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The Effect of Project-Based Learning (PjBL) Assisted by Miniature Media on Students' Learning Outcomes and Creative Thinking Skills in Solar System Material

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Abstract

Science learning media play an important role in the learning process because science is closely related to everyday life and helps students understand themselves and their environment. This study aims to examine the effect of the Project-Based Learning (PjBL) model assisted by miniature media on students' learning outcomes and creative thinking skills in the solar system topic at SMP Negeri 17 Medan. This research used a quasi-experimental method with a pretest-posttest control group design for learning outcomes and a one-posttest control group design for creative thinking. The sampling technique applied was cluster random sampling, where each class was treated as a cluster. Two classes were randomly selected as samples: class VII-2 as the control group receiving conventional instruction, and class VII-3 as the experimental group taught using the PjBL model assisted by miniature media. The research instruments consisted of a multiple-choice learning achievement test and a creative thinking observation sheet based on Torrance's indicators of fluency, flexibility, originality, and elaboration. The instruments were validated by experts and pilot-tested to ensure validity and reliability. Data were analyzed using a one-tailed t-test with SPSS version 30. The results indicated that students taught using the PjBL model with miniature media achieved higher learning outcomes and creative thinking skills than those taught conventionally. The t-test results showed significance values of $0.001 < 0.05$ for both learning outcomes and creative thinking. Therefore, the PjBL model, assisted by miniature media, positively and significantly influences students' learning outcomes and creative thinking skills on the solar system topic at SMP Negeri 17 Medan.

Keywords: PjBL, miniature, learning, creative, thinking

Introduction

Education plays a crucial role in improving the quality of human resources (Maulansya et al., 2023). Through education, individuals can expand their knowledge, sharpen their skills, and foster the attitudes and creativity needed to face life's challenges (Qudsiyah et al., 2023). Natural Science (IPA) is one of the core subjects in junior high schools that aims to provide students with a scientific understanding of natural phenomena (Sintiawati et al., 2021). One of the essential topics in science is the solar system, which includes abstract concepts such as planets, satellites, asteroids, and other celestial bodies (Sulaeman & Rahman, 2022).

In practice, observations and interviews conducted at SMP Negeri 17 Medan revealed that science learning is still dominated by lectures and textbook-based discussions. The limited use of concrete learning media makes it difficult for students to comprehend abstract concepts, particularly those related to the solar system. This condition affects students' learning outcomes, with most achieving scores below the Minimum Mastery Criterion (KKM). Moreover, students' creative thinking skills remain low, as classroom activities rarely promote exploration or the creation of tangible learning products.

In this context, the Project-Based Learning (PjBL) model emerges as a relevant approach to enhance student engagement. PjBL emphasizes project-oriented learning that allows students to be actively involved in solving real-world problems, designing solutions, and producing outcomes that can be presented (Chen et al., 2022). This model not only helps students gain a deeper understanding of subject matter but also fosters critical thinking, collaboration, communication, time management, and creativity. To support the effective implementation of PjBL, concrete media that can visualize abstract concepts is required. One such medium is a solar system miniature, which helps students better understand the form, size, and arrangement of planets, while making the learning experience more tangible and meaningful (Sholichah, 2017).

Previous studies have shown that integrating PjBL with concrete media can improve both learning outcomes and creative thinking skills (Fitriyani et al., 2023). However, most prior research focused on the general application of PjBL without exploring in depth the effectiveness of specific, concrete media designed to match the characteristics of the learning material. Furthermore, the implementation of PjBL in science learning at the junior high school level has often been carried out partially, without a systematic integration of all essential stages, including project design, scheduling, monitoring, and evaluation (Wulandari & Arifin, 2023).

The novelty of this research lies in the specific integration of the Project-Based Learning (PjBL) model with a solar system miniature medium designed to concretize abstract scientific concepts and promote active student engagement in scientific exploration. Unlike previous studies that generally focused on the effectiveness of PjBL or media use separately, this study implements a comprehensive combination of both approaches within a structured framework encompassing all PjBL stages-from project design, scheduling, and product development to presentation and evaluation. This integration not only strengthens students' conceptual understanding and creative thinking skills but also provides a concrete learning experience that connects theory to practice. Therefore, the position of this research extends previous findings by offering a more contextual and innovative model for science learning, particularly in addressing abstract topics such as the solar system at the junior high school level.

Based on this rationale, the present study is grounded in the belief that combining PjBL with miniature media can overcome the limitations of conventional teaching, make abstract concepts more concrete, and encourage students to actively participate in the learning process. This research aims to examine the effect of PjBL assisted with miniature media on the learning outcomes and creative thinking skills of seventh-grade students at SMP Negeri 17 Medan. Specifically, this study seeks to answer whether the use of PjBL with miniature media significantly influences students' achievement in learning about the solar system and whether it also enhances their creative thinking skills.

Thus, this research is expected to contribute to the development of innovative, interactive, and meaningful science learning strategies that not only improve student achievement but also foster creative thinking skills essential to meet the demands of the 21st century.

Research Method

This study aims to analyze the effect of implementing the Project-Based Learning (PjBL) model assisted by miniature media on students' learning outcomes and creative thinking skills in Grade VII at SMP Negeri 17 Medan on the topic of the Solar System. The research employed a quasi-experimental design with a pretest-posttest control group (Harris et al., 2016). Two classes were randomly selected from the population of 319 seventh-grade students in the even semester of the 2024/2025 academic year. Class VII-3 was assigned as the experimental group taught using PjBL assisted by miniature media, while Class VII-2 served as the control group taught using conventional methods. Both groups were given a pretest before the intervention to measure their initial ability, and a posttest after the intervention to assess their learning outcomes and creative thinking development.

The independent variable in this study was the implementation of the Project-Based Learning (PjBL) model assisted by miniature media, while the dependent variables were students' learning outcomes and creative thinking skills. The instruments consisted of a learning achievement test in the form of 30 multiple-choice questions that had been validated for validity, reliability, difficulty level, and discriminating power, as well as an observation sheet for creative thinking skills based on Guilford's four indicators: fluency, flexibility, originality, and elaboration.

Data were collected through tests, observations, and documentation. The pretest and posttest were used to measure improvement in learning outcomes, whereas the observation sheet was employed to evaluate students' creative thinking during the learning process. The instruments were validated by experts and piloted with students outside the sample.

Data analysis was carried out using SPSS version 30 (Ghozali, 2021). Assumption tests, including the normality test (Shapiro-Wilk) and homogeneity test (Levene), were conducted before hypothesis testing (Rahardjanto et al., 2019). A one-tailed t-test was applied to determine the significant differences between the experimental and control groups (Purba & Zunidar, 2025). Decisions were made at a significance level of 0.05. If $p < 0.05$, the null hypothesis was rejected and the alternative hypothesis was accepted, indicating a significant effect of the Project-Based Learning (PjBL) model assisted by miniature media on students' learning outcomes and creative thinking skills.

The research procedure consisted of three stages: preparation, implementation, and completion. The preparation stage involved developing and validating research instruments, conducting preliminary observations, and selecting the sample classes. The implementation stage included administering the pretest, applying the respective learning models in both classes (PjBL with miniature media in the experimental class and conventional methods in the control class), and administering the posttest. The completion stage comprised data processing, data analysis, drawing conclusions, and writing the research report.

Result and Discussion

1. Students' Learning Outcomes on the Solar System Topic

The students' learning outcomes were obtained through the administration of pre-test and post-test given to both the experimental and control classes. Based on the pre-test results, the experimental class achieved an average score of 40.10, with the highest score of 62.50 and the lowest score of 21.87. Meanwhile, the control class obtained an average pre-test score of

41.66, with the highest score of 56.25 and the lowest score of 34.37. The visualization of students' learning outcomes is presented in the form of a graph in Figure 1.

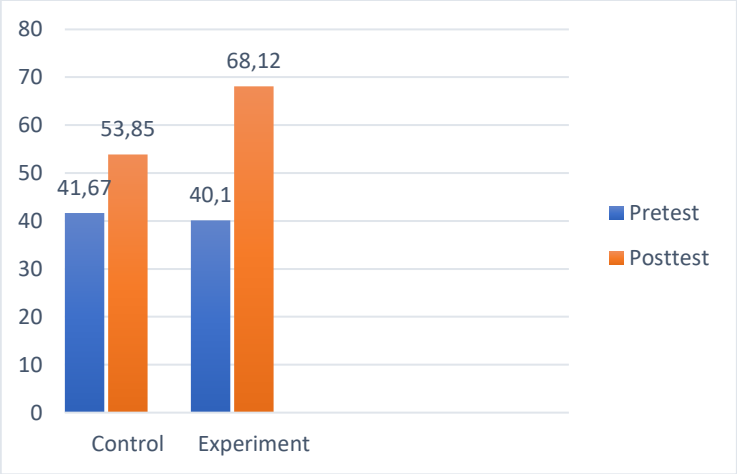

Figure 1. Pre-test and Post-test Data of the PjBL Class Assisted by Miniature Media and the Conventional Class

Based on the post-test results, the experimental class achieved an average score of 68.12, with the highest score of 87.50 and the lowest score of 46.87. Meanwhile, the control class obtained an average post-test score of 53.85, with the highest score of 87.50 and the lowest score of 31.25. The difference in post-test scores between the two classes indicates that the application of an appropriate learning model can significantly influence students' learning outcomes. Although in general, the overall achievement of both classes was still not optimal, the improvement observed in the experimental class was much higher compared to the control class, which only used a conventional learning model. Thus, it can be concluded that the Project-Based Learning (PjBL) model assisted by miniature media is more effective in improving students' learning outcomes compared to the traditional learning approach.

2. Students' Creative Thinking on the Solar System Topic

The students' learning outcomes were obtained through the administration of a post-test given to both the experimental and control classes. Based on the post-test results, the experimental class achieved an average score of 53.33, with the highest score of 65.62 and the lowest score of 37.50. Meanwhile, the control class obtained an average post-test score of 50.93, with the highest score of 62.50 and the lowest score of 31.25. The visualization of students' learning outcomes is presented in the form of a graph in Figure 2.

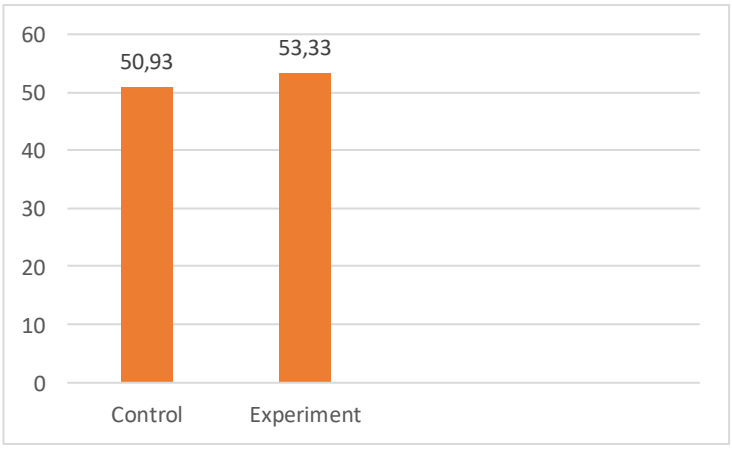

Figure 2. Post-Test Data Of Creative Thinking Scores In The Pjbl Class Assisted By Miniature Media And The Conventional Class

Table 1. Distribution of Post-test Scores of the PjBL Class Assisted by Miniature Media on Creative Thinking

No	Score	Category	Frequency	Percentage
1	100	Ver Creative	0	0
2	80	Creative	7	23
3	60	Fairly Creative	20	67
4	40	Less Creative	3	10
5	20	Not Creative	0	0
	Total		30	100

Table 1. Distribution of post-test scores of students' creative thinking skills after learning with the project-based learning (pjbl) model, assisted by miniature mediaout of 30 students, none were categorized as very creative or not creative. A total of 7 students (23%) were in the creative category, 20 students (67%) were in the fairly creative category, and 3 students (10%) were in the less creative category. No students were classified as very creative or not creative. Referring to the creative thinking category table, only 7 students (23%) achieved mastery (categorized as creative), while 23 students (77%) remained below the mastery threshold. These results indicate that learning through the Project-Based Learning model assisted by miniature media contributes to the improvement of creative thinking skills, although none of the students have yet reached the very creative category.

Table 2 . Distribution of Post-test Scores of Creative Thinking in the Conventional Class

No	Score	Category	Frequency	Percentage
1	100	Ver Creative	0	0
2	80	Creative	6	20
3	60	Fairly Creative	22	73
4	40	Less Creative	2	7
5	20	Not Creative	0	0
	Total		30	100

Table 2. shows the distribution of post-test scores of creative thinking skills in the control class. Out of 30 students, 6 students (20%) were in the Creative category, 22 students (73%) were in the Fairly Creative category, and 2 students (7%) were in the Less Creative category. No students were classified as Very Creative or Not Creative. Referring to the creative thinking category table, the students who achieved mastery (categorized as Creative) amounted to only 6 students or 20% of the total. Meanwhile, 24 students (80%) remained below the mastery threshold.

Discussion

1. The Effect of the Project-Based Learning Model on Students' Learning Outcomes

Based on the results of the t-test for the pretest and posttest using SPSS 30, a significance value (1-tailed) of 0.001 was obtained. Since this value is smaller than the significance level of 0.05 ($0.001 < 0.05$), the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. This means that the implementation of the Project-Based Learning (PjBL) model assisted by miniature media has a significant effect on students' learning outcomes. This finding is consistent with McKinney (2023), who reported that the application of PjBL in secondary science learning can improve student engagement, critical thinking skills,

and conceptual understanding through authentic learning experiences. Furthermore, a study conducted by Kurniawan et al. (2023) also showed that the PjBL approach based on concrete media, such as miniatures, helps students develop a clearer and more enjoyable understanding of abstract concepts. Thus, these findings reinforce the hypothesis that the use of the PjBL model assisted by miniature media significantly influences the improvement of students' learning outcomes, particularly in science learning.

Figure 1. illustrates the comparison of the average pretest and posttest scores of science learning outcomes between the experimental and control classes. In the pretest, the average score of the experimental class was 40.10 and the control class was 41.66, indicating that the initial abilities of the two groups were relatively balanced. After implementing the Project Based Learning (PjBL) model assisted by miniature media in the experimental class, the posttest score increased sharply to 68.12, while the control class only reached 53.85. This difference shows that PjBL with miniature media is effective in improving students' conceptual understanding and learning outcomes. The model enables students to learn through direct experience, actively construct knowledge, and engage in critical thinking and collaboration. This aligns with the constructivist perspective that learning becomes more meaningful when students are actively involved in the process.

Project-based learning provides students with hands-on experiences in constructing knowledge through exploration and creation. This is in line with the findings of Rahayu and Prasetyo (2023), who stated that "the implementation of PjBL can improve student learning outcomes and participation in understanding science concepts because students become more active and responsible for the projects they create". Moreover, Lestari & Nurhayati (2022) also found that the use of media such as miniatures in science projects helps students comprehend abstract concepts through real-life experiences and enhances learning motivation. With students actively engaged in meaningful projects relevant to the subject matter, the PjBL model has proven effective not only in improving learning outcomes but also in fostering independent and collaborative learning attitudes.

In contrast, the learning process in the control class was conducted conventionally. The teacher delivered the Solar System material through presentations and direct explanations, followed by textbook-based exercises. During the activities, students tended to be passive listeners who merely took notes on the information presented. There were no project-based or exploratory activities that encouraged active participation. The learning was predominantly one-directional, with the teacher playing a dominant role as the main source of information. This situation reflects what Hasanah and Mulyani (2022) stated, that conventional learning models tend to limit students' active participation because the process is teacher-centered and lacks meaningful interaction. Such learning often leaves students less motivated, easily bored, and struggling to develop a deep understanding of the material (Sutarto, 2021). In this case, students' roles were limited to listening, taking notes, and answering questions, without opportunities to construct knowledge independently or collaboratively. Therefore, the passive learning atmosphere in the control class demonstrates its limitations in providing meaningful learning experiences, especially in the context of science education which requires conceptual understanding and direct student involvement.

2. The Effect of the Project-Based Learning Model on Students' Creative Thinking

Based on the results of the posttest t-test using SPSS 30, a significance value (1-tailed) of 0.001 was obtained. Since this value is smaller than the significance level of 0.05 ($0.001 < 0.05$), the null hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted. This means that the implementation of the Project Based Learning (PjBL) model assisted by miniature media has a significant effect on students' creative thinking. This indicates that the PjBL model with miniature media encourages students to be more active in exploring ideas, developing creative solutions, and producing tangible works that reflect their creative thinking skills. This finding is consistent with Putri et al. (2019), who reported that PjBL in science learning significantly enhances students' creative thinking compared to traditional teaching

methods. Similarly, Rati et al., (2023) confirmed that PjBL significantly improves aspects of creativity such as fluency, flexibility, originality, and elaboration. Thus, the use of miniature media in learning not only facilitates conceptual understanding but also provides opportunities for students to express their creativity optimally.

As shown in Figure 2, the average posttest score of students' creative thinking ability in the experimental class was 53.33, while the control class achieved an average of 50.93. This difference demonstrates that the implementation of the Project-Based Learning (PjBL) model assisted by miniature media contributes more positively to improving students' creative thinking skills compared to conventional learning in the control class. The higher scores in the experimental class indicate that students were more capable of developing ideas, proposing innovative solutions, and producing creative outputs. This is in line with Sucilestari et al., (2023), who found that the PjBL model effectively supports the development of students' creative thinking because it encourages them to actively design experimental procedures and complete scientific projects independently. Therefore, it can be concluded that PjBL with miniature media creates meaningful learning that trains students to think originally, flexibly, and productively.

Table 1 presents the distribution of posttest scores of students' creative thinking ability in the experimental class after being taught using the PjBL model assisted by miniature media. A total of 7 students (23%) fell into the Creative category, 20 students (67%) were in the Fairly Creative category, and 3 students (10%) were in the Less Creative category. None of the students were classified as Very Creative or Not Creative. This indicates that all students in the experimental class reached at least the Fairly Creative category after the learning process. These findings suggest that the PjBL model with miniature media enhances students' overall creative thinking skills. The relatively high percentage in the Creative category reflects the effectiveness of this learning model in fostering students' originality, flexibility, and elaboration in completing projects.

Table 2 presents the distribution of posttest scores of students' creative thinking ability in the control class, which was not taught using the PjBL model assisted by miniature media. Out of 30 students, 6 students (20%) were in the Creative category, 22 students (73%) were in the Fairly Creative category, and 2 students (7%) were in the Less Creative category. None were classified as Very Creative or Not Creative. This distribution shows that most students did not achieve an optimal level of creative thinking. The proportion of students in the Creative and Very Creative categories was much lower compared to the experimental class, indicating that conventional learning in the control group was less effective in stimulating students' creative thinking. The presence of students in the Less Creative category also suggests that teaching approaches lacking active and contextual engagement limit students' potential for developing creative thinking. This supports Hidayati & Ardiyan (2023), who stated that passive learning with limited student activity tends to weaken creative thinking skills, as students only receive information without engaging in exploratory and challenging experiences.

In this study, the learning material for both the experimental and control classes was the Solar System for grade VII junior high school students. In the experimental class, students were given a project-based task to produce products related to the material. The project was carried out based on the Student Worksheet (LKPD) provided to each group. Five groups were formed with different project variations: groups 1 and 4 created solar system models using styrofoam, groups 2 and 5 designed educational posters, and group 3 used recycled cardboard. Throughout the process, students were actively engaged, enthusiastic, and collaborative in completing their tasks. This shows that applying the Project-Based Learning (PjBL) model with concrete media can enhance student engagement and motivation in learning. This aligns with Agusdianta (2023), who found that PjBL significantly improves students' creative thinking and problem-solving skills in primary education.

During the project, students demonstrated active involvement in various stages of learning, from planning and group discussions to product creation. Each group took initiative in dividing roles such as drawing, cutting materials, writing information, or arranging visual

components. The classroom atmosphere became more lively and dynamicas students not only received material from the teacher but also engaged in discussions and explored creative ideas. Such learning encouraged students to work collaboratively and take responsibility for their outcomes. Lesmana et al. (2023) also reported that PjBL successfully improved students' creativity and collaboration through authentic, task-based projects.

Nevertheless, some challenges were faced during the project. Several groups encountered technical difficulties, such as limited materials, challenges in arranging the planetary scale, or balancing poster design proportions. Additionally, differences in skill levels and interests among group members sometimes resulted in uneven task distribution. However, these challenges were gradually resolved through teacher guidance and peer collaboration. This provided opportunities for students to develop problem-solving skills and adaptability to challenges. These findings are supported by Handoko et al. (2024), who reported that environmentally based project-based Based Learning effectively enhances students' creative thinking through authentic and contextual tasks that are both challenging and meaningful.

A more in-depth analysis indicates that the improvement of students' creativity through Project-Based Learning (PjBL) assisted by miniatures can be explained by cognitive and affective mechanisms that occur during the learning process. Cognitively, the use of miniatures helps students transform abstract concepts into tangible forms that can be directly observed and manipulated, thereby stimulating divergent thinking and the ability to connect various ideas. Affectively, active involvement in creating miniatures fosters a sense of ownership over the project, enhances intrinsic motivation, and builds students' confidence to explore new ideas.

Thus, PjBL assisted by miniature media not only provides meaningful learning experiences but also creates a space for students to imagine, experiment, and innovate. This explains why this approach is more effective in fostering creativity compared to conventional, one-way learning that offers minimal opportunities for idea exploration.

Conclusion

Based on the results and discussion, it can be concluded that students' learning outcomes and creative thinking skills on the topic of the Solar System taught using the Project-Based Learning (PjBL) model assisted by miniature media were higher than those of students taught using conventional methods. Therefore, teachers are encouraged to implement the PjBL model with miniature media to help students better understand abstract concepts, as the use of miniatures can be optimized to visualize the positions and movements of planets more concretely. Schools are also expected to provide adequate learning facilities, including miniature media, to support the implementation of innovative learning models. In addition, teachers need to consistently apply the PjBL model so that students become accustomed to solving problems through collaboration and exploration. Furthermore, periodic evaluations of the effectiveness of miniature media and the implementation steps of the PjBL syntax should be conducted to ensure the achievement of learning objectives. Future research is recommended to apply the Project-Based Learning model assisted by miniature media to other science topics that possess concrete conceptual characteristics, to examine its effectiveness and consistency in improving students' learning outcomes and creative thinking skills in different contexts or at other educational levels.

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