Implementation of Project Based Learning on Students' Learning Interest and Understanding of Physics Concepts

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Abstract - *This research is pre-experimental research which aims to determine the increase in students' interest in learning and understanding of physics concepts after implementing the Project Based Learning (PjBL) model in physics subjects at SMA Negeri 1 Bone. This research uses One Group Pretest-Posttest Design. The class that was the research subject was class XI MIPA 2. The total number of research subjects was 33 students. Data were analyzed using Microsoft Excel 2010 using descriptive analysis and N-Gain test analysis to see the increase in students' interest in learning and understanding of physics concepts by applying the PjBL model to static fluid material. Based on the results of research on interest in learning physics, the average pretest score was 88.78 and the posttest score was 126.45, and for understanding physics concepts, the pretest score was 10 and for the posttest it was 16.12. For the results of the N-Gain test analysis on interest in learning physics, it was found that 33.33% was in the high category and 66.67% was found in the medium category. For the results of the N-Gain test analysis on understanding physics concepts, 33.33% were in the high category and 66.67% were in the medium category. This proves that before implementing the PjBL model, students' interest in learning and understanding of physics concepts were in the medium category. and after implementing the PjBL model, students' interest in learning and understanding of physics concepts is in the high category. The PjBL model can increase interest in learning and understanding of physics concepts in class XI MIPA 2 students at SMAN 1 Bone.*

Keywords: *Interest in Learning Physics; Understanding of Physics Concepts; Project Based Learning*

INTRODUCTION

When observing several class XI students at SMAN 1 Bone, they said they were less interested in physics subjects. From the answers of several students, they tend to feel bored when learning physics. The subject teacher also said that the majority of students got physics exam scores below the KKM standard.

Interests have a big influence on learning conditions, because if the learning material studied is not in accordance with students' interests, students will not learn as well as possible, because there is no attraction for them (Slameto, 2018).

Understanding concepts is a process carried out to truly understand a design or an abstract idea that allows someone to classify an object or event, and understanding concepts is obtained through the learning process (Sonia, et al, 2023). Understanding is the result of teaching and learning which has indicators and each individual can explain or define a piece of information in their own words (Elisa, et al, 2017).

Learning models are instructions used by teachers or lecturers in planning learning in the classroom, starting from preparing learning tools, media and tools, as well as evaluation tools in an effort to achieve learning goals. So the learning model really influences the learning process in the classroom (Tawil, 2011).

Project based learning commonly referred to as PjBL is a learning model based on the fact that students can understand the material more deeply when they actively work with ideas. In particular, PjBL has characteristics including; involving students directly during the learning process,

connecting learning with real life, carried out on a research basis, combined with knowledge and skills, carried out continuously and the final result is a product made by students (Sujana, Atep, et al, 2020).

When implementing PjBL, students discover new things. Students are guided to organize, create designs, complete projects, prepare presentations and evaluate. Students are guided to explore, assess, interpret information in groups. Then students present the results of their project work (Hosnan, 2014).

PjBL is a learning model that requires students to create a project, so students must be more active, creative, innovative and critical. The implementation of PjBL encourages limited knowledge in the classroom to be built little by little through limited context through real experience. Students' knowledge and skills can be obtained by themselves when working on projects (Fitriani, 2020).

According to the results of research conducted by (Rohman, 2021) PjBL has several advantages as follows:

1) It has more effectiveness compared to conventional learning in increasing academic achievement in annual state assessment tests.
2) More effectively used in mathematics, economics, science, social studies, medical skills, clinical studies, and for career or employment and health teaching.
3) It is more practical than conventional learning and has long-term benefits for preparing students to integrate understanding of concepts and principles in science.
4) Can be applied to all subjects and all levels of education.

According to (Vioreza et al, 2020) the learning steps with the PjBL model are as follows:

1) Start with the essential question or basic questions and project determination. Activities carried out by the teacher facilitate students to ask questions regarding the preparation of the theme/topic of a project. Students ask questions as material for the theme/topic of the project to be created.
2) *Design a plan for the projector* designing project completion steps. The teacher facilitates students to design steps for project completion activities and their management. Students design steps for project completion activities and their management.
3) *Create a schedule*or preparing a project implementation schedule. The teacher provides assistance to students in scheduling the steps for making a project. Students discuss the scheduling of all activities that have been designed.
4) *Monitor the students and the progress of the project*or project completion with teacher facilitation and monitoring. The teacher facilitates and monitors students in carrying out the project designs that have been created. Students carry out project creation with monitoring from the teacher.
5) *Assess the outcome*or preparation of reports and presentation/publication of project results. The teacher facilitates students to prepare reports and then present the results of their work. Students prepare a report then present the results of their work.
6) *Evaluate the experience*or evaluation of project processes and results. Teachers and students at the end of the learning process reflect on the activities and results of student project assignments.

Based on the results of observations made at SMAN 1 Bone, the majority of students did not like physics subjects. Students' interest in learning is very poor, indicated by students' lack of activity during the learning process. There are still many students who lack focus when learning. Students' ability to understand concepts is also still low. Most students still get exam results below the KKM score. Therefore, based on the background explanation above, researchers are interested in conducting research on implementing the Project Based Learning Model to Interest in Learning and Understanding of Physics Concepts.

RESEARCH METHODS

This research is pre-experimental research and uses a One-Shot Case Study design which was carried out in the 2023/2024 academic year. The subjects in this research were 33 students of class X MIPA 2 SMAN 1 Bone.

The data collection methodology uses a questionnaire instrument on interest in learning physics and a test of understanding physics concepts in the form of multiple choice questions designed to evaluate students' interest in learning and understanding of physics concepts after implementing the PjBL model, which is called the posttest. The validity of the test is proven through the Gregory test.

The research procedure includes three stages: 1) The preparation stage includes field observations, interviews with physics teachers at SMAN 1 Bone regarding student learning. physics learning conditions, administrative tasks, making teaching materials such as learning implementation plans (RPP), student worksheets (LKPD), teaching materials, and making research instruments; 2) Implementation stage, namely the selected class undergoes learning using the PjBL model which ends with a pretest; and 3) The final stage which includes data processing and descriptive analysis of student data on interest in learning and understanding of physics concepts. After data analysis, the thesis writing stage was carried out which resulted in conclusions regarding the description of interest in learning and understanding of physics concepts for class XI MIPA 2 SMAN 1 Bone who took part in learning using the PjBL model.

The data obtained was analyzed using descriptive statistics, aiming to describe the data without intending to draw generalizable conclusions. The analysis provides an overview of student performance. score of interest in learning and understanding of physics concepts, including average score, highest and lowest scores, standard deviation and variance.

RESULTS AND DISCUSSION

Results

Based on the analysis of interest in learning and understanding of physics concepts for class XI SMAN 1 Bone for the 2023/2024 academic year, the results are presented in the following table.

Table 1. Pretest and Posttest Score Statistics on Students' Interest in Learning Physics

Statistics	Statistical Value	
	Pretest	***Posttest***
Theoretical Minimum Score	30	30
Theoretical Maximum Score	150	150
Minimum Empirical Score	58	104
Empirical Maximum Score	121	145
Average Score ($\bar{X}$)	88.78	126.45
Standard deviation (S)	14.49	12.16
Variance (S2)	207.05	147.94

The table above shows that there is an increase in students' learning interest test results in physics subjects after the PjBL model was implemented. In the initial test (pretest), interest in learning physics had the lowest score, namely 58, the highest score was 121 and the average score was 88.78, which was in the medium category with a standard deviation of 14.49. In the final test (posttest) the lowest score was 104, the highest score was 145, and the average score was 126.45 in the high category.

Table 2. Pretest and Posttest Score Statistics for Students' Understanding of Physics Concepts

Statistics	Statistical Value	
	Pretest	*Posttest*
Number of Samples	33	33
Theoretical Minimum Score	0	0
Theoretical Maximum Score	20	20
Minimum Empirical Score	5	11
Empirical Maximum Score	13	19
Average Score ($\bar{X}$)	10	16,12
Standard Deviation(S)	1,904	2,147
Variance(S2)	3,625	4,610

Based on the table above, it can be seen that the average pretest score of students is 10, while the average posttest score is 16.12. This shows an increase in students' understanding of physics concepts. In addition, standard deviation is also used to measure the extent to which data is spread around the mean. The standard deviation of the pretest score is 1.904, while the standard deviation of the posttest score is 2.147. This difference in standard deviation shows that the posttest score has a higher level of variation compared to the pretest score. The highest and lowest scores for the pretest were 13 and 5, while the highest and lowest scores for the posttest were 19 and 11. This information provides an idea of the variation in scores within groups of students. It can be seen that the posttest score has a higher score compared to the pretest score. This shows an increase in students' overall understanding of physics concepts.

Next, a frequency distribution table for pretest and posttest interest in learning and understanding of physics concepts for class XI MIPA students at SMA Negeri 1 Bone was created.

Table 3. Frequency Distribution and Percentage of Students' Pretest Interest in Learning Physics

Interval Class	Category	Frequency (f)	Percentage (%)
130 – 154	Very high	0	0.00
105 – 129	High	5	15.15
80 – 104	Currently	19	57.58
55 – 79	Low	9	27,27
30 – 54	Very low	0	0.00
Amount		33	100.00

The table above shows that students' interest in learning physics before implementing the PjBL model was 27.27% in the low category, 57.58% in the medium category, and 15.15% in the high category. Furthermore, the frequency distribution of pretest scores on interest in learning physics can be seen in the form of the following diagram.

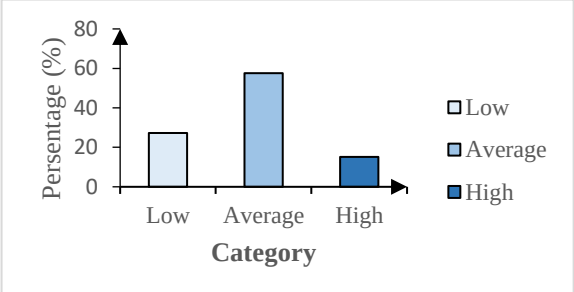

Figure 1. Bar Chart of Pretest Score Percentage of Students' Interest in Learning

The results of the statistical calculation of the frequency distribution of the posttest scores on interest in learning physics for class XI MIPA 2 students at SMA Negeri 1 Bone after implementing the PjBL model are presented in the following table.

Table 4. Frequency Distribution and Percentage of Students' Posttest Interest in Learning Physics

Interval Class	Category	Frequency (f)	Percentage (%)
130 – 154	Very high	16	48.49
105 – 129	High	15	45.45
80 – 104	Currently	2	6.06
55 – 79	Low	0	0.00
30 – 54	Very low	0	0.00
Amount		33	100.00

The table above shows that students' interest in learning physics before implementing the PjBL model was 6.06% in the medium category, 45.45% in the high category, and 48.49% in the very high category. Furthermore, the frequency distribution of posttest scores on interest in learning physics can be seen in diagram form below.

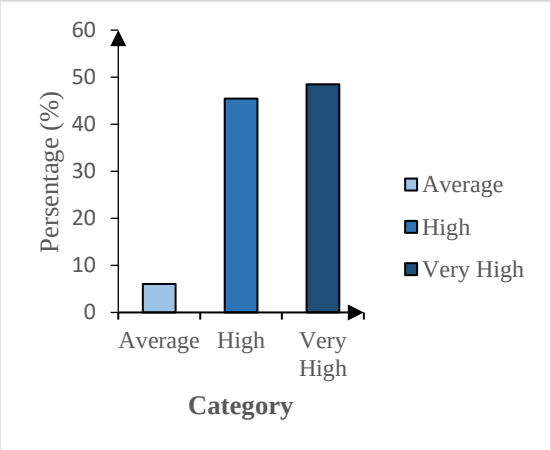

Figure 2. Bar Chart of Posttest Score Percentage of Students' Interest in Learning

Next, a frequency distribution table for the pretest and posttest understanding of physics concepts for class XI MIPA students at SMA Negeri 1 Bone was created.

Table 5. Frequency Distribution and Percentage of Students' Concept Understanding pretest scores

Range	Frequency	Percentage (%)	Category
17 – 20	0	0.00	Very high
13 – 16	0	0.00	Tall
9 – 12	26	78.79	Currently
5 – 8	7	21.21	Low
0 – 4	0	0.00	Very low

Based on Table 5, it is found that the percentage score for understanding physics concepts of class XI MIPA 2 students at SMAN 1 Bone has a high percentage, namely 78.79% in the medium category and 21.21% in the low category. The percentage description of the pretest score for understanding physics concepts of class XI MIPA 2 students at SMAN 1 Bone is shown in the form of a bar chart below.

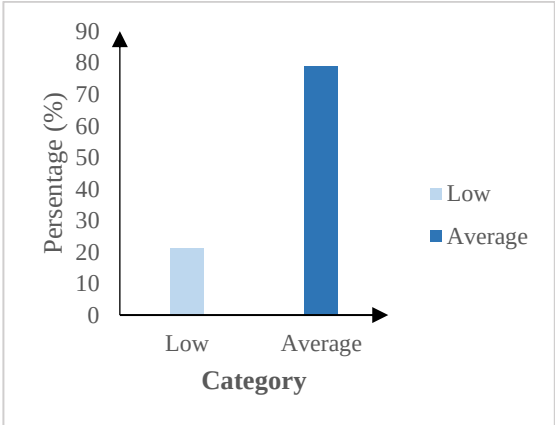

Figure 3. Bar Chart of Percentage of Students' Concept Understanding Pretest Scores

The results of the statistical calculation of the frequency distribution of the posttest scores for understanding physics concepts of class XI MIPA 2 students at SMA Negeri 1 Bone after implementing the PjBL model are presented in the following table.

Table 6. Frequency Distribution and Percentage of Students' Concept Understanding posttest scores

Range	Frequency	Percentage (%)	Category
17 – 20	17	51.51	Very high
13 – 16	13	39.40	Tall
9 – 12	3	9.09	Currently
5 – 8	0	0.00	Low
0 – 4	0	0.00	Very low

Based on Table 6, it is found that the percentage score for understanding physics concepts of class and a percentage of 21.21% in the low category. The percentage of pretest scores for understanding physics concepts of class XI MIPA 2 students at SMAN 1 Bone is displayed in the form of a bar chart in Figure 4.

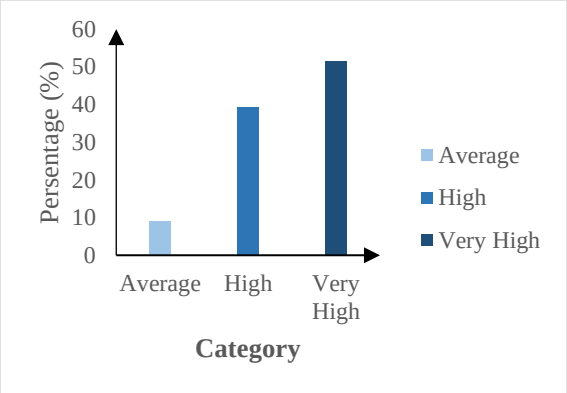

Figure 4. Bar Chart of Percentage of Students' Concept Understanding Posttest Scores

1. Increasing Interest in Learning Physics

The increase in students' interest in learning physics is calculated using the normalized gain formula. The N-Gain value is used to see the increase in interest in learning physics based on students' pretest-posttest results after implementing the PjBL model. In the results of the N-Gain analysis, students' interest in learning physics obtained a value of 0.64, which is in the medium category.

As for the frequency description and the percentage of students' interest in studying in class XI MIPA 2 SMAN 1 Bone is described in Table 7 below.

Table 7. Frequency Distribution and Percentage Increase in Interest in Learning Physics for Class XI MIPA 2 Students

No.	Category	Frequency	Percentage (%)
1.	High	11	33.33
2.	Average	22	66.67
3.	Low	0	0.00
	Amount	33	100.00

The table above shows that 33 students were research subjects. There were 11 students or 33.33% whose interest in learning physics increased to the high category after being taught using the PjBL model. The percentage of students in the medium category is 22 students or 81.25% who have a moderate interest in learning physics after being taught using the PjBL model. The increase in interest in studying physics in class XI MIPA 2 students at SMA Negeri 1 Bone can be depicted in the following bar diagram.

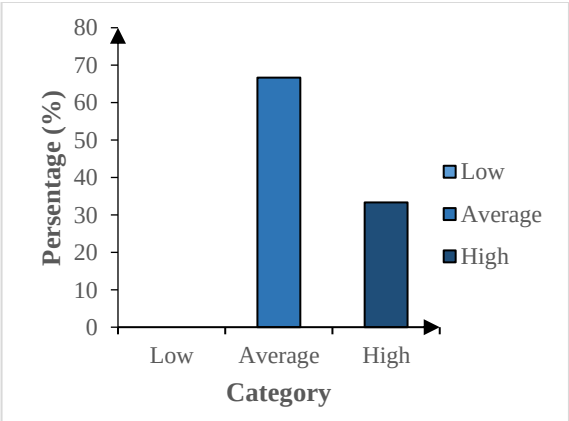

Figure 5. Percentage Increase in Interest in Learning Physics for Class XI MIPA 2 Students at SMA Negeri 1 Bone

Based on the data in Table 7 and Figure 5, it shows that the majority of students have an increased interest in learning in the medium category. This shows that the

increase in interest in studying physics in class XI MIPA 2 students at SMA Negeri 1 Bone is in the medium category.

2. Increased Understanding of Physics Concepts

The increase in students' understanding of physics concepts is calculated using the normalized gain formula. The N-Gain value is used to see an increase in understanding of physics concepts based on students' pretest-posttest results after implementing the PjBL model. In the results of the N-Gain analysis, students' understanding of physics concepts obtained a value of 0.63, which is in the medium category. The description of the frequency and percentage of understanding of physics concepts of class XI MIPA 2 students at SMAN 1 Bone is described in Table 8 below.

Table 8. Frequency Distribution and Percentage Increase in Ability to Understand Physics Concepts of Class XI MIPA 2 Students at SMA Negeri 1 Bone

No.	Category	Frequency	Percentage (%)
1.	High	11	33.33
2.	Average	22	66.67
3.	Low	0	0.00
Amount		33	100.00

The table above shows that 33 students were research subjects. There were 11 students or 33.33% who experienced an increase in understanding of physics concepts in the high category after being taught using the PjBL model. The percentage of 66.67% or 22 students experienced an increase in interest in studying physics in the medium category after being taught using the PjBL model. The increase in understanding of physics concepts for class XI MIPA 2 students at SMA Negeri 1 Bone can be depicted in the following bar diagram.

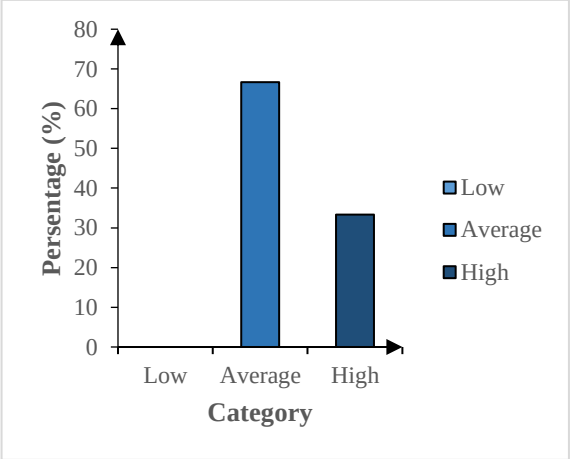

Figure 6. Percentage Increase in Ability to Understand Physics Concepts of Class XI MIPA 2 Students at SMA Negeri 1 Bone

Based on the data in Table 8 and Figure 6, it shows that the majority of students experienced an increase in understanding of physics concepts in the medium category. This shows that the increase in understanding of physics concepts in class XI MIPA 2 students at SMA Negeri 1 Bone is in the medium category.

Discussion

In this research, the Project Based Learning (PjBL) model was applied to students' interest in learning and understanding of physics concepts at SMA Negeri 1 Bone. The research design used was One group pretest posttest with a total of 33 research subjects in class Bone.

Students were given a pretest before implementing the PjBL model which resulted in students' interest in learning physics with an average score of 88.78 which was in the medium category. The pretest results for understanding physics concepts, an average score of 10, are in the medium category, which are presented in the table. After using the PjBL model, students' posttest scores increased, namely the average interest in learning physics was 126.45, which is in the high category. The

average posttest score on students' understanding of physics concepts also increased, namely 16.12, which is in the high category.

The increase in interest in learning and understanding of physics concepts can be seen from the results of the N-gain score analysis on students' interest in learning physics of 0.64 and understanding of physics concepts with an N gain score of 0.63. This indicates an increase in students' interest in learning and understanding of physics concepts in the medium category. This shows that the implementation of the PjBL model can increase students' interest in learning and understanding of physics concepts. However, the increase that occurred was not optimal because it was still in the medium category. So further development of the PjBL model is needed. It is necessary to pay attention to the approach or method used in learning.

The results of this research are relevant to previous research, namely research conducted by (Dwi, et al 2018) which found that the implementation of the PjBL model in physics learning can increase students' interest in learning physics. Students' interest in learning increases along with the project creation process they undertake. Students look more enthusiastic when designing projects, discussing and presenting the results of their project work in front of the class. Previous research is also the same as the results of this research (Farista, et al., 2022) that the PjBL model is effective for increasing interest in learning in physics subjects. Every step of the project work feels fun, not monotonous, increases interest in learning, increases togetherness and cohesiveness, and can exchange ideas with other group members.

The implementation of the PjBL model creates a learning environment that requires students to be active in studying the material more deeply. This is necessary for students to design the project they will carry out. Working on projects in groups makes students discuss so that there is a process of exchanging information between students. Students are also invited to formulate questions, collect information, and apply the physics concepts they have learned into their work, namely projects. By giving interesting assignments such as projects to make simple experimental equipment using used materials, students are actively involved (Beauty, et al., 2021). The project work process must involve all group members playing an active role in thinking, designing ideas by collecting information from various sources.

Based research (Wahyuningsih, et al., 2021) with communication between groups, the learning process creates relationships between students who work together with their members, support each other, and are responsible for their respective tasks that have been mutually agreed upon. This is in line with research conducted by (Sonia, et al., 2021) students who play an active role in project work experience an increase in understanding of concepts in the medium category with a Gain value of 0.5. Students can explore the projects they have created and collaborate with their group friends to complete the projects. Likewise, in research conducted by (Sasmita & Hartoyo, 2020) the implementation of the PjBL model increased students' understanding of physics concepts with a Gain value of 0.52 in the medium category.

Apart from several advantages of implementing the PjBL model which is quite effective in increasing interest in learning and understanding of physics concepts, there are several things that need to be considered. The PjBL model requires a relatively longer time to run effectively. In research conducted by (Samsidar & Widyaningsih,

2022) teachers who are pleasant to students can increase their interest in learning. So, when implementing the PJBL model, the teacher as a facilitator must pay attention to the situation of each student who is sometimes unable to mingle with their group friends. Teachers must also pay attention to students having enough time and funds to work on project assignments for maximum results. This is in line with research conducted by (Roziqin, et al, 2018) that when carrying out the Pjbl learning process teachers need to pay attention to students' activities outside of academic activities.

In research conducted by (Sobri, 2022) it was found that several students already had an interest in studying physics. However, there are also students who still need special attention from teachers to build interest in learning physics. Some students need support from teachers and friends in order to learn optimally.

Using the Project Based Learning (PjBL) learning model has the following advantages: 1). Motivating students in the learning process (Sonia et al., 2021). 2). Helping students become more active, creative and exploratory in learning (Ningsih et al., 2021; Kanza et al., 2020; Suranti et al., 2017). 3). The use of the PjBL learning model has a positive impact on physics learning outcome (Maulana, 2020; Rahayu et al., 2010). 4). Increasing student interest and learning outcomes in class (Vinet & Zhedanov, 2011; Aldila & Mukhaiyar, 2020; Wahyuningsih et al., 2021; Roziqin et al., 2018). 5). Improving students' problem solving abilities and being able to think critically (Agus Susanta, 2020; Makrufi et al., 2018; Hindriyanto et al., 2019; Wahyuningtyas, 2021).

Based on the discussion that the author has presented from this research; it can be concluded that the implementation of the PjBL model in Class XI MIPA 2 SMA Negeri 1 Bone has a positive impact on students' interest in learning and understanding of physics concepts. The gain score was 0.64 for interest in learning physics and the gain score was 0.63 for understanding physics concepts. This shows a significant increase and is in the medium category. So, the PjBL model can be used by teaching staff as an effective learning model.

CONCLUSION

A study on Class XI MIPA 2 at SMA Negeri 1 Bone found that implementing the Project Based Learning (PjBL) model significantly improved students' interest and understanding of physics concepts. Before the intervention, student engagement and comprehension were moderate. However, after using PjBL, these metrics rose to high levels. This suggests that PjBL is an effective strategy for science education, boosting student interest in learning and comprehension of physics.

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