JPPIPA 11(2) (2025)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Influence of Problem Based Learning Model and Learning Interest on Physics Problem Solving Ability of Grade XI High School Students

Mirna[1*], Kaharuddin Arafah[1], Pariabti Palloan[1]

[1] Physics Education, Postgraduat Program, Universitas Negeri Makassar, Makassar, Indonesia.

Received: September 11, 2024
Revised: December 17, 2024
Accepted: February 25, 2025
Published: February 28, 2025

Corresponding Author:
Mirna
mirnasukri1010@gmail.com

DOI: 10.29303/jppipa.v11i2.9139

Abstract: This study is a true experimental design study using a 2x2 factorial design. The purpose of the study is to: find out whether or not the application of the Problem Based Learning model and learning interest has an effect on the results of physics problem solving abilities of class XI MIPA, and to diagram the interaction of the learning model and learning interest on the results of physics problem solving abilities. The research data were obtained by providing a learning interest questionnaire sheet to students before being taught using the learning model in the study, and for the Problem Solving ability test results were carried out after students were taught using the learning model in the study. The data analysis technique used was analysis of variance (ANOVA). Based on the results of the inferential analysis obtained: F count (26.57) > F table 4, it can be concluded that there is a significant difference between students who are taught using the Problem based learning model and students who are taught using the discovery learning model; F count (0.53) < F table 4, it can be concluded that there is no interaction between the learning model and learning interest on the results of students' Problem Solving abilities.

Keywords: Discovery learning; Learning interest; Problem based learning; Problem solving

Introduction

Education in this era is directed towards the development of 21st century competencies consisting of three main components, namely thinking, acting and living in the real world. Related to the issue of educational development at the international level, according to Permendikbud Number 21 of 2016, in physics learning, the competencies that must be achieved are: being able to develop an attitude of curiosity, logic, criticality, and analysis; being able to formulate problems, formulate hypotheses, conclude and design and conduct experiments related to physics. Thus, it can be concluded that physics learning must emphasize high-level thinking skills or what is commonly known as Higher Order Thinking Skills (HOTS). One of the high-level thinking skills is problem-solving skills. Problem solving is the participation of students in a task whose solution method is known by the students themselves based on the theory that has been studied previously (Guo et al., 2020).

In order to find a solution to a problem, students must have the initial knowledge that they have obtained during their learning process in class (Puji et al., 2020; Dong et al., 2020). Problem-solving skills must be provided to students, not only used to solve mathematical concepts, answer questions about learning that only require cognitive aspects, but used by students as provisions to solve all problems in aspects of daily life that involve various elements or complex problems,

How to Cite:
Mirna, Arafah, K., & Palloan, P. (2025). The Influence of Problem Based Learning Model and Learning Interest on Physics Problem Solving Ability of Grade XI High School Students. *Jurnal Penelitian Pendidikan IPA*, *11*(2), 77–83. https://doi.org/10.29303/jppipa.v11i2.9139

therefore problem-solving skills are very important (Pratama, 2020; Iwuanyanwu, 2020).

The physics learning situation at SMA Negeri 1 Campalagian Tengah which is applied by educators in learning based on the results of observations that the learning model applied daily is the discovery learning model in this case referred to as a conventional learning model. According to one educator, students' physics problem-solving ability is still relatively low due to several factors that lead to several characteristics of students in solving problems, including: students cannot solve all the problems given, students have difficulty in translating the meaning of the problems presented, such as maximizing what is known and asked, and applying various appropriate strategies to solve problems, most students have difficulty if given problems that are different from the example problems given by the teacher, lack of mathematical ability in solving problems, thus inhibiting students' problem-solving abilities. Darling-Hammond et al. (2020) and Bruno et al. (2021) obtained research results that most students have low problem-solving abilities, students are accustomed to problems that require simple concepts and have difficulty if given more complex problems.

To overcome students' physics problem-solving abilities, efforts are made in the form of improving learning strategies, namely changing the learning model. One learning model that is suitable for improving students' problem-solving abilities is using the Problem-based learning model. Bruno et al. (2021) and Hidayati et al. (2020), stated that Problem Based Learning is seen as a learning concept that is very appropriate to the demands of 21st century learning which requires students to continuously develop their thinking skills and problem-solving skills, as skills needed in the context of a rapidly changing world. The Problem Based Learning model is a teaching model characterized by the existence of a problem as a context for students to learn to think critically and problem-solving skills and gain knowledge or it can also be interpreted that PBL is a learning atmosphere that is directed by an everyday problem (Widiastuti et al., 2023; Ningrum et al., 2021).

This problem is used to link students' curiosity and analytical skills and initiative over learning materials (Scott-Barrett et al., 2023). The main purpose of Problem Based Learning is to explore students' creativity in thinking and motivate students to continue learning and it must be noted that this learning model is not designed to help teachers provide as much information as possible to students, but problem-based learning is developed to help students develop thinking skills, problem solving, and intellectual skills, learn as adults through their involvement in real or simulated experiences and become independent learners (Spies & Botma, 2020; Morley et al., 2019). The Problem-based learning model is often associated with increased problem-solving skills compared to conventional learning. In general, many studies support the idea that Problem-based learning can be more effective in developing problem-solving skills than conventional learning methods (Yew & Goh, 2016; Yanto et al., 2021). One of the main reasons is because Problem-based learning places students in situations where they have to apply their knowledge directly to solve complex and realistic problems, which promotes critical and analytical thinking. One of the studies conducted by Valdez et al. (2019), showed that students who were involved in Problem-based learning had better and more effective problem-solving skills compared to students who learned through conventional learning methods.

One of the main factors in achieving goals is Interest. According to Schippers et al. (2020) and Swann et al. (2021)" interest is a tendency towards something that consists of feelings of pleasure, attention, sincerity, motives and goals in achieving a goal". Interest in physics is one of the supporting factors for student success when learning physics. The lack of students who have a high interest in learning can cause the ability to solve a problem to be less than optimal (Zhai et al., 2024). Based on this, the researcher wants to see how much influence the Problem Based Learning model has on students' problem-solving abilities in physics learning compared to the learning model applied by teachers, the discovery learning model (conventional) as a whole (Suwandi et al., 2021). In addition, the researcher wants to see the physics problem-solving abilities of students between those taught using problem-based learning and those taught using discovery learning when viewed from the learning interest category of high interest and low interest category (Dawana & Dwikoranto, 2024; Malik et al., 2019).

This study is in line with the research conducted by Suharlan et al. (2023), which shows that the average score of problem-solving abilities with the Problem Based Learning model is higher than the Discovery Learning model so that it can be concluded that the Problem Based Learning model is more effective than the Discovery Learning model in improving physics problem-solving abilities. Based on the description above, the researcher conducted a study entitled "The Effect of the Problem Based Learning Model and Learning Interest on the Physics Problem-Solving Ability of Class XI SMA Students.

Method

Type of Research and Research Design

This research is a True Experiment research conducted in the even semester of the 2023/2024 Academic Year at SMA Negeri 1 Campalagian. The research design used is a 2×2 factorial design:

Table 1. Research Design

Interest in learning (B)	Learning model (A)	
	Problem Based Learning (A1)	Discovey Learning (A_2)
High (B1)	Y[A1B1]	Y [A2B1]
Low (B2)	Y [A1B2]	Y [A2B2]
Total (∑)	Y[A1B1] + Y[A1B2]	Y [A2B1] + Y[A2B2]

The data analysis technique in this study is divided into two parts, namely data analysis related to the instruments to be used in the study and data analysis obtained during the study (descriptive and inferential). Instrument analysis consists of calculating the validity, reliability, level of difficulty of the critical thinking skills test and the discriminatory power of the problem-solving ability test. As for the technical analysis of the research results data, it is divided into two, namely: descriptive statistical analysis by calculating the average, standard deviation, maximum score, minimum score; inferential statistical analysis using a two-way variance analysis test, but previously a prerequisite test was carried out consisting of a normality test using the Chi square test and a homogeneity test of variance.

Population and Sample

The population in this study were all students of class XI MIPA SMA Negeri 1 Campalagian totaling 116 students spread across 4 classes. The sample of this study was 60 people consisting of two classes, namely one experimental class and one control class, which were taken through a simple random sampling technique using a random lot system and produced the papers that were drawn, namely XI MIPA 2 and XI MIPA 1. Class randomization was carried out so as not to interfere too much with the learning process at the school and one of the considerations was that all classes were considered homogeneous because class determination was not based on the ranking and school of origin of students.

Table 2. Sample of Students in Class XI MIPA SMAN 1 Campalagian

Class	Number of Students
XI MIPA 1	30
XI MIPA 2	30
Total	60

Result and Discussion

The data obtained in the study were then analyzed to answer the hypothesis in this study. The scores of the results of students' problem-solving abilities obtained after applying the problem-based learning model and the discovery learning model (conventional) can be seen in Table 1 below:

Table 3. Descriptive Analysis Test

Description	KPM Results in Learning Model A	
	Problem Based Learning (A1)	Discovey Learning (A2)
Sample Size	30	30
Mean $(\bar{X})$	81.76	76.10
Highest Score	97	92
Lowest Score	72	67
Standard Deviation (S)	5.95	6.36
Variance (S^2)	35.49	40.51

Based on Table 3 shows that the average score of the class taught using the Problem Based Learning model is higher than the average score of the class taught using the discovery learning model. Hypothesis testing of data is distinguished based on high and low interests owned by students, so that data is obtained as in table 4.

Table 4. Statistics of Student Learning Interest Scores Based on Physics Problem Solving Ability

Interest in Learning Physics (B)		KPM Results in Learning Model A	
		Problem Based Learning (A1)	Discovey Learning (A2)
Height (B1)	Sample Size	15	15
	Mean $(\bar{X})$	85.80	80.93
	Highest Score	97	92
	Lowest Score	81	73
	Standard Deviation (S)	4.83	4.93
Low (B2)	Sample Size	15	15
	Mean $(\bar{X})$	77.73	71.27
	Highest Score	86	75
	Lowest Score	72	67
	Standard Deviation (S)	3.92	3.08

Based on Table 4, the average score obtained by the group of students with high learning interest in physics through the experimental class with the application of the Problem Based Learning learning model is higher than the control class with the application of the discovery learning model. Meanwhile, the average score obtained by the group of students with low learning interest in physics through the experimental class with the application of the Problem Based Learning learning model is higher than the discovery learning model. The inferential data analysis technique used to test the hypothesis using a 2 × 2 factorial analysis of variance (ANOVA) obtained a summary of the test results in the following table.

Table 5. Summary of ANOVA Test Results

Sources of Variance	JK	Db	RJK	F_h	F_t	Decision Criteria
Within Groups (D)	1015.20	26	39.05	-	-	-
Between Groups (A)	481.67	1	481.67	12.34	1.30	Rejected
Between Rows (B)	1179.27	1	1179.27	30.20	1.30	Rejected
Interaction (AB)	9.60	1	9.60	0.25	1.30	Accepted
Total	2685.73			-	-	-

The table above presents several conclusions regarding the hypotheses explained as follows: Overall, there is a difference in the results of physics problem-solving abilities between students taught using the Problem-based learning model and students taught using the discovery learning model; There is no interaction between the learning model and students' interest in learning physics on the results of physics problem-solving abilities; For students who have a high interest in learning physics, there is a difference in the results of physics problem-solving abilities of students taught using the problem-based learning model and students taught using the discovery learning model; For students who have a low interest in learning physics, there is a difference between the physics learning outcomes of students taught using problem-based learning and students taught using the discovery learning model. To answer hypotheses 3 and 4, a t-test was conducted and the results can be seen in the following table.

Table 6. t-Test Score of Students with High Learning Interest

Experiment	$\bar{x}$	N	s^2	s^2/n	t_{count}	t_{table}	Criteria
Control	85.80	15	23.31	1.55	2.73	1.69	Rejected
Experiment	80.93	15	24.35	1.62			

Table 7. t-Test Score of Students with Low Learning Interest

Experiment	$\bar{x}$	N	s^2	s^2/n	t_{count}	t_{table}	Criteria
Control	77.73	15	15.35	1.02	3.91	1.69	Rejected
Experiment	71.27	15	9.50	0.63			

The results of the descriptive analysis showed that the average score of the physics problem-solving ability of students taught using the problem-based learning model increased compared to the average score of the physics problem-solving ability of students taught using the discovery learning model. Students taught using the problem-based learning model had an average score of 81.76, while students taught using the discovery learning model had an average score of 76.10. From the hypothesis testing, it was found that: Overall, there is a difference in the physics problem-solving ability of students taught using the problem-based learning model and the discovery learning model (Arifianto & Koeswanti, 2022; Yusuf, 2023). The results of this study indicate that overall there is a difference in the physics problem-solving ability of students taught using the problem-based learning model and the discovery learning model (Khairunnisa & Juandi, 2022; Purwaningsih et al., 2020). This is in accordance with the information in the two-way variance analysis which shows F_{count} = 12.34 and F_{table} = 1.30 $F_{count} \geq F_{table}$ so that H0 is rejected and H1 is accepted; There is an interaction between the learning model and learning interest on students' physics problem-solving abilities.

Based on the results of the study, it can be explained that the significance value that shows the effect of the interaction of variance between the learning model and learning interest on physics problem-solving abilities (Rizki et al., 2024; Abtokhi et al., 2021; Wijayanto et al., 2023), shows F_{count} = 0.25 and F_{table} = 1.3, then F_{count} 0.25 <F_{table} = 1.3 so that the hypothesis H0 is accepted, meaning there is no interaction between the learning model and students' learning interests; Differences in problem-solving abilities of students taught using Problem Based Learning with students taught using the Discovery Learning learning model Reviewed from the

high category of learning interest (Bahtiar et al., 2022; Asyhari & Sifa'i, 2021; Hadira et al., 2024). Based on the results of the study, it can be explained that the significance value in the t-test with a t_{count} value (2.73) ≥ t_{table} (1.69) then H_0 is rejected, meaning there is a difference in problem-solving abilities for high category learning interests in physics between students taught using the problem based learning model and students taught using the Discovery learning model (Muhayati et al., 2023; Syafti, 2021), differences in problem-solving abilities of students taught using Problem Based Learning with students taught using the Discovery Learning learning model (Palinussa et al., 2023; Tanjung et al., 2020; Triana et al., 2021).

Reviewed from the low category of learning interest. Based on the research results, it can be explained that the significance value in the t-test with a calculated t value (3.91) ≥ t table (1.69) then H_0 is rejected, meaning that there is a difference in the results of problem-solving abilities for low learning interest in physics between students taught using the Problem Based Learning model and those taught using the Discovery learning model (Kasmiana et al., 2020; Hariyani et al., 2024).

Conclusion

Based on the results of data analysis, the conclusions obtained in this study include, Overall, there is a significant difference in the ability to solve physics problems between students who are taught using the Problem Based Learning model and students who are taught using the discovery learning model; There is no interaction between the learning model and interest in learning physics on students' physics problem solving abilities. Judging from the high interest in learning physics, there is a significant difference in the ability to solve physics problems between students who are taught using the Problem Based Learning model and those who are taught using the discovery learning model. Judging from the low interest in learning physics, there is a significant difference in the ability to solve physics problems between students who are taught using the Problem Based Learning model and those who are taught using the discovery learning model.

Acknowledgments
The researcher would like to thank the supervisor who has guided in the preparation of the article, the PHYSICS teacher who has allowed the research to be conducted in the class he teaches, and the students of class XI SMAN 1 Campalagian who have participated in collecting research data.

Author Contributions
M., conceptualized the research idea, research method, and analyzed the data. K. A. and P. P guided the writing of the review and editing, supervised and validated the instruments used in the study.

Funding
This research did not receive any external funding.

Conflicts of Interest
The author declares no conflict of interest.

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