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Implementation of the Problem-Based Learning Model to Improve Students' Mathematics Learning Outcomes in Grade IV at SD Negeri 060916 Medan Sunggal

Frida Marta Argareta Simorangkir, Indah Simbolon, Hesty Vania Sinaga, Liza Natalia Sitopu, Ade P. Lumban Gaol, Karolina Linvia Fau
Saint Thomas Catholic University, Indonesia
fridasimorangkir86@gmail.com

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Abstract

Low mathematics achievement among fourth-grade students at SD Negeri 060916 Medan Sunggal was associated with teacher-centered instruction that restricted students' active participation in conceptual understanding and mathematical problem-solving. This study aimed to improve students' mathematics learning outcomes on plane geometry through the implementation of the Problem-Based Learning (PBL) model. Classroom action research based on the Kemmis and McTaggart model was conducted in two cycles, each comprising planning, action, observation, and reflection, with 24 fourth-grade students as participants. Data were collected through classroom observations, interviews, achievement tests, and documentation and analyzed using qualitative and quantitative descriptive techniques. The findings demonstrated a progressive improvement in students' mathematics achievement, with the mean score increasing from 76.25 in the pre-cycle to 80.92 in Cycle I and 85.83 in Cycle II. Learning mastery also increased from 66.67% in the pre-cycle to 83.33% in Cycle I and 95.83% in Cycle II. In addition, the implementation of

PBL enhanced students' classroom participation, collaboration, critical thinking, and problem-solving skills. The study concludes that PBL is effective in improving mathematics learning outcomes and the quality of instruction on plane geometry. These findings provide practical evidence for elementary school teachers seeking to implement student-centered, problem-oriented learning that strengthens both academic achievement and higher-order thinking skills.

Keywords: Classroom Action Research; Elementary Mathematics; Learning Outcomes; Plane Geometry; Problem-Based Learning

INTRODUCTION

Education plays a strategic role in developing high-quality human resources through learning processes that foster students' knowledge, skills, and character (Abdillah, 2024; Putra et al., 2025). Mathematics is one of the core subjects that makes a significant contribution to the development of students' logical, critical, systematic, and creative thinking abilities (Jannah et al., 2024; Setiowati et al., 2024). Therefore, mathematics instruction at the elementary school level should not merely emphasize the mastery of computational procedures or arithmetic skills but should also promote students' conceptual understanding and their ability to solve problems encountered in everyday life (Widayati, 2026; Gusmarlia, 2025).

Effective mathematics instruction requires the active engagement of students throughout the learning process (Sari et al., 2022). In this context, teachers are no longer regarded as the sole source of knowledge but rather as facilitators who create meaningful learning experiences through the implementation of innovative instructional models (Nasitha et al., 2026; Pangestu et al., 2026). Student-centered learning is expected to enhance students' learning participation, critical thinking skills, and learning outcomes in an optimal manner (Husna et al., 2025; Rinesti et al., 2019).

However, this ideal condition has not yet been fully realized in Grade IV at SD Negeri 060916 Medan Sunggal. Based on the results of the preliminary classroom observation and the students' learning achievement data from the first semester of the 2025/2026 academic year, it was found that only 16 out of 24 students (66.67%) achieved the Minimum Mastery Criterion (MMC) of 75, while the remaining 8 students (33.33%) did not meet the required standard. These findings indicate that students' mathematics learning

outcomes remain relatively low and require serious attention through improvements in the instructional process.

The results of classroom observations and interviews with the homeroom teacher revealed that the low learning outcomes were influenced by several factors. The instructional process was still predominantly teacher-centered, relying heavily on the lecture method, which resulted in students being passive, participating minimally in classroom discussions, and lacking the confidence to ask questions or express their opinions. Furthermore, most students continued to experience difficulties in developing a deep conceptual understanding of mathematics. They were generally able to solve problems that closely resembled the examples provided by the teacher, but encountered considerable challenges when presented with modified questions or contextual problem-solving tasks. This condition indicates that mathematics instruction remains oriented toward procedural memorization rather than conceptual understanding and problem-solving skills.

These problems have contributed to low learning motivation, underdeveloped critical thinking skills, and suboptimal mathematics learning outcomes among students. If this situation persists, the primary objective of mathematics education—to foster higher-order thinking skills—will be difficult to achieve. Therefore, there is a need for an instructional model that actively engages students in constructing mathematical concepts through solving authentic problems that are closely related to their everyday lives.

One of the instructional models considered appropriate for addressing these challenges is Problem-Based Learning (PBL). The PBL model positions authentic, real-world problems as the starting point of the learning process (Amri et al., 2025; Wardani, 2023), thereby encouraging students to identify problems, engage in discussions, seek relevant information, develop alternative solutions, and formulate conclusions independently as well as collaboratively. Through this process, students not only acquire knowledge but also develop critical thinking, communication, collaboration, and problem-solving skills (Fitriyani et al., 2023).

Numerous previous studies have demonstrated that the implementation of Problem-Based Learning can improve students' learning engagement, conceptual understanding, critical thinking skills, and mathematics learning outcomes (Novita, 2024; Musaidah et al., 2024; Syawalia et al., 2025). Nevertheless, the implementation of the Problem-Based Learning model in mathematics instruction at the elementary school level, particularly in

Grade IV of SD Negeri 060916 Medan Sunggal, has not yet been examined empirically. Each school possesses distinct student characteristics, learning environments, and educational challenges; therefore, the effectiveness of implementing a particular instructional model should be validated through classroom action research.

Based on the foregoing discussion, this study aims to improve the mathematics learning outcomes of Grade IV students at SD Negeri 060916 Medan Sunggal through the implementation of the Problem-Based Learning model. This research is expected to contribute to the advancement of more innovative, active, and student-centered mathematics instructional practices, thereby enhancing both the quality of the learning process and students' learning outcomes at the elementary school level.

METHODS

This study employed Classroom Action Research (CAR) with the primary objective of improving students' mathematics learning outcomes through the implementation of the Problem-Based Learning (PBL) model. Classroom Action Research was selected because it emphasizes the continuous improvement of teaching and learning practices through the implementation of instructional interventions designed to address authentic classroom problems. The research adopted the Kemmis and McTaggart action research model, which consists of four cyclical stages: planning, acting, observing, and reflecting (Machali, 2022; Ramadhani et al., 2026). These stages were implemented repeatedly until the predetermined indicators of research success were achieved.

The study was conducted at SD Negeri 060916 Medan Sunggal during the second semester of the 2025/2026 academic year. The research site was selected based on preliminary classroom observations and interviews with the Grade IV classroom teacher, which revealed that students' mathematics learning outcomes remained low, classroom instruction was predominantly teacher-centered, and students' participation during learning activities had not yet reached the expected level. The participants consisted of all 24 Grade IV students, and total sampling was employed because all students shared similar learning characteristics and encountered the same instructional problems, particularly limited conceptual understanding of the topic of Plane Geometry (Bangun Datar) and unsatisfactory mathematics learning outcomes.

The research was carried out in two action cycles, with each cycle comprising the stages of planning, acting, observing, and reflecting (Jacub et al., 2020; Lubis, 2020). Prior to Cycle I, a pre-cycle stage was conducted to identify students' initial learning conditions through classroom observations, interviews with the classroom teacher, and the administration of a preliminary test. The findings from the pre-cycle served as the basis for designing the instructional intervention implemented in Cycle I.

During the planning stage, the researcher prepared instructional materials, including teaching modules, learning objectives, student worksheets (LKPD), instructional media, observation sheets for teacher and student activities, and learning achievement tests aligned with the syntax of the Problem-Based Learning model. In addition, lesson scenarios and evaluation instruments to be administered at the end of each cycle were developed.

The action stage involved implementing the Problem-Based Learning model according to its instructional syntax: (1) orienting students toward contextual problems, (2) organizing students into collaborative learning groups, (3) facilitating individual and group investigations to identify appropriate solutions, (4) developing and presenting discussion results, and (5) analyzing and evaluating the problem-solving process. Throughout the instructional process, the teacher acted as a facilitator, guiding students in constructing conceptual understanding through discussion and collaborative problem-solving activities.

Observation was conducted simultaneously with the implementation of the instructional intervention. The observations were carried out collaboratively by the researcher and the collaborating teacher using previously developed observation sheets. The observed aspects included the implementation of the Problem-Based Learning syntax, teacher instructional activities, and student learning activities, including participation in discussions, willingness to ask questions, ability to express opinions, group collaboration, and problem-solving performance. The observation data were used to evaluate changes in the learning process throughout each research cycle.

Following the completion of each cycle, the reflection stage was conducted collaboratively by the researcher and the collaborating teacher. During this stage, observation findings, students' learning achievement test results, and challenges encountered during the implementation of the intervention were analyzed comprehensively. The reflection findings served as the basis for revising and improving the instructional process in the subsequent

cycle, thereby minimizing the shortcomings identified in the previous cycle and continuously enhancing instructional quality.

Data were collected through observations, interviews, achievement tests, and documentation. Classroom observations were conducted to obtain information regarding teacher and student activities during the learning process. Interviews with the classroom teacher were undertaken to identify the initial learning conditions and the factors contributing to students' low mathematics achievement. Learning achievement tests were administered during the pre-cycle, at the end of Cycle I, and at the end of Cycle II to measure improvements in students' mathematics learning outcomes following the implementation of the Problem-Based Learning model. Documentation, including photographs of learning activities, attendance records, students' achievement scores, and other supporting documents, was collected to strengthen the research findings.

The research instruments consisted of teacher activity observation sheets, student activity observation sheets, interview guidelines, mathematics learning achievement tests, and documentation records. The achievement test was developed based on the learning achievement indicators for the topic of Plane Geometry, while the observation sheets were designed to evaluate both the implementation of classroom instruction and students' participation throughout the learning process.

To ensure the trustworthiness of the findings, data triangulation was applied by integrating evidence obtained from observations, interviews, achievement tests, and documentation. In addition, collaborative observations involving the classroom teacher contributed to enhancing the credibility of the observational data, while reflections conducted after each cycle facilitated continuous verification and refinement of the instructional intervention.

The collected data were analyzed using descriptive quantitative and descriptive qualitative techniques. Quantitative data, represented by students' mathematics learning achievement scores, were analyzed by calculating the class mean and the percentage of students achieving mastery learning. Qualitative data obtained from observations, interviews, and documentation were analyzed descriptively to describe improvements in instructional implementation, student participation, and learning behavior throughout the research cycles.

This study was conducted with the permission of the school principal and in collaboration with the Grade IV classroom teacher. The research activities were implemented

as part of regular classroom instruction without disrupting the school's academic program. All data collected were used solely for research purposes, and participants' confidentiality and privacy were maintained throughout the study.

RESULTS

This classroom action research was conducted in two cycles, preceded by a pre-cycle stage. Each cycle comprised four stages: planning, implementation of the action, observation, and reflection. The intervention involved the implementation of the Problem Based Learning (PBL) model in Mathematics instruction on the topic of Plane Geometry for fourth-grade students at SD Negeri 060916 Medan Sunggal. The research data were collected through learning achievement tests, observations of teacher and student activities, interviews, and documentation.

During the pre-cycle stage, the learning process was still conducted using a conventional teacher-centered approach. The teacher primarily delivered the instructional content through lectures, while the students mainly listened, took notes, and completed the assigned exercises. This instructional condition resulted in a relatively low level of student engagement throughout the learning process. Most students lacked the confidence to express their opinions, were less active in asking questions, and encountered difficulties in understanding the concepts of plane geometry, particularly when presented with problems requiring reasoning skills. Consequently, the students' learning outcomes did not meet the predetermined indicators of research success. Based on the results of the preliminary test, the class achieved a mean score of 76.25, with a learning mastery percentage of 66.67%, indicating that only 16 out of 24 students attained scores above the Minimum Mastery Criterion (Kriteria Ketuntasan Minimal/KKM) of 75. These findings indicate that the existing instructional process had not yet provided meaningful learning experiences for the students. Therefore, instructional improvement was deemed necessary through the implementation of a more innovative learning model, namely Problem Based Learning (PBL).

The implementation of the intervention in Cycle I began with the preparation of instructional materials and lesson plans aligned with the syntax of the Problem Based Learning (PBL) model. The teacher initiated the learning process by presenting a contextual problem related to students' daily lives. Subsequently, the students were divided into several

groups to discuss possible solutions to the problem. Throughout the learning activities, the teacher provided guidance to each group, facilitated group discussions, and encouraged students to independently construct their understanding of two-dimensional geometric concepts. At the end of the lesson, each group presented the results of its discussion, followed by a collective reflection on the problem-solving process that had been undertaken.

The findings from the implementation of Cycle I indicated an improvement compared with the initial condition. Students began to demonstrate greater enthusiasm and engagement throughout the learning process. Group discussions became more active, although several students still lacked confidence in expressing their opinions and continued to rely on peers with higher academic abilities. Based on the results of the evaluation conducted at the end of Cycle I, the class mean score increased to 80.92, with a learning mastery percentage of 83.33%. A total of 20 students successfully achieved the Minimum Mastery Criterion (KKM), while the remaining 4 students still required additional guidance. Although the indicator of classical learning mastery had been achieved, the reflection results revealed the need for improvements in group management, the provision of learning motivation, and more intensive guidance to ensure that all students could actively participate in the learning process.

Based on the results of the reflection, several improvements were implemented during Cycle II. The teacher provided clearer guidance regarding the steps involved in the problem-solving process, ensured a more equitable distribution of tasks within each group, and created opportunities for all students to express their opinions and present the outcomes of their group discussions. In addition, the teacher provided immediate reinforcement and constructive feedback to students who continued to experience learning difficulties, thereby making the instructional process more effective.

The implementation of the intervention in Cycle II demonstrated more substantial improvements compared with the previous cycle. Students were observed to participate more actively in group discussions, showed greater confidence in asking questions to both the teacher and their peers, and were able to present their problem-solving outcomes in a more systematic manner. Interactions among students also increased, resulting in a more collaborative and student-centered learning environment. The evaluation conducted at the end of Cycle II revealed that the class mean score increased to 85.83, while the learning mastery rate reached 95.83%. A total of 23 out of 24 students successfully achieved scores

above the Minimum Mastery Criterion (KKM), whereas only one student had not yet attained mastery due to persistent difficulties in comprehensively understanding the concepts. Therefore, the predetermined indicator of research success was achieved, as more than 75% of the students attained scores that met the established Minimum Mastery Criterion (KKM).

The improvement in learning outcomes from the pre-cycle stage through Cycle II demonstrates that the implementation of the Problem-Based Learning (PBL) model effectively enhanced both the quality of the learning process and students' mathematics learning outcomes. In addition to the significant increase in achievement scores, positive changes were also observed in students' learning engagement, as they became more active, independent, and collaborative in solving the problems presented during the learning process.

DISCUSSION

The findings indicate that the implementation of the Problem Based Learning model had a positive effect on improving the mathematics learning outcomes of fourth-grade students at SD Negeri 060916 Medan Sunggal. This improvement was reflected in the increase in both the class average scores and the percentage of students achieving learning mastery across each research cycle. These findings suggest that student-centered learning through the resolution of authentic problems is capable of creating more meaningful learning experiences than conventional teacher-centered instruction.

During the pre-cycle stage, the low level of students' learning outcomes was primarily attributed to the learning process being predominantly dominated by the lecture method. Students mainly received information passively, limiting their opportunities to think critically, engage in discussions, and develop problem-solving skills. Consequently, students tended to acquire only procedural knowledge of mathematical concepts without being able to apply them in different contexts. As a result, many students continued to experience difficulties when solving problems that required higher-order reasoning.

Following the implementation of the Problem Based Learning model in Cycle I, notable changes occurred in the learning process. Students began to participate actively by identifying problems, engaging in group discussions, gathering relevant information, and presenting their proposed solutions. These learning activities encouraged students to

construct their own knowledge independently through interactions with both their group members and the teacher. Nevertheless, several challenges were still identified during the first cycle, including the lack of self-confidence among some students in expressing their opinions and the suboptimal level of collaboration within several groups. These issues served as important reflections for refining and improving the instructional process in the subsequent cycle.

The improvements implemented in Cycle II successfully enhanced the quality of the learning process significantly. The teacher was able to manage group discussions more effectively, provide guidance tailored to students' learning needs, and create a more conducive learning environment. Students became more actively engaged in asking questions, responding to their peers, and expressing ideas to solve the problems presented. These learning activities contributed to a better understanding of two-dimensional geometric concepts, resulting in a more substantial improvement in students' learning outcomes.

The improvement in the findings of this study is consistent with the fundamental characteristics of the Problem Based Learning model, which positions contextual problems as the starting point of the learning process. Through investigation, discussion, and reflection, students are provided with opportunities to develop critical thinking, problem-solving, communication, and collaborative skills. Learning is not merely oriented toward achieving higher academic scores but also provides meaningful learning experiences, enabling students to understand and retain mathematical concepts more effectively.

The findings of this study also reinforce those of previous research, which has demonstrated that the implementation of Problem Based Learning enhances mathematics learning outcomes, student engagement, and critical thinking skills at the elementary school level. The effectiveness of this model is closely associated with the teacher's role as a facilitator who creates a supportive learning environment that encourages students to learn independently and collaboratively. Furthermore, the use of problems closely related to students' everyday experiences enables them to connect mathematical concepts with real-life situations more easily, thereby making the learning process more relevant and meaningful.

Overall, the findings indicate that the implementation of the Problem Based Learning model represents an effective alternative for improving mathematics learning outcomes in the topic of Plane Geometry. This instructional model not only enhances students' academic achievement but also promotes active participation, collaborative skills, confidence in

expressing opinions, and problem-solving abilities. Therefore, Problem Based Learning is highly appropriate to be adopted as one of the innovative instructional models in elementary mathematics education to foster an active, meaningful, and student-centered learning process.

The findings of this study provide empirical evidence supporting the effectiveness of the Problem Based Learning (PBL) model in improving mathematics learning outcomes, student engagement, critical thinking, and collaborative skills in elementary education. From a scientific perspective, the study reinforces the constructivist view that meaningful learning is achieved when students actively construct knowledge through authentic problem-solving activities. Practically, the results suggest that elementary school teachers may adopt PBL as an innovative instructional approach to create more student-centered and interactive mathematics classrooms. Methodologically, this classroom action research demonstrates the value of iterative planning, implementation, observation, and reflection in continuously improving instructional practices and addressing learning challenges in authentic classroom settings.

This study has several limitations that should be acknowledged. First, the research was conducted in a single fourth-grade classroom involving only 24 students, which may limit the generalizability of the findings to other educational contexts. Second, the study focused exclusively on the topic of plane geometry and was implemented over two classroom action research cycles; therefore, the long-term effectiveness of the Problem Based Learning model on other mathematics topics was not examined. Finally, although improvements in students' learning outcomes and classroom participation were observed, external factors such as individual learning abilities, motivation, and home learning support were not fully controlled and may have influenced the research outcomes.

CONCLUSION

Based on the findings of the classroom action research conducted over two cycles, it can be concluded that the implementation of the Problem Based Learning (PBL) model effectively improved the Mathematics learning outcomes of fourth-grade students at SD Negeri 060916 Medan Sunggal on the topic of Plane Geometry. This improvement was reflected in the increase in the mean learning achievement score from 76.25 in the pre-cycle stage to 80.92 in Cycle I, followed by a further increase to 85.83 in Cycle II. Furthermore,

the percentage of students achieving classical learning mastery also increased substantially, rising from 66.67% in the pre-cycle stage to 83.33% in Cycle I and reaching 95.83% in Cycle II. These findings indicate that the predetermined success criteria of the study were achieved, as more than 75% of the students attained scores that met or exceeded the Minimum Mastery Criterion (MMC).

The implementation of the Problem Based Learning model not only contributed to improved learning outcomes but also enhanced the overall quality of the learning process. Students became more actively engaged in classroom discussions, demonstrated greater confidence in expressing their ideas, collaborated more effectively in group activities, and developed stronger skills in analyzing and solving problems related to the learning materials. Meanwhile, the teacher assumed the role of a facilitator, guiding students in constructing conceptual understanding through student-centered learning activities. Therefore, the Problem Based Learning model can be considered an effective alternative instructional approach for improving Mathematics learning outcomes in elementary schools. This model fosters a more active, collaborative, and meaningful learning environment, enabling students to develop a deeper understanding of mathematical concepts while simultaneously strengthening their critical thinking and problem-solving skills throughout the learning process.

Future research is recommended to examine the effectiveness of the Problem Based Learning model across different mathematical topics, grade levels, and educational settings with a broader range of participants and longer implementation periods to provide more comprehensive evidence of its impact. In educational practice, teachers are encouraged to integrate Problem Based Learning consistently into mathematics instruction by designing authentic and contextual learning activities that actively engage students in problem-solving, collaboration, and critical thinking, thereby fostering meaningful learning experiences and sustainable improvements in students' learning outcomes.

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