Volume 6, Number 2, June 2025
**Journal of Research on Mathematics Instruction**
DOI: https://doi.org/10.33578/jrmi.v6i2.112
Journal's Webpage: http://jrmi.ejournal.unri.ac.id

# Enhancing Mathematics Achievement with Problem-Based Learning: A Classroom Action Research

Aulia Wahyuni Hendrianti [1], Kartini [2], Atma Murni [3]

[1] Mathematics Education, Universitas Riau, Pekanbaru, 28293, INDONESIA

[2] Mathematics Education, Universitas Riau, Pekanbaru, 28293, INDONESIA

[3] Mathematics Education, Universitas Riau, Pekanbaru, 28293, INDONESIA

**ARTICLE'S INFORMATION**

***Article history:***

Received: Apr-20-2025

Reviewed: Apr-25-2025

Accepted: Jun-10-2025

***Keywords:*** *Classroom Action Research, Mathematics Learning Outcomes, Problem-Based Learning*

**ABSTRACT**

This research was motivated by the low mathematics learning outcomes of students in class VII-1 SMPN 19 Pekanbaru, which was indicated by the achievement of Learning Objective Achievement Criteria (KKTP) of only 8 out of 36 students. The purpose of this study was to increase learning outcomes and improve the learning process of mathematics through the application of the Problem-Based Learning (PBL) model. This research is a Classroom Action Research (PTK) carried out in two cycles, each consisting of planning, implementation, observation, and reflection stages. The research subjects were 36 students with heterogeneous ability levels. The research instruments included learning tools (ATP and teaching modules) as well as observation sheets of teacher activity, students' activity, and learning outcome tests. The results showed an increase in students' activity in the learning process. Students were more active, able to work together in groups, and able to build their own knowledge meaningfully. The percentage of students who reached KKTP increased from the base score of 38.88% to 52.77% in cycle I, and it increased again to 80.55% in cycle II. Based on these data, it can be concluded that the application of the Problem-Based Learning model is effective in improving the learning process and increasing mathematics learning outcomes.

***Corresponding address:***

Aulia Wahyuni Hendrianti,
E-mail: aulia.wahyuni4381@student.unri.ac.id

## INTRODUCTION

Mathematics is one of the compulsory subjects in school that plays an essential role in shaping students' logical, critical, systematic, and creative thinking. According to [1], one of the important goals of mathematics teaching is to develop students' ability to find and use appropriate mathematical arguments and logical connections through various methods of problem solving and justification of mathematical relationships. Mathematics learning aims to develop critical, creative, and systematic thinking skills through an applicative, problem-based, and contextual approach. This is so that students not only master mathematical concepts but can also apply them in everyday life and communicate effectively in a mathematical context [2].

Learning objectives serve as benchmarks that must be achieved in the mathematics learning process. The achievement of mathematics learning objectives can be seen through the mathematics learning outcomes obtained by students. The expected mathematics learning outcomes are, of course, learning outcomes that have met the learning objectives. The achievement of mathematics learning can be seen from the completeness of student learning outcomes. The completeness of these learning outcomes is essential in equipping students to be able to obtain, manage, and utilize information

optimally in their daily lives [3].

Whether or not learning objectives have been achieved can be seen from the mathematics learning outcomes obtained by students [4]. Mathematical learning outcomes can be measured using the Learning Objective Achievement Criteria (KKTP). KKTP can be measured in four ways, namely 1) using criteria descriptions; 2) using rubrics; 3) using scales (value intervals); and 4) interval scales processed from rubrics [5]. KKTP serves as a reference in assessing the achievement of learning objectives, while summative assessment provides information about these achievements. In other words, whether or not KKTP is achieved is obtained through an analysis of the summative assessment results carried out by students. Summative assessment is a process carried out to ensure the achievement of overall learning objectives [6].

However, in learning practice, these objectives have not been fully achieved. Students' mathematics learning outcomes are still relatively low, as seen from the summative assessment data for class VII-1 at SMPN 19 Pekanbaru in the odd semester of the 2024/2025 academic year. Based on data from the mathematics teacher, out of 36 students, only 14 (38.88%) achieved the Learning Objective Achievement Criteria (KKTP) with a minimum score of 70. This figure is relatively low and shows that most students have not met the learning requirements as stipulated in the Minister of Education, Culture, Research, and Technology Regulation Number 21 of 2022 concerning Education Assessment Standards.

The results of observations and interviews conducted by the researcher show that the low learning outcomes are caused by several factors, including: 1) lack of active student participation, resulting in teacher-centered learning; 2) the perception that mathematics is a difficult subject; 3) lack of conceptual understanding, especially in solving contextual problems; and 4) the absence of learning models that can activate students. In learning activities, teachers tend to use lecture methods and give practice questions, without providing explanations about learning objectives, motivation, or the use of models that actively involve students. Students appear passive, only copying answers, and have difficulty understanding contextual problems, making the learning process less meaningful.

These problems require improvements in the learning approach used. One relevant and recommended learning model in the Merdeka Curriculum to overcome these problems is the Problem-Based Learning (PBL) model. The PBL model is a learning model in which students are required to be critical, work together, and be careful in solving real problems related to everyday life by working together in groups to find solutions and build new experiences. The application of the PBL model is considered to improve student learning outcomes because students are faced with real problems, motivating them to solve these problems using their own knowledge or by discovering knowledge together with their group members [7], [8], [9], [10].

According to [11], the advantages of this model include: students better understand the concepts taught because they discover them independently; students are actively involved in problem solving; knowledge is embedded based on the students' existing schemas; students can feel the benefits of learning because the problems solved are directly related to real life; students become more independent and mature, able to express their aspirations and accept the opinions of others, and instill positive social traits in other students, students in group learning interact with educators and other students, and can develop their thinking skills. The steps of the PBL model include: 1) orientation to the problem; 2) organizing students to learn; 3) guiding individual and group investigations; 4) developing and presenting work; and 5) analyzing and evaluating the problem-solving process.

Previous research shows that applying the Problem-Based Learning (PBL) model improved mathematics learning outcomes, as evidenced by the increase in students achieving the minimum mastery criterion from 30% at baseline to 65% after the second cycle in a junior high school in Pekanbaru [12]. Similarly, the mathematics learning outcomes of students in class VIII-1 of SMPN 1 Peranap increased from 59.375% in cycle I to 84.37% in cycle II. These findings reinforce the argument that PBL can be an effective alternative learning model in increasing student engagement and learning outcomes [13].

Based on this description, the application of the Problem-Based Learning model is believed to be an effective solution to improve the mathematics learning outcomes of students in class VII-1 SMPN 19 Pekanbaru. This study focuses on the application of the PBL model to enhance the learning process and learning outcomes in data analysis and probability material, particularly bar charts and pie charts.

## METHODS

This research is a Classroom Action Research (PTK) conducted collaboratively between the researcher and the mathematics teacher of class VII-1 SMPN 19 Pekanbaru. PTK was chosen as a research approach because it is suitable for studying and improving learning practices directly in the classroom through real actions taken by teachers or researchers. This study aims to improve the process and learning outcomes of students' mathematics through the application of the Problem-Based Learning (PBL) learning model. The research was conducted in the odd semester of the 2024/2025 school year, involving 36 students of class VII-1 SMPN 19 Pekanbaru who had heterogeneous ability levels. The class was purposively selected based on initial data showing the low mathematics learning achievement of students and the diversity of abilities that support the implementation of cooperative learning strategies.

The research was conducted in two cycles, each cycle consisting of four stages: planning, action implementation, observation, and reflection [14]. In the planning stage, researchers compiled learning tools in the form of Learning Objectives Flow (ATP), PBL-based teaching modules, observation sheets, and learning outcomes tests. All these instruments were first consulted with the supervisor and collaborating teacher to ensure their feasibility. Researchers also formed cooperative learning groups based on the results of the initial diagnostic test to accommodate the diverse abilities of students.

In the action implementation stage, the researcher acts as a teacher who implements the PBL model in the mathematics learning process. The material used in the research is the content of 'data and opportunities' with a focus on bar charts and pie charts according to phase D of the Merdeka Curriculum. Each cycle consists of two learning meetings and one summative assessment. Meanwhile, observations were carried out by collaborating teachers and peers to assess the implementation of learning actions, both in terms of teacher activity and students' involvement.

Reflection was conducted after each cycle by evaluating the strengths and weaknesses of the action implementation based on the observation results. The strengths found will be maintained in the next cycle, while the weaknesses become a reference in designing improvements. This reflection also includes analysing the implementation of PBL-based learning and students' responses to the applied learning strategy.

The data collected in this study consisted of qualitative and quantitative data. Qualitative data were obtained through teacher and students' activity observation sheets, while quantitative data were obtained from students' learning outcomes tests. The research instruments included learning devices,

observation sheets, and test items that were prepared based on indicators of learning objectives. The data collection techniques used include observation and tests. Observations were used to record the implementation of the learning process and students' participation, while tests were used to measure mathematics learning outcomes.

The data analysis techniques used in this study were descriptive narrative analysis and descriptive statistical analysis. Observation data were analysed narratively to describe the development of the learning process, while learning outcome data were analysed using descriptive statistics in the form of frequency distribution and percentage of Learning Objective Achievement Criteria (KKTP).

The presentation of data using frequency distribution is intended to obtain a clear picture of students' mathematics learning outcomes, so that the improvement of students' mathematics learning outcomes can be achieved. These combined approaches ensure that both qualitative and quantitative aspects of the classroom action are comprehensively represented.

Table 1. Students' Score Interval and Predicate

| Value Interval | Criteria |
|---|---|
| $x < 60$ | Very Low |
| $60 \leq x < 70$ | Low |
| $70 \leq x < 80$ | Medium |
| $80 \leq x < 90$ | High |
| $90 \leq x < 100$ | Very High |

The data analysis that will be carried out on the frequency distribution table is by comparing the frequency of students who reach KKTP. This comparison highlights changes in student achievement across cycles and serves as the basis for calculating the overall improvement rate. The percentage of students who reach KKTP can be calculated in the following way.

$$P = \frac{a}{b} \times 100\% \quad (1)$$

Keterangan:

$P$ : Percentage of students reaching KKTP

$a$ : Number of students reaching KKTP

$b$ : Total number of students

The improvement of the learning process was marked by the increased implementation of the PBL model as planned, as well as the increased involvement of students in learning activities. The improvement in learning outcomes is indicated by a decrease in the number of students who score below the standard and an increase in the number of students who reach or exceed the KKTP after the action is taken. Thus, the action is said to be successful if there is an improvement in the process and learning outcomes of students' mathematics learning after the application of the PBL model from cycle I to cycle II. This success criterion serves as a reference for evaluating the effectiveness of each cycle and guiding subsequent instructional adjustments.

## RESULTS AND DISCUSSION

This class action research aims to improve the mathematics learning outcomes of students in class VII-1 SMPN 19 Pekanbaru through the application of the Problem-Based Learning (PBL) model on the material of bar charts and pie charts. The success of the action is judged by the achievement of the Criteria for Completeness of Learning Objectives (KKTP) set by the school, which is 70. To find out the percentage of KKTP achievement of students' mathematics learning outcomes before and after the action, as seen in Table 2 below. This comparison provides a clear picture of the progress made by students throughout the implementation of the PBL model.

Journal of Research on Mathematical Instruction, Vol. 6, No. 2, June 2025, 19-26
DOI: https://doi.org/10.33578/jrmi.v6i2.112
jrmi.ejournal.unri.ac.id, Online ISSN: 2715-6869

Table 2. Percentage of Achievement of KKTP of Students' Mathematics Learning Outcomes

| | Base Score | Summative Test-1 | Summative Test-2 |
|---|---|---|---|
| Number of students who achieved KKTP (≥70) | 14 | 19 | 29 |
| Percentage of students who achieved KKTP (%) | 38,88% | 52,77% | 80,55% |

Based on Table 2, it is known that the achievement of KKTP of students has increased from before the action to after the action. In the baseline score (pre-action), the number of students who achieved KKTP increased by five people in summative assessment I, or equivalent to a percentage increase of 13.89%. Furthermore, in summative assessment II, the number of students who reached KKTP increased again by 10 people from summative assessment I, resulting in a percentage increase of 27.78%. This shows a gradual increase in students' mathematics learning outcomes after the application of the PBL model. The findings of this study are consistent with prior research demonstrating the effectiveness of the Problem-Based Learning (PBL) model in mathematics education. According to [15], the implementation of the Problem-Based Learning (PBL) model in junior high school probability lessons increased the percentage of students achieving the minimum mastery criterion from 30 % at baseline to 65 % after two action cycles. Similarly, [16] emphasized that Classroom Action Research can effectively enhance the quality of learning processes and outcomes when supported by appropriate statistical analysisBased on the analysis of frequency distribution data, it can be seen that the frequency distribution of students' scores who have not reached KKTP from before the action (base score) to after the action (summative assessment I and summative assessment II). The frequency distribution of students' mathematics learning outcomes can be seen in Table 3 below.

Table 3. Frequency Distribution of Students' Mathematics Learning Outcomes

| Value Interval | Criteria | Students Frequency | | |
|---|---|---|---|---|
| | | Base Score | Summative-1 | Summative-2 |
| $x < 60$ | Very Low | 8 | 15 | 0 |
| $60 \leq x < 70$ | Low | 14 | 2 | 7 |
| $70 \leq x < 80$ | Medium | 14 | 16 | 10 |
| $80 \leq x < 90$ | High | 0 | 1 | 4 |
| $90 \leq x < 100$ | Very High | 0 | 2 | 15 |

Table 3 shows that the frequency distribution analysis of students' scores showed significant changes. After the implementation of the action in summative assessment I, the number of students in the interval increased to 16, plus 1 student with a score of $80 \leq x < 90$ and 2 students with a score of $90 \leq x < 100$. Meanwhile, in summative assessment II, the number of students with low scores ($60 \leq x < 70$) decreased dramatically to only seven students. This increase shows that the application of the PBL model is able to encourage students to achieve higher learning outcomes.

From the aspect of the learning process, the observation results show that the activities of teachers and students have improved from cycle I to cycle II. The application of the PBL model was well implemented in accordance with the stages designed in the lesson plan. Students' participation increased, as seen from the activeness in asking questions, discussing in groups, and responding to the results of friends' presentations. This indicates that learning begins to be student-centered learning, and the teacher acts as a facilitator.

In addition, students showed a tendency to build their own knowledge through the process of discussion and problem-solving in the LKPD. This meaningful learning activity has a positive impact on students' memory and concept understanding. Although the application of the PBL model had a positive effect on learning outcomes and processes, this study also encountered several obstacles. Among them are the limited implementation time that is not in accordance with the plan, the fact that there are still students who are not optimal in group work and prefer to work individually, and less than optimal class conditioning by researchers. In addition, the teacher's observation sheet did not fully describe the learning process that took place. Nevertheless, these shortcomings became material for reflection and improvement in the following learning cycle.

Overall, it can be concluded that the application of the Problem-Based Learning model is effective in increasing mathematics learning outcomes and improving the quality of the learning process in class VII-1 SMPN 19 Pekanbaru, even in the 2024/2025 academic year. PBL encourages students to be more active, collaborative, and independent in building their mathematical knowledge. PBL encourages students to be more active, collaborative, and independent in building their mathematical knowledge, which is consistent with research showing that PBL strengthens students' mathematical connections and habits of mind, effectively improves mathematics learning outcomes and critical-thinking skills, and can significantly raise achievement levels in secondary mathematics classrooms [17], [18], [19].

These results indicate that the improvement in students' achievement was driven not only by exposure to contextual problems but also by a cultural shift toward active and collaborative learning. The challenges encountered highlight that successful PBL implementation requires careful time management, stronger facilitation of group dynamics, and more comprehensive observation instruments. Addressing these aspects in future cycles will help sustain and extend the positive impact of PBL on students' mathematical understanding and engagement.

## CONCLUSIONS AND SUGGESTIONS

Based on the research results, it can be concluded that the application of the Problem-Based Learning (PBL) model has proven to be effective in improving the mathematics learning outcomes of students in class VII-1 of SMPN 19 Pekanbaru. This is indicated by a significant increase in the percentage of completeness from 38.88% in the basic score to 80.55% in the second cycle. The PBL model successfully changed the learning paradigm from teacher-centered to student-centered, where students became more active and motivated in constructing their knowledge through meaningful problem solving.

In light of these research findings, it is recommended that teachers apply the problem-based learning model in mathematics education as it can improve learning outcomes and student engagement. Schools are also expected to support the implementation of learning by providing relevant facilities and infrastructure, while students are expected to participate more actively in discussions and problem-solving. In addition, future researchers are advised to examine the application of the PBL model in different materials or levels, or even combine it with other learning models to obtain more optimal results.

Although the implementation of PBL has a positive impact, several aspects need to be improved in future research, namely: (1) improvement of more realistic time management, (2) development of more comprehensive observation instruments, (3) more effective classroom management strategies, (4) optimization of collaborative learning to ensure the active participation of

all students, (5) expanding the scope of research to different subjects and grade levels, and (6) exploring combinations of PBL with other learning approaches to maximize learning outcomes. Overall, this study proves that the PBL model can be an effective learning alternative to improve the quality of the mathematics learning process and outcomes at the junior high school level.

## REFERENCE

[1] S. Lukáč, "Development and Assessment of Students' Argumentation Skills in Mathematics Teaching," in *10th International Conference on Research in Didactics of the Science (DIDSCI+ 2022)*, 2022, pp. 1–11. doi: 10.1088/1742-6596/3037/1/012019.

[2] Kemendikbudristek, *Salinan Keputusan Kepala BSKAP Nomor 033 Tahun 2022 tentang Perubahan atas Keputusan Kepala BSKAP Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi Nomor 008/H/KR/2022 tentang Capaian Pembelajaran pada Pendidikan Anak Usia Dini*. Indonesia, 2023.

[3] Permendikbudristek, *Salinan Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia Nomor 21 Tahun 2022 Tentang Standar Penilaian Pendidikan Pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, Dan Jenjang Pendidikan Menengah*. Indonesia, 2022.

[4] R. Rahmawati, S. Heleni, and A. Armis, "Penerapan Model Problem Based Learning untuk Meningkatkan Hasil Belajar Matematika Siswa Kelas VIII-B SMP PGRI Pekanbaru Tahun Pelajaran 2019/2020," *JURING (Journal Res. Math. Learn.*, vol. 3, no. 4, pp. 375–384, 2020, doi: 10.24014/juring.v3i4.10218.

[5] Kemendikbudristek, *Panduan Pembelajaran dan Asesmen Anak Usia Dini, Pendidikan Dasar dan Menengah*. Jakarta: Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia, 2022.

[6] Kemendikbud, *Salinan Lampiran Permendikbud No 16 Tentang Standar Proses Pendidikan Dasar dan Menengah*. Indonesia, 2022.

[7] Z. Fardani, E. Surya, and M. Mulyono, "Analisis Kepercayaan Diri (Self Confidence) Siswa Dalam Pembelajaran Matematika Melalui Model Problem Based Learning," *Parad. J. Pendidik. Mat.*, vol. 14, no. 1, pp. 39–51, 2021, doi: https://doi.org/10.24114/paradikma.v14i1.24809.

[8] R. P. Sari, Z. Zuardi, R. Reinita, and A. Zikri, "Penggunaan Model Problem Based Learning terhadap Hasil Belajar dalam Pembelajaran Pkn di Sekolah Dasar," *J. Basicedu*, vol. 4, no. 1, pp. 221–227, 2020, doi: 10.31004/basicedu.v4i1.324.

[9] S. Suratno, K. Kamid, and Y. Sinabang, "Pengaruh Penerapan Model Pembelajaran Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Tingkat Tinggi (HOTS) Ditinjau Dari Motivasi Belajar Siswa," *J. Manaj. Pendidik. dan Ilmu Sos.*, vol. 1, no. 1, pp. 127–139, 2019, doi: https://doi.org/10.38035/jmpis.v1i1.249.

[10] N. Aini, Y. F. Surya, and P. H. Pebriana, "Peningkatan Kemampuan Berpikir Kritis Dengan Menggunakan Model Problem Based Learning (PBL) Pada Siswa Kelas IV MI Al-Falah," *J. Pendidik. Dan Konseling*, vol. 2, no. 2, pp. 179–182, 2020, doi: https://doi.org/10.31004/jpdk.v2i2.1246.

[11] I. G. A. P. Sriwati, "Penerapan Model Pembelajaran Problem Based Learning untuk Meningkatkan Hasil Belajar Matematika Peserta Didik," *Indones. J. Educ. Dev.*, vol. 2, no. 2, pp. 302–313, 2021, doi: https://doi.org/10.5281/zenodo.5244635.

[12] E. Safitri, "Implementing the Problem-Based Learning (PBL) Model to Improve Learning Outcomes in Probability in Junior High Schools," *J. Res. Math. Instr.*, vol. 5, no. 1, pp. 50–59, 2023, doi: https://doi.org/10.33578/jrmi.v5i1.88.

[13] I. Prayogi, A. Armis, and T. Solfitri, "Penerapan Model Problem Based Learning untuk Meningkatkan Hasil Belajar Siswa Kelas VIII-1 SMP Peranap," *AKSIOMA J. Progr. Stud. Pendidik. Mat.*, vol. 12, no. 2, pp. 2415–2425, 2023, doi: http://dx.doi.org/10.24127/ajpm.v12i2.6695.

[14] S. Arikunto, Suhardjono, and Supardi, *Penelitian Tindakan Kelas*. Jakarta: Bumi Aksara, 2021.

[15] E. Safitri, "Implementing the Problem-Based Learning (PBL) Model to Improve Learning Outcomes in Probability in Junior High Schools," *J. Res. Math. Instr.*, vol. 5, no. 1, pp. 50–59, 2023,

doi: https://doi.org/10.33578/jrmi.v5i1.88.

[16] N. S. Rahmi, N. W. S. Wardani, and L. A. Soehono, "Improving Statistical Analysis in Supporting Big Data Era for SMA Negeri 1 Krembung Teachers," *J. Innov. Appl. Technol.*, vol. 10, no. 1, pp. 64–71, 2024, doi: http://dx.doi.org/10.21776/ub.jiat.2024.10.01.012.

[17] Y. W. Purnomo, R. Nabillah, T. A. Aziz, and S. A. Widodo, "Fostering Mathematical Connections and Habits of Mind: A Problem-Based Learning Module for Elementary Education," *Infinity*, vol. 13, no. 2, pp. 333–348, 2024, doi: https://doi.org/10.22460/infinity.v13i2.p333-348.

[18] Sarnoko, Asrowi, Gunarhadi, and B. Usodo, "An Analysis of the Application of Problem Based Learning (PBL) Model in Mathematics for Elementary School Students," *J. Ilm. Ilmu Terap. Univ. Jambi*, vol. 8, no. 1, pp. 188–202, 2024, doi: 10.22437/jiituj.v8i1.32057.

[19] M. M. V. Lubis, Sakur, and S. N. Siregar, "Improving Mathematics Learning Outcomes Through Problem-Based Learning: A Study on Vocational High School Students in Class XI," *J. Res. Math. Instr.*, vol. 6, no. 1, pp. 11–20, 2024, doi: https://doi.org/10.33578/jrmi.v6i1.99.

## BIOGRAPHY

Aulia Wahyuni Hendrianti
The author obtained a Bachelor's degree in Mathematics Education at Universitas Riau. The author is reachable via email at aulia.wahyuni4381@student.unri.ac.id.

Kartini
The author is a lecturer in the mathematics education study program at Universitas Riau. The author is reachable via email at kartini@lecturer.unri.ac.id.

Atma Murni
The author is a lecturer in the mathematics education study program at Universitas Riau. The author is reachable via email at atma.murni@lecturer.unri.ac.id.