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Problem Based Learning as a Strategy to Improve Students' Understanding of GCF and LCM

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Abstract

This classroom action research was conducted in two cycles, each consisting of planning, implementation, observation, and reflection. The study was motivated by the low learning outcomes of fifth-grade students at SDN Cileungsi 02 on the topic of Greatest Common Factor (GCF) and Least Common Multiple (LCM). The participants were 23 students. Data were collected through daily assessments, observation, field notes, and documentation. The findings revealed an improvement in students' mathematics achievement after applying Problem Based Learning (PBL). The class average increased from 55.43 in the pre-cycle (39.13% mastery) to 68.26 in cycle I (60.87% mastery), and 78.69 in cycle II (82.60% mastery). Students also showed better participation, such as asking questions, sharing ideas, and working collaboratively. Thus, PBL effectively improved both learning outcomes and students' active engagement.

Keywords: GCF LCM, Learning Outcomes, Problem Based Learning

1 INTRODUCTION

Elementary education plays a vital role in developing students' logical thinking, problem-solving skills, and independent learning. However, in many schools, mathematics instruction in the early grades remains largely teacher-centered, which limits student engagement. Such teaching practices tend to reduce students' motivation and thereby negatively affect learning outcomes—particularly in topics like Greatest Common Factor (GCF) and Least Common Multiple (LCM).

Preliminary observations at SDN Cileungsi 02 revealed that most fifth-grade students struggled to grasp the concepts of Greatest Common Factor (GCF) and Least Common Multiple (LCM). Based on daily assessments, only 39% of students achieved mastery according to the Learning Mastery Criteria (KKTP), while 61% did not meet the expected standards. Many students were able to perform calculations mechanically but could not explain the reasoning behind their answers. This finding indicates that conventional approaches emphasizing memorization and repetition were ineffective in promoting deep conceptual understanding. To address this issue, it is necessary to apply a learning model that encourages student participation and meaningful learning. One promising alternative is the Problem-Based Learning (PBL) model. PBL presents students with real-world or contextual problems that require collaborative exploration and problem-solving. Through discussion and investigation, students are guided to construct their own understanding of mathematical concepts. According to Hmelo-Silver (2004), PBL helps learners build conceptual knowledge and develop self-directed learning skills. It also aligns with the Merdeka Curriculum in Indonesia, which emphasizes student-centered, inquiry-based learning.

This study aims to describe the implementation of Problem-Based Learning (PBL) in mathematics lessons and to determine its effectiveness in improving fifth-grade students' learning outcomes at SDN Cileungsi 02 on the topics of Greatest Common Factor (GCF) and Least Common Multiple (LCM). The research provides practical evidence of how PBL can serve as an innovative instructional strategy that enhances both students' cognitive performance and motivation. The approach engages students in meaningful learning activities that improve their mastery of mathematical concepts, while also nurturing independent and critical thinkers aligned with the goals of 21st-century education.

2 RESEARCH METHODS

This research employed a Classroom Action Research (CAR) approach based on the spiral model by Kemmis and McTaggart, which consists of four stages: planning, implementation, observation, and reflection (Arikunto, 2019). The CAR model was chosen because it allows teachers to continuously improve teaching practices through reflective cycles, making it highly suitable for addressing learning problems that occur in classrooms. Each stage of the cycle is interconnected—reflection from one cycle becomes the foundation for planning the next—allowing systematic improvements to occur over time. The Problem-Based Learning (PBL) model was applied as the learning strategy. According to Rusman (2018), PBL is an instructional approach that presents students with real-world problems to stimulate critical thinking, collaboration, and independent learning. Through discussion, exploration, and teamwork, students actively construct their understanding rather than passively receiving information. Problem-Based Learning (PBL) is a set of instructional models that use problems as the central focus to develop problem-solving skills, subject matter understanding, and self-regulated learning (Yudha, 2018). In this study, the use of PBL was expected to help students grasp the concept of Greatest Common Factor (GCF) and Least Common Multiple (LCM) more meaningfully, thereby improving their learning outcomes.

This study was conducted in two cycles, each consisting of the stages of planning, implementation, observation, and reflection. The first cycle aimed to identify and address factors contributing to students' low achievement, while the second cycle focused on refining instructional strategies to reach optimal learning outcomes. During each cycle, researchers collaborated with the classroom teacher to design lesson plans, prepare learning materials, and create relevant evaluation tools. Adjustments were made based on the reflection results of the previous cycle to ensure continuous progress. The research subjects were 23 fifth-grade students of SDN Cileungsi 02 during the even semester of the 2024/2025 academic year. The class was purposively selected based on preliminary data indicating that only 39% of students met the Minimum Mastery Criteria (KKTP), while 61% had not yet achieved it. These findings demonstrated the need for innovative learning models such as PBL to enhance student engagement and achievement.

The research instruments included achievement tests, observation sheets, and documentation. The achievement tests consisted of multiple-choice and essay questions designed to measure students' mastery before the action (pre-cycle), after Cycle I, and after Cycle II. Observation sheets were used to record teacher and student activities during the learning process, focusing on indicators of activeness, cooperation, and problem-solving (Suharsimi, 2013). Meanwhile, documentation such as photos, field notes, and score records served as supporting evidence to strengthen the validity of the data. The collected data were then analyzed descriptively to determine the improvement of learning outcomes across cycles.

Overall, this research design was expected to provide a clear picture of how the PBL model could improve students' mathematical understanding and achievement, particularly in the topic of GCF and LCM, through active, meaningful, and reflective learning experiences.

3 RESULT AND DISCUSSION

3.1 Research Results

3.1.1 Description of pre-research result

In the pre-action stage of this Classroom Action Research (CAR), the researcher first conducted a series of observations to identify the initial learning conditions of the students. The preliminary observation aimed to gather baseline data on students' performance in understanding the concepts of the Greatest Common Factor (GCF) and Least Common Multiple (LCM). This pre-research step was essential to determine the extent of students' mastery before implementing the Problem-Based Learning (PBL) model and to identify areas that required instructional improvement. During this stage, the researcher also analyzed learning materials, lesson plans, and assessment results used in previous mathematics lessons. The findings revealed that the learning process tended to be teacher-centered, where the teacher dominated explanations while students passively listened and memorized formulas. As a result, students showed limited engagement in problem-solving activities, which affected their conceptual understanding. Many students were able to follow procedural steps but struggled to apply concepts to real-world mathematical problems, indicating shallow comprehension.

Based on the daily assessment results, the class obtained an average score of 55.43. In that semester, the Learning Mastery Criteria (KKTP) was set at 70. Out of 23 students, only 9 students (39.13%) reached the mastery level, while 14 students (60.87%) did not meet the standard. This data indicated that most students had not yet achieved the expected level of competence in Mathematics, particularly in the topics of GCF and LCM. The low achievement level suggested that conventional learning approaches were less effective in facilitating students' understanding of abstract mathematical concepts. These results became the foundation for implementing the Problem-Based Learning (PBL) model in the subsequent cycles. The aim was to explore a more effective and engaging instructional approach that encourages students to think critically, work collaboratively, and take an active role in the learning process. Through PBL, it was expected that students would experience a more interactive, meaningful, and enjoyable learning atmosphere, enabling them to build deeper conceptual understanding and improve their learning outcomes.

3.1.2 Description of cycle 1 result

In the implementation stage of Cycle I, learning activities were carried out in accordance with the lesson plan that had been systematically prepared. The learning process applied the Problem-Based Learning (PBL) model, which was designed to make students more active and engaged in understanding mathematical concepts through real-life problem-solving activities. Each stage of learning was organized sequentially according to the PBL framework to ensure that students could follow a structured and meaningful learning process. The learning process began with a problem orientation stage, where the teacher presented contextual mathematical problems related to the concepts of Greatest Common Factor (GCF) and Least Common Multiple (LCM). These problems served as a stimulus to encourage students to think critically and connect mathematical concepts with everyday situations. After that, students were divided into small groups, allowing them to collaborate, exchange ideas, and develop strategies to solve the given problems together. During the group discussion stage, students analyzed the problems, identified relevant mathematical principles, and shared their reasoning with peers. The teacher acted as a facilitator by guiding the discussion, providing prompts when necessary, and ensuring that all students participated actively. Through this collaborative process, students were not only encouraged to find correct answers but also to explain the reasoning behind their solutions, fostering deeper conceptual understanding. Next, each group conducted a presentation session to share their discussion results with the class. This activity helped students improve their communication and reasoning skills, as well as build confidence in expressing mathematical ideas. The teacher provided constructive feedback and clarified misconceptions that arose during the presentations.

At the end of the cycle, students were given an individual evaluation test to assess their learning outcomes in the cognitive domain. This test aimed to measure students'

mastery of the GCF and LCM concepts after learning through the PBL approach. The results from this test served as data to evaluate the effectiveness of Cycle I implementation and to identify areas for improvement in the next cycle..

3.1.3 Description of cycle 2 results

In Cycle II, the researcher again conducted the learning process through the stages of planning, action implementation, observation, and reflection. The planning in this cycle was focused on addressing the weaknesses found in Cycle I and enhancing the aspects that had shown positive results, so that the application of the Problem-Based Learning (PBL) model on Greatest Common Factor (GCF) and Least Common Multiple (LCM) materials could be carried out more optimally. The improvements made in Cycle II included refining the learning media, providing clearer instructions for group activities, and optimizing the time allocation for discussions and presentations. The teacher also gave more guidance during problem-solving sessions, ensuring that all students were actively involved in each stage of PBL. The learning atmosphere became more interactive, and students demonstrated higher enthusiasm and collaboration in completing assigned tasks.

During the implementation of Cycle II, students were again guided through the stages of PBL, starting from problem orientation, group discussion, presentation of results, and evaluation. They were encouraged to think critically, analyze real-life mathematical problems, and discuss alternative solutions collaboratively. The researcher and teacher jointly observed the learning process, focusing on indicators such as student activeness, collaboration, confidence, and understanding of concepts. The results of these observations showed that students participated more actively and were more confident in expressing their mathematical reasoning compared to the previous cycle. The test results in Cycle II indicated a significant improvement compared to Cycle I. Out of 23 students who took part in the evaluation, 19 students (82.61%) achieved or exceeded the Minimum Mastery Criteria (KKTP), while only 4 students (17.39%) had not yet met the standard. The highest score obtained by students was 93, and the lowest score was 60, showing a considerable improvement from the previous cycle. The average class score also increased notably, reflecting the effectiveness of the PBL model in enhancing students' conceptual understanding and problem-solving abilities.

This achievement demonstrates that the implementation of the PBL model, supported by refined strategies in Cycle II, successfully increased students' engagement, motivation, and learning outcomes. Students became more confident, independent, and cooperative in solving mathematical problems. Although a small number of students still required additional assistance to reach mastery, the overall results confirmed that Problem-Based Learning can serve as an effective and innovative instructional model to improve mathematics learning outcomes at the elementary level.

3.2 Discussion of research results

The findings from both research cycles revealed that the majority of students successfully achieved learning mastery, demonstrating a significant improvement in the overall quality of learning. This progress was reflected not only in their increasing test scores but also in their heightened participation and engagement during classroom activities. Through group discussions, students were able to share ideas, collaborate effectively, and assist one another in solving problems related to the Greatest Common Factor (GCF) and the Least Common Multiple (LCM).

The improvement occurred because the teacher's implementation of the Problem-Based Learning (PBL) model became more effective in facilitating active and student-centered learning. The results showed that the success of learning improvement was influenced not only by the teacher's instructional strategy but also by the growing motivation, enthusiasm, and collaboration among students.

Although the outcomes were generally positive, several challenges remained. A few students still required additional time and guidance to comprehend questions involvinhigher-order reasoning. This indicates the need for more targeted support and flexible time

management during lessons. Overall, the two research cycles demonstrated that consistent application of the PBL model enhanced learning outcomes, student discipline, and cooperation, while also promoting a more engaging and meaningful mathematics learning environment.

3.3 Recapitulation of Students' Learning Outcomes

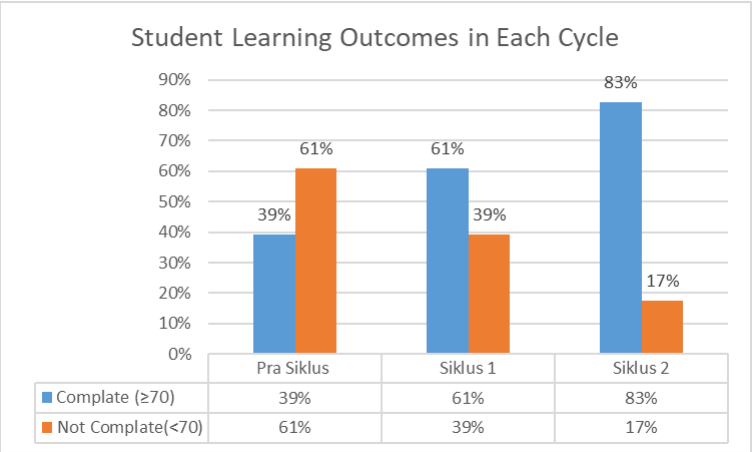
This classroom action research shows that the use of the Problem-Based Learning (PBL) model had a significant influence on improving student learning outcomes in the mathematics subject of Grade V, on the material of the Greatest Common Factor (GCF) and the Least Common Multiple (LCM). This was evidenced by student completion increasing from 39% in the pre-action stage, to 61% in cycle 1, and finally reaching 83% in cycle 2. This change showed that there was continuous improvement in the quality of the learning process carried out by teachers through the consistent application of the PBL model. The following was an example table

Tablel 1. Students' Learning Outcomes Test Results

Information	Pre-Cycle	Cycle 1	Cycle 2
Complete	39,13%	60,87%	82,6%
Not Complete	60,87%	39,13%	17,4%

Based on the picture and table above, in the pre-cycle stage, the evaluation results showed that 39% of students achieved KKTP, while the other 61% were still classified as incomplete. In cycle 1, the percentage of learning completeness increased to 61%, while students who had not completed decreased to 39%. Furthermore, in cycle 2, the percentage of student completeness increased to 83%, while students who had not completed decreased to 17%. This increase from cycle 1 to cycle 2 showed that the learning strategy implemented had provided effective results in improving student learning completeness.

3.4 Histogram of the Recapitulation from Pre-Cycle to Cycle II



Picture 1. Graph Of Student Learning Outcomes For Each Cycle

The histogram above illustrates the improvement in students' learning outcomes from the pre-cycle to Cycle II. In the pre-cycle, only 39.13% of students met the Minimum Mastery Criteria (KKTP), while 60.87% had not yet achieved mastery. After implementing the Problem-Based Learning (PBL) model in Cycle I, the percentage of students who achieved

mastery increased to 60.87%, showing a significant improvement in learning performance. In Cycle II, the percentage rose even higher to 82.60%, indicating that most students successfully mastered the learning objectives. This upward trend demonstrates the effectiveness of the PBL model in enhancing students' understanding of the Greatest Common Factor (GCF) and Least Common Multiple (LCM). The continuous increase across cycles reflects the positive impact of active learning, collaboration, and contextual problem-solving on students' mathematics achievement. Overall, the histogram clearly visualizes the progressive improvement in student performance as a result of applying Problem-Based Learning.

4 CONCLUSION

This classroom action research demonstrated that the implementation of the Problem-Based Learning (PBL) model successfully improved fifth-grade students' mathematics learning outcomes on the topics of the Greatest Common Factor (GCF) and the Least Common Multiple (LCM). The improvement was evident from the increase in the percentage of students achieving mastery, from 39% in the pre-cycle to 61% in Cycle I, and 83% in Cycle II. This steady progress indicates that PBL effectively enhanced students' understanding of mathematical concepts through active participation and problem-solving activities. Students also showed higher engagement and motivation in learning. They were more active in discussions, collaborated effectively in groups, and displayed greater confidence when explaining their answers. The classroom atmosphere became more dynamic and interactive, allowing students to think critically and express their ideas freely. The use of real-life problems in PBL helped students relate mathematics to daily experiences, making the lessons more meaningful. Teachers observed that students' learning independence and cooperation improved throughout the cycles. In conclusion, the application of the PBL model not only increased students' academic achievement but also fostered positive learning attitudes. Therefore, PBL can be considered an effective and innovative strategy to improve both learning outcomes and student engagement in mathematics.

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