Implementation of Problem-Based Learning Model to Improve High School Students' Problem-Solving Ability on Physics Materials

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Abstract *– This research aims to see whether there is an influence of the problem-based learning model on students' problem-solving abilities in physics material at SMAN 9 Gowa. This research is Pre-Experimental research using One Group Pretest-Posttest Design so that only one class without control class. The population of this study were students of class XI MIPA 1 until XI MIPA 5. The research sample was taken using a simple random class technique, namely class XI MIPA 5 SMAN 9 Gowa. The research instrument is a test instrument for students' physics problem solving abilities in the form of 6 selected essays that use the valid criteria. The research results showed that the physics solving abilities of class XI MIPA 5 students before being taught by applying the problem based learning model were in the low problem category as indicated by the average score of 42.5. Problem solving ability of students before the application of the PBL model is 64% in the medium category, 32% in the low category and 4% in the very low category. The ability to solve physics problems of class XI MIPA 5 students after being taught by applying the problem based learning model is in the high category as shown by the average score of 61.7. Problem solving ability of students after applying the PBL model is 56% in the high category, and 44% in the medium category and nothing student have low and very low problem solving ability. In the pretest, problem solving ability has the lowest score is 19, the highest score is 47 and the average score is 42.5 which is in the medium category with a standard deviation is 6.7, while in the posttest, the lowest score is 50, the highest score is 75, and the average score is 61.7 which is in the high category with a standard deviation is 6.8. There was a significant increase in the physics problem solving abilities of class XI MIPA 5 students after being taught using the problem-based learning model with the N-Gain category = 0.34 (medium criteria).*

Keywords*: Problem-Based Learning, Problem Solving Skill*

INTRODUCTION

In the life of every human being, problems must occur so that the problem will make someone think deeply in order to solve it, therefore we need to have the ability to solve a problem. Currently, students' problem-solving skills are very lacking due to several factors, namely conventional learning that is still widely used in schools today which focuses more on transferring knowledge from teachers to students, students are also often only faced with easy and routine problems, and lack of student motivation to solve a problem (Hotimah, 2020).

To overcome the lack of students' problem-solving skills, a learning strategy is needed that can provide opportunities for students to develop their critical and creative thinking skills. One of the learning strategies that can be used is the Problem Based Learning (PBL) learning model. PBL is a student-centred and problem-oriented learning model. In PBL students are faced with real problems that they must solve independently or in groups.

The application of the PBL model can improve students' problem-solving skills because PBL provides opportunities for students to use their knowledge and skills to solve real problems, solve new, complex and non-routine problems, students can also work together in groups to solve a problem.

Using the PBL learning model is expected to be a solution and can train students' physics problem solving skills so that students will be more active in learning and will create a more interesting atmosphere so as to reduce student boredom in the classroom. With more active learners, it is expected that it will improve the physics problem solving ability of students.

1. Problem-based learning model

According to Ngalimun (2017) problem-based learning, hereinafter abbreviated as PBL, is one of the innovative learning models that can provide active learning conditions to students. PBL is a learning model that involves students to solve a problem through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have the skills to solve problems.

2. Problem-Solving Ability

According to Veronica (2018), the main obstacle in learning physics is students who always feel difficulties and physics problems, so students are taught to be able to solve physics problems using existing sources through a process of practice in physics studies. This means that students do not directly acquire physics problem solving skills and teachers, but through a process of continuous practice. In addition, students must have an understanding of physics concepts to be able to solve problems.

According to Martawijaya et al., (2015) in solving problems students must think, try hypotheses and if they succeed in solving the problem then students learn something new. To be able to solve problems, a person needs knowledge and abilities that are related to the problem. These knowledge and abilities must be processed creatively in solving the problem. Problem solving ability is a skill that includes the ability to seek information, analyse situations, and identify problems with the aim of producing alternatives or solutions so as to take an action decision to solve the problem.

The objectives to be achieved in this study are to determine the physics problem solving ability of students before applying the Problem Based learning model, to determine the physics problem solving ability of students after applying the Problem Based learning model and to determine the increase in physics problem solving ability of students after applying the Problem Based Learning model.

RESEARCH METHODS

This research was conducted at SMAN 9 Gowa during the odd semester of class XI in the academic year 2023/2024. The study aimed to investigate the application of the problem-based learning model in enhancing students' physics problem-solving abilities. The methodology employed in this research is quantitative, specifically using a pre-experimental design. Pre-experimental research focuses on the effects of the treatment applied to the subjects being observed (Sugiyono, 2016). The study population consisted of students from class XI MIPA 5 at SMAN 9 Gowa for the 2023/2024 school year. The sample for this study included 25 students from class XI MIPA 5, selected through simple random sampling. This random sampling technique ensures that every member of the population has an equal chance of being included in the sample, regardless of any existing strata within the population.

The research design used is as follows:

Pre-Test	Treatment	Post-Test
O_1	X	O_2

Description:

O_1 = Experimental group prestest score

X = Treatment using the PBL model

O_2 = Posttest value of the experimental group

(Sugiyono, 2017)

The data collection technique used in this study was a researcher using an essay question test. After observing the research site regarding the population to be taken and determining the sample to be used during the implementation stage and the pretest given before learning is carried out to find out the extent of the ability of students before receiving material. And the postest given after learning is done. For instruments using problem solving ability test sheets in the form of essay questions totalling 6 questions on pretest and posttest.

Data Analysis Techniques

1. Descriptive Statistical Analysis

Descriptive analysis in this study is intended to describe the physics learning outcomes of students before (pretest) and after (posttest) taught through the application of the PBL model with flipbook media, student activity in the learning process. Which then the results will be displayed in the form of ideal score, highest score, lowest score, score range, average score, standard deviation, variance and percentage.

2. N-gain analysis

N-gain analysis is used to determine the improvement of physics learning outcomes. To find out the difference between the posttest and pretest scores, the normalised gain score is used. The improvement that occurs before and after learning is calculated using the normalised gain formula (N-gain), which is as follows:

$$g = \frac{s\ post\ test - s\ pre\ test}{s\ max - s\ pre\ test} \quad (1)$$

S post-test: Final test score
S pre-test: Initial test score
S max: The maximum score that can be achieved

The criteria for the N-Gain level according to Meltzer & David are:

Table 1. N-Gain Level Categories

Limitations	Category
$g \geq 0{,}7$	High
$0{,}7 > g \geq = 0{,}3$	Medium
$g < 0{,}3$	Low

RESULTS AND DISCUSSION

Results

To obtain data on student learning outcomes, a test was given in the form of questions in the form of essay questions as many as 6 numbers, then obtained by analysing the data descriptively.

Table 2. Descriptive analysis results of Pretest and Posttest scores on problem solving skills of students

	Pretest	*Postest*
Lowest score	19	50
Highest score	47	75
Average score ($\bar{X}$)	42,5	61,7
Standard Deviation	6,7	6,8

The table above shows that there is an increase in the test results of students' problem-solving skills in physics subjects after being taught with PBL model learning. In the initial test (pretest) problem solving ability has the lowest score is 19, the highest score is 47 and the average score is 42.5 which is in the medium category with a standard deviation is 6.7, while in the final test (posttest) the lowest score is 50, the highest score is 75, and the average score is 61.7 which is in the high category with a standard deviation is 6.8.

1. Descriptive Analysis of the Pretest Score of Students' Problem Solving Ability

The results of the pretest score of problem-solving ability of students of class XI MIPA 5 SMAN 9 Gowa before the application of the PBL model indicated that the majority of students had limited proficiency in tackling physics problems.

Specifically, many students struggled with fundamental concepts, which was reflected in their scores, as a significant portion fell below the minimum competency threshold established by the curriculum.

Table 3. Frequency Distribution and Percentage of pretest scores of Problem-Solving Ability of Learners

Score Range	F	Percentage (%)	Category
81 – 100	0	0	Very High
61 – 80	0	0	High
41 – 60	16	64	Medium
21 – 40	8	32	Low
1 – 20	1	4	Very Low

The table above shows that the problem solving ability of students before the application of the PBL model is 64% in the medium category, 32% in the low category and 4% in the very low category. The following can be seen an overview of the frequency of problem-solving ability of students in class XI MIPA 5 SMA Negeri 9 Gowa after the pretest (initial test).

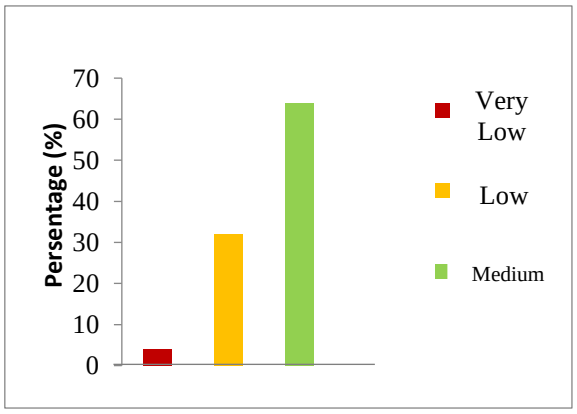

Figure 1. Diagram of the Percentage of Pretest Score of Problem-Solving Ability of Students

2. Descriptive Analysis of Posttest Score of Students' Problem Solving Ability

The results of statistical calculations of the posttest score data of the problem-solving ability of students in class XI MIPA 5 SMA Negeri 9 Gowa after the application of the PBL model in class XI MIPA 5 in the following table.

Table 4. Frequency Distribution and Percentage of posttest scores of Problem Solving Ability of Learners

Score Range	F	Percentage (%)	Category
81 – 100	0	0	Very High
61 – 80	14	56	High
41 – 60	11	44	Medium
21 – 40	0	0	Low
1 – 20	0	0	Very Low

Table 4 shows that the problem-solving ability of students after applying the PBL model is 56% in the high category, and 44% in the medium category. For more details, here is a description of the frequency of the problem-solving ability of students in class XI MIPA 5 SMA Negeri 9 Gowa on the posttest.

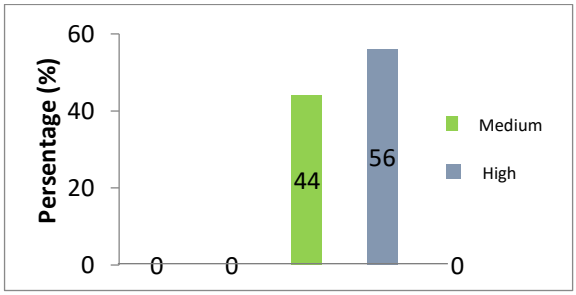

Figure 2. Chart of Percentage Score of Posttest of Problem-Solving Ability of Students

As for seeing the difference from the pretest and posttest results of class XI MIPA 5 SMA Negeri 9 Gowa can be seen in Table 5 and Figure 3.

Table 5. Frequency Distribution and Percentage of Pretest and Posttest Score of Problem-Solving Ability of Students

Score Range	Category	Pretest Frequency	Posttest Frequency
81 – 100	Very High	0	0
61 – 80	High	0	14
41 – 60	Medium	16	11
21 – 40	Low	8	0
1 – 20	Very Low	1	0

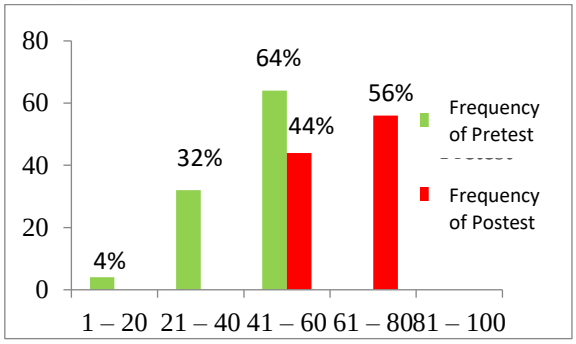

Figure 3. Diagram of Percentage Score of Pretest and Posttest of Problem-Solving Ability of Students

The increase in physics problem solving ability of students as a whole (one class) is 60.4. With the value of g = 0.34, it can be concluded that the improvement of problem-solving ability of students of SMAN 9 Gowa.

Table 6. Frequency Distribution and Percentage of Improvement of Problem Problem-Solving of Students Class XI MIPA 5 SMAN 9 Gowa

No.	Category	Frequency	Percentage %
1.	High	0	0
2.	Medium	15	60
3.	Low	10	40
N	Total	25	100

Table 6 shows that most of the students of class XI MIPA 5 SMAN 9 Gowa have problem solving skills in the medium category, namely 60%.

The improvement of problem-solving ability of students of class XI MIPA 5 SMAN 9 Gowa can be depicted on a graph as in Figure 4.

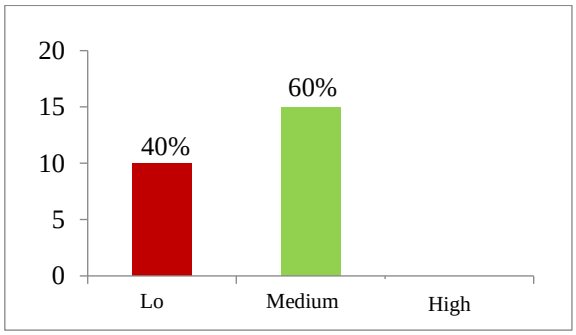

Figure 4. Percentage of Improvement of Problem-Solving Ability of Students of class XI MIPA 5 SMAN 9 Gowa

Discussion

Based on the results of the research that the physics problem solving ability of students can be obtained by conducting pretests and posttests, from the results of pretests and posttests using descriptive analysis and N-Gain analysis to determine the physics problem solving ability of students before and after applying the Problem Based Learning (PBL) model to students of class XI MIPA 5 SMA Negeri 9 Gowa.

Based on descriptive analysis, it shows that there is a significant increase between the physics problem solving ability of students before and after being taught using the Problem Based Learning (PBL) learning model. This can be seen in the average score obtained during the pretest which is 42.5. And the average score on the posttest is 61.7. This shows an increase in the physics problem solving ability of students in class XI MIPA 5 SMA Negeri 9 Gowa after applying the problem-based learning (PBL) learning model. To find out how much the physics problem solving ability of students increased, the N-Gain test was conducted. From the results of the N-Gain analysis obtained an increase in physics problem solving ability of students of 0.34 and included in the medium category.

The results of this study are relevant to previous research conducted by (Prasekti & Marsigit (2017) the overall problem solving ability of students after applying the problem-based learning model has increased students' problem solving ability by mastering the four stages of problem solving skills including understanding the problem, planning strategies, carrying out the solution plan and checking the results again. Based on the results of data analysis, it is obtained that the application of the problem-based learning model can increase student learning activities on the concept of Heat and Heat

Transfer in Class XI MIA 4 MAN 2 Bengkulu City. The application of problem-based learning model can improve students' problem solving ability in learning physics on the concept of Heat and Heat Transfer in Class XI MIA 4 MAN 2 Bengkulu City.

The results of other studies show the same thing that problem based learning model have positive impact to improve problem solving ability, learning outcome of student at senior high school (Prasekti & Marsigit, 2017). The advantages of the problem based learning model are facilitates students to be independent, participate actively, develop problem solving abilities and think critically (Imandala et al., 2019). The problem based learning model requires students to be active when teaching and learning activities take place and are given the freedom to develop their creativity (Setyadi & Saefudin, 2019).

Accoding to research results by (Wijayanti et al., 2016) it was found that the problem based learning model was more effective than the group investigation model. The other researcher get the results of the research show that there is a positive influence when learning applies the problem based learning model on students' problem solving abilities which get a significance value of <0.05 which proves that Ha is accepted. Apart from that, the research results also showed that students in the experimental class experienced a greater average increase when compared to the control class (Setyaningsih & Rahman, 2022).

Accoding to research result of Pebriyani & Pahlevi (2020) show that there is an influence of the Problem Based Learning (PBL) learning model accompanied by Concept Mapping Technique on students' problem solving abilities. Problem based learning also can influence leaning outcome and critical thinking of students at senior high school (Pebriyani & Pahlevi, 2020).

Simomora (2019) stated that there is an influence of the use of the Problem Based Learning (PBL) model on students' problem solving abilities on the subject matter of static fluids and the other Researcher states that there is a significant influence of the Problem Based Learning (PBL) learning model on students' problem solving abilities on prisma material (Yasa & Bhoke, 2019). Previous research has proven that the Problem Based Learning (PBL) learning model can improve abilities of student problem solving (Hasanah et al., 2021).

CONCLUSION

Based on the results of research and discussion, it can be concluded that the physics problem solving ability of students of class XI MIPA 5 SMA Negeri 9 Gowa before being taught by applying the problem based learning model (PBL) is in the low category, the physics problem solving ability of students of class XI MIPA 5 SMA Negeri 9 Gowa after being taught by applying the problem-based learning model (PBL) is in the high category. And there is an increase in the physics problem solving ability of students in class XI MIPA 5 SMA Negeri 9 Gowa which means after being taught by applying the problem-based learning (PBL) learning model with the Gain index in the medium category.

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