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# IMPLEMENTING THE PROBLEM-BASED LEARNING MODEL TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITY

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**ABSTRACT** This research addresses the low level of mathematical problem-solving ability among eighth-grade students of MTs PP Nurul Islam Kampung Baru, class VIII.1. The study aims to enhance the learning process and improve students' mathematical problem-solving skills through the application of the problem-based learning model. Conducted as Classroom Action Research, the study was carried out in two cycles, each comprising the stages of planning, implementation, observation, and reflection. The research involved 30 students from class VIII.1 as participants. Data collection was performed using observation and mathematical problem-solving tests. The findings revealed an improvement in students' problem-solving abilities, with average scores increasing from 26.5 in the initial test to 52.33 in the first cycle and 65.5 in the second cycle. These results demonstrate that implementing the problem-based learning model effectively enhances both the learning process and students' mathematical problem-solving skills at MTs PP Nurul Islam Kampung Baru.

**Keywords**: problem-based learning, mathematical problem-solving, classroom action research, learning improvement

**ABSTRAK** Penelitian ini membahas rendahnya kemampuan pemecahan masalah matematis di kalangan siswa kelas VIII.1 di MTs PP Nurul Islam Kampung Baru. Penelitian ini bertujuan untuk meningkatkan proses pembelajaran dan kemampuan pemecahan masalah matematis siswa melalui penerapan model pembelajaran berbasis masalah. Penelitian ini dilakukan dalam bentuk Penelitian Tindakan Kelas (PTK) yang dilaksanakan dalam dua siklus, masing-masing terdiri dari tahap perencanaan, pelaksanaan, observasi, dan refleksi. Penelitian melibatkan 30 siswa kelas VIII.1 sebagai peserta. Pengumpulan data dilakukan melalui teknik observasi dan tes kemampuan pemecahan masalah matematis. Hasil penelitian menunjukkan peningkatan kemampuan pemecahan masalah siswa, dengan rata-rata skor meningkat dari 26,5 pada tes awal menjadi 52,33 pada siklus pertama, dan 65,5 pada siklus kedua. Hasil ini menunjukkan bahwa penerapan model pembelajaran berbasis masalah


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secara efektif meningkatkan proses pembelajaran dan kemampuan pemecahan masalah matematis siswa di MTs PP Nurul Islam Kampung Baru.

**Keywords**: pembelajaran berbasis masalah, pemecahan masalah matematis, penelitian tindakan kelas, peningkatan pembelajaran

## INTRODUCTION

In the field of education, mathematics serves as a crucial discipline that plays a significant role across various areas of knowledge while enhancing students' critical thinking abilities. In mathematics, students are expected to demonstrate the capability to solve problems. The importance of problem-solving skills is emphasized by Hendriana and Soemarmo (in Agustami et al., 2021), who argue that solving mathematical problems constitutes the essence of mathematics learning and forms the foundation of the subject itself. Problem-solving is a critical phase where students generate ideas, hone mathematical skills, and gain new knowledge (Rahmawati et al., 2019).

Aligned with the 2013 curriculum, the objectives of mathematics education are to cultivate thinking skills that enable students to understand, apply, and communicate relationships between concepts accurately in solving problems (Depdiknas, 2014). As such, mathematical problem-solving skills are essential competencies for students. Lestari and Yudhanegara (2018) define mathematical problem-solving skills as the ability to address both routine and non-routine problems, whether theoretical or applied. These skills are vital for overcoming real-life challenges, fostering students' ability to develop innovative and creative ideas. According to Nurfitriyanti (2016), problem-solving also nurtures creativity, allowing students to produce original ideas or adapt existing ones. Similarly, Kharisma and Asman (2018) highlight the importance of mathematical problem-solving skills as a gateway to exploring new ideas and enhancing mathematical competencies.

Based on the findings from a literature study, particularly the research conducted by Nufus et al. (2019) at SMP Negeri 31 Pekanbaru, the average score of the mathematical problem-solving skills test among all participating students was 39.5, with the highest score recorded at 87.5 and the lowest at 6.25. These results highlight that the level of mathematical problem-solving skills among students remains low. To further examine the problem-solving skills of the students in class VIII.2 at MTs PP Nurul Islam Kampung Baru, the researcher administered a preliminary test on the Pythagorean theorem material. This topic was chosen as it precedes the primary subject of the study. The alternative solutions provided by students were evaluated based on specific problem-solving indicators, yielding the following results:

1. Understanding the problem: 14 students (46.66%) achieved the optimal score.
2. Planning the solution: 3 students (10%) achieved the optimal score.

3. Implementing the solution plan: 17 students (56.66%) achieved the optimal score.
4. Interpreting the results obtained: 4 students (13.33%) achieved the optimal score.

These findings demonstrate significant variations in students' problem-solving skills across different indicators, suggesting the need for targeted interventions to improve these competencies.

In indicator 1, 14 out of 30 students successfully outlined what they knew and what was being questioned in the problem, while the remaining students directly attempted to answer without documenting the given information or the questions. This discrepancy was likely due to the researchers' instructions being conveyed verbally rather than explicitly written down. For indicator 2, only 3 students managed to create effective problem-solving plans, as most students struggled to identify and construct accurate mathematical models. On indicator 3, 17 out of 30 students demonstrated the ability to solve problems accurately, completely, and systematically. However, for indicator 4, which involves interpreting results, none of the students were able to draw accurate conclusions, indicating a lack of familiarity with this skill. The initial test results suggest that students are not accustomed to tackling mathematical problems systematically.

Interviews with students revealed their challenges in completing the test: 1) they found the test questions difficult and lacked a clear understanding of problem-solving procedures; and 2) they experienced confusion and hesitation, which led them to provide answers based on their own reasoning. Additional observations and interviews with the mathematics teacher at MTs PP Nurul Islam Kampung Baru, who teaches class VIII.1, revealed that some students remain passive during classroom activities, relying heavily on the teacher's explanations without attempting independent exploration of the material. Many students merely observe and copy answers from higher-performing peers. The teacher acknowledged that students are not adequately trained in solving problem-based questions. During lessons, the teacher typically explains the material in front of the class and provides example problems but does not emphasize the step-by-step solution process. Consequently, students do not develop an understanding of systematic problem-solving techniques. Furthermore, some students exhibit a lack of motivation and avoid challenging questions, opting instead to copy answers from peers or wait for teacher guidance. The teacher has not yet implemented group learning activities or used student activity sheets. As a result, the teaching and learning process remains one-directional, students are not actively engaged, and they struggle to approach problems using structured problem-solving stages.

To address the issue at MTs PP Nurul Islam Kampung Baru regarding the low level of mathematical problem-solving skills, deliberate efforts are required to improve students' abilities. Mawaddah and Anisah (2015) emphasize that to enhance


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mathematical problem-solving skills, teachers should provide meaningful learning experiences that deepen students' understanding of mathematics. Teachers need to implement teaching methods or models that align with the learning objectives and the 2013 curriculum. One such effective model is the problem-based learning (PBL) model.

According to Krismayanti (2018), PBL plays a significant role in fostering mathematical problem-solving skills. PBL involves students actively engaging in group discussions, generating ideas, and utilizing relevant information, with the primary focus being on the process of solving problems while acquiring the required knowledge (Assegaff & Sontani, 2016). This model allows students to participate directly in each problem-solving stage using their own strategies, fostering creativity in addressing challenges and expanding their knowledge (Yustianingsih et al., 2017).

Previous studies have shown that implementing PBL can enhance students' mathematical problem-solving skills. Notable research by Novianti et al. (2020), Sumartini (2016), Hidayat and Sariningsih (2018), and Rahmadani (2019) provides evidence supporting this claim. Therefore, in addressing the challenges in mathematics learning for class VIII.1 at MTs PP Nurul Islam Kampung Baru during the even semester of the 2023/2024 academic year, the implementation of the PBL model on the topic of flat-sided space figures aims to improve teaching and learning activities. This initiative is expected to bring positive changes and significantly enhance students' mathematical problem-solving skills.

## METHODS

This study is classified as classroom action research (CAR) conducted in collaboration with the mathematics teacher. The research took place at MTs PP Nurul Islam Kampung Baru during the even semester of the 2023/2024 academic year, involving 30 students from class VIII.1 as research participants. The research was carried out in two cycles. Following the first cycle, a mathematical problem-solving ability test was administered, and after the second cycle, another test was conducted. Each cycle included the stages of planning, implementation, observation, and reflection.

The planning phase involved preparing learning materials, which included a syllabus, lesson plans designed to cover topics such as the surface area and volume of rectangular prisms, cubes, prisms, and pyramids, as well as student activity sheets for four meetings. Tests were also prepared to assess problem-solving abilities in each cycle, along with observation sheets to record teacher and student activities. During the implementation phase, the planned actions were carried out over two meetings, followed by a test. Observations were conducted during the learning activities to evaluate teacher and student performance. The mathematics teacher observed the researcher’s teaching, while peers of the researcher observed the students' activities.

The reflection stage involved reviewing the actions implemented in each cycle to identify areas of improvement for subsequent cycles. Data collection employed both observation techniques and problem-solving tests, with instruments including observation sheets and test materials. Data analysis was conducted by reviewing the observations of teacher and student activities through narrative descriptive analysis and analyzing the results of the problem-solving tests quantitatively based on established criteria. The success of the research was determined by assessing improvements in the second cycle compared to the first, particularly in terms of student engagement, the ability to solve mathematical problems effectively, and a class-wide improvement in average test scores.

## FINDING AND DISCUSSION

The results of this research encompass qualitative data analysis, including observations from teacher and student activity sheets, as well as quantitative data analysis focusing on the mathematical problem-solving abilities of students during the learning process. The implementation of learning activities adhered to the lesson plans, which covered introductory activities, core activities, and concluding activities (Depdiknas, 2016).

In the introductory phase, improvements were observed from cycle 1 to cycle 2. Initially, students were inattentive during the teacher's explanation of apperception, motivation, and learning objectives. However, by cycle 2, the students began to pay closer attention to the researcher during the presentation of learning steps. In the core phase, notable progress was also evident. During cycle 1, students faced difficulties completing the student worksheets and were reluctant to present their work, requiring the researcher to call on them directly. By cycle 2, students demonstrated greater adaptability in completing the worksheets, and some voluntarily presented their work without being prompted. The concluding phase showed similar improvements; in cycle 1, students were still unsure during the formative test, whereas by cycle 2, they had grown accustomed to the process. Through the implementation of the problem-based learning model, weaknesses observed during cycle 1 were addressed through planned improvements, leading to a significantly enhanced learning process by the end of cycle 2.

The results of the students' performance in cycle 1, as measured by their achievement on the problem-solving indicators, are presented in Table 1. These indicators include understanding the problem, planning the problem-solving, implementing the problem-solving plan, and interpreting the results. Each indicator was assessed based on the number of students who achieved the maximum score and the corresponding percentages. The table provides a comprehensive view of how students performed on each problem-solving aspect and highlights areas that require further improvement.


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Table 1. Student Achievement on Problem-Solving Indicators in Cycle 1

| Aspect of Problem-Solving Skills Measured | Question Number | Number of Students Achieving Max Score | Percentage (%) |
|---|---|---|---|
| Understanding the problem | 1 | 23 | 76,66% |
| | 2 | 24 | 80% |
| | 3 | 20 | 66,66% |
| | 4 | 16 | 53,33% |
| Planning the problem-solving | 1 | 22 | 73,33% |
| | 2 | 21 | 70% |
| | 3 | 4 | 13,33% |
| | 4 | 1 | 3,33% |
| Implementing the problem-solving plan | 1 | 23 | 76,66% |
| | 2 | 22 | 73,33% |
| | 3 | 1 | 3,33% |
| | 4 | 0 | 0% |
| Interpreting the results obtained | 1 | 18 | 60% |
| | 2 | 13 | 43,33% |
| | 3 | 0 | 0% |
| | 4 | 0 | 0% |

Most students in cycle 1 demonstrated strong performance in "understanding the problem," as evidenced by their ability to accurately organize what they knew and what was being questioned. However, the performance on the remaining indicators—namely "planning the problem-solving," "implementing the problem-solving plan," and "interpreting the results"—was relatively low. The main challenges faced by students included difficulty in comprehending the questions and inefficient time management. Many students spent excessive time solving questions 1 and 2, leaving inadequate time to address questions 3 and 4. This reflects the need for better guidance and strategies to address these aspects in subsequent cycles.

Table 2. Student Achievement on Problem-Solving Indicators in Cycle 2

| Aspect of Problem-Solving Skills Measured | Question Number | Number of Students Achieving Max Score | Percentage (%) |
|---|---|---|---|
| Understanding the problem | 1 | 24 | 80% |
| | 2 | 23 | 76,66% |
| | 3 | 22 | 73,33% |
| | 4 | 21 | 70% |
| Planning the problem-solving | 1 | 23 | 76,66% |
| | 2 | 26 | 86,66% |
| | 3 | 11 | 36,66% |
| | 4 | 4 | 13,33% |
| Implementing the problem-solving plan | 1 | 25 | 83,33% |
| | 2 | 25 | 83,33% |
| | 3 | 3 | 10% |
| | 4 | 2 | 6,66% |

| Aspect of Problem-Solving Skills Measured | Question Number | Number of Students Achieving Max Score | Percentage (%) |
|---|---|---|---|
| Interpreting the results obtained | 1 | 22 | 73,33% |
| | 2 | 26 | 86,66% |
| | 3 | 0 | 0% |
| | 4 | 0 | 0% |

Based on Table 2, the overall results in Cycle 2 indicate an improvement in students' mathematical problem-solving abilities compared to Cycle 1. The ability to address all aspects of problem-solving has shown an increase, demonstrating progress in their understanding and application of problem-solving strategies. However, while there is evident growth, the improvement observed is relatively moderate, suggesting the need for continued efforts to enhance these skills further.

The improvement in students' mathematical problem-solving skills before and after the implementation of the action can be observed in Table 4 below.

Table 3. Student Problem-Solving Skills Qualifications

| Score Interval | Number of Students | | | Qualification |
|---|---|---|---|---|
| | Initial Test | Cycle 1 | Cycle 2 | |
| 85,00 – 100 | 0 | 0 | 2 | Very Good |
| 70,00 – 84,99 | 1 | 4 | 8 | Good |
| 55,00 – 69,99 | 0 | 11 | 20 | Fair |
| 40,00 – 54,99 | 8 | 11 | 0 | Poor |
| 0 – 39,99 | 21 | 4 | 0 | Very Poor |

Table 3 demonstrates that there was a steady improvement in students' problem-solving qualifications across the study. In the initial test, most students fell into the very poor category, with 21 students classified as such, while 8 students were categorized as poor and only 1 student achieved a good qualification. By Cycle I, progress became evident as 4 students reached the good category, while the numbers in the sufficient and poor categories both increased to 11. The very poor category saw a sharp decrease to only 4 students. In Cycle II, further improvements were observed. Two students achieved the very good qualification, 8 students were classified as good, and 20 students reached the sufficient category. Notably, there were no students remaining in the poor or very poor categories, indicating a substantial enhancement in students' overall problem-solving abilities.

The improvement in students' mathematical problem-solving skills can also be observed classically, as presented in Table 4. The average score of students' problem-solving skills in cycle 2 reached 65.5, which reflects a significant improvement compared to the scores in cycle 1 (52.33) and the initial test (26.5). The improvement in cycle 1 occurred as students were introduced to the importance of problem-solving through the application of structured problem-solving procedures.


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However, during cycle 1, students often skipped crucial steps in the problem-solving process, which prevented them from achieving optimal scores. For instance, several students did not fully document their problem-solving plans and directly attempted to find solutions. Others made errors in calculations, which led to incorrect answers and flawed interpretations. The weaknesses identified in cycle 1 were addressed and minimized in cycle 2, allowing students to achieve better results and demonstrate significant progress in their problem-solving skills.

Table 4. Improvement of Average Problem-Solving Skills Scores

| | Problem-Solving Skills Score | | |
|---|---|---|---|
| | Initial Test | Cycle I | Cycle II |
| Average | 26,5 | 52,33 | 65,5 |
| Score Improvement | | 25,83 | 13,17 |

The average test score of students' mathematical problem-solving abilities in cycle 2 increased significantly to 65.5 compared to cycle 1, which was 52.33, and the initial test score, which was only 26.5. The results of the test in cycle 1 indicated that students had been introduced to the importance of problem-solving through structured procedures. However, many students skipped essential steps in the problem-solving process, leading to suboptimal scores. For instance, some students directly attempted to find solutions without fully documenting their problem-solving plans, while others made calculation errors, resulting in incorrect answers and misinterpretations. These shortcomings were effectively addressed in cycle 2, as reflected in the students' improved performance.

Based on the research findings, the actions taken in this study were successful. These results align with Novianti, Putri, and Maimunah (2020), who found that the application of the Problem-Based Learning model improved students' problem-solving abilities at SMPN 9 Pekanbaru. In this study, the learning process demonstrated consistent progress from the first meeting to the second cycle. During the orientation phase, students became accustomed to reading and understanding problems. In the organizing learning activities phase, they identified problems and actively expressed their opinions. During the guiding group investigation phase, students collaborated effectively within their groups and regularly sought assistance when encountering difficulties with their worksheets. In the developing and presenting work phase, students were eager to present the results of group discussions. Lastly, during the analyzing and evaluating phase, they confidently commented on and provided feedback for their peers' work.

The shortcomings observed in cycle 1 served as a basis for improvement in the second cycle. As a result, the stages of the Problem-Based Learning model were implemented more effectively during the second cycle. This was evident from the active participation of most students in the learning process. Students asked

questions, responded to queries from their teacher and peers, and took initiative by presenting their work in front of the class. These improvements highlight the success of the Problem-Based Learning model in enhancing students' mathematical problem-solving abilities and fostering an engaging learning environment.

## CONCLUSIONS AND RECOMMENDATIONS

The conclusion that can be drawn from this study is that the Problem-Based Learning (PBL) model effectively improves the learning process and enhances the mathematical problem-solving abilities of students in MTs PP Nurul Islam Kampung Baru, class VIII.1, particularly on the topic of flat-sided space shapes. This improvement is evident from the increased student engagement and the higher levels of mathematical problem-solving abilities demonstrated by the students. It is recommended that teachers consistently emphasize and monitor the importance of following all stages of problem-solving. This ensures that students do not skip any steps, thereby minimizing errors in arriving at solutions. Additionally, when designing student activity sheets, teachers should use clear, simple, and communicative language to help students better understand the instructions and engage more effectively with the materials.

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