

The Effect of *Problem-Based Learning* (PBL) Model on Students' Motivation and Learning Outcomes on Respiratory System Material Class VIII SMP Negeri 2 Jayapura

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ABSTRACT

This research was conducted to examine the impact of the Problem-Based Learning (PBL) model on students' motivation and academic achievement in the respiratory system topic for eighth-grade students at SMP Negeri 2 Jayapura. The study applied a quasi-experimental design using a pretest-posttest control group approach with purposive sampling. Data collection instruments included multiple-choice tests and a learning motivation questionnaire. The analysis of questionnaire data revealed that the PBL model positively influenced students' learning motivation, as indicated by the t-test result ($t = 1.820$), which exceeded the critical value ($t = 1.670$). Additionally, the learning outcome data demonstrated a significant effect of the PBL approach, as shown by the t-test result ($t = 5.310 > t = 1.670$), leading to the acceptance of the alternative hypothesis (H_1).

INTRODUCTION

Education serves as a key pillar in a nation's progress and development. It is described as a deliberate and systematic effort to establish a conducive learning environment, allowing students to actively cultivate their potential in various aspects such as spiritual values, self-discipline, personal character, intelligence, moral integrity, and essential competencies needed both personally and socially (Law No. 20 of 2003). The purpose of education is not limited to maximizing academic results, but also focuses on the process by which students engage in meaningful learning. In this context, learning activities conducted in schools form an integral part of educational implementation (Lindawati, 2013).

Rismawati (2021) states that achieving educational goals requires students to engage directly with their environment, which is facilitated by the teacher during the teaching and learning process. Each instructional activity must be well-planned, implemented, evaluated, and supervised to ensure its effectiveness and efficiency. The instructional approach should be tailored to the nature of the subject matter. In both primary and secondary education, the learning experience is expected to be interactive, motivating, enjoyable, challenging, and capable of encouraging active student participation. Learners are entitled to engage freely in learning activities relevant to the subject content, while teachers and students are expected to collaborate to achieve learning objectives (Ummah, 2009).

The teacher's role is crucial in enhancing the effectiveness and appeal of the learning process. A conducive classroom environment can be established through the use of appropriate instructional models, which enable students to participate actively and achieve optimal learning outcomes (Haetami, 2007). It is essential for educators to apply varied instructional strategies to increase student interest and engagement. However, in practice, not all teachers utilize diverse teaching models in classroom settings.

Natural science (IPA) is a core subject taught in Indonesian junior high schools (SMP). Science learning involves student-teacher interaction, engagement with the environment, and utilization of various learning resources to achieve basic competencies. One of the key science topics is the human respiratory system, outlined in Core Competency 3.9, which emphasizes analyzing its structure, function, and associated health disorders. Core Competency 4.9 involves presenting student work on maintaining respiratory health. Observations at SMP Negeri 2 Jayapura during a student teaching practicum (PPL) revealed that the school has adopted a scientific approach aligned with the 2013 curriculum. However, instruction remains teacher-centered and relies heavily on the Direct Instruction model. This model does not adequately involve students in the learning process, leading to passive behavior. Indicators of low learning motivation include inattentiveness, lack of focus, disengagement, and signs of fatigue during lessons.

The lack of student motivation in learning contributes to suboptimal academic performance, as seen among eighth-grade students at SMP Negeri 2 Jayapura. Based on the analysis of daily assessment scores in science—particularly in the topic of the respiratory system—a number of students had not

yet met the minimum mastery criteria (KKM), which is set at 75. This indicates the need for variation in instructional strategies. Teachers can enhance both student motivation and learning outcomes through a range of efforts, including the application of suitable learning models or approaches. Selecting the right instructional model plays a significant role in facilitating student development (Fathurrohman, 2017).

A widely adopted instructional model in today's curriculum is Problem-Based Learning (PBL). In essence, PBL presents real-world problems as the foundation for learning, prompting students to engage in exploration and discovery to find viable solutions. This process leads to more meaningful and lasting understanding (Hiderasti, 2013). According to Shoimin (2014), PBL fosters critical thinking and problem-solving skills by placing students in realistic contexts where they must apply their knowledge. Additionally, students are encouraged to think independently and creatively, allowing them to tackle everyday challenges more effectively (Rukmana, 2012).

The application of this model encourages students to take an active role in the learning process, thereby helping to enhance both their motivation and academic performance. This finding aligns with the study by Badaruddin (2015), entitled "*The Effect of PBL Model on Motivation and Biology Science Learning Outcomes of MTs Nurul Huda Sarimulyo Ngawen Blora Students*," which demonstrated that the PBL approach positively affects students' motivation and learning outcomes. Furthermore, research by Nurhikmah (2013) also indicates that the PBL model contributes to improving the effectiveness of science education.

In light of the issues previously outlined, this study aims to examine the influence of the Problem-Based Learning (PBL) model on the respiratory system topic, specifically regarding students' motivation and academic performance at SMP N 2 Jayapura. Accordingly, the research questions formulated are as follows: (a) Does the application of the PBL model affect students' learning motivation in science classes for grade VIII at SMP N 2 Jayapura?; (b) Does the use of the PBL model have an impact on students' learning outcomes in science classes for grade VIII at SMP N 2 Jayapura?

THEORETICAL REVIEW

PBL Learning Model (PBL)

According to Delisle as cited in Abidin (2014), the problem-based learning (PBL) approach is designed to assist educators in nurturing students' abilities to think critically and solve problems throughout their learning process. The PBL method engages learners in addressing real-life challenges, which can stimulate their motivation and curiosity. As noted by Gunantara (2014), this model also serves as a platform for students to cultivate both critical and higher-order thinking skills. Furthermore, Abidin (2014) emphasizes that the PBL framework offers learners genuine and meaningful experiences by encouraging active participation, knowledge construction, and the application of academic content to real-world contexts. Thus, PBL can be viewed as a student-centered learning approach that connects new concepts with students' prior knowledge

(meaningful learning), enabling them to work collaboratively in groups to solve real-life problems while utilizing various educational resources.

Fathurrohman (2015) describes problem-based learning (PBL) as an instructional approach that engages students with real-world issues that are complex, unstructured, and open-ended. This setting provides opportunities for learners to enhance their critical thinking and problem-solving skills while simultaneously constructing new knowledge. Similarly, Zulharman (as cited in Lefudin, 2017) explains that PBL begins with authentic, real-life problems that prompt students to explore and analyze based on their prior experiences and understanding. Through this process, learners generate new insights and build upon existing knowledge. A key component of the PBL approach is collaborative discussion in small groups, which supports active exploration of problems. The emphasis is placed not only on grasping concepts related to the issue at hand but also on applying scientific reasoning to find solutions, thereby deepening comprehension and promoting real-world application.

Problem-Based Learning (PBL) is an instructional approach that integrates real-world, complex issues into the learning environment. It engages students in actively seeking and constructing solutions based on their prior knowledge and individual capabilities. In this setting, the teacher assumes the role of a facilitator, guiding rather than directly instructing. Through the implementation of the PBL model, learners are encouraged to collaborate in groups to explore potential resolutions and are given the chance to analyze a problem from diverse viewpoints and dimensions.

According to Herdiawan et al. (2019), the PBL approach is closely associated with collaborative learning. Before exploring solutions, students are first introduced to the problem and then gain relevant knowledge to support their problem-solving efforts. This method ensures coherence and incorporates the assessment of students' problem-solving processes. There are three core principles that define the PBL model. First, it emphasizes a sequence of engaging learning tasks that go beyond passive activities like listening and memorization. Instead, students are encouraged to think critically, communicate, analyze information, and draw meaningful conclusions. Second, PBL centers its learning on problem-solving, using real-life problems as the foundation of the learning experience. Third, solutions are developed through a scientific reasoning process that follows a structured and empirical pathway. A systematic approach involves progressing through defined phases, while empirical thinking is rooted in objective evidence and observable data (Sanjaya, 2013).

Table 1. Syntax of PBL model

Phase	Teacher Activities
1 Orient students to the problem	The teacher conveys the goals of the lesson, provides information regarding the needed resources, and stimulates students' involvement in problem-based learning activities.

2 Organizing students to learn	The teacher assists learners in outlining and coordinating the tasks necessary to explore and address the given problem.
3 Guiding individual/group investigations	he teacher facilitates students in seeking suitable information, performing experiments, and developing reasoning to address the issue.
4 Developing and presenting work	The teacher supports students in analyzing their inquiry results and evaluating the strategies utilized during problem solving.
5 Analyzing and evaluating the problem-solving process	The teacher assists learners in assessing their inquiry results and the methods applied during the learning process.

Learning motivation

Learning motivation refers to the internal force that initiates, directs, and sustains a student's engagement in learning activities toward achieving specific goals (Manuhutu, 2015). The concept derives from the Latin term *movere*, implying an inner drive to act purposefully (Cleopatra, 2015). Motivation encompasses a learner's desire, internal push, and psychological need to undertake meaningful tasks. Robbins and Judge (2015) describe motivation as the process explaining the intensity, direction, and persistence of effort toward goal achievement. According to Kusnandar (2019), intrinsic motivation is vital for effective learning. McDonald in Kompri (2016) adds that motivation involves an energy shift within the individual, often expressed through emotional and behavioral responses directed at achieving objectives.

Motivation and learning are closely interconnected, with each influencing the other. Students tend to engage more diligently in their studies when they possess strong motivation. Thorndike describes learning as an interaction process between a stimulus – such as thoughts, emotions, or movements – and a corresponding response. This perspective aligns with the views of Goog and Brophy, who argue that learning involves an individual's interaction process that results in acquiring new behaviors through experience. These behavioral transformations are reflected in students' ability to adopt new response patterns to their surroundings, encompassing skills, knowledge, attitudes, competencies, comprehension, emotions, values, physical attributes, character traits, and social interactions (Kompri, 2016). Drawing from these theories, it can be concluded that motivation to learn plays a pivotal role in energizing and supporting students' engagement in the learning process. Motivation serves as a driving force, whether intrinsic or extrinsic, that compels individuals to act in order to meet their needs.

Learning outcomes

Learning outcomes represent behavioral changes and function as feedback to enhance the teaching and learning process. These behavioral changes encompass the cognitive, affective, and psychomotor domains (Sudjana, 2014). As stated by Trianto (2015), learning outcomes are the result of a structured learning process, typically assessed through various forms of evaluation tools, including written, oral, and performance-based tests. Essentially, learning outcomes reflect the transformation in individual behavior following participation in educational activities. These changes are observable across cognitive, affective, and psychomotor dimensions. One way to evaluate the success of an educational process is by examining the extent to which students achieve desirable learning outcomes. In essence, the effectiveness of education is often measured by the quality of students' achievements. Learning outcomes become evident after a sequence of instructional activities and are commonly identified through evaluation procedures and observed improvements in student performance at the conclusion of the learning process.

Learning outcomes can manifest through various types of student actions or behavioral developments. According to educational theories, these outcomes can be categorized into several types. First, *habits* refer to consistent, automatic ways of acting that are acquired through repeated learning and are performed without conscious awareness, as long as the relationship between the individual and the object remains stable. Second, *skills* are purposeful, conscious actions resulting from muscular activity, controlled and coordinated by the nervous system. Unlike habits, skills require attention and continuous practice to be maintained. Third, *accumulated perceptions* include the recognition and comprehension of symbols, numbers, and meanings acquired through observation and learning, especially in connection with concrete objects. Fourth, *association and memorization* involve memory formation through reinforcement, which may occur intentionally or through imitation and natural associations. Fifth, *understanding and conceptual learning* arise from rational cognitive processes, typically driven by the search for answers to "why" and "how" questions. Sixth, *attitudes* represent learners' affective responses, tendencies, and dispositions toward particular objects or situations, shaped within social contexts, and ranging from positive to negative orientations. Seventh, *values* serve as internal standards for distinguishing right from wrong, acquired through ethical learning processes that include stages such as compliance, identification, comprehension, and internalization. Lastly, *morals and religious beliefs* reflect the application of ethical values in interpersonal relationships, and the internalization of spiritual or transcendental principles, such as faith in a higher power.

Learning outcomes represent the primary objective of educational activities conducted in schools. These outcomes can be enhanced through deliberate and systematic efforts, which facilitate positive behavioral and cognitive changes—collectively referred to as the learning process. The culmination of this process is the achievement of student learning outcomes. At the classroom level, individual student outcomes contribute to the overall collection of class learning results. These outcomes emerge from the dynamic

interaction between teaching and learning. From the teacher's perspective, this process concludes with the evaluation of student performance, whereas from the student's viewpoint, learning outcomes signify the peak of their educational journey (Sudjana, 2014).

METHODOLOGY

This study employed an experimental approach utilizing a quasi-experimental design. Specifically, the research implemented a pretest-posttest control group format, where one group (the experimental group) received instruction through the Problem-Based Learning (PBL) model, while the other group (the control group) was taught using conventional methods such as lectures, questioning, and answering. Both groups were administered a pretest prior to the intervention and a posttest afterward to measure changes. The research took place at SMP Negeri 2 Jayapura during the even semester of the 2023/2024 academic year, from April to May 2024.

The population, defined as the entire set of subjects possessing particular characteristics identified by the researcher to be studied and generalized (Sugiyono, 2013), consisted of all eighth-grade students at SMP Negeri 2 Jayapura. The sampling technique used was purposive sampling, selected based on specific criteria relevant to the study's purpose (Sugiyono, 2018). In this case, classes were chosen based on similar average scores and relatively low academic performance. As a result, class VIII-K (32 students) was designated as the experimental group, while class VIII-J (32 students) served as the control group.

The research involved both independent and dependent variables. The independent variable (X) was the PBL instructional model. The dependent variables (Y), influenced by the intervention, were student motivation and learning outcomes. These variables were assessed to determine the effectiveness of the PBL model in improving students' academic engagement and performance.

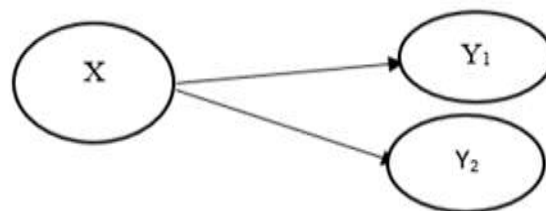


Figure 1. Independent And Dependent Variables

The data collection techniques in this study involved administering both pretests and posttests, as well as distributing questionnaires to students. Accordingly, the instruments used included a learning outcomes test consisting of multiple-choice items and a student motivation questionnaire developed using the Likert scale. The Likert scale employed five response options: strongly agree, agree, neutral (undecided), disagree, and strongly disagree. Prior to the main study, the instruments underwent validity testing. For the pretest data, both normality and homogeneity tests were conducted as part of the prerequisite analysis. If the data met these assumptions, parametric tests such as regression

analysis and the t-test were applied. If the assumptions were not met, non-parametric tests were used instead.

RESULTS

Validity test results

Instrument that will be used to measure its validity is a *questionnaire* and learning outcomes at the form of by pretest and posttest. according to the result that have been carried out on the instrument in the form of a questionnaires from the number of statements totaling 20, the valid ones are 12 statement items. and the *pretest-posttest* learning outcomes instrument totaling 40 questions, 20 valid items were obtained.

Reliability test results

Table 2. result of Instrument Reliability of Test

Variable	Cronbach's Alpha	Description
Questionnaire Motivation (Y1)	0,714	Reliable
Learning Outcomes (Y2)	0,707	Reliable

According to the result on Table 2 shows the *Cronbach of Alpha* value of all variables > 0.05. So, all research variables are reliable. In other words, all questionnaire statement items and *pretest-posttest* question items can be said to be reliable and can be used as instruments to collect data.

Control Class data results

According to the results of the *pretest-posttest* data calculation in the control of class, which was not given treatment, namely only using the lecture method, seen in the following table:

Table 3. Control Class Pretest Posttest Scores

<i>Data</i>	<i>Pretest</i>	<i>Posttest</i>
<i>N</i>	32	32
<i>Highest Score</i>	60	80
<i>Lowest Score</i>	25	40
<i>Average</i>	43,28	62,96

According to the result on the pretest-posttest in the table of student learning outcomes on respiratory system material in the control class using the conventional learning model with a total of 32 students, the average of pretest score was 43.28, and in the of posttest, average score was 62.96.

Experimental Class Data Results

The results of the *pretest-posttest* data calculation in the experimental class before and after being given treatment, namely by using the *PBL* learning model, can be seen in the following table:

Table 4. *Experimental Class Pretest Posttest Scores*

Data	Pretest	Posttest
N	32	32
Highest Score	70	90
Lowest Score	25	55
Average	52,50	75

According to the results of *pretest* data in the table of student learning of outcomes in respiratory system in the experimental class before being given treatment, namely with a total of 32 students, an average value of 52.50 was obtained. The results of *posttest* data after being treated using the *PBL* learning model obtained an average value of 75. These data show an understanding of students.

Results Of the Motivation Questionnaire Data

The data on learning motivation uses a Likert scale questionnaire, with a total of 20 statements before being tested for validity, and then 12 statement items are valid or can be used for further testing. This data was obtained from 64 respondents from the total experimental class and control class as follows:

Table 5 . Questionnaire Results

Indicator	Control Class	Experimental Class
N	32	32
Highest Score	54	53
Lowest Score	22	29
Average	42,53	45

Based on the results of the questionnaire calculation in the table, the average of the experimental class is 45, and the average of the control class is 42.53.

Prerequisite Test Results

The normality test is used to determine whether the data is normally distributed or not. In a regression the dependent variable, independent variable or both have a normal or near normal distribution. To test the normality of the data using the *Kolmogorov-Smirnov* test with the provisions if $\text{Asymp. Sig} > 0.05$ then the data is normally distributed.

Experimental Class Pretest-Posttest Normality Test

After testing the normality of pretest data in the Experiment class and Control class, the following data were obtained:

Table 6. Normality of experimental class pretest-posttest

Learning Outcome	Kolmogorov-Smirnov		Conclusion
	Significance	α	
Pretest	0,99	0,05	Normally distributed data
Posttest	0,050	0,05	Normally distributed data

Table above shows that the pretest data obtained a significance value of 0.99. where $0.99 > 0.05$. and posttest data 0.50. where $0.50 > 0.05$. it can be concluded that the experimental class data is normally distributed.

Control Class Pretest-Posttest Normality Test

After testing the normality of posttest data in the Experiment class and control class, the following data was obtained:

Table 7. Normality Of Control Class Pretest-Posttest

Result Learning	Kolmogorov-Smirnov		Conclusion
	Significance	α	
Pretest	0,50	0,05	Normally distributed data
Posttest	0,80	0,05	Normal distributed data

About the table above, control of class prettest obtained a significance value of 0.50. Where $0.50 > 0.05$. and posttest data obtained a value of 0.80. where $0.80 > 0.05$, it can be concluded that the experimental class data is normally distributed.

Normality Test of Student Motivation Questionnaire

After testing the normality of student learning motivation questionnaire data, the following data was obtained:

Table 8. Normality of questionnaire

Questionnaire learning motivation	Kolmogorov-Smirnov		Conclusion
	Significance	α	
Experimental class	0,06	0,05	Normal distributed data
Control class	0,08	0,05	Normal distributed data

In the table above, the experimental class questionnaire obtained a significant value of 0.06. where $0.06 > 0.05$. and the control class questionnaire data obtained a value of 0.08. where $0.08 > 0.05$. it can be concluded that the experimental and control class questionnaire data are normally distributed.

Homogeneity Test Of Student Learning Motivation Questionnaire

Table 9. Homogeneity test of questionnaire

Questionnaire	Significance	A	Conclusion
Experimental class	0,136	0,05	Homogeneous
Control class	00,136	0,05	Homogeneous

In the table above, the motivation questionnaire data in the experimental and control classes obtained a significance value of 0.136. Where $0.136 > 0.05$, it can be concluded that the experimental and control class data are homogeneous.

*Hypothesis Test Results
 Simple Linear Regression Test.*

Table 10. Simple linear regression test results of PBL model (X) on motivation (Y1)

Coefficients ^a		Unstandardized Coefficients	Standardized Coefficients
Model		B	Beta
1	(Constant)	41.834	
	PBL Model (x)	.074	.113

a. Dependent Variable: Learning Motivation

Based on the table of the results of calculating the simple regression coefficient, the constant coefficient value is 41.834, the coefficient of the independent variable (X) is 0.74. So that the regression equation is obtained:

$$Y_1 = 41.834 + 0.074 X$$

Referring to the equation above, it can be identified that the constant value is 41.834. Mathematically, this indicates that in the absence of any effect from the PBL model (x), the students' learning motivation score would remain at 41.834. In addition, the regression coefficient value of 0.074 for the independent variable demonstrates that for every one-unit increase in variable x, the learning motivation score (variable y) increases by 0.074, indicating a positive direction of the relationship between the two variables.

Simple Linear Regression Test Results PBL Model (x) Against Learning Outcomes (Y2)

Table. 11 Simple Linear Regression Test Results PBL Model (x) Against Learning Outcomes (Y2)

Coefficients ^a				
		Unstandardized Coefficients	Standardized Coefficients	
Model		B	Std. Error	Beta
1	(Constant)	57.885	5.830	
	PBL Model (x)	.331	.110	.481

a. Dependent Variable: Learning Outcome

Based on the table of the results of calculating the simple regression coefficient, the constant coefficient value is 57.885, the coefficient of the independent variable (X) is 0.331. So that the regression equation is obtained:

$$Y_2 = 57.885 + 0.331 X$$

Based on the above equation, it is known that the constant value is 57.885 mathematically, this constant value states that if there is no influence from the PBL model (x), then the score value of learning outcomes is 57.885. Furthermore, the value of 0.331 contained in the regression coefficient of the independent variable illustrates that the direction of the relationship between variable x and variable y will cause an additional score of 0.331.

Test t

After data processing, the data obtained from the t test results are as follows:

Table. 12 PBL model test (X) on learning motivation (Y1)

Paired Samples Test								
		Paired Differences						
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	Sig. (2-tailed)	
n	Mean			Lower	Upper		df	
Motivation Class	-2.469	7.675	1.357	-.298	5.236	1.820	31	.078

The t_{count} result obtained using SPSS is 1.820. Decision making if $t_{(count)} > t_{(table)}$ then H_a is accepted and H_o is rejected. From the calculation of $t_{(count)}$ of $1.820 > t_{table}$ which is 1.670 at a significant level of 5%, then H_a is accepted and H_o is rejected. From the results of hypothesis testing it is proven that "There is an effect of PBL learning model on learning motivation".

Table 13. t test of PBL model (X) on Learning Outcomes (Y₂)

		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Significance		Mean	Std. Error
						One-Sided p	Two-Sided p	Difference	Difference
Learning Outcome	Equal variances assumed	2.304	.134	5.310	62	.000	.000	12.031	2.266
	Equal variances not assumed			5.310	59.270	.000	.000	12.031	2.266

The result of t_{count} obtained is 5.310. Decision making if $t_{(count)} > t_{(table)}$ then H_a is accepted and H_o is rejected. From the results of the calculation of t_{count} of $5.310 > t_{table}$ which is 1.670 significant level of 5%, then H_a is accepted and H_o is rejected. From the results of testing the hypothesis it is proven that "There is an effect of the PBL learning model on learning outcomes"

Coefficient of Determination

The basis for making decisions on the coefficient of determination (R^2) test is, if the coefficient of determination is equal to 0 ($R^2 = 0$), it means that the variation of Y cannot be explained by X at all. Meanwhile, if $R^2 = 1$, it means that the variation of Y as a whole can be explained by x.

Table 14. Test Results of the Coefficient of Determination of PBL Model on Motivation

Model Summary ^b				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.306 ^a	.613	.020	4.495

a. Predictors: (Constant), Model_PBL

b. Dependent Variable: Motivation_Learning

Based on the table above, it can be seen that the value of R^2 (Adjusted R Square) is 0.613, equivalent to 61.3%. This means that the effect of the PBL model on learning motivation is 61.3%. The remaining 38.7% is influenced by other factors not examined.

Table 15. Test results of the coefficient of determination of the PBL model on learning outcomes

Model Summary^b			
Model	R	Adjusted R Square	Std. Error of the Estimate
1	.481 ^a	.232	7.157

a. Predictors: (Constant), Model_PBL

b. Dependent Variable: Learning Outcome

Based on the table above, it can be seen that the value of R² (Adjusted R Square) is 0.232, equivalent to 23.2%. This means that the PBL learning model on learning outcomes is 23.2%. The remaining 76.8% is influenced by other factors not examined.

DISCUSSION

According to the validity and reliability test data previously displayed, the instruments used are eligible for use in this study. Likewise, the normality and homogeneity tests obtained normal and homogeneous data, so that the data is feasible to proceed to test the proposed hypothesis.

Effect of PBL learning model (X) on motivation (Y1)

The results of the simple linear regression analysis revealed a constant value of 41.834. This indicates that when there is no increase in the PBL learning model score, the predicted learning motivation score remains at 41.834. Furthermore, the regression coefficient for the independent variable (PBL model) is 0.074, which signifies a positive relationship. This means that for every one-unit increase in the PBL variable, the learning motivation score (Y_1) increases by 0.074 points. The coefficient of determination (R^2) test results showed that the PBL learning model contributed 61.3% to the variance in students' learning motivation, while the remaining 38.7% is influenced by other variables not examined in this study. The implementation of the PBL model had a significant impact on students' motivation. This was evident in the experimental group, where students demonstrated greater engagement in group discussions, asked more questions, expressed personal opinions, and proposed relevant solutions to learning problems.

These findings align with the study by Niemi et al. (2018), which reported that students in the experimental group who were taught using the PBL approach exhibited higher levels of motivation compared to those in the control group. According to their research, the PBL model fosters student involvement in generating ideas to solve problems, serving as a foundation for acquiring new knowledge. This process stimulates students' intrinsic motivation to learn. Enhancing motivation leads to increased student participation in questioning, answering, responding to instructional content, and maintaining discipline, which in turn encourages students to develop learning strategies and styles that suit them during classroom activities.

Effect of PBL learning model (X) on learning outcomes (Y₂)

The results of the simple linear regression analysis indicated a constant value of 57.885. This suggests that when the PBL learning model variable is at zero (i.e., when no implementation occurs), the predicted score for student learning outcomes remains at 57.885. Moreover, the regression coefficient of 0.331 for the independent variable (X) indicates a positive linear relationship with the dependent variable Y₂ (learning outcomes). In other words, for every one-unit increase in the PBL model variable, there is a corresponding increase of 0.331 points in the learning outcomes score. The coefficient of determination (R²) showed that the PBL model contributed 23.2% to the variance in learning outcomes, while the remaining 76.8% was influenced by other unexamined factors. These results affirm that the PBL model has a meaningful influence on student learning outcomes. The PBL approach transitions the learning process from a teacher-centered to a student-centered paradigm, emphasizing contextual learning and direct experience. As a result, students become more actively involved in formulating and answering questions throughout the learning process.

Furthermore, PBL requires learners to be actively engaged with the learning material and encourages them to focus their cognitive efforts on the problems presented. This engagement helps students not only to understand the underlying concepts more deeply but also to apply scientific methods in problem-solving, thereby reinforcing the transfer of knowledge to real-world contexts. This conclusion supports findings by Lestari (2017), who reported that the implementation of PBL enhanced student engagement and initiative in classroom activities, ultimately contributing to improved learning outcomes. In addition, the findings of this study are consistent with research conducted by Didik (2012), who found that the impact of the PBL model was evident through the differences in student motivation scores. Students in the experimental group achieved scores within the "good" category, while those in the control group were predominantly in the "sufficient" category, indicating lower motivation.

In both the experimental and control groups, the learning process involved the use of Learner Worksheets (LKPD), which were adapted to suit each respective instructional model. LKPDs were utilized during the first through third meetings. In the first session, students in the experimental class appeared unfamiliar with working on problem-based LKPDs, likely due to their prior learning experiences, which primarily involved traditional group discussions and the use of publisher-provided worksheets. However, by the second and third meetings, students demonstrated improvement and gradually adapted to the PBL-based LKPD. According to Astuti (2021), LKPDs designed within the PBL framework serve as a guiding tool for students to engage in investigative activities. These tools help learners identify concepts and formulate solutions to presented problems, thereby facilitating conceptual understanding and problem-solving competence.

The Problem-Based Learning (PBL) model enhances students' comprehension of subject matter by allowing them to discover solutions through guided exploration and group collaboration. This student-centered approach sharpens understanding by encouraging active inquiry. Kusumaningtias (2013) supports this perspective, asserting that grouping students and facilitating

independent problem-solving through dialogue with teachers and peers significantly improves the achievement of desired learning outcomes. In contrast, conventional learning often centers on the teacher, resulting in passive student involvement. The implementation of PBL in experimental classes, however, shifts the focus toward active learning. Through PBL, students engage directly with real-world challenges presented by the instructor, fostering interaction among peers as they work collaboratively to resolve these problems.

The PBL model significantly boosts students' creativity and cognitive skills by engaging them in authentic, everyday issues drawn from their personal and environmental contexts. Such real-life phenomena not only enrich the learning process but also promote deeper understanding. Instruction structured around the PBL framework is inherently student-driven, which enhances lesson comprehension, encourages active participation, and adds meaningful value to the learning experience. It also cultivates critical life skills by teaching students how to identify solutions, act proactively, and take responsibility for constructing knowledge. Moreover, PBL supports the development of problem-solving abilities and strengthens connections between prior knowledge and new learning. By engaging with familiar problems, students experience more meaningful learning. The PBL approach enhances retention, fosters relevant knowledge acquisition, improves leadership and collaboration, and motivates learners. Its student-centered orientation empowers learners to identify and define problems, gather relevant information, generate alternative solutions, and resolve issues effectively.

Specifically in science learning – such as respiratory system topics – PBL actively involves students in constructing knowledge, thereby improving their academic outcomes. It encourages students to apply what they have learned to real-life situations, making the learning process more practical, relevant, and impactful.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings and analysis, the following conclusions can be drawn: a) The Problem-Based Learning (PBL) model significantly influences students' learning motivation; b) The PBL model also has a notable effect on students' academic achievement.

In light of these results, the study recommends the following: future implementations of the PBL model should consider integrating it with other instructional strategies to optimize its effectiveness in the classroom. Additionally, upcoming research should aim to include assessments of the affective and psychomotor domains to provide a more comprehensive evaluation of student learning outcomes.

FURTHER STUDY

Use innovations in the application of this model, such as the use of more diverse media and techniques.

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