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The Influence of The Problem Based Learning Model to Improve Student Learning Outcomes on Newton's Law Material at SMA Negeri 1 Percut Sei Tuan

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ABSTRACT

This study aims to determine whether the influence of problem-based learning models can improve student learning outcomes in the main material of Newton's law in the even semester of class X of SMA Negeri 1 Percut Sei Tuan. This study is a quasi-experimental study. The population of the study was all students of class X of SMA Negeri 1 Percut Sei Tuan consisting of 10 classes, then sampling was carried out using random sampling techniques. The instrument used to determine student learning outcomes was a learning outcome test in the form of a multiple-choice test totaling 20 questions. The results of the study obtained an average pretest score of the experimental class of 34.58 and a control class of 32.77. After the pretest data was normal and the difference test was homogeneous, the values of the two classes were obtained that both classes had the same initial abilities. Then different treatments were given, namely the experimental class with a problem-based learning model and the control class with a conventional model. The average posttest score of the experimental class was 81.66 and the control class was 65.69. After the normal and homogeneous posttest data were obtained, the difference test values of the two classes showed that there were differences due to the influence of the problem-based learning model on student learning outcomes in the main material of Newton's law in class X of SMA Negeri 1 Percut Sei Tuan.

Introduction

21st century education has experienced many changes along with the development of technology and teachers are required to be able to keep up with these developments (Devanda dan Eizar, 2023). One of the problems in the world of education today is the weakness of the learning process. The development of students' thinking abilities in the learning process, students are often given directions to be able to memorize various information. These gaps are supported by the results of related previous studies. This is in accordance with the facts on the ground.

Based on literature studies conducted by researchers, students generally do not like physics lessons because they think physics is just a collection of complicated formulas, they do not understand the application of physics in everyday life, so students' interest in learning is low, especially for students who don't like mathematics (Napsawati, 2019). Low interest in learning can also be caused by less effective learning (Rakhmah dan Pradikto, 2025). This is because students are less able to solve problems in learning physics such as problems in questions and problems in everyday life. Another cause is that learning is dominated by teachers who deliver material using teacher-centered lecture methods, carried out conventionally

Based on research conducted at SMA Negeri 1 Percut Sei Tuan, the problem found by researchers was the low learning outcomes of students in physics subjects. This is supported by the results of the initial

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test data given to 20 students with a total of 10 questions and it was found that the average student score was still below the criteria for achieving learning objectives (KKTP). Students are less able to comprehend, understand and apply the material taught. This is because 60% of students tend to memorize definitions and formulas, the learning carried out is less related to daily life, resulting in students not understanding the concepts of physics material.

Based on observations at SMA Negeri 1 Percut Sei Tuan, the learning used by teachers is still predominantly teacher-centred, namely still using conventional learning models, where teachers only explain the material and students are not actively involved in the learning process. Teachers also predominantly use the lecture method. This causes students to be less active in learning, so that students are less encouraged to develop their thinking abilities. Learning using the teacher's lecture method only focuses on explaining mathematical problems and is rarely given problems, this makes students accustomed to learning only limited to the material provided. This is characterized by a lack of students being able to organize strategies, a lack of ideas that emerge when the teacher gives them problems, and lecture methods that do not provide opportunities for discussion so that knowledge absorption is less than optimal.

One learning solution that can be used to improve student learning outcomes is to change physics learning from teacher-centered to student-centered. One learning model that can be used by teachers is to apply a problem-based learning model, which allows students to actively participate in the learning process, namely by using a problem-based learning (PBL) model. The PBL model is a learning where students are faced with authentic (real) problems so that it encourages students to think critically, creatively and collaboratively. According to Arends (2012) PBL is a model of discovery that trains students to handle bona fide problems so that students can gather their own insights, practice higher thinking skills, grow self-confidence and become more independent. The PBL model needs to be taught to students to learn to understand their environment, because the problems presented in learning using this model are authentic problems. Students' ability to analyze, solve problems and make decisions will increase students' interest and motivation in learning through learning using the PBL model. Students will learn by searching for information, analyzing, and finding solutions to given problems. According to research by Damayanti & Mediatati (2023), it is concluded that the application of the problem based learning (PBL) model can improve learning outcomes. According to Sari (2023), the PBL model can increase students' interest or curiosity because students become more active in asking questions about the material by relating it to the real world, responding to questions well and being able to answer them, draw conclusions and solve problems, and so on. The PBL model is student-centered problem-based learning whose learning involves students in solving real-world problems that are relevant to the learning content. Students will learn by searching for information, analyzing, and finding solutions to given problems. According to Pasinggi (2023), the application of the PBL model has a positive influence on improving student learning outcomes where the PBL model facilitates problem-based learning which makes physics concepts more contextual. Based on research by Sulatri (2022), it is said that implementing the PBL model can improve students' physics learning outcomes.

Methods

This research was conducted at SMA Negeri 1 Percut Sei Tuan in the even semester of the 2024/2025 academic year. The population in this study were all students of class X of SMA N 1 Percut Sei Tuan consisting of 10 classes. This type of research is a quasi-experiment involving two classes with each class consisting of 36 students. The type of research used in this research is quasi-experimental The research sample consisted of two classes that were given different learning models. Class X-6 with 36 students as the experimental class was given treatment with the problem based learning (PBL) model, while class X-2 with 36 students as the control class was given treatment using the conventional learning model.

Table 1
Two Group Pretest-Posttest Research Design

Class	Pretest	Handling	Posttest
Experiment	T_1	X	T_2
Control	T_1	Y	T_2

Information:
X = Learning using the Problem Based Learning Model
Y = Learning using conventional learning models
T_1 = Pre-Test for the experimental and control classes.

T_2 = Post-Test for the experimental and control classes.

The instrument used to collect student outcome data is a student learning outcome test on Newton's law material. Before the test is tested on the sample class, the test is first tested to determine its discriminatory power, level of difficulty, reliability and validity. The hypothesis proposed in this study is:

H_a : The influence of the Problem Based Learning learning model in improving student learning outcomes on the main material of Newton's Law at SMA N 1 Percut Sei Tuan Medan.

H_0 : There is no influence of the Problem Based Learning learning model in improving student learning outcomes on the main material of Newton's Law at SMA N 1 Percut Sei Tuan Medan

Test the requirements using statistical product and service solution (SPSS). The requirement tests used are normality using Kolmogorov-Smirnov and homogeneity of variance using Lavena test. Hypothesis testing using t test with SPSS version 25.

Result and Discussions

The research data is described by displaying the pre-test and post-test results for both the experimental and control classes. The data obtained from the study showed that the results of the initial ability test in the experimental class obtained the smallest value of 15, the largest value of 60, and the average value of 34.58, while the results of the initial ability test in the control class obtained the smallest value of 15, the largest value of 45, and the average value of 32.77. In the experimental class after learning with the problem based learning (PBL) model, the posttest results were obtained with the smallest value of 70, the largest value of 95, and the average value of 81.66. The control class that was given conventional learning showed the posttest results with the smallest value of 50, the largest value of 85, and the average value of 65.69. The results of the study obtained showed the influence of the use of the problem based learning (PBL) model to improve students' cognitive learning outcomes.

Based on the data obtained, it shows that the average initial ability value in the experimental class and the control class is not too different. Then the pretest data from the two sample classes were processed using the t-test hypothesis test to determine the similarity of the average initial ability level.

Table 2
Pretest Result Data for Experimental Class and Control Class

Experimental Class		Control Class	
Value Interval	Frequency	Value Interval	Frequency
15-20	4	15-20	5
21-30	11	21-30	10
31-40	15	31-40	15
41-50	4	41-50	6
51-60	2	51-60	0
Average	34,58	Average	32,77
Standard Deviation	9,95	Standard Deviation	9.13
Variance	96,35	Variance	81,17

After the treatment was carried out, a post-test was conducted on the experimental class and the control class. The post-test was conducted to see the difference in knowledge between the experimental class and the control class after the treatment was given.

Table 3
Posttest Result Data for Experimental Class and Control Class

Experimental Class		Control Class	
Value Interval	Frequency	Value Interval	Frequency
70-75	10	50-55	7
76-80	10	56-65	15
81-85	9	66-70	6
86-90	5	71-75	3
91-95	2	76-85	5
Average	81.66	Average	65.69
Standard Deviation	6.65	Standard Deviation	9.19
Variance	43.05	Variance	82.15

The posttest data obtained the control class score lower than the experimental class score. With the lowest score in the range of 50-55 while the lowest score in the experimental class was in the range of 70-75. The highest score in the control class was in the 76-80 score interval, while the highest score in the experimental class was in the 91-95 score interval. This proves that there is a difference in ability after being given different treatments between the experimental class and the control class.

1) Statistical Requirements Testing

a) Normality Test

The test results were analyzed using the t-test with prerequisites, namely that normality and homogeneity must be tested. Normality test is one of the requirements that must be met before hypothesis testing is carried out. The normality test on pretest data is intended to determine whether the sample comes from a normally distributed population or not.

The normality test on pretest data used is the Shapiro-Wilk test with a significance level of α = 0.05. After data processing, the normality test can be seen in Table 4.

Table 4
Results of Two-Class Sample Data Normality Test

Test	Class	Statistic	Sig	Description
Pretest	Experiment	0.95	0.114	Normal
	Control	0.95	0.127	Normal
Poss-test	Experiment	0.94	0.063	Normal
	Control	0.95	0.181	Normal

The data in Table 4 shows that the results of the significance values from the initial test and final test in the experimental class and control class are normally distributed.

b) Homogenity Test

The homogeneity test was conducted to determine whether the two samples came from two homogeneous populations or not and could represent the entire population or not. The homogeneity test of the two classes was conducted using the Levene Test using SPSS with a significance of α>0.05. The results of the homogeneity test can be seen in Table 5.

Table 5
Results of the Homogeneity Test of Pretest Learning Outcomes

Test	Levene Statistic	df1	df2	Sig	Description
Pretest	0.013	1	70	0.911	Homogen
Posstest	3.027	1	70	0.86	Homogen

Based on Table 5, it shows that the significant value of learning outcomes is greater than 0.05. Based on the significance value of the pretest and posttest data on student learning outcomes. it can be concluded that the initial and final test scores in the experimental and control classes come from a homogeneous population and can represent the entire population.

The data shown in the results of the normality test and homogeneity test indicate that the research sample is normally distributed and homogeneous. so it meets the requirements for conducting a hypothesis analysis using the t-test.

2) Hypothesis Testing

The hypothesis tested on the pretest data is in the form. A two-tailed t-test is carried out to see the similarity in the level of initial knowledge in the experimental class and the control class before being given treatment.

Table 6
Results of the Pretest t-Test Learning Outcomes

	Mean	Std. Deviation	Std. Error Mean	t	Sig(2-tailed)
Experiment	34.58	9.955	1.659	0.802	0.425
Control	32.78	9.137	1.523	0.802	0.425

Table 6 shows the results of the t-test on the pretest of the experimental class and the control class. The sig value (2-tailed) of the pretest of the experimental class and the control class is 0.425 > 0.05. Based on the Sig value (2-tailed) obtained in the pretest of the experimental class and the control class. the Sig value (2-tailed) is greater than α. so Ha is rejected and H0 is accepted. so it can be concluded that the control class and the experimental class have the same initial ability.

The results of the hypothesis test to see the differences in student learning outcomes from the two classes using the t-test are presented in table 7.

Table 7
Posttest t-test Results Learning Outcomes

Test Instru-ment	T_{value}	Std. Devi-ation	Std. Error Mean	t	Sig(2-tailed)
Experiment vs Control	8.447	6.655	1.532	8.447	0.000

Table 7 shows the results of the t-test on the Posttest of the experimental class and the control class. The sig value (2-tailed) obtained in the pretest of the experimental class and the control class Sig value (2-tailed) 0.000 < 0.05. it is concluded that H0 is rejected. H0 is rejected and Ha is accepted. so there is an influence of the problem based learning (PBL) model to improve student learning outcomes.

The results of the study showed differences in student learning outcomes due to the influence of the problem based learning (PBL) model on Newton's law material in class X. even semester of SMA Negeri 1 Percut Sei Tuan. This is indicated by the difference in pretest and posttest scores in the experimental and control classes. The average pretest score of students in the experimental class was 34.58 and the average posttest score was 81.66. while in the control class the average pretest score was 32.77 and the average posttest score was 65.69. This proves that the abilities of students who use the problem based learning (PBL) learning model are better than conventional learning. The results of this study are in accordance with the results of the study (Pasinggi.. 2019) where the results of the study showed that the use of the problem based learning model can improve student learning outcomes so that it has a positive impact. Students feel happy during the learning process using the problem-based learning model because they can connect events related to their daily lives with the knowledge they learn. The results of research from (Damayanti & Mediatati.. 2023) also stated that the application of problem-based learning models has been proven effective in improving student learning outcomes. By using this model. there is a significant increase in student academic achievement. According to Derlina & Sihotang's research (2013). there is a significant difference between the learning outcomes of students who are given a problem-based learning model and a conventional learning model. The same research results were also found in Novriyanti & Derlina's research (2014) which stated that student learning outcomes in classes using the problem-based learning model increased because the model can increase activity. critical and creative thinking skills and students' physics solving abilities. In the study (Yulianti & Gunawan. 2019) it was stated that learning with the problem-based learning model can improve student learning outcomes by linking learning to the surrounding life.

The problem-based learning model applied in this study consists of five phases. In the first phase. namely student orientation to the problem. students are given several questions or issues related to everyday life. Then continued with the second phase. namely organizing students to learn; in this phase the teacher helps students to identify and manage learning tasks related to the problem. Then students are divided into several study groups. and student worksheets are distributed. The third phase guides individual and group investigations; in this phase students review student worksheets. collect information. and analyze through literature studies to obtain explanations and solutions to problems. and the teacher guides students in reviewing student worksheets. In the fourth phase. namely developing and presenting work results. students discuss with their group mates to produce problem-solving solutions and show them. The fifth stage is analyzing and evaluating the problem-solving process. at this stage students present the results of student worksheets and conclude the learning.

In the control class. the researcher used conventional learning. where in this learning the lecture method was used. The researcher provided materials and some practice questions to students. During learning in the control class. students were not given problems. students were also not formed into groups and did not conduct experiments. Students were only given material in the form of explanations of Newton's laws that they wrote down in notebooks and worked on questions. During the learning process. students did not have discussions to solve a problem. so students were passive in learning and only oriented towards memory and could not apply concepts in the real world. Students were not dominant in learning because learning was centered on the teacher. this caused the learning outcomes of students in the control class to get lower scores compared to the experimental class.

The results showed that the average posttest in the experimental class. which was 81.66. was greater than the average control class. which was 65.69. So it can be concluded that there is an influence of the use of the problem based learning (PBL) model to improve students' cognitive learning outcomes on Newton's law material in class X of SMA Negeri 1 Percut Sei Tuan in the 2024/2025 academic year. The application of the problem-based learning model has been proven effective in improving student learning outcomes. By using this model. there was a significant increase in students' academic achievement (Damayanti & Mediatati.. 2023; Puspita et al.. 2019).

Problem-based learning model offers several significant benefits for students. Through active involvement in solving real-world problems. students develop a deep understanding of certain concepts and acquire problem-solving skills. critical thinking skills. collaboration. communication. and strong intrinsic motivation. Researchers faced several obstacles during the implementation of the study. The obstacles experienced regarding the problem of time control were sometimes difficult to control. One example of difficulty is time control because the class is not conducive. Keeping the class conducive during the teaching and learning process is one of the difficult things to do. This was overcome by researchers by extra in controlling the class so that learning can be carried out properly.

Conclusions

Based on the results of the analysis and t-test testing that has been carried out on class X students of SMA Negeri 1 Percut Sei Tuan on the material on Newton's Laws for the 2024/2025 academic year. it is concluded that the physics learning outcomes obtained by applying the problem based learning model to Newton's law material in class X-6 of SMA Negeri 1 Percut Sei Tuan have an average of 81.66 which has met the KKTP value of 70.00. The physics learning outcomes obtained in class X-2 of SMA Negeri 1 Percut Sei Tuan as a control class that was given treatment using a conventional learning model.

obtained an average value of 65.69 where this result is lower than the results obtained by the experimental class. There is a significant influence in the application of the problem based learning model on the achievement of physics learning outcomes. Newton's Law material in SMA Negeri 1 Percut Sei Tuan which is shown after conducting a t-test on the posttest value of student learning outcomes after being taught using the problem based learning (PBL) model on Newton's Law material obtained sig 0.000.

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