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Research Article

The Influence of the Problem Based Learning Model and Students' Learning Motivation Towards Physics Learning Outcomes Students of SMAN 5 Takalar

Abstract

This study investigates the influence of the Problem-Based Learning (PBL) model and students' learning motivation on physics learning outcomes among Grade XII science students at SMAN 5 Takalar. Motivated by low achievement rates under conventional instruction, only 54.9% of students reached the minimum competency standard—this experimental research involved 70 students divided into two homogenous groups: an experimental class applying PBL and a control class using direct instruction. Data was collected through tests and questionnaires, then analyzed using descriptive statistics, two-way ANOVA, and t-tests. The results showed that students taught with PBL outperformed those in conventional settings, with an average score of 42.06 compared to 31.74. PBL was also effective across both high and low learning motivation levels. However, no significant interaction was found between the learning model and motivation. These findings suggest that PBL can a consistently effective instructional approach to enhance learning outcomes in physics education, regardless of students' motivation levels.

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1. Introduction

High school physics learning often encounters challenges related to student motivation and learning outcomes. Physics requires a deep conceptual understanding and higher-order thinking skills, yet conventional teaching methods—still widely used and teacher-centered—tend to limit student engagement and interaction [1]. This lack of interactivity reduces student motivation and, consequently, hampers mastery of physics concepts, as seen at UPT SMAN 5 Takalar.

Academic records indicate that in the second semester of the 2023/2024 academic year, only 54.9% of the 144 twelfth-grade science students at UPT SMAN 5 Takalar met the minimum competency standard (KKM = 80), while 45.1% did not [2]. This suggests that the learning model used may not effectively support students in achieving desired outcomes.

Problem-Based Learning (PBL) is a student-centered model that encourages active engagement through solving real-life problems. PBL has been shown to enhance conceptual understanding, critical thinking, and learning motivation, especially in subjects requiring higher-order cognitive skills like physics [3], [4]. Research shows that students taught using PBL are generally more motivated and achieve better learning outcomes than those taught via traditional methods [5].

However, PBL may not yield the same results for all learners. Students with low motivation may require tailored approaches to fully engage in PBL environments [6].

This study aims to address the following questions: (1) Is there a difference in physics learning outcomes between students taught using the PBL model and those taught conventionally? (2) For students with high learning motivation, is there a significant difference in outcomes between the two methods? (3) For students with low motivation, does PBL still provide advantages? (4) Is there an interaction between learning model and learning motivation in influencing physics learning outcomes?

The findings are expected to benefit students, teachers, researchers, and schools. For students, PBL may facilitate easier mastery of physics concepts. For teachers, it offers an interactive, STEAM-oriented approach to enhance instructional quality. For researchers, it provides valuable insights into the implementation of PBL. For UPT SMAN 5 Takalar, this study could inform teaching strategies to better support students' academic success.

2. Materials and Methods

This study applies a quantitative experimental research design involving two class groups: one experimental and one control. Both classes were assumed to be homogenous in academic ability. The control group was taught using conventional direct instruction, while the experimental group received instruction through the Problem-Based Learning (PBL) model.

2.1. Population and Sample

The population comprised all Grade XII Science Program (PIA) students at UPT SMAN 5 Takalar, totaling 140 students across four classes (see Table I).

Table 1. Population Distribution

No	Class	Number of Students
1	XII PIA 1	35
2	XII PIA 2	35
3	XII PIA 3	35
4	XII PIA 4	35
	Total	140

Class XII PIA 1 was selected as the experimental group, and XII PIA 3 as the control group, each with 35 students.

2.2. Instruments

Student learning outcomes were measured using multiple-choice tests, while learning motivation was assessed using a Likert-scale questionnaire containing both positive and negative statements. Each instrument was validated before use.

2.3. Data Collection

Data were collected via written questionnaires and physics tests administered before and after treatment. Instruments aimed to evaluate the effect of PBL and learning motivation on student performance [3].

2.4. Observation Technique

Classroom observations were conducted to support and validate findings from tests and questionnaires, focusing on the interaction between learning model implementation and students' motivation levels [4].

2.5. Implementation Steps

Both groups participated in ten learning sessions. The experimental class followed the PBL model covering topics such as electric current, resistance, Ohm's law, and Kirchhoff's law, with collaborative and hands-on learning activities. The control class used direct instruction and individual tasks (see Table II).

Table 2. Summary of Learning Activities

Meeting	Experimental Group	Control Group
1	Motivation questionnaire	Motivation questionnaire
2–9	PBL sessions with presentations & practicum	Direct teaching, assignments, and group tasks
10	Post-test on physics learning outcomes	Post-test on physics learning outcomes

This methodological framework was designed to assess the impact of PBL and learning motivation levels on students' academic performance in physics.

3. Results

3.1 Description of Learning Activities

Learning activities conducted in this study were divided into two classes: the experimental class and the control class. The control class received conventional learning, while the experimental class implemented the Problem-Based Learning (PBL) model integrated with the Merdeka Curriculum.

The learning process followed the lesson plans that had been developed and validated. The implementation of the PBL model in the experimental class focused on student-centered learning through problem orientation, group discussions, and student presentations. Learning activities in both classes were conducted in three phases: pre-instruction, during instruction, and post-instruction.

- Pre-instruction phase: This phase included the distribution of pretests to assess the students' initial abilities and determine group formations based on pretest results.
- During instruction phase: In the experimental class, PBL activities were conducted following the syntax of the model: problem orientation, organizing students, guiding individual/group investigations, developing and presenting work, and analyzing and evaluating problem-solving processes. Meanwhile, in the control class, learning was carried out using the conventional lecture method.
- Post-instruction phase: Students in both classes were given posttests to evaluate their learning outcomes. Observations and documentation were also conducted during the implementation of learning to collect data related to student engagement and motivation.

3.2 Physics Learning Outcomes

The Merdeka Curriculum provides flexibility not only for students to develop their potential but also for schools to manage curricula based on regional autonomy, and for teachers to design learning plans (RPP) independently. Previously, lesson plans were considered too rigid and administratively burdensome. Under the Merdeka Curriculum, lesson planning has been simplified to essential components, allowing teachers more time to evaluate learning effectively [1].

According to the Ministry of Education and Culture [2], the *Merdeka Belajar* policy consists of four main points: (1) replacing the National Standardized School Examination (USBN) with assessments determined by educational institutions; (2) replacing the National Exam (UN) with a Minimum Competency Assessment and Character Survey; (3) simplifying the lesson plan format; and (4) implementing zoning in student admissions.

Learning outcomes are defined as abilities acquired by students through consciously managed mental activity. They reflect the results of learning efforts and signify student satisfaction with the process. The Merdeka Curriculum emphasizes not only academic achievement but also the development of character in line with the *Pancasila Student Profile* [3].

In physics learning, outcomes represent changes in students' behavior that can be observed and measured such as growth in knowledge, attitude, and skills. These changes indicate educational progress, for example, from "not knowing" to "knowing," or from being impolite to showing respect. According to Bloom's Taxonomy, learning outcomes are categorized into three domains [4]:

1. Cognitive related to intellectual achievements, including six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation.
2. Affective involving emotional attitudes and values, with five levels: receiving, responding, valuing, organizing, and characterizing.
3. Psychomotor related to motor skills and coordination.

Although the cognitive domain is often emphasized, effective learning requires assessments that also consider the affective and psychomotor domains to ensure holistic student development.

Table 3. Student Learning Outcomes in the Experimental and Control Classes

Description	Control Class	Experimental Class
Number of Students	35	35
Maximum Empirical Score	39	47
Minimum Empirical Score	25	33
Maximum Ideal Score	50	50
Minimum Ideal Score	0	0
Standard Deviation	4.01	3.35
Average Score	31.74	42.06

Table 3 shows that the experimental class, which applied the Problem-Based Learning (PBL) model, obtained a higher average and maximum score than the control class. This indicates that the PBL model positively influenced students' physics learning outcomes.

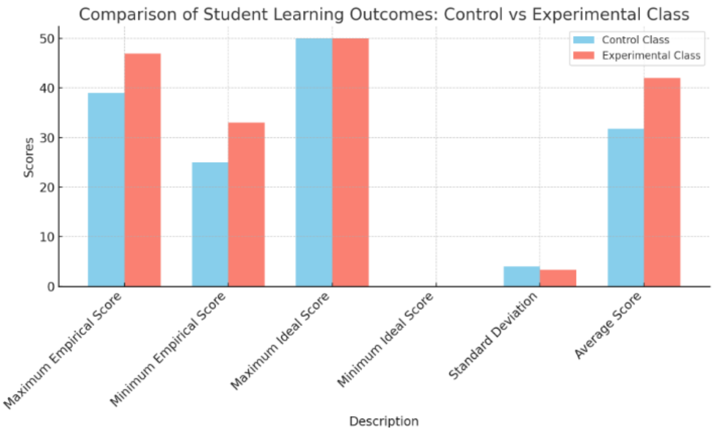

Figure 1. Comparison of student learning outcomes

The bar chart above illustrates the comparison of student learning outcomes between the control class and the experimental class using various statistical indicators. The experimental class shows a higher maximum empirical score (47) compared to the control class (39), indicating a better top performance among students. The minimum empirical score in the experimental group (33) is also higher than that in the control group (25), suggesting overall better lower-bound performance.

Both classes share the same ideal maximum (50) and minimum scores (0), as expected based on the assessment scale. However, the standard deviation is slightly lower in the experimental class (3.35) than in the control class (4.01), indicating a more consistent performance among students in the experimental class.

Most notably, the average score in the experimental class is 42.06, significantly higher than the 31.74 average in the control class. This highlights the effectiveness of the Problem-Based Learning (PBL) model in improving overall student performance in physics compared to conventional learning methods.

Table 4. Frequency Distribution of Learning Outcomes for Experimental and Control Classes

No	Score Interval	Score Percentage	Frequency (Control)	Frequency (Experimental)	Category
1	41 ≤ X ≤ 50	90 ≤ X ≤ 100	0	25	Excellent
2	31 ≤ X < 41	81 ≤ X < 90	21	11	Good
3	21 ≤ X < 31	72 ≤ X < 81	14	0	Fair
4	11 ≤ X < 21	63 ≤ X < 72	0	0	Poor
5	X < 11	X < 63	0	0	Very Poor
	Total		35	35	

Table 4 illustrates that the majority of students in the experimental class fell into the *Excellent* category, while the control class mostly fell into *Good* and *Fair* categories. This reinforces the conclusion that the PBL model improves student achievement more effectively than conventional teaching methods.

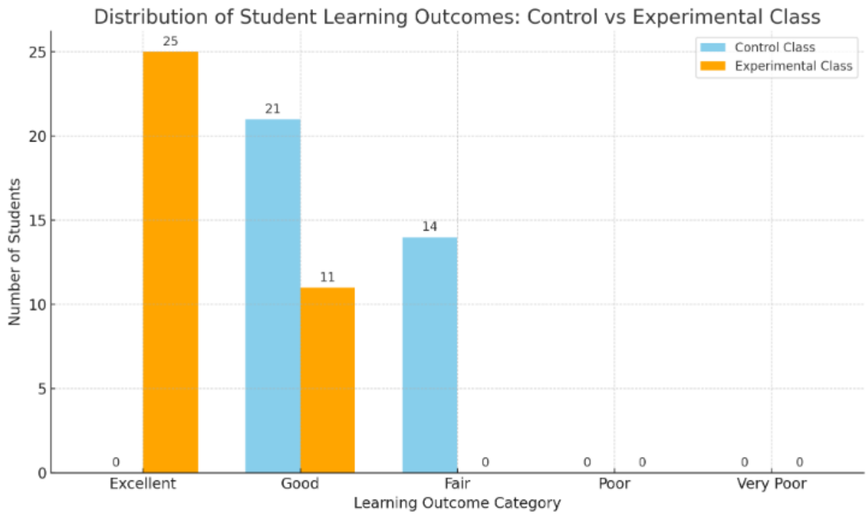

Figure 2. Distribution of Learning Outcomes

The graph clearly shows a stark contrast between the two classes. In the experimental class, the majority of students (25 out of 35) fell into the *Excellent* category, while the remaining 10 students were in the *Good* category. In contrast, none of the students in the control class achieved an *Excellent* rating. Instead, most students in the control class were distributed across the *Good* (21 students) and *Fair* (14 students) categories. This comparison supports the conclusion that the experimental teaching method most likely involving Problem-Based Learning (PBL) significantly enhances student performance when compared to traditional methods used in the control class.

4. Discussion

Learning outcomes represent the culmination of the teaching and learning process. A persistent issue in educational settings is the low achievement levels among students. The implementation of the Problem-Based Learning (PBL) model has demonstrated a positive effect on learning outcomes, fostering active and independent learning. Through PBL, students are encouraged to explore, solve problems, and articulate new ideas based on their own discoveries, which enhances conceptual understanding and academic performance.

This study was conducted at SMAN 5 Takalar to examine the influence of the PBL model and learning motivation on student outcomes in Grade XII. The experimental group, comprising 35 students, was taught using the PBL approach, while the control group, also consisting of 35 students, received instruction via conventional methods. The objective was to determine whether the PBL model could enhance learning outcomes more effectively than traditional teaching strategies.

The descriptive analysis revealed significant differences in learning outcomes between the two groups. In the control class, the highest student score was 39, while in the experimental class, the highest score reached 47. Similarly, the lowest score in the control group was 25, compared to 33 in the experimental group. The standard deviation in the control class (4.01) was higher than that in the experimental class (3.35), indicating greater score variability in the control group. Furthermore, the average score in the control class was 31.74, whereas in the experimental class, it was substantially higher at 42.06.

The frequency distribution of student learning outcomes also supports this trend. In the "Excellent" category (scores between 41 and 50), 25 students were from the experimental class, while none were from the control class. In contrast, most students in the control class fell within the "Good" (21 students) and "Fair" (14 students) categories. These findings suggest that the PBL model substantially improved student performance compared to the conventional approach.

An analysis of learning motivation revealed that students in the experimental class, regardless of whether they exhibited high or low motivation, generally achieved higher motivation scores than those in the control class. Among students with low motivation, those in the experimental group had an average score of 119.5, compared to 100.7 in the control group. For students with high motivation, the experimental group averaged 127.0, compared to 107.6 in the control group. These findings indicate that the PBL model positively influences not only learning outcomes but also students' motivation to learn.

Inferential statistical analysis was conducted to further validate these findings. Prior to hypothesis testing, normality and homogeneity tests were carried out, both confirming that the data met the necessary assumptions. Subsequently, a two-way ANOVA was conducted to investigate the interaction between learning models and student motivation on learning outcomes. The results showed a significant main effect of the PBL learning model on student achievement (sig = 0.001 < 0.05), indicating that the model significantly influences learning outcomes. This aligns with previous research by Ashad (2012) and Putra (2016), both of which demonstrated that the PBL model significantly enhances students' cognitive, affective, and psychomotor competencies in science learning.

However, the interaction effect between the learning model and learning motivation was not statistically significant (sig = 0.177 > 0.05). This suggests that while the PBL model independently influences student outcomes, its effect does not vary based on students' levels of motivation. This conclusion was supported by the plot diagram (Figure 4.1), which showed that the interaction lines between the learning model and motivation did not intersect, indicating no significant interaction effect.

Further analysis using post hoc (follow-up) tests was conducted to examine specific differences between groups. The T-test results for students with high motivation yielded a significance value of 0.061 (> 0.05), and for students with low motivation, a significance value of 0.122 (> 0.05). These findings indicate that while the PBL model improves learning outcomes overall, it does not significantly influence outcomes when examined solely within high- or low-motivation student groups.

In conclusion, the PBL learning model demonstrates a clear and significant positive impact on student learning outcomes compared to conventional teaching methods. Although student motivation did not significantly interact with the learning model in affecting achievement, students in the experimental group displayed higher learning motivation and achievement overall. These results highlight the potential of the PBL approach as a more effective alternative for enhancing academic success.

5. Conclusions

Based on the findings of this study, it can be concluded that the Problem-Based Learning (PBL) model significantly improves student learning outcomes compared to conventional methods. Students in the experimental class achieved a higher average score (42.06) than those in the control class (31.74). This positive impact was evident across different levels of student motivation. Among students with high learning motivation, the PBL group outperformed the control group with an average score of 42.94 versus 25.67, while for students with low motivation, the PBL group also showed higher results (38.83) compared to the control group (30.90). These differences were statistically significant at a 0.05 significance level. However, the analysis indicated no significant interaction between learning models and learning motivation ($p = 0.832 > 0.05$), suggesting that the effectiveness of PBL is consistent regardless of students' motivational levels.

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