Mataram, hal itu ditunjukkan dari hasil observasi yang dilakukan peneliti pada tanggal 28 Februari tahun 2023, dimana peneliti telah mengambil sampel nilai hasil belajar siswa dari buku daftar nilai kelas V, seperti yang di tampilkan pada tabel 1.1 dibawah ini:

Table 1.1. Student Test Scores in Grade V for Mathematics Subject

Minimum Mastery Criteria (MMC)	**70**
Number of students scoring ≥ 70	18 students
Number of students scoring < 70	19 students
Average test score	68.37
Targeted Classical Mastery (%)	70%
Achieved Classical Mastery (%)	48.64%

Source: Fifth grade score record book, SDN 3 Mataram.

Based on the data, out of 37 students who participated in the learning outcome test, 19 students did not meet the passing grade, while 18 students did. The average class score was 68.37, with a classical mastery percentage of only 48.64%. Observations also revealed that for several basic competencies, many students had not achieved the Minimum Mastery Criteria (MMC) of 70% or the targeted classical mastery level.

This was further confirmed through interviews with the Grade V teacher, who indicated that students consistently underperformed in Mathematics. The low learning outcomes in Mathematics were attributed to the nature of the subject, which requires critical thinking, analytical skills, and logical reasoning. Moreover, the teacher expressed challenges in selecting effective teaching methods and appropriate learning media. The teaching approach often relied on lectures and repetitive drills, resulting in a teacher-centered learning process. Consequently, students remained passive and worked individually, rather than engaging in collaborative activities.

To address these challenges, the Problem-Based Learning (PBL) model was identified as a potential solution. PBL presents students with contextual or real-world problems to solve, stimulating active engagement and fostering collaborative learning. Through PBL, students are encouraged to work in teams, discuss, and exchange ideas to solve problems. This approach promotes meaningful learning, where students apply existing knowledge and seek out additional information to solve the given problems. In a PBL setting, the teacher assumes the role of a facilitator, guiding students as they observe, collaborate, and utilize resources. Teachers provide references and create an environment where students can present their problem-solving results. By focusing on real-world problems, PBL enables students to connect theoretical concepts with practical applications, thereby improving their understanding and learning outcomes.

1.1. Can the implementation of Problem-Based Learning improve Mathematics learning outcomes in the topic of three-dimensional shapes for Grade V students at SDN 3 Mataram in the academic year 2022/2023?
1.2. How is Problem-Based Learning implemented to enhance Mathematics learning outcomes in the topic of three-dimensional shapes for Grade V students at SDN 3 Mataram in the academic year 2022/2023?

To address the problem of low Mathematics learning outcomes, the researcher implemented the PBL model in the instructional design. In this approach, students were presented with real-world problems related to three-dimensional shapes and their volumes. Working in teams, students explored learning resources, analyzed the problems, and proposed solutions. This method eliminated the need for rote memorization, as students focused on understanding the material through problem-solving activities. By fostering an environment of collaboration and inquiry, the PBL model aimed to improve students' engagement and critical thinking skills. This, in turn, was expected to result in enhanced learning outcomes. The primary objective of this study was to explore the implementation of Problem-Based Learning in improving Mathematics learning outcomes for Grade V students at SDN 3 Mataram in the academic year 2022/2023. The research sought to identify effective practices in PBL and measure its impact on students' academic performance in the topic of three-dimensional shapes..

2. METHOD

This research was conducted at SDN 3 Mataram, located at Jl. Lombok No. 3, Rembiga, Selaparang District, Mataram City, West Nusa Tenggara Province. SDN 3 Mataram, specifically in the fifth grades, faced the issue of low learning outcomes, which was the primary reason for conducting this study at the school. Geographically, SDN 3 Mataram is situated on the outskirts of Mataram City in a strategic location that is easily accessible, as it is located on Jl. Lombok No. 3, a road that connects to the residential areas of Rembiga. The road is relatively quiet, providing a conducive environment for learning, ensuring that the learning process is comfortable and undisturbed.

The research was conducted during the second semester when the fifth grades students at SDN 3 Mataram were undergoing their learning process. The study was not conducted during the first semester due to various reasons, including administrative processes related to the researcher's academic program and the timing of the study's topic decision. The subjects of this study were the fifth grades students of SDN 3 Mataram, with a total of 37 students, consisting of 15 male students and 22 female students, as well as the teacher of the fifth grades. The fifth grades were selected because it is the class that experienced low learning outcomes in Mathematics.

In this study, the observer was Mrs. Musahadah, S.Pd., a supervising teacher at SDN 3 Mataram, and a pre-service teacher from Universitas Mataram's PPG program. Several factors were investigated in this research, including:

2.1. Teacher Factors

The factor examined concerning the teacher was the teacher's activity in implementing the Problem-Based Learning model. The focus was to assess whether the implementation had improved and if it was in accordance with the scenario that had been prepared.

2.2. Student Factors

The factor examined regarding the students was the students' learning outcomes, measured through learning outcome tests after the teaching sessions, as well as the students' engagement during the lessons.

2.3. Operational Description of Research Variables

In this study, the Problem-Based Learning model is a series of learning activities that emphasize problem-solving. The stages involve presenting issues related to three-dimensional shapes and their volumes. Students, working in groups, discuss and find solutions to the problems presented, while the teacher facilitates and provides guidance to each group. Each group then presents their solution to the problem. In this research, learning outcomes refer to the scores achieved by students after undergoing an assessment at the end of the learning process. These scores are expected to meet or exceed the Minimum Mastery Criteria (MMC) for Mathematics, which has been set at 70.

This action research involves teaching activities planned in two cycles, with each cycle consisting of 3 lessons. The teaching in the first cycle serves as the basis for improvements and development in the subsequent cycle. Similarly, the second cycle provides a foundation for further improvements in subsequent cycles, if needed. At the end of each cycle, an evaluation and reflection are conducted between the implementing pre-service teacher and the supervising teacher as a collaborator. This activity is conducted to assess the implementation of the Problem-Based Learning model, student learning outcomes, and any obstacles or challenges faced during the process. According to Arikunto (2014: 16), action research generally goes through four stages: (1) planning, (2) action implementation, (3) observation, and (4) reflection. The flow of classroom action research is illustrated in Figure 3.1 below:

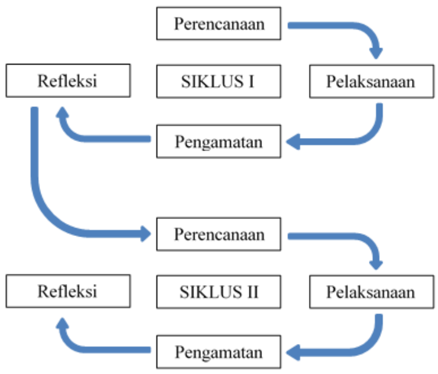

Figure 3.1 Flow of Classroom Action Research

a. Individual Completion
Analysis of learning outcomes Using the PAP (Benchmark Assessment) model, Sudijono (2005: 315) explains that PAP means that the grades given to students must be based on absolute standards, the giving of grades to students is carried out by comparing the raw scores of the test results they have. by individuals, with the ideal maximum score (SMI).

$$NA = \frac{SA}{Smi} x100$$

Explanation:
NA: Final Score
SA: Actual Score
Smi: Maximum Ideal Score

b. Classical Completion
The class completion percentage can be calculated using the following equation:

$$KK = \frac{P}{N} x100\%$$

Explanation:
KK: Classical Mastery
P: Number of students who scored ≥ 70
N: Number of students who took the test

c. Class Average Grade
The average class score can be calculated by adding up the scores of all students who took the test and then dividing the result by the number of students who took the test. The equation is as follows:

$$M = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{N}$$

Explanation:
M: Class average
Xn: Individual student's score
N: Number of students

1. Teacher Activity Data Analysis
To analyze teacher activity data, the following equations can be used:
a. Calculating the ideal maximum score (*SMi*)
The number of indicators observed is known : 16
Highest score for each indicator : 3
So, the maximum score is : 16 x 3 = 48

a. Calculating the ideal mean (*Mi*)

$$Mi = \frac{1}{2}\,(SMi)$$

Explanation:
Mi: Ideal mean
SMi: Ideal maximum score

$Mi = \frac{1}{2}\;48 = 24$

b. Calculating Standard Deviation (*SD*)

$$SDi = \frac{1}{3}\,(Mi)$$

Explanation:
Mi: Ideal mean
SMi: Ideal maximum score

$SDi = \frac{1}{3}\;(24) = 8$

By using the equation above, the criteria for teacher activity can be determined. The following are guidelines for determining the criteria using a five-point scale. Please note table 3.2 below:

Table 3.2 Guidelines for Determining Teacher Assessment Criteria in Implementing the *Problem Based Learning Model* :

No	Interval Formula	Interval	Criteria
1	M+1.5SD<SA≤48	37-48	Very good
2	M+0.5SD<SA≤M+1.5SD	29-36	Good
3	M-0.5SD<SA≤M+0.5SD	21-28	Pretty good
4	M-1.5SD<SA≤M-0.5SD	13-20	Not good
5	0<SA≤M-1.5SD	0-12	Not good

3. Student Activity Data Analysis
To analyze student activity data, the following equations can be used:
a. Calculating the ideal Maximum Score (*SMi*)
The number of indicators observed is known : 16
Highest score for each indicator : 3
So, the maximum score is : 16 x 3 = 48
b. Calculating the ideal mean (*Mi*)

$$Mi = \frac{1}{2}\,(SMi)$$

Explanation:
Mi: Ideal Mean
SMi: Ideal Maximum Score

$$Mi = \frac{1}{2}\;48 = 24$$

c. Calculating Standard Deviation (*SD*)

$$SDi = \frac{1}{3}\,(Mi)$$

Explanation:
Mi: Ideal Mean
SMi: Ideal Maximum Score

$SDi = \frac{1}{3}\;(24) = 8$

By using the equation above, the criteria for student activity can be determined. The following are guidelines for determining the criteria using a five-point scale:

Table 3.1 Guidelines for Determining Student Activity Criteria in Participating in Learning Activities:

No	Interval Formula	Interval	Criteria
1	M+1.5SD<SA≤48	37-48	Very active
2	M+0.5SD<SA≤M+1.5SD	29-36	Active
3	M-0.5SD<SA≤M+0.5SD	21-28	Quite active
4	M-1.5SD<SA≤M-0.5SD	13-20	Less active
5	0<SA≤M-1.5SD	0-12	Not active

The success criteria in this research are:

1. Teacher activity in implementing learning models has increased, with the criteria "good"
2. Student activity in participating in learning increases, with the criteria "active"
3. Individually, students have been able to achieve a score of 70 or more, meaning they have achieved the minimum completion for the Mathematics subject, or are said to have completed their studies.
4. The number of students who have achieved minimum completion is 70% of the total number of students with an average class score of ≥ 70.

3. RESULT AND DISCUSSION

1. Resukt

a. Cycle I

In Cycle I, the teacher received a score of 35, placing them in the "good" category, which indicated that the teacher's activity during the lesson was effective and in line with the expectations for implementing the Problem-Based Learning (PBL) model. The students, on the other hand, had an average score of 34, which reflected that they were "active" participants throughout the learning process. This level of activity indicates that the students engaged with the content, participated in discussions, and worked collaboratively on problem-solving tasks, a key component of PBL.

When analyzing the students' learning outcomes, 32 students participated in the test. Among these, 23 students scored 70 or higher, meeting the minimum passing score for the subject. However, 9 students scored below 70, which indicates that some students were still struggling to meet the learning objectives. The lowest score was 45, while the highest was 85. The average score for the class was 69.19, which is slightly below the targeted passing score of 70.

Despite the class completion percentage being 71.87%, which is above the minimum threshold of 70% for class mastery, the average score was still below the expected standard. This suggests that while most students were able to complete the tasks and reach a passing score, the overall level of understanding was not yet at the desired level. As a result, the study was continued into Cycle II with the aim of further improving the effectiveness of the teaching methods and the students' performance. The focus for Cycle II would be to enhance the learning strategies, reinforce the concepts, and provide additional support to the students who did not reach the passing score in Cycle I.

b. Cycle II

In Cycle II, the teacher achieved a score of 43, which placed them in the "good" category, indicating an improvement in their instructional activity compared to Cycle I. This score reflects the teacher's enhanced ability to engage and manage the classroom, as well as their effective application of the teaching methods, particularly in supporting student participation and learning outcomes. The students, on the other hand, achieved an average score of 46, which placed them in the "very active" category. This improvement signifies that the students were more engaged in the learning process, demonstrating a higher level of participation, interaction, and motivation throughout the lessons.

When examining the students' learning outcomes in Cycle II, the results showed a significant improvement. Out of the 32 students who participated in the test, 27 students scored 70 or higher, indicating a marked improvement in the number of students who met the target score compared to Cycle I. Only 5 students scored below 70, which was a notable reduction in the number of underperforming students. The lowest score in this cycle was 60, and the highest was 95, demonstrating a wider range of performance but overall higher achievement. The average score for the class in Cycle II was 71.48, which is above the target of 70, and represents a significant increase from the previous cycle.

The class completion percentage also saw a notable rise to 84.37%, which is a considerable improvement from the previous cycle's 71.87%. This increase in class mastery suggests that the adjustments made during Cycle II were effective in improving both teaching practices and student outcomes. The results from Cycle II indicate that the instructional strategies employed were successful in enhancing student performance, and the study may be considered for further refinement in future cycles to continue improving learning quality.

2. Discussion

This classroom action research was conducted over two cycles, each consisting of 3 lessons (3 × 35 minutes), with 80 minutes dedicated to teaching and 25 minutes for student learning evaluation. In this discussion section, the researcher will address several key aspects, including the main purpose of the study, the reasons and rationale behind choosing the Problem-Based Learning (PBL) model, the teacher's activity in applying the PBL model, student engagement during lessons using PBL, and the student learning outcomes after implementing PBL.

The primary goal of this action research is to improve the mathematics learning outcomes of grade V students at SDN 3 Mataram, who had previously shown suboptimal performance. Additionally, the research aimed to create a more active, innovative, and engaging learning environment, which was achieved by improving both teacher and student activity. The teacher was able to engage more diverse activities, and students became more independent in mastering the learning content, ultimately reaching the curriculum's expected competencies. This study utilized the Problem-Based Learning (PBL) model, which begins with real-world problems related to the lesson content. In Cycle I, a problem about spatial geometry was introduced, and in Cycle II, the focus was on the volume of three-dimensional objects and their connection to cubic roots. In PBL, students work collaboratively in teams to solve problems, and through the process of problem-solving, they independently study the material, leading to the achievement of the learning objectives. The decision to use PBL is based on the theoretical foundation provided by experts and research findings, which emphasize the effectiveness of this model in improving student learning outcomes.

Teacher activities, as observed in Cycle I, showed a score of 35, placing the teacher in the "good" category, indicating the effective application of PBL as per the lesson plan. The use of media, such as videos, was employed to help students visualize abstract concepts. The teacher also facilitated collaborative work, guided students in observing and formulating problems, and provided resources for data collection. However, based on reflections with the observer, some areas for improvement were identified. For example, the teacher needed to provide more guidance and motivation for students to fully comprehend the messages delivered through media. Additionally, issues with teaching aids such as a malfunctioning projector were noted, which reduced the instructional time.

In Cycle II, the teacher made adjustments based on the previous cycle's shortcomings. For example, the teacher provided additional resources, guided students more effectively in problem formulation, and used verbal reinforcement to motivate students. These changes led to an increase in the teacher's activity score to 43, placing the teacher in the "very good" category. Student activity, as observed in Cycle I, showed a score of 34, placing the students in the "active" category. The PBL model significantly increased student engagement, as evidenced by their enthusiasm in observing media presentations, responding to questions, collecting data, and discussing problem solutions. However, some students were less active in discussions, and some groups were less conducive to collaboration. In Cycle II, these issues were addressed by ensuring better group dynamics, motivating students to engage with the learning media, and providing incentives for participation. As a result, student activity improved to a score of 46, placing the students in the "very active" category.

The students' learning outcomes also showed significant improvement. In the pretest, the average score was 68.37, with a completion rate of 48.64%. In Cycle I, the average score increased to 69.19, with a completion rate of 71.87%. However, this was still below the target of 70, prompting the continuation of the study into Cycle II. In Cycle II, the average score further improved to 71.48, with a completion rate of 84.37%, indicating that the target was successfully met. These results suggest that the application of the PBL model effectively improved students' mathematics learning outcomes. The PBL model improved student engagement and learning outcomes by presenting real-world problems that motivated students and prompted them to independently search for solutions. Collaborative problem-solving allowed students to deepen their understanding of the material. According to Hendry et al. (in Rusman, 2012: 231), PBL is grounded in constructivist theory, where understanding is gained through interaction with problem scenarios and the learning environment, and learning occurs through collaboration and the exchange of diverse perspectives.

4. CONCLUSION

Based on the results of the research conducted, it can be concluded that the implementation of the Problem Based Learning model improved the Mathematics learning outcomes of fifth-grade students at SDN 3 Mataram. In the first cycle, the average student learning outcomes were 69.19, with a mastery percentage of 71.87%. In the second cycle, there was an improvement, with the average student learning outcomes reaching 71.48, and a mastery percentage of 84.37%. The Problem Based Learning model was applied by first orienting students to the problem through observation activities and concrete media. The teacher then introduced the problem related to solid geometry and its volume, which became the problem for the students to solve. Subsequently, students worked collaboratively in teams, collecting data, discussing, reasoning, associating, and exchanging understanding to find a solution to the problem.

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