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The Effect of Project-Based Learning on High School Students' Motivation and Learning Outcomes in Biology Practicum

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Abstract

A student must have high learning motivation and learning outcomes in biology learning, and the only way to achieve this is by applying project-based learning. The purpose of this study is to find out the effect of project-based learning on high school students' learning motivation and outcomes in biology practicum. This type of research is qualitative with a quasi-experimental approach carried out through pretest and posttest. The population of this study is all 56 students of grade XI, and the sample selection uses a saturated sampling technique, resulting in all 56 students of grade XI being chosen. Data was collected through questionnaires and tests. After the data was obtained, it was analyzed using descriptive statistical analysis, prerequisite tests for analysis, and inferential statistics. The results of this study showed that project-based learning has an effect on students' learning motivation and learning outcomes after the treatment, as evidenced by the N-Gain scores: the experimental class had a learning motivation score of 0.789, which is high, while the control class had 0.245, which is low. As for students' learning outcomes, the experimental class scored 0.80, which is high, and the control class scored 0.20, which is low. Therefore, the conclusion is that implementing project-based learning in biology practicums can create a more active, meaningful, and student-centered learning experience.

Keywords: Project-Based Learning, Learning Motivation, Student Learning Outcomes

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1. Introduction

In today's era, a student needs to have various competencies to be able to face the challenges in increasingly complex biology learning. Once these competencies are acquired, they will be enthusiastic about participating fully in all lessons (Fernando et al., 2024). With this in mind, every student is expected to have a strong spirit within themselves (Agrifina et al., 2023). They need to be able to respond to all kinds of lessons taught (Utami et al., 2024). To reach this goal, every teacher is required to develop their ability to design efficient learning models (Herlina & Nur, 2023). One of the student competencies mentioned is learning motivation.

Learning motivation is the driving force for students to be able to follow a series of learning activities optimally (Hakim & Yunus, 2026). Besides that, motivation makes students more disciplined in attending every stage of the learning process (Rahman, 2021). On the other hand, motivation can help students determine a more efficient direction in their learning (Latief et al., 2022). Not only that, strong motivation can boost the quality of students in improving their learning outcomes (Sipayung et al., 2025).

Learning outcomes are the real achievements that students gain after going through all stages of learning (Qomariyah et al., 2026). In addition, learning outcomes can determine the intelligence that students have (Hulu et al., 2025). On the other hand, learning outcomes are also a measure of how well students understand what they have learned (Indah & Fadilah, 2024). Beyond that, high learning outcomes reflect students' skills in being able to adapt to various learning models (Putri et al., 2021).

Unfortunately, the benefits and usefulness of learning motivation and the expected learning outcomes that are supposed to lead to students' success in biology lessons still seem low (Nurfatia et al., 2026). Observations made by the researcher at SMA Negeri 7 Pangkep showed that in the human respiratory system topic, which requires student collaboration, it has not been carried out well. Besides that, in discussion activities, interactions among students are still not visible. On top of that, the use of practical tools and materials is also still a problem. Therefore, students need directed and active learning to boost their motivation in achieving optimal learning outcomes. One type of learning meant is project-based learning (Amalia & Haerani, 2025).

Various studies have actually been conducted by several researchers, such as Habib et al., (2025) on the effect of project-based learning on students' learning motivation, and Amalia & Haerani, (2025) on the effect of project-based learning on students' learning outcomes. Research shows that project-based learning can effectively boost students' motivation and learning outcomes. However, learning activities at SMA Negeri 7 Pangkep are still dominated by conventional methods that focus on memorizing concepts. In addition, teachers need to have the competence to design project-based learning in a more effective and flexible way for students. This kind of research needs to be done in the field of education, especially in learning biology on the topic of the human respiratory system, so that it can provide knowledge and experience for teachers about the benefits and importance of project-based learning. Thus, this can serve as a reference for teachers to develop more focused and efficient learning, which in turn motivates students to learn and achieve the expected learning outcomes. Therefore, this study was conducted to examine the effect of project-

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based learning on the learning motivation and outcomes of high school students in biology laboratory activities.

2. Methods

This research was conducted at SMA Negeri 7 Pangkep, Pangkajene Regency, South Sulawesi Province during the even semester in April 2026. This location was chosen because initial observations showed that biology practical lessons, especially on the human respiratory system, are still mostly taught using conventional methods. This study is a type of quantitative research with a quasi-experimental approach. The research variables include the independent variable, which is the project-based learning model (X), and the dependent variables, which are learning motivation (Y1) and learning outcomes (Y2).

This study uses a pretest-posttest control group design by giving both an initial test (pretest) and a final test (posttest) to the experimental class and the control class, which had equal affective and cognitive abilities before and after the implementation of different teaching methods: project-based learning for the experimental class and conventional teaching methods for the control class. The study population includes all 56 students of Grade XI who were selected based on inclusion criteria, namely having studied the human respiratory system material and having critical thinking, collaboration, and problem-solving skills. A total sampling technique was used, so all 56 Grade XI students were included in the research sample.

This research procedure started after the researcher obtained research permission, then data collection was carried out by conducting initial observations, preparing teaching modules (lesson plans), validating the learning tools with validators, and determining the class to be sampled. Next, pretest and questionnaire data were collected in both classes before the treatment was given. After obtaining pretest and questionnaire data, treatments were carried out using project-based learning methods and conventional learning methods every day for two weeks. Then, project-based learning and conventional learning methods were applied, followed by collecting posttest and questionnaire data in the same way. Finally, physical evidence was collected in the form of activity photos, student worksheets, and attendance lists.

Data was collected through questionnaires and tests. The questionnaire measured students' learning motivation using a Likert scale with five indicators and 30 statements. Meanwhile, the test measured students' learning outcomes through multiple-choice questions before and after the treatment. Data analysis was carried out using descriptive statistics, prerequisite tests, and inferential statistics. Descriptive statistics were used to find out the level of students' learning motivation and learning outcome scores in both classes through the N-Gain Score (Normalized Gain) formula. The prerequisite test, in the form of a normality test, was done to determine if the data were normally distributed using the Kolmogorov-Smirnov (Shapiro–Wilk) test, meaning the data are considered normally distributed if the significance value (p-value) > 0.05. Inferential statistics, in the form of hypothesis testing, were conducted to analyze the data partially and simultaneously using the t-test (Independent Samples T-Test).

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$$N - Gain = \frac{Posttest\ Score - Posttest\ Score}{Ideal\ Score - Pretest\ Score}$$

3. Result and Discussion

Table 1.
Descriptive Study Motivation of Students in the Experimental and Control Classes

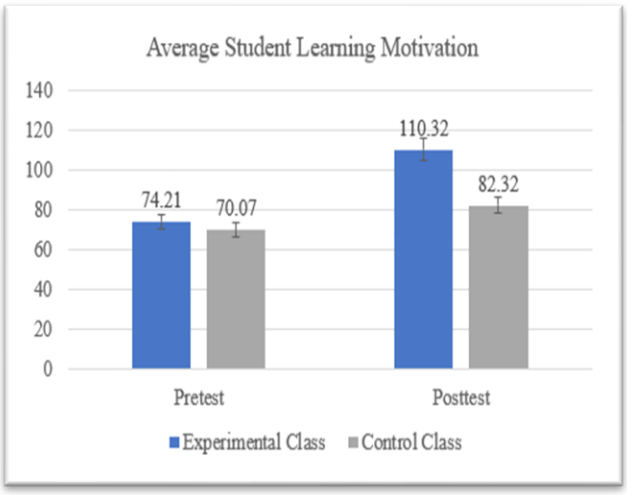
	N	Minimum	Maximum	Mean	Std. Deviation
Experimental Pretest	28	64	88	74,21	5,795
Experimental Posttest	28	98	120	110,32	5,605
Control Pretest	28	62	79	70,07	3,999
Control Posttest	28	74	95	82,32	5,186
Valid N (listwise)	28				

Table 2.
Student Learning Motivation Levels of the Experimental and Control Classes

Class	Mean Pretest	Mean Posttest	N-Gain	N-Gain (%)	Category
Experimental Class	74,21	110,32	0,789	78,9	Tall
Control Class	70,07	82,32	0,245	24,5	Low

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Figure 1.
Comparison Graph of Average Pretest and Posttest Scores



The N-Gain calculation for the experimental class gave an average score of 78.9%, which is on the higher side, as shown in Graph 1 above. This means that the teaching method used in the experimental class was effective in boosting students' motivation to learn. On the other hand, the control group got a low average N-Gain score of 24.5%. Although the motivation to learn did increase in the control group, the increase was much smaller compared to the experimental group. So, descriptively speaking, it can be said that the experimental class experienced a higher boost in student learning motivation than the control class. This shows that the project-based learning strategy applied in the lab sessions of the experimental class was more successful in boosting students' learning motivation.

Table 3.
Descriptive Results of Student Learning in the Experiment and Control Classes

	N	Minimum	Maximum	Mean	Std. Deviation
Experimental Pretest	28	60	80	70,57	5,224
Experimental Posttest	28	86	100	94,25	3,503
Control Pretest	28	53	78	63,25	6,433

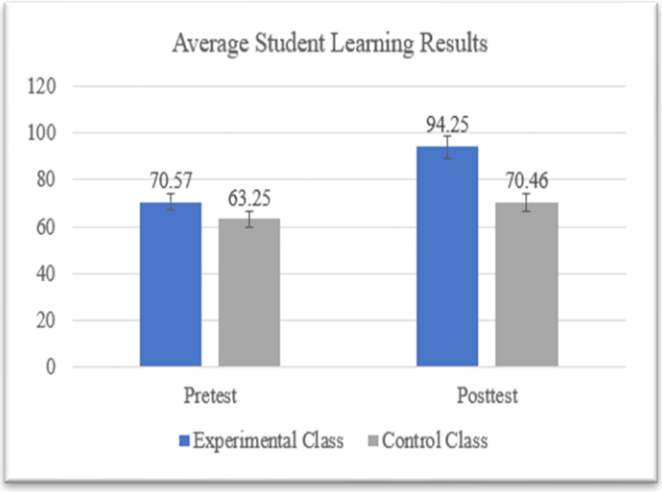
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Control Posttest	28	64	81	70,46	4,247
Valid N (listwise)	28				

Table 4.
Student Learning Outcome Scores of the Experimental and Control Classes

Class	N	Mean Pretest	Mean Postest	N-Gain	Category
Experimental Class	28	70,57	94,25	0,80	Tall
Control Class	28	63,25	70,46	0,20	Low

Figure 2.
Comparison Graph of Average Pretest and Posttest Scores



Based on the graph 2 above, it shows that the difference between pretest and posttest scores in the experimental class is higher than in the control class. The results indicate that project-based learning in the biology practicum class has a better impact on improving students' learning outcomes on the human respiratory system material. So, this type of learning can help students

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understand concepts more deeply through effective, collaborative, and project-based learning experiences compared to conventional learning methods.

The Impact of Project-Based Learning on High School Students' Motivation in Biology Lab

Based on the research conducted on the experimental and control classes, it is known that project-based learning in biology lab has a significant impact on the learning motivation of 11th grade students at SMA Negeri 7 Pangkep on the topic of the human respiratory system. The results of this study are proven through descriptive statistical analysis, which shows an increase in the average learning motivation level in the experimental class from 74.21 to 110.32, while the control class only increased from 70.07 to 82.32. These results were obtained because project-based learning can create a more meaningful learning experience, as students are actively involved from the project planning stage, practical implementation, report preparation, and project result presentations. This active involvement gives students the chance to develop a sense of responsibility for their learning, boost their curiosity, and build confidence in solving problems related to human respiratory system material. This is similar to Habib's research, which showed that project-based learning can help boost students' learning motivation, evidenced by an increase in student motivation from 43% to 77% in cycles I and II. This improvement happened because project-based learning encourages students to actively participate in the learning process, so they don't get bored just listening to the teacher's explanations (Habib et al., 2025). According to Maulina Dalam Nurfatia et al., (2026), project-based learning successfully raises learning motivation to a very high level by strengthening social interactions within groups.
The N-Gain score also shows the experimental class getting a value of 0.789, which is categorized as high, while the control class only scored 0.245, categorized as low. The normality test results using the Shapiro–Wilk test show a statistical value of 0.974 for the experimental class pretest and 0.967 for the posttest. These values are close to 1, which indicates that the data distribution is close to normal. Based on the Shapiro–Wilk test significance values, the pretest was 0.701 and the posttest was 0.503, both greater than 0.05, which means that the students' learning motivation data meet the normality assumption. Meanwhile, the results of the Independent Samples T-Test showed a significance value of 0.000 (<0.05), indicating that there is a significant difference in the level of learning motivation between students who learn using a project-based learning model and those who learn using conventional learning. This is similar to Nurfatia's research which showed that project-based learning can significantly boost students' learning motivation, with the average rising from 59% in the 'moderate' category in cycle I to 78% in the 'high' category in cycle II. The increase in student motivation is based on project-based learning, which can create a more active, creative, and collaborative learning environment ((Nurfatia et al., 2026). According to Apriyanti, innovative and varied learning models can fully engage students, so that learning can be achieved effectively (Apriyanti et al., 2023). Meanwhile, Susilawati stated that project-based learning is an approach that utilizes tools as a means to achieve knowledge, attitudes, and skills, thus creating a conducive and non-monotonous learning environment (Susilawati, 2023).

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The Impact of Project-Based Learning on High School Students' Biology Lab Results

Based on the results of research conducted on the experimental and control classes, it was also found that project-based learning in biology practicals has a significant impact on students' learning outcomes. This is shown by the increase in the average learning outcome scores in the experimental class from 70.57 to 94.25, while in the control class it only increased from 63.25 to 70.46. This improvement in learning outcomes happened because students had the opportunity to learn concepts through hands-on experience during the project, where they conducted observations, practical work, discussions, problem-solving, and even presented their results. This activity encourages students to understand concepts more deeply rather than just memorizing material, which often happens in conventional learning. This result aligns with Amalia's research, which showed that the significant value obtained was 0.000, well below the significance level of 0.05, indicating that project-based learning strongly influences students' cognitive learning outcomes (Amalia & Haerani, 2025). According to Asan in (Hentje H et al., 2025), project-based learning promotes active learning that involves social and intellectual interaction in real activities, which directly impacts students' motivation and learning outcomes.

The N-Gain analysis results also showed that the experimental class scored 0.80, which falls into the high category, while the control class scored 0.20, which is considered low. Meanwhile, the Independent Samples T-Test results showed a significance value of 0.002 (<0.05), so it can be concluded that project-based learning has a significant impact on student learning outcomes. This is similar to Hentje's research, which showed that the average posttest score of the experimental group, 86.1, was significantly higher than the control group, 78.8. This increase happened because project-based learning is effective in boosting student engagement and academic outcomes. Collaborative and practical project activities can create meaningful learning and help students connect biology concepts with real-life experiences Rati said in Amalia & Haerani, (2025), this improvement occurs because project-based learning gives students the chance to develop knowledge and skills simultaneously through exploring real-world problems.

4. Conclusion

In this study, project-based learning was examined, and the results showed that after the treatment, there was a positive impact on the learning motivation and learning outcomes of 11th-grade students at SMA Negeri 7 Pangkep who participated in biology practicum on the human respiratory system.

The results indicate that project-based learning has a significant effect on students' learning motivation and learning outcomes after the treatment. Based on these results, the recommendation is for teachers to apply project-based learning in biology practicum with more varied and engaging steps because it has been proven to boost students' motivation and learning outcomes. As for future researchers, it is suggested to implement project-based learning while assessing critical thinking skills, creativity, collaboration, and with a larger sample size to observe the effectiveness of this model.

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