

# The PBL Model in Statistics to Improve Eighth-Grade Students' Mathematical Problem-Solving Skills

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## ABSTRACT

This study aims to improve students' mathematical problem-solving skills through the implementation of the Problem-Based Learning model in Statistics material. The research was conducted in class VIII-1 at SMP Negeri 2 Tibawa with 26 students. This study uses classroom action research. The data collection techniques used were observation and tests. The instruments in this study consisted of teacher activity observation sheets, student activity observation sheets, and written tests. The study was conducted in two cycles. The implementation of learning by applying the Problem-Based Learning model to Statistics material in class VIII at SMP Negeri 2 Tibawa improved mathematical problem-solving skills. This is indicated by the results showing that mathematical problem-solving skills increased from 34.62% in cycle I to 88.46% in cycle II.

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## INTRODUCTION

Mathematics is a discipline that plays a crucial role in daily life, particularly in terms of advances in knowledge and technology, enhancing human cognitive abilities, and problem-solving. Mathematics trains individuals to hone their ability to think critically, rationally, systematically, and evidence-based (Majid et al., 2025). Mathematics is essential for honing students' thinking skills, logical reasoning, problem-solving abilities, and communication skills in conveying mathematical ideas and expertise (Widiastuti & Nindiasari, 2022). Sabroni (2017) states that the learning objectives of mathematics in schools are to serve as a tool for logical, sharp, innovative, structured, and rational thinking. Mathematics holds the potential for the development of knowledge, skills, and attitudes. This potential can be shaped and developed through mathematics education. Among the various potentials it offers, one is problem-solving skills. The ability to solve problems is considered a crucial element for students to possess so they can handle various issues in mathematical topics (Usman et al., 2021).

To optimize the development of students' mathematical problem-solving skills, mathematics instruction should be designed so that students become active participants in the process of discovering solutions, rather than mere recipients of information. Attri (Akuba et al., [2020](#)) states that problem-solving ability can be defined as an individual's capacity to utilize complex logical reasoning to find solutions to problems. According to Mawaddah & Anisah ([2015](#)), mathematical problem-solving is the skill of identifying known and unknown variables, formulating a plan, implementing it, and interpreting the resulting solution. Habuke et al. ([2022](#)) note that one of the most essential competencies for students in mathematics is problem-solving skills. However, students' skills in solving mathematical problems remain at a low level; approximately 73% of students still demonstrate problem-solving abilities that are considered low (Sumartini, [2016](#)). Students indeed still lack proficiency in problem-solving because this skill is underdeveloped in the teaching-learning process (Supraptinah, [2019](#)). According to Polya, problem-solving skills consist of four steps: understanding the problem, formulating a strategy, carrying out the steps according to the plan, and reviewing the results or solution to the problem (Riyanto et al., [2024](#)).

Observations conducted at SMP Negeri 2 Tibawa revealed that many students have not yet mastered mathematical problem-solving skills. Students face difficulties when analyzing the problems presented; during the problem-identification phase, they are unable to identify key information in the problems because they misinterpret the instructions and struggle to plan a solution strategy. In fact, in most cases, students simply write down their answers immediately, especially for word problems. Furthermore, one of the factors contributing to this issue is a learning environment that tends to be monotonous, where teachers employ teaching methods that lack variety or, in other words, the learning process is teacher-centered. This situation is reflected in the daily test data presented in Table 1.

**Table 1.** Average Scores on Daily Quizzes for Each Class on the Statistics Material

| No | Tahun     | Jumlah Siswa/Kelas | KKM | Presentase Kelulusan | Ket.   |              |
|----|-----------|--------------------|-----|----------------------|--------|--------------|
|    |           |                    |     |                      | Tuntas | Tidak Tuntas |
| 1  | 2024/2025 | 28/VIII-1          | 70  | 28,57%               | 8      | 20           |
| 2  | 2024/2025 | 28/VIII-2          | 70  | 46,42%               | 12     | 15           |
| 3  | 2024/2025 | 28/VIII-3          | 70  | 57,14%               | 16     | 12           |

*Source: SMP Negeri 2 Tibawa*

Based on the table above, it can be seen that the graduation rates for students in the 2024/2025 academic year across all classes in statistics remain relatively low, at 28.57%, 46.42%, and 57.14%. However, among these percentages, the students' scores in Class

VIII-1 are lower than those of the other two classes, specifically 28.57% for the 2024/2025 academic year. Based on the figures obtained, it is evident that students' ability to understand the material particularly in solving problems, which are often part of exams still needs improvement. Based on the issues outlined, a method is needed to improve students' problem-solving skills through an appropriate learning model.

The use of the PBL model can be an effective way to improve students' mathematical problem-solving skills while also increasing their active participation during learning activities. The PBL approach also serves as an alternative to improve and strengthen students' critical thinking and mathematical problem-solving skills (Mulis, 2020). This is consistent with Suarsana & Mahayukti (2013), which indicates that the use of PBL can help students solve problems while also making them more careful in identifying relevant data related to the problems they face. These findings also show that the use of PBL successfully improves students' mathematical problem-solving skills. With the PBL approach, students are able to identify available information and determine appropriate strategies to solve problems. The use of the PBL model can be an effective way to improve students' problem-solving skills while increasing their active participation during learning activities (Ismail et al., 2025). Manurung et al. (2022) state that using PBL can encourage students' active participation in constructing mathematical concepts while solving the given problems.

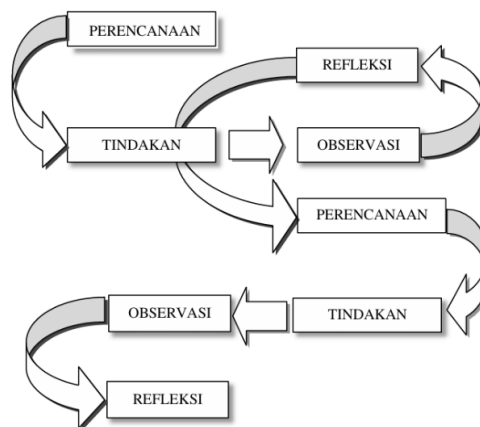
Problem-Based Learning (PBL) is an instructional approach that involves addressing real-world problems, enabling students to hone their critical thinking and problem-solving skills, as well as grasp key concepts and knowledge from the subject matter (Anwar & Jurotun, 2019). According to Hakim (2022), PBL consists of five steps: problem-oriented learning; organizing students for learning; guiding individual and group investigations; developing and presenting results; and analyzing and evaluating the process. PBL helps students solve problems (Pauweni & Iskandar, 2020). The PBL model shows that students who use this model have strong problem-solving skills (Sholikah et al., 2023). This method hones students' ability to search for, explore, and express ideas, making it suitable for solving math problems (Abbas, 2021). The PBL model is presented as an effort to develop problem-solving skills oriented toward real-world situations (Habibah et al., 2022). However, some of these studies are still general in nature and have not specifically examined the application of PBL to statistics in junior high school (SMP).

## METHOD

This study was conducted at Tibawa State Junior High School (SMP) No. 2, located in Tibawa Subdistrict, Gorontalo Regency, Gorontalo Province, Indonesia during the second semester of the 2025/2026 academic year. This classroom action research focused

on efforts to improve the mathematical problem-solving skills of students in class VIII-1 through the implementation of PBL. The subjects of this study were the students of class VIII-1 at SMP Negeri 2 Tibawa; of the total 26 students, there were 12 male students and 14 female students.

This study employed a classroom action research method from the beginning to the end of the study. The research was based on the spiral research design model by Stephen Kemmis and Robyn McTaggart.



**Gambar 1.** Model PTK Kemmis & McTaggart (Parnawi, [2020](#))

Data collection techniques involved observation and testing. The observations were divided into two categories: observations of teachers implementing the PBL model and observations of student activities during the classroom learning process. As for the tests, which use test instruments to measure students' mathematical problem-solving abilities, this study utilizes a problem-solving essay test. Before using the aforementioned instruments in the study, all instruments underwent validity testing, consisting of expert validity and empirical validity, followed by data reliability testing. The indicators used in this study included observations of teachers' implementation of the PBL model, student activities during the learning process, and tests of mathematical problem-solving skills. These instruments were then analyzed quantitatively.

To measure the success of the research conducted in this class. The following are the success indicators used by the researcher:

- 1) At least 80% of the observation results regarding teacher activities meet the minimum criteria (good).
- 2) At least 80% of the observation results regarding student engagement meet the minimum criteria (active) in the learning process.
- 3) At least 80% of all students have achieved a minimum proficiency score of  $\geq 70$  in statistics.

## RESULTS AND DISCUSSION

### Results

This Classroom Action Research (CAR) was conducted in Class VIII-1 at SMP Negeri 2 Tibawa in May 2026 during the 2025/2026 academic year, focusing on statistics. The research subjects consisted of 26 students 12 boys and 14 girls with varying levels of problem-solving ability. This study was conducted in two cycles, as the results of Cycle I did not meet the predetermined success indicators. This can be seen in Table 2.

| No | Aspects Observed                             | Success Indicators                                                        | Cycle I Results           | Cycle II Results  | Improve ment | Success Categories   |
|----|----------------------------------------------|---------------------------------------------------------------------------|---------------------------|-------------------|--------------|----------------------|
| 1  | Teachers' Skills in Managing PBL Instruction | At least 80% fall into the "Good" category                                | 77.78% (not yet achieved) | 100% (Achieved)   | Up 22.22%    | Achieved in Cycle II |
| 2  | Student Activities in PBL Instruction        | At least 80% fall into the "Active" category                              | 66.67% (not yet achieved) | 100% (Achieved)   | Up 33.33%    | Achieved in Cycle II |
| 3  | Mathematical Problem-Solving Test Results    | At least 80% of students meet the proficiency standard (score $\geq$ KKM) | 34.62% (not yet achieved) | 88.46% (Achieved) | Up 53.84%    | Achieved in Cycle II |

Based on the summary table above, it is evident that all observed aspects showed a significant improvement from Cycle I to Cycle II. In Cycle I, teachers' skills in managing PBL-based learning remained at 77.78%, with two indicators still in the "Fairly Good" category, thus failing to meet the minimum success target of 80%. Similarly, student activity reached only 66.67% in the "active" category, and the problem-solving test results achieved a mastery rate of only 34.62%. This indicates that the interventions in Cycle I were not yet optimal, necessitating improvements and reflection before proceeding to Cycle II.

After implementing corrective actions in Cycle II, there was a very encouraging improvement in all three aspects. Teacher skills reached 100%, with all indicators falling into the "Good" and "Very Good" categories. Student activity also increased to 100%, with all students falling into the "Active" and "Very Active" categories. Meanwhile, the results of the students' mathematical problem-solving ability test showed the most dramatic improvement, rising from 34.62% to 88.46%, with 23 out of 26 students achieving scores above the minimum passing score. With all established success

indicators ( $\geq 80\%$ ) met in Cycle II, this classroom action research was deemed successful and concluded after Cycle II.

### **Discussion**

The results of the analysis in Cycle I, based on observations of teachers' capabilities in implementing PBL-based instruction, showed that all observed aspects were rated "Good," while several aspects were rated "Fair," indicating a need for improvement. Specifically, teachers were not yet sufficiently initiating lessons by posing problems and guiding students to articulate their own ideas and theories, helping students review the process/outcomes of problem-solving. This resulted in changes in student learning activities, where students were less able to collaborate in gathering information to solve problems, less able to discuss or ask questions to identify problems, less able to formulate and resolve problems between students and teachers, and less able to discuss and find alternative solutions to problems. As a result of the suboptimal implementation of instruction, students' mathematical problem-solving abilities also fell short of expectations; only 34.62% of students achieved the minimum passing score (KKM). Therefore, the established success criteria have not been met

The findings from Cycle II, regarding the results of observations of teachers' activities in managing learning using the PBL model, generally fell into the "good" and "very good" categories; in Cycle I, several aspects were classified as "fairly good" but were improved upon in Cycle II. Among these, the aspect of presenting problems at the beginning of the lesson and guiding students to articulate their own theories and ideas was categorized as "very good" in Cycle II; teachers were highly effective in presenting problems at the start of the lesson and guiding students to articulate their own theories and ideas. The next aspect rated "fairly good"—helping students review the problem-solving process and outcomes—showed improvement in Cycle II, as the teacher was more effective in facilitating students to revisit the steps and solutions to the problem. These improvements had a positive impact on student activities, with several aspects advancing from the "fairly active" to the "active" category. These aspects include student activities in collaborating to gather information to solve problems, discussing/asking questions to identify problems, formulating problems and solving problems between students and the teacher, as well as discussing alternative solutions to problems. Consequently, the improvement in the quality of teaching by the teacher also encouraged student engagement, thereby enhancing students' mathematical problem-solving skills. The results of the mathematical problem-solving test indicated that 88.46% of students had achieved learning mastery. This achievement demonstrates that the performance indicators established in this study were successfully met in Cycle II.

There was an improvement in students' problem-solving skills due to the use of the PBL model, consistent with Anggiana (2019) who argued that by having students practice solving problems assigned by teachers daily, the PBL learning model can effectively train and help them develop problem-solving skills.

In this cycle, although students' mathematical problem-solving skills generally showed a significant improvement—with a mastery rate of 88.46%, meaning 23 out of 26 students met the mastery criteria—it turned out that three students had not yet reached the minimum passing score. These three students struggled with problem-solving. However, they were not simply left behind or ignored. The researcher and subject teachers provided special additional guidance outside of regular class hours. The guidance was conducted individually and incorporated a mathematical problem-solving approach with more detailed explanations, accompanied by additional example problems similar to those on the Cycle II test. During the tutoring sessions, the three students were encouraged to ask questions more actively, express their own ideas, and were guided step by step in solving statistics problems using the PBL model. After participating in two intensive tutoring sessions, the three students took a retest, and the results showed that they successfully achieved the minimum passing score. Thus, overall, all students in Class VIII-1 at SMP Negeri 2 Tibawa have mastered mathematical problem-solving skills in the statistics curriculum. This demonstrates that the teacher does not only focus on class-wide achievement but also ensures the individual mastery of each student, leaving no one behind.

Therefore, the action hypothesis in this study which states that teaching statistics using the PBL model will improve the mathematical problem-solving skills of students in Class VIII-1 at SMP Negeri 2 Tibawa has been proven to be true and is scientifically acceptable.

## CONCLUSION

Based on the research findings and discussion, it can be concluded that teaching using the Problem Based Learning (PBL) model can improve the mathematical problem-solving skills of eighth-grade students in VIII-1 at SMP Negeri 2 Tibawa in the area of statistics. This is evidenced by the results of teachers' implementation of the PBL model, which improved from Cycle I with a success rate of 77.72% to 100% in Cycle II, while student engagement also increased from Cycle I with a success rate of 66.67% to 100% in Cycle II. Consequently, the percentage of students who passed the mathematical problem-solving test increased from 34.62% in Cycle I to 88.46% in Cycle II.

Based on the findings of this study, the following recommendations can be formulated:

1. Teachers can continue to use the problem-based learning (PBL) approach not only for statistics but also as an alternative for other relevant subjects, to create active learning experiences and encourage student engagement.
2. Students are encouraged to be more proactive in working on practice problems, particularly in statistics, to strengthen their understanding of the material and their mathematical problem-solving skills.
3. For schools and teachers, the results of this study can serve as a reference in instructional planning.

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