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The effect of project-based learning on improving students' science learning outcomes at private schools

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ABSTRACT

There is still a lack of creativity and innovation in teachers when selecting learning models, so students are less active in learning, and their learning outcomes are low. This study aims to analyze the project-based learning model on the science learning outcomes of students at private junior high school Bhayangkari 3 Rantauprapat in the 2024/2025 academic year. The research design used in this study is an experimental research type with the One-Group Pretest-Posttest model. Before administering treatment, a pretest is conducted to assess the group's initial stability and condition, ensuring clarity before proceeding with the intervention. After the clarity of the group's condition can be seen, then treatment is provided using a project-based learning model. The study results showed that the language of students who previously did not understand and were less active in the learning process became more active. Students can construct their understanding through groups and individuals in learning materials. After using the project-based model, the average value was 75,00, while the conventional one was 67,411. This shows a positive influence on science learning outcomes in the application of the project-based model. This also indicates that active learning strategies foster student engagement and improve academic performance.

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INTRODUCTION

Education is an effort carried out consciously and planned to realize a generation with high character and quality so that they can become a generation that can follow the dynamics of the development of the times. Education is essential for developing physical and spiritual human potential and is integral to individual and social existence. It fosters awareness, responsibility, and the ability to interact within society, making it a fundamental aspect of human life (Zuhdi, 2021). In applying science and technology, education greatly supports the ability to utilize, develop, and master applied science and basic science in a balanced manner. Improving the quality of human resources can also be done through education. Education is a discourse that can be used to develop all humans' potential. Therefore, in human life, education is an essential thing that has an important role, be it in the family, society, or the life of the nation and state (Rogošić et al., 2020).

To achieve educational goals, the efforts that can be made are to carry out the learning process to help students become quality human resources. In achieving quality human resources, learning methods are very appropriate as critical components that can form the basis for developing the quality of human resources (Betan et al., 2023). Learning methods are essential tools in shaping students' mindsets and skills. One is by actively involving students in the learning process, which can be done by selecting the right learning model according to the material being taught and by looking at the condition of students as learners. The use of a learning model enhances student motivation, encourages active participation, fosters higher-order thinking skills, and promotes collaboration (Rinasari & Sriyanto, 2022).

The characteristics of science learning encompass a variety of dimensions that contribute to compelling educational experiences. High-quality science education emphasizes mastery of disciplinary content, hands-on engagement, and the development of scientific literacy, which collectively foster students' critical thinking and character development. Science learning activation involves dispositions and skills that enhance engagement and success in science learning. Key dimensions include fascination, values, and scientific sensemaking, which influence students' choices and learning outcomes (Dorph et al., 2016). Science learning is characterized by intellectual rigor, emphasizing depth of conceptual understanding over memorization. It involves sparking curiosity, addressing preconceived ideas, utilizing inquiry-based approaches, and cooperative and collaborative learning strategies. Positive experiences in science learning can lead to increased knowledge and a desire for further exploration in the field.

In addition, an innovative approach following the times can ensure that students not only gain knowledge in the form of theory but can also develop practical skills that are very much needed in everyday life (Nurnainah & Nurnaeni, 2023). Student understanding and achievement not only cover cognitive aspects but also involve character development, creativity, and critical thinking skills. The project-based learning (PjBL) model has significantly improved learning outcomes across various educational contexts. This model emphasizes active student engagement through projects requiring critical thinking, creativity, and collaboration, enhancing cognitive and psychomotor skills. The effectiveness of PjBL is supported by multiple studies, demonstrating its positive impact on student performance and motivation (Muhria et al., 2004). Educators act as facilitators on PjBL, guiding students in goal setting, task organization, and project evaluation, which fosters autonomy and critical thinking. So that student learning outcomes can increase (Sousa, 2024).

Studies have demonstrated that PjBL significantly improves science learning outcomes. The study found that the Project-Based Learning (PjBL) model significantly influenced the learning outcomes of biology (Cahyani et al., 2024). Conversely, the project-based learning (PjBL) model significantly enhances the cognitive learning outcomes of junior high school students in science (Abidin, 2024). Student learning outcomes can be seen when their mental development is better than before learning. A student's mental development level can manifest in cognitive, affective, and psychomotor types—meanwhile, a teacher's success when students have good interests and grades in their subjects.

Education in Indonesia is still relatively low and has not been optimally successful, especially for science subjects. The low science learning outcomes of students at SMP Swasta Bhayangkari 3 are caused by low student learning outcomes and also due to a lack of interest in science lessons, resulting in a lack of understanding of the learning material, which has an impact on students who do not have learning completeness. In addition, the low science learning outcomes are also due to the lack of readiness of students to take science lessons; this is due to the lack of interest in learning students, so they are not ready to learn. In the context of science learning at the Junior High School (SMP) level, using the PjBL learning model can be an enjoyable alternative to improve student learning outcomes (Palayukan et al., 2023).

Optimizing PjBL strategies and assessing long-term learning outcomes is essential to maximize its potential in early science education (Harnita, 2024). Key factors contributing to its effectiveness include student engagement, collaboration, and hands-on activities that enhance understanding (Adnan et al., 2024). However, it emphasizes PjBL's overall superiority in fostering academic success, particularly in science subjects, and suggests that specific conditions and methodologies should be refined and optimized. Continuous empirical research is recommended to enhance PjBL's effectiveness and adaptability in educational strategies, indicating that the context and implementation of PjBL are crucial for achieving desired outcomes (Rehman et al., 2024).

Implementing PjBL has emerged as a promising pedagogical approach to address learning gaps and enhance academic performance across diverse educational settings. By fostering engagement, critical thinking, and collaboration, PjBL improves academic outcomes and equips students with essential 21st-century skills. PjBL is a practical pedagogical approach that enhances student engagement and understanding of science, potentially addressing learning gaps and improving academic performance across diverse educational settings, particularly in teaching sustainable energy concepts (Hamidah, 2021). The weaknesses of PjBL can be identified through various dimensions, including implementation challenges, assessment difficulties, and potential disparities in student engagement. However, this learning model has many advantages and is easy to apply, especially in science learning. So, this research used the PjBL model on science learning to improve learning outcomes. This study aims to analyze the project-based learning model on the science learning outcomes of students at private junior high school Bhayangkari 3 Rantauprapat in the 2024/2025 academic year.

METHOD

This research is a quantitative study with a quasi-experimental type of research. Sugiyono (2019) defines experimental research as research that aims to find specific treatments' effects on others under controlled conditions. Experimental research is a type of research that determines whether or not each treatment has an impact on the sample being studied. The research design used in this study is the One-Group Pretest Posttest. The first thing done before being given treatment is a pretest to determine the stability and clarity of the group's condition before being given treatment.

The population in this study were all students of class VII, SMP Swasta Bhayangkari 3 Rantauprapat, with a population of 150 people. Sampling must be carried out so that the correct sample (example) is obtained and can function as an example or describe the actual state of the population. In other words, the sample must be representative. According to Arikunto (2019), a sample is a portion of the entire population. If the population is known and the number of subjects is large or more than 100, it can be taken between 10% to 15% or 20% to 25% or more, depending on the researcher's ability in terms of time, energy, and funds. The research sample was selected randomly (simple random sampling). The sample in this study was taken as much as 27% of the existing population, namely 27 x 150: 100% = 40,5 rounded up to 40 students were recommended by science teachers, selected based on the criteria of consistently low science learning scores. The calculated average value, the formula used, is shown in the equation. (1).

$$M = \frac{\sum fx}{N} \qquad (1)$$

Where M is mean, $\sum fx$ is the number of frequencies, and N is the number of samples. The hypothesis used the T-test formula.

RESULTS AND DISCUSSION

Various factors influence learning outcomes, one key factor being the choice of learning models. Selecting an appropriate learning model can significantly enhance learning quality, positively impacting student engagement and overall learning outcomes (Amalia et al., 2018). Learning outcomes are specific statements that describe what a student should be able to know, do, or demonstrate after completing a course, focusing on the skills and competencies required for real-world applications in an outcome-based learning framework (Palittin, 2019). The learning model used in this study is the PJBL teaching model. The researcher conducted a pretest before learning and a posttest after learning. The questions used in the pretest and posttest are the same. This is done to find out how to improve student learning outcomes. The results of the analysis of student pretest data are presented in Figure 1.

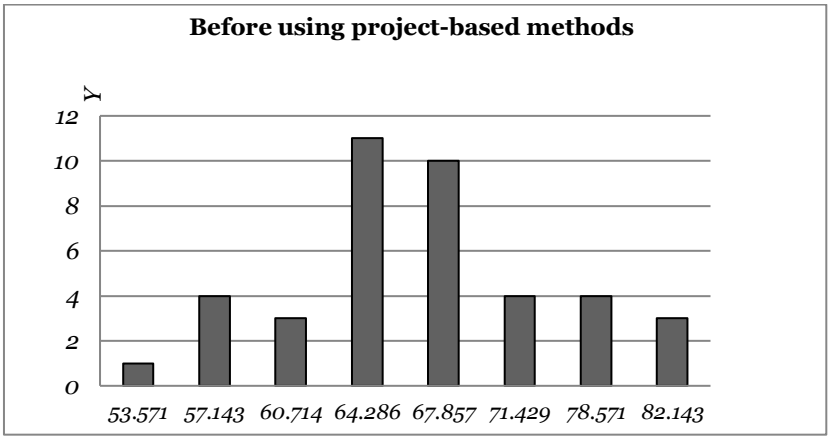


Figure 1. Pretest score graph

Based on Figure 1, it can be seen that from the data calculation, the average value is 67,411 with a standard deviation of 7,19. It can be concluded based on the data that as many as 7 students (17,5%) are in the good category, 32 students (80%) are in the sufficient category, and 1 student

(2,5%) is in the less category, following the description of the general quality of student scores 67.411 in the adequate category. This shows that student learning outcomes are still low before using the PJBL model. That students' knowledge before learning is still low, so there is a need for a learning model that can improve student learning outcomes. Therefore, the PJBL learning model was implemented. The PJBL's effectiveness enhances student learning outcomes (Uki et al., 2024). However, key factors influencing the effectiveness of learning models on outcomes include learner inputs (skill, will, thrill), prior knowledge, motivation to learn, and awareness of success criteria. These factors determine how learning agents impact factual, deep, and transfer learning levels (Hattie & Donoghue, 2018). Meanwhile, the analysis of posttest data is presented in Figure 2.

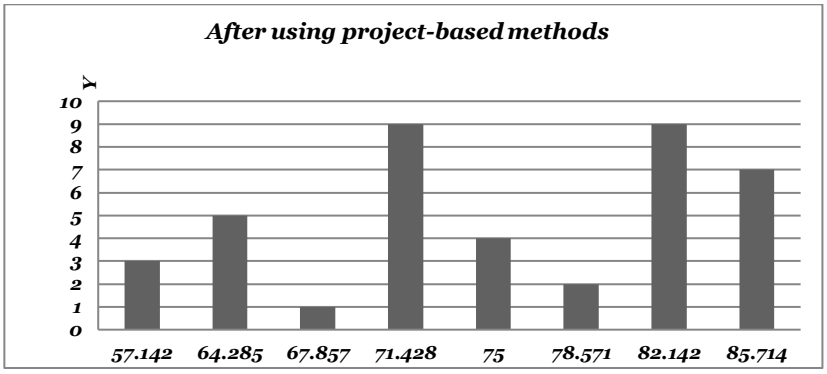


Figure 2. Posttest score graph

Figure 2 shows that from the data calculation above, the average value or mean is 75,00 with a standard deviation of 6,245. It can be concluded that as many as 22 students (55%) are in the good category, and 18 students (45%), according to the description of the general quality of students, score 75 in the good category. Figures 1 and 2 show an increase in student learning outcomes after using the PJBL learning model. This aligns with Rahman et al. (2024); these studies show that PjBL improves learning outcomes across different contexts. In addition, according to Nurhadiyati et al. (2020), PJBL gives a positive response from students. PjBL encourages student engagement through hands-on projects that are relevant to their lives. This method has been linked to increased motivation and participation, as evidenced by significant improvements in posttest scores compared to pretests (Emiliana et al., 2024). PjBL improves learning outcomes by engaging students through structured, hands-on projects that cater to diverse backgrounds and abilities. Integrating learning media enhances motivation and involvement, increasing student engagement and improving academic performance. The data of the hypothesis test can be seen in Table 1.

Table 1. The data hypothesis

Average Pretest Score	Average Posttest Score	t-Test
67,411	75	4,218

Based on Table 1, it can be seen that the t-test value is greater than that of the t-table, the t-table at a significance level of 5% with df = N-l = 40 - 1 = 39, a significance level of 5% is obtained of 2,02. Based on the t-test and t-table values above, it can be seen that $t_{test} > t_{table}$, namely 4.216> 2,02. Thus, H_o is rejected, and Ha is accepted. This proves that the project-based method has a positive effect on improving student outcomes in learning science. According to Lilies et al (2024),

the PjBL model significantly enhances learning outcomes across various educational settings. Zainal et al (2024) said that the project-based learning (PjBL) model had demonstrated significant advantages in improving learning outcomes for junior high school students in science. Then, the PBJL encourages students to take ownership of their learning through meaningful projects, enhancing motivation and engagement (Sousa, 2024). Thus, student learning outcomes can increase after the learning process is carried out using PJBL. The application of this model can also change the learning atmosphere to be more creative, active, and independent (Azhari et al., 2023). Moreover, the PJBL learning model can make learning more meaningful and improve students' learning outcomes (Safitri et al., 2022). Through project-based learning, learning that takes place is much more interesting and meaningful for students because learning is not only teacher-centered but also involves students directly in learning activities.

In the PJBL model, students are instructed to create a project, where in the process of working on the project, students are guided to understand and relate the subject matter, which can make students' the subject matter last for a long time (Azhari et al., 2023). In addition, using the PjBL model provides students with experience in organizing a project and managing resources such as tools and materials used to complete the assigned project. Besides, the iterative assessment process inherent in PJBL further supports skill mastery and a deeper understanding of concepts (Mutanga, 2024). Then, the Concept Learning Model also focuses on helping students understand and apply the concepts and address common issues related to conceptual misunderstandings (Anggraini, 2023). Zulhelmi et al (2023) said that A good understanding of the material reduces misunderstandings and improves student learning. Implementing the PjBL model is reasonably practical from three aspects, namely, the aspect of independence, the aspect of group cooperation, and the aspect of psychomotor mastery (Safitri, 2023). Thus, PjBL is effectively used to improve the learning outcomes of SMP Swasta Bhayangkari 3 Rantuprapat.

CONCLUSION

Based on the research results, it can be concluded that project-based learning methods positively influence student learning outcomes. The basic concept of this method emphasizes the application of knowledge in a practical context, allowing students to develop a deeper understanding of the concept. The project-based learning method can improve student science learning outcomes at SMP Swasta Bhayangkari 3 Rantuprapat in the 2024/2025 Academic Year. The project-based learning model is expected to be an alternative learning model that can be applied to online learning while still being adjusted to the learning material and student character. Therefore, the choice of learning model affects student learning outcomes.

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