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A Correlational Study of Activity and Physics Learning Outcomes in the Implementation of Problem Based Learning among Grade XI Science Students at MAN 1 Mataram

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Abstract—This study aims to (1) describe the level of student learning activity, (2) describe the level of student physics learning outcomes, and (3) analyze the relationship between learning activity and physics learning outcomes in the implementation of Problem-Based Learning (PBL). This research employed a correlational design with a quantitative approach. The population consisted of all 168 students in the eleventh-grade science classes, and a saturated sampling technique was used so that the entire population become the sample. Descriptive analysis was used to determine the levels of student learning activity and physics learning outcomes. For hypothesis testing, non-parametric statistics (Spearman correlation) were used because the data were not normally distributed. The results showed that (1) the level of student learning activity was 20.8% high, 49.4% medium, and 29.8% low; (2) the level of student physics learning outcomes was 1.2% high, 83.9% medium, and 14.9% low; (3) the Spearman correlation test revealed a significant positive correlation between the two variables (sig. 2-tailed = 0.003 < 0.05) with a low correlation level (correlation coefficient = 0.226). Based on the coefficient of determination, the contribution of learning activity to physics learning outcomes was only 5.1%. Thus, it can be concluded that there is a significant positive relationship between learning activity and physics learning outcomes, although this relationship is low and contributes only slightly.

Keywords— Learning Activity, Physics Learning Outcomes, Problem Based Learning.
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1. Introduction

21st century education is no longer only oriented towards mastering academic content, but also on developing competencies such as critical thinking, communication, collaboration, and creativity, so that students can adapt and contribute to a dynamic global society [1]. The consequence of this demand has led to a shift in the learning paradigm from teacher-centered to *student-centered* learning. This shift is not only due to pedagogic trends, but is also based on empirical evidence from various modern learning studies and theories that states that students learn more effectively when they are actively involved in the learning process [2]. So that student learning is very crucial in optimizing learning outcomes in this era.

Learning activity is one of the internal factors that has a significant contribution to the achievement of learning outcomes. Activeness includes not only physical activities, but also cognitive and social involvement in the learning process, such as asking questions, discussing, expressing opinions, and exploring concepts [3]. Theoretically, the constructivist approach pioneered by Piaget, asserts that knowledge is actively constructed by students through interaction with the learning environment, not just passively received from the teacher [4].

In practice, the application of constructivism theory has been proven to be able to encourage student activity while creating a conducive learning atmosphere, which ultimately has an impact on improving learning outcomes [5]. This is in line with research [6], through a meta-analysis of 225 studies, they showed that classes that actively engaged students experienced an average increase in learning outcomes of about 6% as well as a 1.5-fold reduction in the risk of failure compared to passive classes. These findings emphasize that active learning plays an important role in optimizing learning outcomes, especially in subjects that are loaded with abstract concepts such as physics.

The study of physics, which deals with natural phenomena and their underlying principles and laws, ranging from microscopic to macroscopic, requires students to not only memorize theories, but also to understand the relationships between concepts more deeply [7]. This characteristic requires them to play the role of subjects who actively build their knowledge independently during the learning process [8]. However, the complexity and abstract nature of physics material are often an obstacle for students. They are prone to misconceptions, difficulty analyzing problems, and difficulty making calculations. As a result, their understanding of physics concepts could not develop optimally [9]. To overcome these conditions, an innovative learning strategy is needed that can encourage activeness while improving the quality of learning.

In the context of learning innovation, *the Problem Based Learning* (PBL) model is seen as one of the effective strategies to increase learning activity. This model places contextual problems as the starting point for learning, thus encouraging students to think critically, independently, confidently, collaborate with others, and actively seek solutions [10]. In addition, PBL has been proven to be able to change learning from teacher-centered to student-centered, so that students become more active in solving real problems collaboratively, which ultimately has an impact on improving learning outcomes [11].

However, based on the results of an interview with one of the physics teachers at MAN 1 Mataram on September 5, 2025, information was obtained that although the PBL model has been implemented, there are several obstacles that hinder its effectiveness. First, the heterogeneous educational background and prior knowledge of students make their learning speed different, even most of them still have difficulty understanding abstract concepts of physics. Second, the number of students reaches 42 people per class (fat class) making teachers unable to provide guidance individually. Third, the available time allocation is sometimes not enough to complete all stages of learning. Although the activeness of students is quite high, the teacher stated that this condition actually overwhelms teachers and makes it difficult to control the classroom atmosphere to remain conducive. As a result, the learning process is not fully optimal in facilitating the understanding of concepts and the achievement of student learning outcomes.

This condition shows that even though PBL has been implemented at MAN 1 Mataram, there has not been an empirical study that specifically analyzes the relationship between student learning activity and physics learning outcomes in this limited classroom context. This gap is an important basis for conducting research that focuses on the correlational analysis between the two variables.

2. Method

The type of this study is *correlational research* with a quantitative approach. The research design is a *simple correlational design* with one independent variable and one bound variable. Schematically, the design of this study is shown in Figure 1.

Figure 1. Simple Correlation Design
Sources [12]

The research was carried out at MAN 1 Mataram, from April to May 2026. The population in this study is all students of class XI Science with a total of 168 students. The sampling technique used is saturated sampling, where all members of the population will be used as research samples.

This study consists of two variables, namely the independent variable (active learning) and the bound variable (physics learning outcomes). This study employed secondary data obtained directly from Grade XI physics teacher. Learning activity data consisted of observation-based assessments of students' activities during the implementation of PBL, while learning outcome data consisted of First-Semester Midterm Examination scores for the 2025/2026 academic year. The data are collected through documentation and analyzed using descriptive statistics to determine the levels of students' learning activity and physics learning outcomes, which are then categorized into three categories, namely high, medium, and low. The data normality test is the Kolmogorov-Smirnov, used to analyze the relationship between activeness and students' physics learning outcomes in the implementation of *Problem Based Learning,* non-parametric analysis (Spearman correlation) is used because it do not require normal distributed data. The value of the correlation coefficient obtained is then interpreted based on the criteria in Table 1 to determine the level of relationship between the two variables. The entire statistical analysis process in this study uses IBM SPSS Statistics 25.

Table 1. Interpretation of the Correlation Coefficient

Relationship Strength	Coefficient Intervals
Very Strong	0.80 – 1.000
Strong	0.60 – 0.799
Moderate	0.40 – 0.599
Low	0.20 – 0.399
Very Low	0.00 – 0.199

Source: [12]

3. Result and Discussion

Students' Learning Activeness

Learning activity data is obtained through the assessment of student activities by teachers during the physics learning process. The teacher gives the assessment using tick symbols, namely ✓✓✓ (three ticks) for very active, ✓✓ (two ticks) for active, ✓ (one tick) for moderately active, and – (strip mark) for inactive. However, the explicit assessment criteria (e.g.: the number of times students ask questions in a single meeting are categorized as very active) are not recorded in detail by the teacher. Activeness assessments tend to be qualitative and general. This is one of the limitations because the researcher is not directly involved in the assessment process. For the purposes of quantitative analysis, the four categories are converted into numerical scores in the range of 0 to 100. Each category is represented by the midpoint of its score interval. The very active category is in the range of 76-100 so the midpoint is "88". The active category is in the range of 51-75 with a midpoint of "63". The category is quite active in the range of 26-50 with a midpoint of "38". The inactive category is in the range of 0-25 with a midpoint of "13".

The results of descriptive statistical analysis shows that the average student learning activity score is 46.18 with a standard deviation of 27.698, the lowest score is 13, and the highest score is 88. Based on the reference of the grade category that has been determined, in the active learning category, 49.4% of students are in the medium category, 29.8% of students are in the low category, and 20.8% of students are in the high category. The distribution of the frequency of student learning activity is presented in Table 2.

Table 2. Distribution of Students' Learning Activeness

Categories	Value Range	Number of Students	Percentage
High	$X \geq 74$	35	20.8%
Medium	$19 \leq X < 74$	83	49.4%
Low	$X < 19$	50	29.8%

Table 2 shows that most students (49.4%) are in the medium category. Thus, in general, the level of student learning activity in the implementation of PBL is moderate. This achievement is understandable because PBL has provided space for students to engage in discussions, problem-solving, information searching, and delivery of work. The characteristics of PBL are able to transform learning dynamics from a conventional teacher-centered approach to a more interactive and student-centered approach through collaboration in solving authentic problems [13]. In a theoretical framework, these findings are in line with the constructivist view that positions students as the main subjects in the learning process, as it emphasizes the importance of active *learning* through real and contextual problem-solving [4].

However, the proportion of active learning in the high category that is still low shows that not all students are able to adapt from conventional learning patterns to learning that requires independence such as PBL. Based on the results of interviews with teachers, there are three main factors that affect this condition. First, the number of students exceeding forty per class makes it difficult for the teacher to thoroughly monitor individual engagement. Second, the limited learning time causes the PBL stages to not always run optimally. Third, differences in students' prior abilities also affect their participation, especially because the characteristics of abstract physics materials demand analytical skills and mathematical reasoning. These findings are in line with the results of research [14] that identified various challenges in the implementation of PBL, such as teacher or educational readiness, inflexible time allocation, and the process of student adaptation to learning schemes that require active involvement. Meanwhile, [15] explained that the success rate of the implementation of problem-based learning is largely determined by the students' prior knowledge or understanding.

Based on this presentation, it can be concluded that overall the implementation of PBL has been able to create a more participatory learning atmosphere than conventional learning, but its effectiveness is still influenced by class factors, time, prior ability, student adaptation, and material characteristics.

Physics Learning Outcomes

The learning outcome data consists of secondary data in the form of First-Semester Midterm Examination (UTS) scores, which, under the Merdeka Curriculum are referred to as Mid-Semester Summative (STS), obtained from Grade XI physics teacher. The test instrument used by the teacher consisted of 25 multiple-choice questions with cognitive levels of C2 (understanding), C3 (applying), and C4 (analyzing) based on Bloom's taxonomy revised by Anderson and Krathwohl. Questions with cognitive levels of C5 (evaluating) and C6 (creating) were not included in the test instrument because they were less relevant to the multiple-choice question format, as well as considerations of time allocation and material coverage. Each correct answer is given a score of "4", while an incorrect answer is given a score of "0", so the total score is in the range of 0-100.

The results of descriptive statistical analysis shows that the average score of students' physics learning outcomes is 72.79 with a standard deviation of 16.927, the lower score is 16 and the highest score is 92. Based on the reference of the grade category that has been determined, in physics learning outcomes, 83.9% of students are in the medium category, 14.9% are in the low category, and 1.2% are in the high category. The frequency distribution of students' physics learning outcomes is presented in Table 3.

Table 3. Distribution Physics Learning Outcomes

Categories	Value Range	Number of Students	Percentage
High	X ≥ 90	2	1.2%
Medium	56 ≤ X < 90	141	83.9%
Low	X < 56	25	14.9%

Table 3. shows that 83.9% of students are in the medium category. Meanwhile, students with high learning outcomes are only 1.2% and students with low learning outcomes reaches 14.9%. These results reflect that the implementation of PBL is quite successful in facilitating students to understand physics concepts through the problem-solving process, even though their achievement at a more in-depth level of concept mastery is not yet fully optimal. The low percentage of students in the high category is inseparable from the same factor as learning activity, namely the difference in students' prior abilities. Students who have a solid understanding of basic concepts are better able to follow the PBL process, while students with limited prior knowledge tend to participate in discussions only at a procedural level. The characteristics of abstract physics material also influence students' physics learning outcomes, especially when students are faced with problems with cognitive levels C3 and C4 that require the ability to connect among concepts. Time constraints also contribute, as the reflection stages that are important to strengthen understanding are often missed or done in a hurry.

Another factor that is no less influencing is the large number of students per class, which is more than 40 students with only one teacher. This condition makes teachers unable to provide intense assistance to all students individually. Teachers have difficulty monitoring the progress of each student's comprehension, especially those who have learning difficulties. In this case, students who need additional explanations or guidance in working on the problem do not always get enough attention. Thus, misunderstandings that should be corrected immediately become undetectable and continue.

The findings on these barriers are also supported by several previous studies that highlight the factors that determine the success of PBL implementation. [16] explained that the role of teachers as facilitators is a crucial factor in determining the success of PBL. Teachers must be able to create a supportive learning environment, provide adequate learning resources, and provide appropriate guidance to each student. Meanwhile, [17] highlights the barriers to the learning process stemming from the heterogeneity of students' prior understanding. This condition forces teachers to provide basic understanding first in addition to teaching physics material. [18] reinforces these findings by revealing that the implementation of PBL is able to improve student learning outcomes, provided that it is supported by careful adjustment to the characteristics of the material, time allocation that is appropriate to the level of depth and breadth of the material, and the quality of the problems given to students.

Thus, although PBL has a positive impact and is quite successful in helping students achieve a moderate level of understanding of physics concepts, the achievement at a deeper mastery level is not optimal. Real obstacles such as differences in prior abilities, abstract materials, time constraints, and the large number of students per class are the main obstacles. Therefore, the effectiveness of PBL in improving learning outcomes requires improvements and appropriate solutions to minimize the negative impact of each of these obstacles, so that the improvement of student learning outcomes in the high category can be achieved by all students.

The Relationship Between Students' Learning Activeness and Physics Learning Outcomes

Based on the interview with the physics teacher, the learning model commonly implemented in the classroom was Problem-Based Learning (PBL). The teacher stated that the instructional process generally followed the PBL syntax, namely: (1) orienting students to the problem, (2) organizing students for learning, (3) guiding individual and group investigations, (4) developing and presenting the results of students' work, and (5) analyzing and evaluating the problem-solving process. However, the researcher was not directly involved in the instructional activities, did not collect or examine lesson plans, and did not systematically observe the implementation of each PBL phase. Therefore, this study was conducted as a correlational investigation in a natural setting based on information provided by the teacher rather than as an experimental study with strict controls.

Before conducting a correlation test to find out the relationship between the two variables, a data normality test was first carried out. The results of the normality test are presented in Table 4.

Table 4. Normality Test Results

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Activeness	.224	168	.000	.841	168	.000
Learning Outcomes	.207	168	.000	.815	168	.000

Based on Table 4, the results of the Kolmogorov-Smirnov normality test shows that the data on students' physics activity and learning outcomes obtained a value of Sig. 0.000, which means that the data is not normally distributed (Sig. value < 0.05). This data abnormality is likely due to two factors. First, the activeness data is ordinal (the conversion results of the categories are very active, active, moderately active, inactive), so the distribution of data tends to be concentrated on only a few values. Second, large sample counts (n=168) may cause the Kolmogorov-Smirnov assay to tend to produce small significance values even though the distribution of data is visually not far from normal. Since the data is not normally distributed, the correlation test is continued using a non-parametric statistic i.e. Spearman correlation. The test results are presented in Table 5.

Table 5. Correlation Spearman's Results

Correlations				
			Activeness	Learning Outcomes
Spearman's rho	Activeness	Correlation Coefficient	1.000	.226**
		Sig. (2-tailed)	.	.003
		N	168	168
	Learning Outcomes	Correlation Coefficient	.226**	1.000
		Sig. (2-tailed)	.003	.
		N	168	168

Based on Table 5, the results of the Spearman test obtains a sig value. (2-tailed) of 0.003, which is smaller than the set significance level (5% or 0.05). The significance value shows that there is a significant relationship between students' activity and physics learning outcomes in the implementation of PBL. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (Ha) is accepted. The value of the correlation coefficient of 0.226 shows that the relationship between the two variables is positive with a low level of relationship. Meanwhile, the value of the determination coefficient (ρ^2) of 0.051 or equivalent to 5.1% shows that student activity only contributes very little to physics learning outcomes.

The low correlation coefficient indicates that the activeness measured in this study primarily reflects students' behavioral engagement such as participating in discussion, asking and answering questions, and contributing to group activities, rather than deeper cognitive engagement. While these observable behaviors demonstrates students' involvement during learning, they do not necessarily indicate meaningful conceptual understanding or deep scientific reasoning. Students may actively participate in classroom interactions without fully comprehending the underlying physics concepts being discussed. This finding is particularly relevant in physics learning, where achievement depends not only on participation, but also on conceptual understanding, mathematical reasoning, and the ability to apply concepts in problem-solving situations. Consequently, students who appear highly active during classroom activities may not always achieve high learning outcomes if their conceptual understanding remains limited, whereas some less active students may still achieving good academic performance due to strong conceptual mastery and independent learning habits. Therefore, the observed activeness may have contributed only marginally to learning outcomes because the instrument primarily captured observable classroom behavior rather than the depth of students' cognitive processing.

Despite its relatively small contribution, the positive relationship between student activeness and physics learning outcomes remains theoretically meaningful. In *Problem Based Learning* (PBL), students are encouraged to actively involve in discussions, investigations, and problem-solving process that facilitate knowledge construction. This finding is consistent with constructivist learning theory and the demands of the Merdeka Curriculum which advocate active and student-centered learning [13]. Theoretically, the constructivist perspective put forward by Piaget emphasizes on knowledge being actively constructed through individual interaction with the learning environment, whereas Vygotsky highlights the importance of social interaction in building understanding [19].

The relatively low coefficient of determination also indicates that physics learning outcomes are influenced by various factors beyond student activeness. Students' prior abilities and intelligence may directly affect their capacity to understand and integrate new concepts, while learning environment, instructional facilities, and teachers' classroom management may influence the effectiveness of the learning process itself. Consequently, although student activeness contributes positively to learning outcomes, efforts to improve achievement through PBL should not focus solely on increasing classroom participation. Instead, they should also address broader contextual and instructional factors that support students' cognitive development and learning performance.

Overall, the activeness and learning outcomes of physics in the implementation of PBL in Grade XI students of science MAN 1 Mataram have a positive correlation with the low category ($\rho = 0.226$). These results show a lower level of relationship compared to previous studies. [20] found a very strong relationship between the two variables in the application of Discovery Learning, with a coefficient of 0.874. Then, [21] also reported a positive relationship between learning activities and student learning outcomes in chemistry lessons, with a correlation coefficient value of 0.405 (sufficient relationship level). Finally, research by [22] found that the correlation between activity and physics learning outcomes with the Group Investigation model resulted in a sufficient level of association with a correlation coefficient of 0.7 at the second meeting.

Thus, although all studies show a positive relationship between activeness and learning outcomes, the strength of the relationship varies. This difference may be due to differences in subject characteristics, learning models, and constraints in the field. These findings reflect that student activity alone is not enough to improve physics learning outcomes optimally. It is necessary to strengthen other factors outside of this activity so that the learning outcomes achieved can be optimal.

The main contribution of this study is to provide empirical evidence that student activity is positively and significantly related to physics learning outcomes in the context of PBL implementation, as well as to provide a practical basis for teachers to design learning that is not only oriented to physical activity, but also to strengthening students' cognitive engagement and scientific reasoning.

The limitation of this study lies in the use of secondary data in the form of documentation of grades from teachers, so that the research only represents academic achievements based on existing grades. This study was also limited to one school, so generalization of results needs to be done carefully. In addition, the correlational design did not allow researchers to deduce cause-and-effect relationships. Further research is recommended using experimental design or mixed methods involving other variables such as learning motivation, critical thinking skills, and the quality of implementation of problem-based learning in the classroom.

4. Conclusion

Based on the results of the research and discussion, it can be concluded that:

a. The findings of this study indicate that the level of student activeness and physics learning outcomes among Grade XI Science students at MAN 1 Mataram were predominantly in the medium category with a percentage of 49.4%. Furthermore, the results revealed a significant positive relationship between student activeness and physics learning outcomes ($\rho = 0.226$, $p < 0.05$). However, the strength of the relationship was low, with a coefficient of determination of 0.051, indicating that student activeness accounted for only 5.1% of the variance in physics learning outcomes.
b. These findings suggest that although student activeness contributes positively to learning outcomes, it is not the primary factor determining students' achievement in physics. The relatively small contribution of activeness indicates that observable participation during learning activities alone is insufficient to ensure optimal academic performance. Physics learning requires not only behavioral engagement, but also deeper cognitive processed, including conceptual understanding, mathematical reasoning, and problem-solving abilities. Therefore, student achievement is likely influenced by a complex interaction of cognitive, personal, and contextual factors beyond classroom participation.
c. From a theoretical perspective, the findings support constructivist learning theory, which emphasizes the importance of active participation in knowledge construction. At the same time, the results suggest that behavioral engagement alone may not fully explain variations in learning outcomes, highlighting the importance of considering broader dimensions of student learning, particularly cognitive engagement, in understanding academic achievement.
d. Practically, the findings imply that efforts to improve learning outcomes in physics should not focus solely on increasing students' classroom participation. In the context of Problem Based Learning (PBL), teachers should not only encourage students to engage actively in discussions and collaborative activities, but also facilitate deeper conceptual understanding, mathematical reasoning, and meaningful problem-solving processes. Greater attention should also be given to other factors that may influence achievement, learning readiness, and the overall quality of instructional support. Therefore, optimizing physics learning requires a comprehensive approach that integrates active participation with strategies that strength students' cognitive development and understanding of concepts.

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