JURNAL ABSIS
Jurnal Pendidikan Matematika dan Matematika
Vol. 7 No. 2, December 2024

IMPROVING MATHEMATICAL PERFORMANCE THROUGH THE PROBLEM-BASED LEARNING MODEL

Melati Putri Irawan[1], Rini Dian Anggraini[2], Syofni[3]
[1,2,3] Universitas Riau, Indonesia
melati.putri6326@student.unri.ac.id

ABSTRACT This study addresses the low mathematics achievement levels among students in class VIII.2 at SMP Negeri 35 Pekanbaru during the 2023/2024 academic year. The research aims to enhance the learning process and improve mathematics achievement by implementing the Problem-Based Learning (PBL) model. This study employs Classroom Action Research to identify problems and implement targeted actions to resolve them. The subjects comprised 19 male students and 20 female students with heterogeneous ability levels. The research instruments included the Flow of Learning Objectives, Teaching Modules with attached Student Worksheets, Diagnostic Assessments, Formative Assessments, and Summative Assessments. Observation sheets and learning outcome tests were used for data collection. The results indicate significant improvements in the learning process across cycles, as demonstrated by increased mathematics achievement. The number of students meeting the Learning Objective Achievement Criteria rose from 17 students (43.59%) in Cycle I to 25 students (64.10%) and further to 29 students (74.36%) in Cycle II. The study concludes that the application of the PBL model effectively improved both the learning process and mathematics achievement in class VIII.2 at SMP Negeri 35 Pekanbaru during the 2023/2024 academic year, particularly on the topic of the System of Linear Equations in Two Variables.

Keywords: problem-based learning, mathematics learning outcomes, system of linear equations of two variables, classroom action research

ABSTRAK Penelitian ini membahas rendahnya tingkat pencapaian matematika siswa kelas VIII.2 di SMP Negeri 35 Pekanbaru pada tahun ajaran 2023/2024. Penelitian ini bertujuan untuk meningkatkan proses pembelajaran dan hasil belajar matematika melalui penerapan model Problem-Based Learning (PBL). Penelitian ini menggunakan Penelitian Tindakan Kelas (PTK) untuk mengidentifikasi masalah dan menerapkan tindakan yang ditargetkan guna menyelesaikan masalah tersebut. Subjek penelitian terdiri dari 19 siswa laki-laki dan 20 siswa perempuan dengan tingkat kemampuan yang heterogen. Instrumen penelitian meliputi Alur Tujuan Pembelajaran (ATP), Modul Ajar dengan lampiran Lembar Kerja Siswa (LKS), Penilaian Diagnostik, Penilaian Formatif, dan Penilaian Sumatif. Lembar observasi dan tes hasil belajar digunakan untuk pengumpulan data. Hasil penelitian menunjukkan adanya peningkatan signifikan dalam proses pembelajaran dari siklus ke siklus, yang ditunjukkan oleh peningkatan hasil belajar matematika siswa. Jumlah siswa yang mencapai Kriteria

https://doi.org/10.30606/absis.v7i2.2606

Ketercapaian Tujuan Pembelajaran (KKTP) meningkat dari 17 siswa (43,59%) pada Siklus I menjadi 25 siswa (64,10%) dan selanjutnya menjadi 29 siswa (74,36%) pada Siklus II. Penelitian ini menyimpulkan bahwa penerapan model PBL berhasil meningkatkan proses pembelajaran dan hasil belajar matematika pada siswa kelas VIII.2 di SMP Negeri 35 Pekanbaru tahun ajaran 2023/2024, khususnya pada materi Sistem Persamaan Linear Dua Variabel (SPLDV).

Keywords: problem-based learning, hasil belajar matematika, SPLDV, penelitian tindakan kelas

INTRODUCTION

Learning outcomes are an essential aspect for teachers to evaluate students' learning abilities, as each student possesses unique academic potential and achievements (Meliyana et al., 2023). Learning outcomes refer to the acquisition of abilities in the form of knowledge (cognitive), attitudes or character (affective), and skills (psychomotor), which are demonstrated through behavioral changes after participating in activities or learning processes (Setyo et al., 2020).

In mathematics, learning outcomes are assessed based on the scores obtained by students during the teaching and learning process. These scores must meet the criteria for achieving learning objectives established by the school. The assessment process involves evaluating students' learning results against these predetermined criteria (Permendikbud, 2022).

According to the mathematics teacher of class VIII.2 at SMP Negeri 35 Pekanbaru during the odd semester of the 2023/2024 academic year, many students in class VIII.2 have not yet met the school's criteria for achieving learning objectives, which is set at a score of 72. Data from the summative assessment of 39 students in the class reveals that only 8 students achieved the required score. This situation highlights a significant gap between the actual learning outcomes and the expected achievements in mathematics for class VIII.2 at SMP Negeri 35 Pekanbaru.

Observations were conducted to examine the learning process in class VIII.2 at SMP Negeri 35 Pekanbaru. Based on the results of these observations, the learning activities did not align with the process standards outlined in Permendikbudristek No. 16 of 2022. According to these standards, the learning environment should be organized in an interactive, inspiring, enjoyable, and challenging manner. It should motivate students to actively participate and provide sufficient space for their initiative, independence, and flexibility in line with their talents, interests, as well as their mental and physical development. Additionally, teachers are expected to act as role models, provide guidance, and facilitate learning effectively.

In response to these issues, a Diagnostic Assessment Test was administered to students in class VIII.2. Assessment is crucial for identifying the obstacles and weaknesses faced by students during the learning process (Firmanzah & Sudibyo, 2021). The diagnostic test focused on problems related to Linear Equations in One

Variable. The results revealed that student learning outcomes were still below expectations. Specifically, only 43.59% of students met the criteria for achieving learning objectives. Out of 39 students who took the test, only 17 students reached the required benchmark.

Interviews with mathematics teachers at SMP Negeri 35 Pekanbaru were also conducted to gain further insight into student activities during the learning process. The interviews revealed several issues contributing to the students' low performance. The teacher reported that students were generally passive, reluctant to ask questions when they did not understand the material, and unable to solve problems beyond the methods demonstrated by the teacher. Furthermore, students struggled to answer story problems, and there was a noticeable gap in performance between high- and low-achieving students.

The teacher has made several efforts to improve student learning outcomes in class VIII.2 at SMP Negeri 35 Pekanbaru, such as increasing the number of practice questions to train students in problem-solving and assigning homework related to the learning materials. However, despite these efforts, the mathematics learning outcomes of students in class VIII.2 remain unsatisfactory, with many students failing to reach the minimum competency criteria set by the school.

Teachers can enhance the learning process and its outcomes by implementing a learning model that encourages students to actively build knowledge independently, making the learning experience more meaningful and leading to improved mathematics learning outcomes. A suitable learning model should motivate students, increase their engagement during the learning process, and help them understand the material more effectively, ultimately improving their academic performance. Based on the previously identified problems, there is a need for a learning model that organizes students around real-life problems, enabling them to develop problem-solving skills relevant to their daily lives while improving their academic outcomes. One such model is Problem-Based Learning (PBL).

According to Arifin (2021), the PBL model is centered on real-world problems to foster students' potential. This approach allows students to better understand conceptual material, which can lead to improved learning outcomes. One way to encourage students to actively engage in learning is by providing opportunities to solve problems they encounter. This idea is supported by Gazali (2016), who states that connecting learning materials to students' conditions—such as their hobbies, needs, cognitive development, daily environment, and prior knowledge—can positively impact students. It makes them more active in learning, enhances their enjoyment of the process, and fosters a readiness to interpret concepts for solving mathematical problems and their applications. The Problem-Based Learning model aligns well with these principles, as it encourages students to actively participate and construct knowledge while solving meaningful, real-world problems.

https://doi.org/10.30606/absis.v7i2.2606

Various studies have demonstrated the effectiveness of the Problem-Based Learning (PBL) model. Research conducted by Rahmawati, Heleni, and Armis (2020) on the topic of the Two-Variable Linear Equation System shows an improvement in the percentage of students achieving the basic scores to Quiz I, increasing from 33.33% to 53.55%, and further improving from Quiz I to Quiz II, reaching 76.67%. Similarly, a study by Triandini (2024) on the same topic revealed that the percentage of students achieving basic scores rose from 40.7% (11 students) in Cycle I to 51.8% (14 students) in Cycle II, eventually reaching 62.9% (17 students). Another study by Situmorang and Samosir (2020) on the topic of the Two-Variable Linear Equation System also demonstrated significant improvement, with the percentage of basic scores to the first assessment increasing from 2.86% to 28.57%, and from the first to the second assessment reaching 88.57%. These findings indicate that the PBL model is highly effective in enhancing student learning outcomes.

The topic of the Two-Variable Linear Equation System was chosen due to its relevance to real-life contexts. Examples include problems involving numbers, age, money, investment, business, sizes, groceries, and movement. Through the application of the PBL model, it is expected that students will not only improve their mathematics learning outcomes but also enhance their ability to solve practical, everyday problems.

Based on the issues identified, improvements in the teaching and learning process are considered necessary by implementing a learning model that fosters better mathematics learning outcomes. This study aims to explore and apply the PBL model to enhance students' mathematical achievement, particularly in the context of the Two-Variable Linear Equation System.

METHODS

This study employed Classroom Action Research (CAR), which is described as research conducted in the classroom during the learning process (Saputra et al., 2021). The research followed a cyclical model comprising two cycles, each consisting of four stages: planning, implementation, observation, and reflection, as outlined by Arikunto et al. (2019). Each cycle was carried out over two meetings, with an additional meeting dedicated to formative assessment to evaluate students' progress.

The participants of this study were 39 students from class VIII at SMP Negeri 35 Pekanbaru during the even semester of the 2023/2024 academic year, comprising 19 male and 20 female students with varying levels of ability. Data collection was conducted using both qualitative and quantitative methods. Qualitative data were obtained through observation sheets to monitor teacher and student activities during the learning process. These sheets included specific indicators for activities carried out during the introduction, core, and closing phases of each lesson.

Quantitative data were gathered through diagnostic, formative, and summative assessments to evaluate students' mathematics learning outcomes.

The learning tools utilized in this study included teaching modules and student worksheets aligned with the learning objectives. Observation sheets were used to systematically document teacher and student activities, as well as their alignment with the Problem-Based Learning (PBL) model. The qualitative data analysis, as suggested by Muslich (in Junita, Solfitri, & Siregar, 2020), followed three steps: data reduction, which involved summarizing and focusing on key aspects; data display, where the observations were presented descriptively; and conclusion drawing, where insights were interpreted based on the observed trends.

Quantitative data analysis focused on evaluating the percentage of students achieving the learning objectives, as well as examining trends in student performance. The progression between cycles was analyzed by comparing baseline, formative, and summative assessment results. Descriptive analysis of frequency distribution was also used to summarize student achievement and categorize it into levels such as very low, low, medium, high, and very high.

The success of each cycle was determined by improvements in both the learning process and students' mathematics learning outcomes. According to the guidelines provided by Arikunto et al. (2019), the learning process was considered successful if teacher and student activities became more active and aligned with the objectives of the PBL model. An increase in the percentage of students achieving the learning objectives and an improvement in average student scores between cycles further indicated positive progress.

FINDING AND DISCUSSION

The data collected in this study included observations of teacher and student activities during the learning process, as well as the results of mathematics tests conducted with the students. These observations and assessments provided a comprehensive understanding of the learning process and the effectiveness of the Problem-Based Learning (PBL) model in improving students' mathematics learning outcomes. The findings are analyzed and discussed in this section, focusing on the progress made across cycles and the impact of the PBL model on both the learning process and student achievement.

During the first cycle, several barriers and shortcomings were identified in the learning process. Students experienced difficulties working collaboratively in groups, with some preferring to work independently or immediately seeking help from the teacher when faced with challenges. Additionally, some students copied their peers' work without actively contributing. Time management issues also arose, as group work on Student Worksheets consumed more time than anticipated. Certain activities, such as formative tests, were not completed within the allocated

https://doi.org/10.30606/absis.v7i2.2606

time. These challenges were reflected in the observation sheets of teacher and student activities during the lessons.

In the second cycle, improvements were made based on reflections from the first cycle. Students demonstrated increased participation in the learning process, including responding to questions during the apperception stage and engaging more actively with the Problem-Based Learning (PBL) model. The students became more accustomed to the PBL approach, as reflected in their confident responses to questions. Furthermore, there was a noticeable improvement in their enthusiasm during group presentations and when concluding their learning outcomes. These developments were a result of adjustments made in response to the shortcomings identified in the first cycle.

Data Analysis of Students' Mathematics Learning Outcomes

The analysis of students' mathematics learning outcomes considered the achievement of Learning Objective Completeness Criteria, frequency distribution, and central tendency. Table 1 summarizes the percentage of students achieving KKTP across the baseline score, Summative Test-1, and Summative Test-2

Table 1 The percentage of students achieving criteria

Achievement	Base Score	Summative Test -1	Summative Test -2
Number of students achieving criteria (≥72)	17	25	29
Percentage of students achieving criteria (%)	43.59%	64.10%	74.36%

The data in Table 1 illustrates a consistent improvement in students achieving KKTP from the baseline to Summative Test-1 and further to Summative Test-2. This indicates that the implementation of actions during the cycles effectively enhanced student learning outcomes. Table 2 presents the frequency distribution of student scores across the baseline, Summative Test-1, and Summative Test-2.

Table 2 The frequency distribution of student scores

Value Interval	Predicate	Student Frequency		
		Base Score	Summative Test-1	Summative Test-2
$40 \leq x < 52$	Very Low	2	0	0
$52 \leq x < 64$	Low	12	4	0
$64 \leq x < 76$	Medium	13	14	16
$76 \leq x < 88$	High	9	13	17
$88 \leq x < 100$	Very High	3	8	6

From Table 2, it can be observed that the frequency of students in the "very low" and "low" categories decreased significantly, while the frequency in the "medium" and "high" categories increased. For example, the "very low" category ($40 \leq x < 52$)

decreased from 2 students at baseline to 0 in Summative Test-1 and Summative Test-2. Similarly, the "low" category ($52 \leq x < 64$) dropped from 12 students at baseline to 4 in Summative Test-1 and 0 in Summative Test-2. Meanwhile, the "high" category ($76 \leq x < 88$) increased from 9 students at baseline to 17 in Summative Test-2, reflecting significant progress.

The central tendency analysis also demonstrated improvement in students' mathematics learning outcomes. The mean score increased from 69.64 at baseline to 76.77 in Summative Test-1 and 78.54 in Summative Test-2. These results indicate consistent progress in students' learning achievements.

Based on the results of data analysis, teacher and student activities in applying the PBL model were carried out in accordance with the lesson plan. Observations during the learning process in class VIII.2 SMP Negeri 35 Pekanbaru revealed consistent progress from the first to the second meeting, as well as from the third to the fourth meeting. Shortcomings identified in the first cycle were utilized as evaluation material to be addressed in the second cycle. Consequently, in the learning process during the second cycle, the steps of the problem-based learning model were implemented more effectively in each meeting. This was evident in the increased active participation of students in learning activities, such as observing and answering questions posed during the lessons.

The implementation of PBL provided students with opportunities to actively engage in the learning process. Students demonstrated confidence in expressing opinions and asking questions to the teacher, engaging in group discussions while working on the student worksheets, and responding to their peers' presentations. Additionally, students were encouraged to construct their own understanding, making the learning process more meaningful and memorable.

The results of the Criteria for Achieving Learning Objectives achievement analysis indicated significant improvement. The percentage of students who achieved the criteria increased from 17 students (43.59%) at the baseline score to 25 students (64.10%) in cycle I, and further to 29 students (74.36%) in cycle II. The frequency distribution analysis revealed a positive shift in learning outcomes, marked by a decrease in the frequency of students scoring in the "very low" ($40 \leq x < 52$) and "low" ($52 \leq x < 64$) categories. Concurrently, there was an increase in the frequency of students scoring in the "medium" ($64 \leq x < 76$) and "high" ($76 \leq x < 88$) categories.

Further analysis of central tendency demonstrated consistent improvement in students' mathematics learning outcomes. The mean (average), median (middle value), and mode scores increased from the baseline to Summative Test-I, and from Summative Test-I to Summative Test-II. These findings affirm that the actions taken during the implementation of the PBL model effectively enhanced the learning experience for class VIII.2 at SMP Negeri 35 Pekanbaru.

From the analysis and discussion, it can be concluded that the PBL model proved to be highly effective in improving students' learning achievement. This effectiveness

https://doi.org/10.30606/absis.v7i2.2606

is attributed to the PBL approach's focus on problem-solving, which sharpens students' ability to read, comprehend, and resolve mathematical problems. These findings align with previous studies by Andika et al. (2024) and Robiyanto (2021), which demonstrated that the implementation of the Problem-Based Learning model enhances student learning outcomes. Additionally, this is consistent with Sanjaya's statement, as cited in Klarici et al. (2021), that Classroom Action Research is considered successful when iterative actions lead to a narrowing of the problem being addressed and, ultimately, its resolution.

Furthermore, in terms of learning outcomes from cycle I to cycle II, the number of students achieving the Criteria for Achieving Learning Objectives increased significantly. Based on the teacher and student activity sheets, as well as the analysis of students' mathematics performance data, it can be concluded that the hypothesis of the proposed action was accepted. The implementation of PBL successfully improved the learning process, enhanced students' mathematics learning outcomes, and increased the percentage of students achieving the Criteria for Achieving Learning Objectives in class VIII.2 SMP Negeri 35 Pekanbaru during the even semester of the 2023/2024 academic year on the topic of the System of Linear Equations of Two Variables.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion, it can be concluded that the implementation of the Problem-Based Learning (PBL) model effectively improves the learning process, enhances mathematics learning outcomes, and increases the percentage of students achieving the Criteria for Achieving Learning Objectives in class VIII.2 at SMP Negeri 35 Pekanbaru during the even semester of the 2023/2024 academic year, particularly on the topic of the System of Linear Equations of Two Variables (SPLDV). The PBL model can be used as an alternative approach for teachers to engage students in active and meaningful learning. However, while the model encourages students to solve contextual problems, it requires careful time management. Therefore, teachers or researchers applying the PBL model should monitor and guide students effectively throughout the learning process to ensure that time constraints do not hinder the achievement of learning objectives.

REFERENCES

Andika, S., Solfitri, T., & Kartini. (2024). Penerapan model Problem Based Learning untuk meningkatkan hasil belajar matematika peserta didik kelas VIII MTs Hayatul Islamiyah Pangean. *Jurnal Absis: Jurnal Pendidikan Matematika dan Matematika*, 6(2), 870–883.

Arifin, S. (2021). *Model PBL (Problem Based Learning) berbasis kognitif dalam pembelajaran matematika*.

Arikunto, S., Suhardjono, & Supardi. (2019). *Penelitian tindakan kelas*. Bumi Aksara.

Firmanzah, D., & Sudibyo, E. (2021). Implementasi asesmen diagnostik dalam

pembelajaran IPA pada masa pandemi COVID-19 di SMP/MTs wilayah Menganti, Gresik. *Pensa E-Jurnal: Pendidikan Sains, 9*(2), 165–170. https://ejournal.unesa.ac.id/index.php/pensa/index

Gazali, R. Y. (2016). Pembelajaran matematika yang bermakna. *Math Didactic: Jurnal Pendidikan Matematika, 2*(3), 181–190. https://doi.org/10.33654/math.v2i3.47

Junita, D., Solfitri, T., & Siregar, N.S. (2020). Penerapan model PBL untuk meningkatkan hasil belajar matematika peserta didik kelas VII-A SMP Negeri 40 Pekanbaru. *Jurnal Absis: Jurnal Pendidikan Matematika dan Matematika, 3*(1), 230–239. https://doi.org/10.30606/absis.v3i1.570

Klarici, M. J., Saragih, S., & Maimunah, M. (2021). Implementation of Problem Based Learning model to improve the mathematics learning outcomes of students in class VII.5 SMP Negeri 4 Pekanbaru. *Edu Math: Jurnal Program Studi Pendidikan Matematika, 12*.

Meliyana, A., Arham, A., Panigoro, M., Hafid, R., Hasiru, R., & Sudirman, S. (2023). Pengaruh fasilitas belajar siswa terhadap hasil belajar siswa. *Journal of Economic and Business Education, 1*(2), 26–33. https://doi.org/10.37479/jebe.v1i2.17904

Permendikbud. (2022). Standar penilaian pendidikan Permendikbudristek No 21 tahun 2022. *Kementerian Pendidikan dan Kebudayaan Riset dan Teknologi, 3.* https://www.gurusumedang.com/2022/06/standar-penilaian-pendidikan.html

Rahmawati, R., Heleni, S., & Armis, A. (2020). Penerapan model Problem Based Learning untuk meningkatkan hasil belajar matematika siswa kelas VIII-B SMP PGRI Pekanbaru tahun pelajaran 2019/2020. *JURING (Journal for Research in Mathematics Learning, 3*(4), 375. https://doi.org/10.24014/juring.v3i4.10218

Robiyanto, A. (2021). Pengaruh model Problem Based Learning terhadap hasil belajar siswa. *Journal of Classroom Action Research, 2*(1), 114–121.

Saputra, N., Zanthy, L. S., Gradini, E., Rif'an, A., & Arifin, A. (2021). *Penelitian tindakan kelas* (M. Arif (Ed.); 1st ed.). Yayasan Penerbit Muhammad Zaini. https://books.google.com/books?hl=id&lr=&id=zeM3EAAAQBAJ&oi=fnd&pg=PA1&dq=Saputra,+N.+2021.+Penelitian+Tindakan+Kelas.+Aceh:+Yayasan+Penerbit+Muhammad+Zaini,+Google+Buku.&ots=BEbDWEIbN3&sig=ncKe_JtCj284J1LKYNZsWz6mWDo

Setyo, A. A., Fathurahman, M., & Anwar, Z. (2020). *Strategi pembelajaran Problem Based Learning, Volume 1* (H. Djafar (Ed.); 1st ed.). Yayasan Barcode.

Situmorang, M. S., & Samosir, K. (2020). Penerapan model pembelajaran PBL untuk meningkatkan hasil belajar siswa. *Journal of Classroom Action Research, 2*(1), 15–19. https://doi.org/10.29303/jcar.v2i1.398

Triandini, E., Heleni, S., & Saragih, S. (2024). Penerapan model PBL untuk meningkatkan hasil belajar matematika siswa kelas VIII1 SMPN 6 Siak Hulu. *Jurnal Absis: Jurnal Pendidikan Matematika dan Matematika, 6,* 910.