

Improving Learning Outcomes in Solid Geometry through Project-Based Learning (PjBL) Using Concrete Media in Grade 3 at SDN 6 Kaur

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ARTICLE INFO

Keywords:

PjBL; Solid Geometry;
Concrete Media

Article history:

Received 2025-04-14

Revised 2025-05-23

Accepted 2026-06-27

ABSTRACT

Mathematics learning in elementary schools is essential for developing students' logical thinking and problem-solving skills. However, learning outcomes in solid geometry often remain low due to abstract teaching methods, limited instructional media, and low student engagement. This study aimed to improve students' Mathematics learning outcomes on the topic of solid geometry through the implementation of Project-Based Learning (PjBL) using concrete media. The study employed Classroom Action Research (CAR) conducted in two cycles, each consisting of planning, action, observation, and reflection. The participants were 25 third-grade students of SD Negeri 6 Kaur, Bengkulu. Data were collected through achievement tests, observations, and documentation. The results showed improvements in both learning implementation and student achievement. The observation score of PjBL implementation increased from 75% in Cycle I to 91.67% in Cycle II. Students' average score improved from 65 to 82, while the mastery learning percentage increased from 60% to 90%. In addition, students demonstrated higher levels of participation, collaboration, creativity, and conceptual understanding. These findings indicate that Project-Based Learning (PjBL) supported by concrete media is effective in improving elementary school students' learning outcomes in solid geometry.

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1. INTRODUCTION

Mathematics learning in elementary schools plays an important role in developing students' logical, systematic, critical, and creative thinking skills. Mathematics functions not only as a body of knowledge but also as a means of training students to solve problems related to everyday life. Therefore, Mathematics instruction needs to be designed effectively in order to provide meaningful learning experiences for students.

However, in practice, Mathematics learning in elementary schools still faces various problems, particularly in abstract topics such as solid geometry. Solid geometry requires students to understand three-dimensional shapes, the properties of solid figures, and the relationships among their elements. These concepts require good visualization skills and often cause difficulties for students when learning is carried out only through verbal explanation without the use of appropriate media.

According to Hidayati (2024), the implementation of Project-Based Learning (PjBL) supported by concrete media is an effective instructional approach to improve students' motivation and Mathematics learning outcomes, particularly in solid geometry at the elementary school level. This model emphasizes students' active involvement through project activities related to real-life experiences, making learning more meaningful.

Based on preliminary observations conducted among third-grade students at SD Negeri 6 Kaur, Bengkulu, students.

Mathematics learning outcomes on the topic of solid geometry were still relatively low. Of the 25 students, only 10 students, or 40%, achieved the Minimum Mastery Criterion (MMC) of 70, while the remaining 15 students, or 60%, did not reach the MMC. The low learning outcomes were caused by learning that was still dominated by lecture methods and the lack of learning media that could help students understand abstract concepts concretely. In addition, students tended to be passive during the learning process and were less involved in learning activities.

These problems indicate a gap between the ideal condition of Mathematics learning, which should be active, meaningful, and student-centered, and the actual classroom condition, which still tends to be conventional. Therefore, an instructional innovation is needed to increase student engagement while helping students understand solid geometry concepts more concretely. One alternative that can be used to overcome these problems is the implementation of the PjBL model using concrete media.

The PjBL model is a learning model that emphasizes learning through projects so that students are actively involved in the learning process. In this model, students do not merely receive information but also engage in observing, designing, creating, and presenting the projects they have produced.

The use of concrete media in learning also plays an important role because it is in accordance with the cognitive development characteristics of elementary school students. Through concrete media, students can directly observe and manipulate objects so that abstract concepts become easier to understand. In addition, the use of concrete media can increase students' interest, motivation, and active participation during the learning process.

Previous studies have shown that the implementation of PjBL can improve students' learning outcomes and active participation. Rohman et al. (2024) found that the PjBL model can improve students' learning motivation and critical thinking skills. In addition, Astuti and Lestari (2023) showed that the use of concrete media can improve students' learning outcomes in solid geometry. Based on the explanation above, this study aims to improve students' Mathematics learning outcomes in solid geometry through the implementation of PjBL using concrete media among third-grade students at SD Negeri 6 Kaur, Bengkulu.

2. METHODS

Mathematics plays an essential role in developing elementary school students' logical, critical, and creative thinking skills. Beyond its function as a body of knowledge, mathematics equips students with problem-solving abilities applicable to everyday situations. Therefore, mathematics instruction should provide meaningful learning experiences that actively engage students in the learning process.

Despite its importance, mathematics learning in elementary schools often encounters challenges, particularly in abstract topics such as solid geometry. Understanding three-dimensional shapes, their properties, and the relationships among their elements requires strong visualization skills. Consequently, students frequently experience difficulties when instruction relies primarily on verbal explanations without adequate learning media. Preliminary observations conducted in Grade III of SD Negeri 6 Kaur, Bengkulu, revealed low learning outcomes in solid geometry. Of the 25 students, only 40% achieved the

Minimum Mastery Criterion (MMC) of 70, while 60% failed to meet the required standard. These results were associated with teacher-centered instruction, limited use of instructional media, and low student participation during learning activities.

One instructional approach that has the potential to address these challenges is Project-Based Learning (PjBL) supported by concrete media. PjBL promotes active student involvement through project activities that connect learning with real-life experiences. Meanwhile, concrete media enable students to observe and manipulate objects directly, helping them understand abstract mathematical concepts more effectively. This combination is particularly suitable for elementary school students, whose cognitive development is strongly supported by hands-on learning experiences.

Previous studies have demonstrated the effectiveness of both PjBL and concrete media in improving learning outcomes. Rohman et al. (2024) reported that PjBL enhances students' learning motivation and critical thinking skills, while Astuti and Lestari (2023) found that concrete media improve students' understanding of solid geometry concepts. Building upon these findings, this study aims to improve Mathematics learning outcomes in solid geometry through the implementation of Project-Based Learning (PjBL) using concrete media among third-grade students at SD Negeri 6 Kaur, Bengkulu.

3. FINDINGS AND DISCUSSION

3.1. Finding

This study was conducted in two cycles by implementing the Project-Based Learning (PjBL) model using concrete media in Mathematics learning on the topic of solid geometry for third-grade students at SD Negeri 6 Kaur, Bengkulu. Each cycle consisted of planning, action, observation, and reflection stages. The data collected included observations of the implementation of the PjBL model, students' learning activities, and students' learning outcomes. The results were analyzed to determine improvements in both the implementation of learning activities and students' achievement after the application of PjBL with concrete media.

3.1.1. Implementation of the Project-Based Learning Model

During Cycle I, students were divided into several groups and were assigned to identify and observe solid geometric shapes using concrete media such as cubes, rectangular prisms, and cylinders made from cardboard. Students were also asked to determine the nets of the shapes based on their group work and present the results of their discussions in front of the class.

The observation results of PjBL implementation in Cycle I are presented in Table 1.

Table 1. Observation Results of PjBL Implementation in Cycle I

No.	Observed Aspect	Score	Category
1	Inquiry Activity	70	Fair
2	Collaboration	75	Fair
3	Creativity	80	Good
4	Communication	85	Good
5	Conceptual Understanding	90	Very Good
6	Pancasila Student Profile Character	90	Very Good

As shown in Table 1, the implementation of the PjBL model in Cycle I was generally satisfactory. However, the aspects of inquiry activity and collaboration still required improvement. Several students remained passive, were reluctant to ask questions, and had not yet participated optimally in group discussions. In addition, some students still required substantial guidance from the teacher in completing group projects. The highest scores were obtained in conceptual understanding and

Pancasila Student Profile character (90), while inquiry activity received the lowest score (70), indicating that students still needed support to become more actively engaged in project-based learning activities.

After reflecting on the results of Cycle I, improvements were made in Cycle II. The teacher provided clearer instructions, increased guidance during group work, and optimized the use of concrete media. Students were again divided into groups and assigned to construct solid geometry frameworks using straws and plasticine/clay. Each group then presented its project by explaining the number of vertices, edges, and faces of the solid shape they had created.

The observation results of PjBL implementation in Cycle II are presented in Table 2.

Table 2. Observation Results of PjBL Implementation in Cycle II

No.	Observed Aspect	Score	Category
1	Inquiry Activity	80	Good
2	Collaboration	85	Good
3	Creativity	90	Very Good
4	Communication	90	Very Good
5	Conceptual Understanding	95	Very Good
6	Pancasila Student Profile Character	95	Very Good

Table 2 shows that all observed aspects improved in Cycle II. Students became more active in asking questions, collaborating with peers, creating solid geometry models, and presenting project results confidently. These improvements indicate that the revisions made after Cycle I had a positive impact on student engagement and participation.

A comparison of the implementation of PjBL in Cycles I and II is presented in Table 3.

Table 3. Comparison of PjBL Implementation in Cycles I and II

No.	Observed Aspect	Cycle I (%)	Category	Cycle II (%)	Category	Improvement
1	Teacher explains learning objectives	75	Good	95	Very Good	20%
2	Teacher provides project-driving questions	70	Good	90	Very Good	20%
3	Students actively participate in group discussions	68	Fair	88	Very Good	20%
4	Students use concrete media	72	Good	92	Very Good	20%
5	Group collaboration	70	Good	90	Very Good	20%
6	Students complete project tasks	65	Fair	85	Good	20%
7	Teacher guides project activities	78	Good	95	Very Good	17%
8	Students present project results	67	Fair	87	Very Good	20%
9	Students ask and respond to questions	64	Fair	84	Good	20%
10	Learning process is active and enjoyable	73	Good	93	Very Good	20%

The results indicate that the implementation of PjBL with concrete media significantly improved students' participation, collaboration, creativity, and communication skills throughout the learning process.

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3.1.2. Students' Learning Outcomes

Students' learning outcomes were assessed through achievement tests administered at the end of each cycle. The comparison of learning outcomes between Cycle I and Cycle II is presented in Table 4.

Table 4. Students' Learning Outcomes in Cycles I and II

Cycle	Mean Score	Mastery Learning (%)
Cycle I	65	60
Cycle II	82	90

As shown in Table 4, students' learning outcomes improved substantially from Cycle I to Cycle II. The mean score increased from 65 to 82, representing an improvement of 17 points. Similarly, the percentage of students achieving mastery learning increased from 60% to 90%, representing an increase of 30 percentage points.

These findings indicate that the implementation of PjBL using concrete media helped students develop a better understanding of solid geometry concepts. Students were not only exposed to teacher explanations but were also actively involved in project activities, observing geometric shapes, constructing models, participating in discussions, and presenting their work to classmates.

3.2. Discussion

The results of the study showed that the implementation of the Project-Based Learning (PjBL) model using concrete media was able to improve both the quality of learning implementation and students' Mathematics learning outcomes on the topic of solid geometry. These improvements were reflected in the observation results of PjBL implementation in Cycles I and II, as well as in the increases in students' average scores and learning mastery percentages.

In Cycle I, the learning process using the PjBL model was implemented fairly well; however, several aspects had not yet reached optimal levels, particularly students' inquiry activity and collaboration. The observation results indicated that some students still experienced difficulties in participating in project-based learning activities. Students tended to be passive, lacked confidence in expressing their opinions, and were not yet accustomed to working collaboratively in groups. This condition occurred because the previous learning process relied mainly on lecture-based instruction, so students were not familiar with learning activities that required active participation and engagement.

Following reflection and improvements in Cycle II, the implementation of learning activities improved across all observed aspects. The teacher provided clearer explanations, increased guidance during group discussions, and optimized the use of concrete media throughout the learning process. These improvements resulted in greater student participation in asking questions, engaging in discussions, expressing ideas, and collaborating with group members to complete project tasks.

The improved implementation of learning activities in Cycle II demonstrates that the PjBL model can create a more active and meaningful learning environment. Students were not merely recipients of information from the teacher; rather, they were directly involved in discovering and constructing knowledge through project-based activities. Activities such as creating solid geometry models, identifying geometric shapes, and presenting group project results provided students with opportunities to gain direct learning experiences.

The increase in student participation during the learning process contributed to the improvement of learning outcomes. This was evident from the increase in the average student score from 65 in Cycle I to 82 in Cycle II, while the percentage of learning mastery increased from 60% to 90%. These improvements indicate that students developed a better understanding of solid geometry concepts after participating in learning activities that integrated the Project-Based Learning (PjBL) model with concrete media.

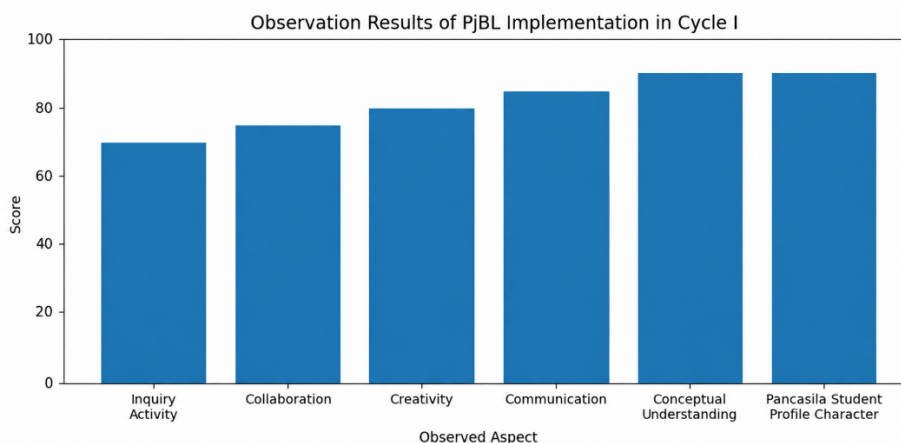


Figure 1. Results of PjBL Implementation Observation in Cycle I

Based on the observation results of PjBL implementation in Cycle I, the aspects of conceptual understanding and Pancasila Student Profile character achieved the highest scores, both reaching 90 and categorized as very good. In contrast, inquiry activity obtained the lowest score of 70 and was categorized as fair. These findings indicate that some students still required guidance to become more actively engaged in seeking information, asking questions, and participating in project-based learning activities. The results suggest that although students had begun to adapt to the PjBL approach, additional support was still needed to foster inquiry skills and encourage active participation throughout the learning process.

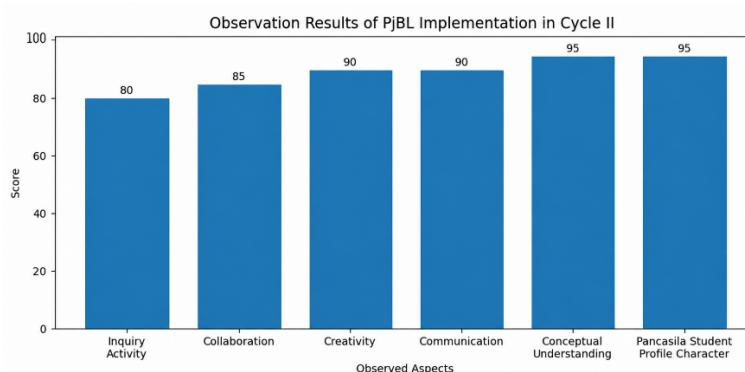


Figure 2. Results of PjBL Implementation Observation in Cycle II

Based on the observation results of PjBL implementation in Cycle II, improvements were evident across all observed aspects. The aspects of conceptual understanding and Pancasila Student Profile character achieved the highest scores, both reaching 95 and categorized as very good. Meanwhile, inquiry activity obtained a score of 80 and was categorized as good. These findings indicate that students became more actively engaged in the learning process, demonstrated stronger collaboration within their groups, and developed a better understanding of solid geometry concepts through project-based activities supported by concrete media.

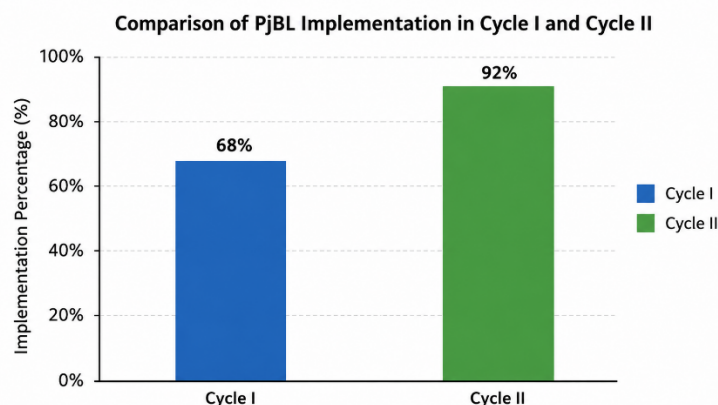


Figure 3. Comparison Chart of PjBL Implementation in Cycle I and Cycle II

In this study, the concrete media used included solid geometry models made of cardboard, straws, and clay, which helped students visualize abstract concepts in a more tangible form. As a result, students were able to understand the elements of solid geometry, such as faces, edges, and vertices, more easily. In the PjBL model, students did not merely receive information passively; instead, they actively searched for information, discussed ideas, collaborated, and completed projects in groups. The interactions that occurred during the learning process enabled students to exchange ideas and develop a better understanding of the material being studied.

To provide a clearer picture of the improvement in students' learning outcomes in each cycle, the data on students' average scores and mastery learning percentages are presented in the following chart.

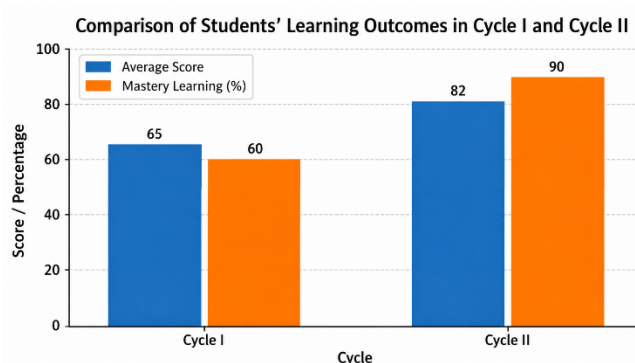


Figure 4. Comparison of Students' Learning Outcomes in Cycle I and Cycle II

Based on Figure 4, a significant improvement in students' learning outcomes was observed after the implementation of Project-Based Learning (PjBL) using concrete media. The average score increased from 65 in Cycle I to 82 in Cycle II, representing an increase of 17 points. Similarly, the percentage of mastery learning increased from 60% in Cycle I to 90% in Cycle II, indicating an improvement of 30 percentage points. These findings suggest that the implementation of PjBL supported by concrete media effectively enhanced students' understanding of solid geometry concepts and increased their engagement in the learning process.

This study is supported by the findings of Rohman et al. (2024), which showed that the implementation of the PjBL model can improve students' learning motivation and critical thinking skills. In addition, Adhiah (2023) found that the use of concrete objects can improve students' learning outcomes in solid geometry. This finding is also strengthened by Rahayu (2019), who reported that project-based learning helps students understand solid geometry concepts more actively through observation, problem-solving activities, and direct learning experiences.

The improvement in students' learning outcomes in this study was influenced not only by the learning model but also by the use of concrete media that suited the characteristics of elementary school students. Concrete media allowed students to make direct observations, making previously difficult concepts easier to understand. Furthermore, group-based project activities also helped develop students' social skills, including collaboration, communication, responsibility, and self-confidence.

To provide a clearer description of the observation results of PjBL implementation in Cycle I, the scores for each observed aspect are presented in the following chart.

Based on the observation results of PjBL implementation in Cycle I, conceptual understanding and Pancasila Student Profile character obtained the highest scores, both reaching 90 and categorized as very good. Meanwhile, inquiry activity received the lowest score of 70 and was categorized as fair. This indicates that some students still needed guidance to become more active in seeking information, asking questions, and participating in project-based learning activities.

4. CONCLUSION

Based on the classroom action research conducted, it can be concluded that the implementation of the Project-Based Learning (PjBL) model using concrete media improved both the quality of learning implementation and students' Mathematics learning outcomes on the topic of solid geometry in Grade III at SD Negeri 6 Kaur, Bengkulu. The implementation of PjBL, assessed through observation, showed improvement from Cycle I to Cycle II in the aspects of inquiry activity, collaboration, creativity, communication, conceptual understanding, and Pancasila Student Profile character.

The implementation of PjBL using concrete media also improved students' learning outcomes, as indicated by the increase in average scores and mastery learning percentages from Cycle I to Cycle II. Project-based learning, which actively involved students in observing, creating, and presenting project results, provided more meaningful learning experiences and helped students understand solid geometry concepts more effectively. Therefore, the PjBL model supported by concrete media can be used as an effective instructional alternative to improve the quality of Mathematics learning in elementary schools, particularly on the topic of solid geometry.

Acknowledgments: The authors would like to express their sincere gratitude to the principal, teachers, and students of SD Negeri 6 Kaur, Bengkulu, for their cooperation and active participation throughout this study. The authors also appreciate the support provided by colleagues and school staff who assisted in the implementation of the classroom action research and data collection process. Their contributions were invaluable to the successful completion of this research.

Conflicts of Interest: The authors declare no conflict of interest.

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