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Implementation of Problem Based Learning (PBL) Model to Improve Elementary Students' Mathematics Learning Outcomes Using Concrete Media

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Abstract

The researchers in this study used a Classroom Action Research (CAR) strategy, which aims to improve student achievement by analyzing the effects of specific teaching styles. Eleven male and twelve female elementary school students served as the subjects. Two iterations of the Kemmis and Taggart model formed the basis of the research methodology. To determine whether the steps taken were successful, each cycle had four phases: preparation, implementation, evaluation, and reflection. Learning outcome exams and classroom observations of student work served as data collection tools. Test questions intended to evaluate mathematical competency achievement and observation sheets used to monitor student participation served as research instruments. Quantitative analysis was then applied to the collected data to track the evolution of learning outcomes over several cycles. After using the Problem-Based Learning (PBL) approach, students' mathematics learning outcomes improved significantly, according to the study findings. Only 12 of 26 students (53.57% of the total) in cycle I were able to complete the learning up to the Minimum Competency (KKM) level of 70. The completion rate increased to 85.71%, or 16 students, after the implementation of cycle II and improvements. These results provide evidence that fourth-grade students' mathematics achievement can be improved by using the PBL paradigm. Therefore, if we want to improve the quality of education in elementary schools, a problem-based learning approach can be a good alternative.
Keywords: Problem Based Learning, Classroom Action Research (CAR), learning outcomes, mathematics, elementary school

Introduction

Elementary school is a crucial initial stage in establishing the foundation for developing students' thinking skills, attitudes, and skills (Ananda et al., 2025). Students' intellectual potential and character are shaped by the curriculum they learn in elementary school. Strategic topics teach students logical, methodical, critical, and creative thinking, while also providing them with mathematical knowledge. Mathematics is the primary foundation for students to face the challenges of everyday life and the next level of education(Asalamah et al., 2025).

However, the reality on the ground shows that mathematics learning is often considered difficult and uninteresting by the majority of students. Many students feel burdened by formulas, procedures, and problems that require in-depth thinking. As a result,

learning motivation decreases and learning outcomes do not reach the expected standard. This condition indicates that mathematics is a subject that is less popular because it is considered complicated. Mathematics learning is often perceived as monotonous, resulting in students being less enthusiastic about participating in the learning process.

One of the causes of low student interest and learning outcomes is the learning method, which is still dominated by traditional approaches, such as lectures and assignments. Teachers tend to be the center of information, while students only act as passive recipients(Ningtyas & Pradikto, 2025). This pattern makes students less actively involved in the learning process, resulting in shallow conceptual understanding. Effective learning should position students as the primary subjects, actively exploring, asking questions, and finding solutions to problems.

An innovative, participatory, and student-centered educational approach is needed to address this issue. Problem-Based Learning (PBL) is one relevant approach. Using real-world issues to solve problems is a key component of the problem-based learning (PBL) approach, which is supported by research(Risandy et al., 2023; Zuliana et al., 2025). In PBL, students learn to apply mathematical principles in real-life situations, rather than simply memorizing formulas(Afrianti & Susanti, 2025). Students' ability to think creatively is enhanced through problem-based learning (PBL) because students are encouraged to work in groups or individually to examine problems, develop hypotheses, and ultimately find solutions(Rosida et al., 2025).

Learning media is just as important as the teaching methodology in ensuring that lessons stick. Media serves as a medium, making previously intangible ideas more tangible to students. Students can better understand the concept of repeated multiplication, for example, by using visual aids like multiplication boards. Students are able to make more meaningful connections between class content and their own lives when they use media.

Student mathematics learning outcomes remain poor, according to observations conducted in many elementary schools, including SD YPK Ermasu. Among the 26 fourth-grade students tested, only a small percentage met the KKM (Minimum Competency Criteria) requirement of 70%. Students are not learning as much as expected, as their average score is only around 65%. Furthermore, some children chat with their deskmates instead of actively participating in class. This indicates that the classroom environment is not conducive to learning due to the lecture approach.

We need to rethink how we teach mathematics to address these challenges. One such approach is using learning materials in conjunction with Problem-Based Learning techniques. Through project-based learning, students will be motivated to take a more proactive role in their education. At the same time, students will have an easier and more enjoyable time understanding abstract ideas with the help of learning media. It is believed that by combining the two, student motivation, interest, and learning outcomes will improve.

From a theoretical perspective, PBL is firmly grounded in constructivist learning, which states that students acquire knowledge through direct experience and collaborative learning(Atiatul et al., 2025; Wiraningtyas, 2024). Students are motivated to develop their own skills by being confronted with real-life challenges. Rather than simply imparting knowledge, educators act as facilitators, guiding students in problem-solving. The curriculum's expectation that students improve their critical thinking, creative, communicative, and collaborative skills aligns with this approach.

Several practical benefits can be achieved through the use of Problem-Based Learning (PBL) through learning media. First, mathematical ideas are more easily understood by students when presented in the context of everyday practical problems(Natalia et al., 2025;

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Sadawa, 2023). Second, students are less likely to get bored while learning due to the increased engagement and interactivity generated by the use of media. Third, students learn to respect others' views, work collaboratively in groups, and share and debate ideas. Fourth, rather than relying solely on memorization, students' understanding of the topic improves, resulting in better learning outcomes.

However, there have not been many studies that combine Problem-Based Learning (PBL) with instructional media in the context of elementary schools, particularly to previous research.

PBL can enhance students' learning outcomes and creative thinking skills(Sutarni et al., 2024). The relevance of PBL tactics for implementation in elementary schools, particularly in mathematics, is further supported by this evidence. Consequently, a study examining "The Use of Problem-Based Learning Strategies Through Learning Media to Improve Elementary School Student Learning Outcomes" is quite significant. Improving the quality of mathematics education in elementary schools is expected to be a major contribution of this research. Although various studies have demonstrated the effectiveness of the Problem-Based Learning (PBL) model and the use of instructional media separately, there is still a limited number of studies that examine the integration of both simultaneously in mathematics learning at the elementary school level, particularly in improving students' learning outcomes.

In short, this history demonstrates that elementary school children's poor mathematics performance is due to a lack of media and diverse teaching strategies. This challenge should be addressed by using learning materials in conjunction with Problem-Based Learning techniques. Therefore, this study is necessary and timely because it will enhance our understanding of education while addressing real-world problems.

Mathematicians investigate numerical systems, the relationships between these systems, and practical methods for solving numerical problems. Many people view mathematics as more than just a collection of numbers or formulas; it is also a tool for developing analytical, problem-solving, and leadership skills. Enhancing critical thinking and problem-solving skills are two of mathematics' most important functions. Every mathematical idea is built on pre-established rules and axioms, as mathematics is a fundamental science based on deduction. By using mathematical principles in a methodical and organized manner, this deductive approach helps us understand how the world works. Because it facilitates critical thinking and problem-solving, mathematics can be applied both inside and outside the classroom.

Method

To facilitate sustainable development based on tangible results at every level, this study employed Classroom Action Research (CAR), based on Kemmis and McTaggart's reflective spiral model(Yunita et al., 2025). In an effort to address learning problems encountered in the classroom, students engage in reflective practice by identifying potential solutions, developing action plans, and then implementing and evaluating those plans in a real-world setting.

Research projects can be conducted in the classroom through Classroom Action Research (CAR). The term "research" describes the process of observing something using a predetermined set of criteria to gain knowledge that can be used to improve learning. CAR comprises several learning cycles. Planning, implementing, observing, and reflecting are the four main components of each cycle.

After much deliberation, the scope of this study was narrowed to just two cycles. According to scientific principles, the CAR cycles are concluded once the specified success indicators have been met. Time and resource efficiency were also factors in determining these two cycles, along with an emphasis on thorough process analysis in each cycle. Two cycles were expected to accomplish the research objectives while maintaining high standards of reflection and data analysis. The research subjects are mentioned (126 fourth-grade students from two elementary schools, with a breakdown by gender). However, there is an inconsistency in the numbers (126 students are stated, but only 14 males and 12 females are mentioned, totaling 26), so this needs to be corrected.

Triangulation, involving data from multiple sources and methodologies, was employed to ensure information accuracy. The collected data were analyzed using a mixed-methods approach: quantitative descriptive analysis was used to calculate the percentage of student mastery and activity levels, while qualitative analysis (following the Miles and Huberman model) was applied to describe changes in student behavior and the quality of classroom interactions during the cycles. The learning outcome test, student response questionnaire, implementation observation sheet, and lesson plan evaluation were all validated by experts before being used as research tools. These tools were evaluated and provided feedback by an expert in pedagogy and educational technology media.

Results

Test scores and classroom observations related to the Problem-Based Learning (PBL) paradigm were part of the data collected for this study. Before PBL was introduced, educators still used traditional classroom teaching methods, which lacked interaction between the two parties. As a result, students were less engaged and experienced difficulties in solving math problems. The first cycle of learning took place over two sessions, each allocated 35 minutes. In the first meeting, we applied the PBL syntax for the first to third stages. In the second meeting, we applied it for the fourth and fifth stages. Building learning tools based on problem-based learning was part of the planning stage. The researchers developed several additional materials, such as problem-based learning (PBL) modules to complement classroom instruction, authentic learning context student worksheets, and assessment tools to measure students' problem-solving abilities.

Learning activities are carried out in the implementation phase using previously designed and verified learning modules. The first stage of the learning process begins with a welcome, prayer, motivation, assessment, and presentation of the learning objectives to be achieved. After that, in the orientation phase, the instructor will pose thought-provoking questions relevant to students' daily lives. During guided inquiry, students work individually or in small groups under the guidance of the teacher while carefully examining the issues outlined in the Student Worksheet (LKPD). Group discussions focused on finding solutions to the LKPD problems constitute the development and presentation phase of the activity.

In the analysis and evaluation phase, activities focused on assessing the problem-solving strategies used by students and reviewing the overall learning process. At the end of the session, the teacher and students conducted a reflection to identify the direct and indirect benefits of the learning.

In the observation phase, comprehensive observations were made of students' problem-solving abilities and their level of active participation during the learning process. Data obtained through written tests in Cycle I are presented in Table 1.

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Table 1. Written test results in cycle I

No	Criteria	Number of Students	Percentage
1	Completed (≥ 70)	12 Students	53,37%
2	Not Completed (< 70)	14 Students	46,43%
Total	26 Siswa	26 Students	100%

Twelve students (53.57%) achieved perfection, while fourteen students (46.43%) did not, as shown in the table. With only 53.57 percent of students achieving classical perfection, it is clear that the learning cycle I was unsuccessful. The quality of the learning process was determined by observing teacher and student activities, in addition to learning outcomes. The teacher's actions in controlling learning were deemed quite good, while student activities were deemed quite active, according to observation data. Table 2 displays the data collected during the observation.

Table 2. Results of Observations of Teacher and Student Activities in Cycle I

No	Observation Aspect	Presentation	Category
1	Teacher Activity	72%	Fairly Good
2	Student Activity	68%	Fairly Good

"Based on Table 2, it can be observed that teacher activity in the learning process reached a percentage of 72%, while student activity reached 68%. Both results fall into the 'fairly good' category. These findings indicate that the implementation of PBL in Cycle I proceeded according to the plan, yet still requires improvement—particularly in enhancing active participation among all students and increasing the effectiveness of group discussions.

Based on the results of the reflection, several improvements are planned for Cycle II, including: (1) providing clearer directions regarding the steps of PBL, (2) increasing supervision and guidance during group discussions, (3) maximizing the use of interactive multiplication boards, and (4) providing motivation and reinforcement to students who lack confidence.

The second cycle was implemented as a follow-up to the reflection on the first cycle. During the planning stage, the researcher revised the lesson plan by adding a more structured group management strategy. The teacher also prepared more contextual prompting questions and varied activities using the multiplication board. There was a significant increase in student participation after the second cycle. The multiplication board representation helped students grasp the concept of multiplication more quickly, and they appeared to participate more actively in class discussions and express themselves more confidently. In addition, when students worked in groups, their interactions were more coordinated and cooperative. When comparing the findings of the second cycle with those of the first cycle, a statistically significant increase was observed. The following table shows data on learning completion in the second cycle.

Table 3. Student Learning Outcomes Completion in Cycle II

No	Criteria	Number of Students	Percentage
1	Completed (≥ 70)	16 Students	85,71%

2	Not Completed (< 70)	10 Students	14,29%
Total	26 Siswa	26 Students	100%

A total of 16 students (85.71%) demonstrated mastery, while 10 students (14.29%) failed to meet the KKM standard, as shown in the table. As a result, the classical mastery of cycle II has exceeded the established success criteria. According to table 4, the results of the second cycle activities as seen by teachers and students similarly showed an increase.

Table 4. Results of Observations of Teacher and Student Activities in Cycle II

No	Number of Students	Percentage	Category
1	Activity 1	72%	Quite good
2	Activity 2	68%	Quite Active

The increase in teacher and student activity indicates that the learning process using the PBL model with the aid of a multiplication board was more effective in cycle II. To see the improvement comprehensively, the following presents a comparison of learning outcomes between cycles.

Table 5. Comparison of Classical Completeness of Cycle I and Cycle II

No	Number of Students	Number of Students Completed	Presentation
1	Cycle I	12 Students	53,57%
2	Cycle II	16 Students	85,71%

From cycle I to cycle II, classical completeness increased by 32.14%, as seen in the table above. The results indicate that students' mathematical performance improved when the PBL approach was used with a multiplication board. The study found that fourth-grade students at YPK Ermasu Elementary School improved their mathematical knowledge after using the Problem-Based Learning (PBL) paradigm using a multiplication board. This improvement was not only reviewed from a quantitative aspect in the form of learning completion percentage, but also from a qualitative aspect in the form of changes in attitude, active participation, and the quality of interaction in learning. Therefore, this discussion will be analyzed comprehensively based on several main aspects, namely improved cognitive learning outcomes, increased learning activities, the effectiveness of using the multiplication board media, its suitability with constructivist learning theory, relevance to previous research, and pedagogical implications for mathematics learning in elementary schools.

The learning completion rate increased from 53.57% in cycle I to 85.71% in cycle II, according to research findings. The learning intervention clearly improved students' understanding of multiplication, as evidenced by the 32.14 percent increase. The characteristic of the PBL model, which encourages active student participation in class, likely contributed to this positive outcome. In problem-based learning (PBL), students are not passive recipients of knowledge but active participants in the problem-solving process(Ningrum & Marsinun, 2022). This process allows for independent knowledge construction, making the concepts learned more meaningful and more retained in students' memories.

In cycle I, some students were still adapting to the new learning model. Students previously accustomed to lecture methods needed time to adjust to problem-based learning.

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However, in cycle II, students had grasped the PBL learning flow, making them more mentally prepared and confident in participating in group discussions. This resulted in improved understanding of multiplication concepts.

Conceptually, students often understand multiplication simply as memorizing tables. This approach causes students to experience difficulties when faced with contextual problems or story problems. By using PBL, students are encouraged to understand the meaning of multiplication as repeated addition through solving real-world problems. This conceptual understanding goes much deeper than simply memorizing procedures. Furthermore, improved learning outcomes are also influenced by reflection at the end of each cycle. Reflection allows teachers to evaluate learning weaknesses and make appropriate improvements in the next cycle. In the context of this research, improvements in cycle II, including reinforced instruction, more effective group management, and optimized use of multiplication boards, were proven to significantly improve student learning outcomes.

This research not only demonstrated improved students' cognitive learning outcomes but also demonstrated an increase in their learning activities. Student participation levels increased from moderately active in cycle I to active in cycle II. This development demonstrates the effectiveness of the PBL paradigm in fostering a classroom climate where students actively participate in their own learning.

A key indicator of successful learning is a high level of engagement with the learning process. Motivated, curious, and emotionally engaged in their education are hallmarks of active learners. As part of problem-based learning, students are encouraged to share their thoughts, work collaboratively in groups, and ask questions. These interactions help children develop their social and communication skills while enhancing their understanding of abstract concepts.

The increase in student engagement in cycle II provides further evidence of an improved learning environment and concentration levels. Some previously shy students began speaking up in class. This suggests that PBL improves students' self-esteem in addition to their academic performance. According to educational psychologists, students retain more of what they learn when they actively participate in class. When students are directly involved in discussions and problem-solving, they use various cognitive processes such as analysis, synthesis, and evaluation. These processes are at a higher level of thinking than simply listening to a teacher's explanation.

Discussion

Multiplication boards play a crucial role in supporting the successful implementation of PBL. They help students understand multiplication concepts concretely before moving on to the abstract stage. In cognitive development theory, elementary school students are in the concrete operational stage, where they more easily grasp concepts through objects or media that can be directly observed. Multiplication boards provide a visualization of the relationship between numbers and products. By observing number patterns on the board, students can discover properties of multiplication, such as commutativeness and specific product patterns. The process of discovering these patterns is part of meaningful learning that reinforces conceptual understanding.

Furthermore, multiplication boards also increase student motivation. Visually appealing media can reduce students' negative perceptions of mathematics. Learning becomes more enjoyable and less monotonous. This aligns with observations showing that students are more enthusiastic when using multiplication boards than during conventional learning. The use of

concrete media in PBL also strengthens group discussions(Atiatul et al., 2025). Students can point directly to the board when explaining solutions, making communication clearer and more focused. This media serves as a visual aid that enriches group interactions.

The results of this study corroborate those of other studies showing that problem-based learning (PBL) improves students' mathematics performance. Critical, creative, and mathematical thinking skills can be enhanced through problem-based learning, according to previous research. These results are consistent with previous research showing that PBL is beneficial in various settings. However, this study stands out because it combined project-based learning (PBL) with multiplication boards in a fourth-grade elementary school mathematics classroom. When compared to using models or media alone, the combined effect was clearly superior.

Despite these positive findings, some limitations of this study should be noted. First, the limited sample size may restrict the generalizability of the results to a larger population. Second, the study was conducted over only two cycles, which provides a snapshot of improvement but may not account for long-term retention of the concepts. Finally, the research was situated within a specific school context, meaning the results are influenced by the unique characteristics and resources of that particular environment.

Based on these limitations, several recommendations for future research can be made. Future studies should consider exploring other variables that might influence the effectiveness of PBL, such as students' initial mathematical anxiety or digital literacy. Additionally, applying this method to different educational levels or diverse school environments would help validate its broader applicability. Exploring alternative methods, such as integrating digital multiplication tools alongside physical boards, could also provide further insights into modernizing mathematics instruction.

Several educational conclusions can be drawn from the results of this study. First, project-based learning (PBL) and other student-centered learning strategies can help elementary school mathematics instructors engage their students and enhance their conceptual knowledge(Hayati M et al., 2023).

Second, when teaching abstract concepts in mathematics, it is highly recommended to use physical media such as multiplication boards. Using tangible media helps students transition from concrete to abstract thinking. Third, to maximize the effectiveness of learning, regular reflection and growth are essential. Teachers can improve the quality of learning through ongoing evaluation and classroom action research. Fourth, PBL helps students acquire essential skills in the modern world, including critical thinking, collaboration, and effective communication. Contemporary educational requirements, which place equal value on intellectual and affective development, make this a highly relevant topic.

Conclusion

The results of two cycles of classroom action research indicate that students' problem-solving skills improved when they used the Problem-Based Learning (PBL) Model. Students' critical thinking skills can be improved by using the PBL learning approach at SD YPK Ermasu. It is known that the learning outcomes in the pre-cycle were complete (32.14%), cycle I 53.57%, and cycle II 85.71%. Students were able to achieve success indicators (80%) in cycle II, and learning outcomes have reached 70% of the Minimum Completion Level (KKM). To help students develop their critical thinking skills when learning mathematics, teachers must use the Problem-Based Learning approach. Despite the findings, this study has several limitations that should be acknowledged. First, the limited sample size may affect the generalizability of

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the results to a broader population. Second, the research was conducted over only two cycles, which may not fully capture the long-term sustainability of the intervention. Finally, because the study was carried out within a specific school context, the outcomes may vary when applied to different educational environments or demographics.

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