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Implementation of Problem Based Learning Model to Improve Problem Solving Ability in Static Fluid Material

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Abstract: This study aims to improve students' problem solving by implementing the Problem Based Learning learning model. The sample used in this study was 30 students of class XI IPA-2. This study used a pre-experimental research design with a one group pre-test and post-test design, problem solving data were collected through essay pre-test and post-test questions. Analysis of problem solving data was tested with statistics, namely the N-Gain test, hypothesis testing using the Paired Sample T.Test. The results of the problem solving data analysis obtained an average pre-test value (67) and post-test (96) with an average N-Gain (0.81) in the high category. The results of hypothesis testing on the Paired sample T-Test obtained a sig value (2-tailed) of 0.000 <0.05, thus the results stated that the hypothesis testing in the study showed that Ha was accepted and Ho was rejected. It can be concluded that the application of the Problem Based Learning learning model can improve problem solving for class XI IPA-2 students at SMA Negeri 1 Peukan Bada on static fluid material.

Keywords: Problem based learning model, problem solving ability, static fluid.

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INTRODUCTION

The problem of education in Indonesia is that current education only focuses on memorization and does not develop thinking skills. To create these activities, the learning process must be centered on students using direct experience so that it can develop students' thinking skills. One of the models used by teachers is the problem-based learning model. According to Kiswanto (2017), problem-based learning is an activity by raising and using problems to be used as material for students to think about solving problems and gaining knowledge from the activity. Meanwhile, according to Elizabeth & Sigahitong, (2018), namely in problem-based learning, students are faced with practical problems as a basis for learning, or in other words, students learn through problems.

Learning at the high school level should be more creative, teachers always create new ideas to learn physics, this makes students more active in learning. Based on facts in

the field, in the teaching and learning process, many students do not master problem solving, especially in solving questions. For example, there are some students in finding answers without showing evidence. Judging from the definition above, problem solving, it turns out that there are still our students who do not know what problem solving and creativity are, especially in high school. In this case, not only students, but there are still teachers who like to use conventional methods, even though they know that these methods have many shortcomings. As a result, the learning process is only centered on the teacher, not centered on the students, which ultimately has an impact on decreasing creativity and not really understanding how to solve the problems they give to their students.

So one of the solutions proposed by researchers to improve problem-solving skills for students is to apply the "Problem Based Learning (PBL) Learning Model". The PBL learning process which is in such a way directs students to think using scientific methods so that they are able to solve every problem that arises, in this PBL learning process can also trigger students to be more active in showing their creativity.

The results of other studies also strengthen the results of previous studies, as expressed by Hudha M.N et al., (2017) The feasibility of PBL-based physics learning modules on the topic of rotational equilibrium and dynamics is very valid based on the assessment of material experts (94.8%), media experts and high school physics teachers on the content component (95%), presentation component and language component (88.5%). Based on these problems, the formulation of the problem in this study is: Can the use of the Problem Based Learning (PBL) learning model improve problem solving in static fluid material?

The problem of education in Indonesia is that current education only focuses on memorization and does not develop thinking skills. In other words, human resources are required to have broad knowledge, problem-solving skills that can be applied in everyday life. To create these activities, the learning process carried out must be student-centered by using direct experience so that it can develop students' thinking skills. One of the models used by teachers is the problem-based learning model.

Mayasari., et al. (2022) put forward the meaning of the learning model, namely a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve certain learning goals, and functions as a guideline for learning designers and teachers in planning teaching and learning activities. A learning model is a conceptual framework that describes a systematic (regular) process for organizing learning activities (experiences) to achieve learning goals (learning skills). According to Anwar, M., & Nurul, F. (2017) in their research, a learning model is a systematic process or steps to support teachers in the learning process in the classroom, so that learning achieves the desired learning goals. According to Dayeni, in Khairiani., (2017), problem-based learning models can be effective in increasing student motivation because they utilize the motivational effects of curiosity, challenges, authentic tasks, involvement, and autonomy, all factors that increase student motivation to learn.

Problem-based learning is one method in learning that uses problems as the first step in collecting and integrating new knowledge. In an effort to solve the problem, students will gain the knowledge and skills needed for the problem. According to Bukhori (2017), problem-based learning is a method or way of learning that is characterized by the presence of real problems, a real-world problems as a context for students to learn critically and problem-solving skills and gain knowledge. The same research was stated by Ardner in Fathurrohman M., (2015) stating that problem-based learning is an alternative interesting learning model in traditional classroom learning. With a problem-based learning model, lecturers present students with a problem, not lectures or assignments. So that students become more active in learning to find and solve problems.

The problem-based learning (PBL) learning model is a learning model that is based on real life. According to Elizabeth & Sigahitong, (2018), namely in problem-based learning students are faced with practical problems as a basis for learning, or in other

words students learn through problems. According to Arends in Caesariani (2018), problem-based learning is a student-centered learning where learning starts from structured problems and real-world situation problems. Problem-based learning aims to develop and apply important skills, namely problem solving based on self-study skills or group collaboration in gaining broad knowledge. Lecturers have a role to provide inspiration so that students' potential and abilities are maximized. Aslan, A. (2021) also stated that Problem Based Learning is a learning model that begins with problems found in a work environment to collect & integrate new knowledge developed by students independently. This model also focuses on student activity in solving problems. (Prasetyo & Winoto 2020).

Every learning model must have a main goal to be achieved, as well as problem-based learning. The purpose of this learning model is 1) Improving students' critical thinking skills; 2) Training students in solving a problem systematically; 3) Helping students understand the role of adults in real life; and 4) Encouraging students to become independent and responsible individuals.

Characteristics of Problem Based Learning according to Yazdani (2017) are 1) Starting from one problem in the "Ploblem Based Learning" method, a problem is the main element in learning activities. Problems are given by the teacher or from student experience; 2) Problems are related to the real world, the problems given must be problems that actually occur in real life; 3) Learning objectives are around problems, not disciplines. So learning objectives are limited according to the problems submitted, not intact according to the learning material they should be; 4) Giving responsibility for forming and running their learning process. The learning process is handed over to students to form groups and discuss to solve problems, while the teacher only accompanies and helps to explain after students present the results of their discussions; 5) Discussion of problems is carried out in group discussions Discussion of problems is carried out in groups so that children can exchange ideas and actively express their opinions and knowledge related to the problem; and 6) Presenting the problem in the form of results that have been discussed previously. After discussing with the group and looking for additional information from various references related to the problem, students present the results of the discussion, namely the solution to the problem given.

METHODS

In accordance with the problems that have been stated previously, the type of this research is pre-experiment. This research was conducted at SMAN 1 Peukan Bada which is located in Lam Hasan Village, Peukan Bada District, Aceh Besar Regency, in the odd semester with two meetings, Academic Year 2024/2025. The sampling technique used in this study was the purposive sampling technique.

The number of samples in this study was class XI IPA totaling 30 students or all students registered in the class. In collecting research data, a data collection technique is needed that is in accordance with the data required in the study. In class XI IPA, a test was carried out in the form of essay questions. The questions were carried out in two stages, namely, pre-test questions were carried out before starting the application of the learning model and post-test questions would be given after implementing learning by implementing the Problem Based Learning learning model was completed.

Data analysis on student problem solving was obtained through the results of pre-test and post-test questions. The increase that occurred before and after learning, Sugiyono (2012) calculated using the G-Factor (N-Gain) formula which is stated in the following formula,

$$g = \frac{Skor\ Posttest - skor\ pretest}{skor\ \max - skor\ pretes}$$

RESULTS

The results of the analysis of the N-Gain test on the pre-test and post-test results of experimental class students at SMA Negeri 1 Peukan Bada.

Table 1. Gain Index Data Test Results

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
N-gain score	30	.67	.96	.8123	.08129
Valid N (listwise)	30				

Based on the data in table 1, the calculation results obtained the minimum pre-test score is 67 and the maximum post-test score is 96. From these data it can be seen that the average pre-test score is lower than the post-test score. Testing the data has explained that there is an increase in problem solving for students in learning before and after being treated.

The data in table 1 has also answered the results of the N-Gain Test, namely the Mean or Gain obtained from the data table is 0.812, in accordance with the N-Gain assessment criteria that have been determined in table 1, that if g> 0.70 then the results of the learning interpretation obtained by students are high. Therefore, referring to the test results listed in table 4.2, it can be concluded that the results of the interpretation of class XI IPA.2 students are high.

Table 2. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Pretest	.218	30	.001	.934	30	.062
Posttest	.164	30	.039	.959	30	.298

Based on the table above, it shows that the significance value for the pre-test is 0.062 and the significance value for the post-test is 0.298, as the decision making in the normality test, namely if the significance value is greater than 0.05, it can be concluded that the research results on the pre-test and post-test in class XI IPA.2 are normally distributed.

Table 3. Paired Sample Statistic Test Results

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Before being given treatment	44.1333	30	13.86321	2.53106
	After being given treatment	89.8333	30	4.40285	.80385

Based on the results of the Paired Sample Statistical Test in table 3 above, it shows that the average value of students before being given treatment was 44.13 and the variance was S = 13.86, while the average value of students after being given treatment was 89.83 and the variance was S = 4.40.

Table 4. t-Test Results

Paired Differences								
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	T	Df	Sig. (2-tailed)

Pair1	Before being given treatment - after being given treatment	-80.41991	8.04746	1.46926	-83.42488	-77.41494	-54.735	29	.000

Because the test used is the Paired T-Test, the basis for decision making in this test is if the Sig. (2-tailed) value <0.05, then there is a significant difference in the problem solving questions in the pre-test and post-test data and if the Sig. (2-tailed) value > 0.05, then there is no significant difference in the problem solving questions in the pre-test and post-test data. Based on the Output table of the T-Test results above, the sig. (2-tailed) value is 0.000 <0.05. Thus, the results state that Ha is accepted because there is an increase in Problem Solving and Creativity of class XI IPA-2 students in the Static Fluid material at SMA Negeri 1 Peukan Bada using the Problem Based Learning (PBL) model.

DISCUSSION

The Problem Based Learning learning model is a student-centered learning approach, where students are given real problems as triggers to find solutions. In physics learning, this model is very relevant because physics is a discipline that prioritizes problem solving based on scientific concepts and principles. By using PBL, students are faced with contextual problems that encourage them to think critically, analyze information, and find the right solution.

PBL has a significant influence on improving students' problem-solving abilities because this method requires them to be more active in exploring physics concepts. Students not only receive information passively, but also play an active role in finding and understanding concepts in depth. This helps them develop high-level thinking skills that are needed to solve physics problems. One of the main aspects of PBL that improves problem-solving abilities is the provision of challenging and contextual problems. In physics learning, students are often faced with questions that require a deep understanding of concepts, not just memorizing formulas. With real-world-based problems, students can connect theory with practical applications, making it easier to understand the concepts taught.

In addition, PBL encourages students to work collaboratively in groups. In this process, they learn to discuss, convey ideas, and consider various points of view before making decisions in solving problems. This ability to work together also trains them to think systematically and logically, which are essential skills in solving physics problems. PBL also emphasizes the use of systematic problem-solving strategies. Students are trained to identify problems, collect relevant information, analyze data, design solutions, and evaluate the results. This process helps them understand how to think scientifically in solving physics problems, so that they do not only rely on memorizing formulas.

In physics learning, students often have difficulty understanding abstract concepts, such as motion, force, energy, and electricity. By using PBL, students can more easily understand these concepts because they are given the opportunity to discover the concepts themselves through exploration and experimentation. For example, in learning Newton's laws, students can be given real-world scenarios involving force and acceleration, so that they can understand the application of these concepts in everyday life.

PBL also increases students' learning motivation because they feel more involved and challenged in solving problems. Compared to lecture methods that tend to be monotonous, PBL provides a more interesting and meaningful learning experience. Students feel responsible for their own learning, which ultimately increases their curiosity

and enthusiasm in learning physics. In addition to improving conceptual understanding, PBL also trains students to have critical and analytical thinking skills. In the problem-solving process, students must be able to assess the available information, distinguish between relevant and irrelevant information, and construct logical arguments. This ability is very important not only in physics learning, but also in everyday life.

Another advantage of PBL is its ability to train students to become independent learners. In this model, the teacher acts as a facilitator who helps students find solutions, not as the main source of information. This encourages students to be more active in seeking information from various sources, such as books, journals, or the internet, so that they are accustomed to learning independently and not only relying on explanations from the teacher. In addition, the application of PBL in physics learning can help students develop communication and presentation skills. In the PBL process, students are often asked to explain the results of their analysis and solutions in front of their classmates. This trains them to convey ideas clearly, organize their thoughts well, and defend their arguments with strong data and evidence.

From a learning evaluation perspective, students who learn with the PBL approach tend to have better abilities in dealing with problem-solving-based exams. Because they are accustomed to facing challenging problems in the learning process, they are better prepared to face exam questions that require high conceptual understanding and analytical skills. PBL also has a positive impact on the development of student creativity. In solving problems, students are encouraged to think outside the box and try various solution approaches. This helps them not only to be fixated on one solution, but also to be able to explore various possibilities that can be used in solving a physics problem. However, the application of PBL in physics learning also has challenges, such as longer time in the learning process and the need for teacher skills in guiding discussions. Therefore, it is important for teachers to design problems that are appropriate to the right level of difficulty and ensure that students stay on the right learning track.

PBL is an effective approach in improving students' problem-solving abilities in physics learning. By providing challenging problems, training critical thinking skills, and encouraging exploration and collaboration, this model helps students not only understand physics concepts more deeply, but also develop skills that are useful for their future. Therefore, the application of PBL in physics learning is highly recommended as a strategy to improve the quality of science education.

CONCLUSION

The Problem Based Learning (PBL) learning model applied in the Physics subject of Static Fluid material can improve problem-solving skills for students. This is indicated by the value of g> 0.70 getting the results of student learning interpretation of 0.81 which is high criteria and is proven again by hypothesis testing Based on the Output Table of the Paired Sample T-test results above, the sig. value (2-tailed) is 0.000 <0.05. Thus, the results state that this hypothesis test shows that Ha is accepted and Ho is rejected.

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