The Effect of Problem Based Learning (PBL)Assisted by PhET Applications on Physics Problem Solving Ability of Students

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Abstract. This study aims to analyze the effect of the problem-based learning model assisted by the PhET application on students' ability to solve physics problems. The type of research was quasi-experimental. The design used is a two-group pretest-posttest design. The population tested was class X, science students. For the experimental group, the learning process uses a problem-based learning model assisted by the PhET application, while the control class uses a conventional learning model. The data collection instrument used an essay test. The average post-test result in the experimental group (73.9) was higher than the control group (54.7) with a t-test obtained $t_{count} > t_{table}$. The physics problem-solving ability of students in the experimental group was significantly higher than the control group. The result of N-gain in the experimental group was 0.61 with a good category. It can be concluded that the problem-based learning model is effective in improving students' problem-solving abilities in physics.

Keywords: *problem-based learning, PhET, problem-solving skills*

1. Introduction

The problem of Indonesian education today and in the future is wide and complex. One of the most important problems in the world of education is efforts to improve the quality of education, namely by improving the quality of human resources through education.

Education itself has a very important role in the life of the nation[1]. This was emphasized by Hasibuan who said that one of the strategies to improve the quality of human resources is to build the education sector as one of the main tools in development[2]. One of the most important lessons in the world of education that is learned at the secondary school level is Physics.

Physics is one of the subjects given by schools at the secondary level which plays a very important role in the success of educational goals. Physics is a subject that can foster students' thinking skills that are useful for solving problems in everyday life[3]. According to Hastuti, physics also discusses concepts and laws as products and makes observations, experiments, and investigations as processes. One of the objectives of learning physics contained in the 2013 Curriculum is to master concepts and be able to solve problems in developing knowledge and self-confidence as a provision to continue education at a higher level. [4].

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Problem-solving ability is one of the higher-order thinking skills used in the current curriculum. Problem-solving is generally described as developing a solution to the problems encountered based on the knowledge of understanding the basic concepts studied previously. Problem-solving not only emphasizes quantitative aspects such as mathematical equations and procedures but also emphasizes qualitative analysis aspects in the form of choosing the right concepts and principles in solving problems[5].

Based on observations in the classroom, the learning process at SMA Negeri 7 Medan currently does not improve students' problem-solving abilities because teachers still use conventional learning models in classroom learning activities. This is reinforced by teacher interviews at SMA Negeri 7 Medan that teachers lacked in exploring students' physics problem-solving abilities. In the 21st century, physics research focuses on problem-solving because problem-solving skills are considered necessary for students to produce creative and innovative solutions in dealing with current world problems[6]. Conventional learning is learning that focuses on pouring knowledge from teacher to student, without paying attention to students' preconceptions or ideas that already exist in students. This makes the learning process passive and students only become recipients of the information.

This conventional learning causes learning to be less meaningful, and as a result, students' ability to understand physics concepts is low and has implications for students' physics problem-solving abilities. This can be seen from the scores they get in odd semesters. A total of 21% of students scored 80-90, 66% of students scored 50-70 and 13% of students scored 0-40.

Based on these conditions, there is an effort that must be made to overcome the students' physics learning process, especially at SMA Negeri 7 Medan, so that students can improve their understanding of physics concepts and problem-solving abilities. Efforts to solve the problems faced by students are to determine a learning model that can actively involve these students in learning activities. Viewed from the context of improving the quality of education, the problem-based learning (PBL) model is one of the learning models that can be used to improve the learning system. We realize that so far the ability of students to be able to solve problems has not been paid attention to by every teacher. The PBL model puts the problem as the keyword of the learning process. A learning model that can help students to understand physics concepts correctly and improve students' physics problem-solving skills is problem-based learning.

According to the Hudha model problem-based learning (PBL) is a model that uses problems in real everyday life as a context for students to learn about how to solve problems and acquire knowledge and concepts that are essential to the subject matter, so PBL will make students independent learner[7].

The problem-based learning (PBL) model will lead students to understand concepts and be able to solve physics problems well. This is in line with research by Dwi & Setot that problem-based learning (PBL) can significantly improve students' understanding of physics concepts and problem-solving abilities[8]. Halim, et al said that problem-based learning (PBL) showed indicators of concept understanding had increased, as well as Ekawati showed that problem-based learning (PBL) could improve students' physics problem-solving abilities[9].

Based on the above problems, it is necessary to do a method to overcome these problems by using a problem-based learning (PBL) model for students to more easily understand the concepts of physics in solving physics problems in everyday life, especially in the material of

simple harmonic motion. Another thing that the author uses is to use a virtual lab in the form of PhET (Physics Education Technology) to make it easier for researchers to manage the time used during research.

2. Literature

2.1. Problem-Based Learning (PBL)

According to Duch problem-based learning (PBL) or problem-based learning is a teaching model characterized by real problems as a context for students to learn critical thinking and problem-solving skills and gain knowledge.[10].

The problem-based learning (PBL) model is the most significant innovation in education, Margetson further said that the problem-based learning (PBL) model helps to improve the ability to understand concepts and facilitate success in solving problems.[11].

Based on the opinions of several experts, it can be concluded that the problem-based learning (PBL) model is a learning model that begins with providing authentic/real problems where the problem is experienced in the daily lives of students. Students solve problems to find new concepts or knowledge.

2.2. Problem Solving Skill

Tarhadi, defines problem-solving as a way of thinking, analyzing, and reasoning using experience and knowledge related to the problem. There are several types of problems, namely; (1) Problems whose solution procedures already exist and are known to students; (2) Problems whose solution procedures are not yet known by students; (3) Problems for which the solution procedure is not known at all and or the data needed to find the solution is not known. Sintha defines a problem as a situation in which a person or group of people is asked to complete a task for which there is no available algorithm that matches the solution method[13].

The ability to problem-solving is a basic ability that must be possessed by each individual to solve a problem. Ekawati (2018) states that physics has a large enough role in providing various abilities to students for structuring thinking skills and problem-solving abilities in everyday life.[14].

3. Methodology

This type of research is a quasi-experimental study, which aims to determine whether there is a consequence of something imposed on students, namely students. This study involved two classes of samples that were given different treatments. The experimental class was given treatment in the form of learning using a problem-based learning model. The control class was given treatment in the form of learning using conventional learning.

This study involved two classes that were given different treatments, to determine the students' physics problem-solving ability, a test would be conducted on both classes before and after being given treatment. The design of this quasi-experimental research was the two-group pretest-posttest design.

4. Results & Discussion

In the SPSS 16.0 calculation results, the output of statistical test data from the post-test results of students' physics problem-solving abilities who were given the PhET-assisted Problem Based Learning and the results of students' physics problem-solving abilities using conventional learning can be seen in Table 1.

Table 1. Posttest t-test Physics problem-solving ability

T Uji Test Value	DK	Sig
3,634	69	0,001

Based on Table 1 obtained the value of Sig. of 0.001. Therefore, the value of Sig. 0.000 <0.05, it can be said that the test results reject Ho or accept Ha in the 5% alpha level. Thus, it can be concluded that there is a significant difference in the problem-solving abilities of students who are taught physics with the problem-based learning (PBL) model assisted by PhET with students who are taught using conventional learning. In other words, the results of students' physics problem-solving abilities who were given the PhET-assisted Problem Based Learning (PBL) learning model were better than conventional learning.

Students who were taught by the PhET-assisted Problem Based Learning (PBL) learning model ((x) postes=73.9) were higher than the average post-test results of students' physics problem-solving abilities taught by conventional learning, namely (x postes=54.7). These results prove that the Problem Based Learning (PBL) learning model gives good results in students' physics problem-solving abilities. The principles developed in the Problem Based Learning (PBL) model such as asking clear and straightforward questions, providing opportunities for students to correct questions, pointing out points that do not fit, providing guidance on the theory used, and providing an atmosphere of intellectual freedom, providing encouragement and support for student interactions, exploration results, formulations, and generalizations can make students better understand the material taught by the teacher. This is what causes differences in students' physics problem-solving abilities between these two lessons.

5. Conclusions

There are differences in the results of the post-test on the physics problem-solving ability of students who are taught using the Problem Based Learning (PBL) model with the help of PhET applications with students who are given conventional learning. The experimental class obtained an average of 73.9 and the control class obtained an average of 54.7. Problem Based Learning (PBL) learning model assisted by the PhET application is better at improving students' physics problem-solving ability than conventional learning.

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