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APPLICATION OF PROJECT-BASED LEARNING MODELS WITH PROBLEM-BASED LEARNING TO DETERMINE THE ABILITY OF STUDENTS' PHYSICS PROBLEM-SOLVING SKILLS

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Abstract. This research aiming to determine students' physics problem-solving skills taught with Project-Based Learning (PjBL) and Problem Based Learning (PBL) models on optical instrument material in class XI Semester II students of MAN 1 Medan T.P 2018/2019. This type of research is quasi-experimental. Sampling was done by random sampling by taking 2 classes from 7 classes randomly, namely class XI MIA-5 as the experimental class with the PBL model and class MIA-1 as the experimental class with the PjBL model. The instrument used to determine problem-solving skills as a learning outcome test in the form of an essay with a total of 7 questions and this study three observers were assisted to assist researchers in carrying out their research. The data in this study are analyzed using a t-test and gain test. The results showed that the problem-solving abilities of students who were taught with the PjBL learning model were better than those taught with model PBL

Keywords: *Project-Based Learning and Problem Based Learning, Problem Solving Skills.*

INTRODUCTION

Education can be interpreted as a process of changing the behavior of students to become adult human beings who can live independently and as members of society in the natural environment in which the individual is located (Sagala, 2012). Formal education is a means to produce quality human resources. School education as formal education is education obtained by a person in school regularly, systematically, stratified, and approaching clear and strict conditions (Hasbullah, 2006).

The reality in the field that is obtained from the results of observations in MAN 1 Medan is that science learning is not student-centered but teacher-centered. When learning takes place, knowledge transfer is carried out face to face, lectures, and demonstrations in front of the class. Students are less active in learning activities so that their ability to solve problems is to develop skills in applying, processing, and developing physics concepts.

The preliminary study of MAN 1 Medan on January 17, 2019, in one of the XI classes with 38 students, 3 questions, where the question is a problem-solving question, with an assessment rubric based on problem-solving abilities. Obtained the following data: for question number 1 on indicators of understanding the problem 42.59%, planning 45.37%, solving problems 27.78%, and checking again 35.18%; for question number 2 on the indicators of understanding the problem 19.44%, planning 42.59%, solving problems 34.44%, and checking back 61.11%; for question number 3 on the indicator of understanding the problem 27.78%, planning 41.67%, solving the problem 19.44%, and checking back 42.59%. These results indicate that the level of problem-solving abilities of students in these schools is still low. Teachers need to equip students with the ability to solve problems. Problem-solving is seen as one of the main skills that students must have when entering the real world.

Problem-solving is seen as one of the main skills students must possess when entering the real world. Also, students are not maximal when practicing. When students do a practicum, the teacher must provide in detail how the practicum procedure will be carried out so that the practicum is by the learning objectives to be achieved. Creative thinking skills and problem-solving for students will be easier to sharpen if students are given a problem based on experience gained in the real world. Students' creative thinking skills can be integrated into a variety of subjects, one of which is science subjects especially in the field of Physics studies. Therefore, an effort is needed to improve problem-solving skills for students (Anjarsari, 2014).

The model of project-based learning emphasizes learning activities that are relatively long, student-centered, and integrated with real-world practices and issues so that with this model learning outcomes and students' interest in learning physics are expected to increase (Ngalimun & Pd, 2014). The PBL model places the same emphasis on academic learning goals and the competencies needed by students more than ever in the 21st century. Through a well-designed project experience, students learn how to contribute to team efforts to solve problems creatively and collaborate effectively(Boss & Krauss, 2014).

METHODS

This research has been conducted at MAN 1 Medan. The research period is conducted on 30 April – 25 May in the even semester of the academic year 2018/2019. The research population is all students of class X MIA. This type of research is quasi-expansive. The sample consisted of two classes namely the experimental class and the control class taken by cluster random sampling technique with the design of Two groups Pretest-Posttest Design. This research was analyzed with SPSS 21, t-test, and gain test. From the results of the pretest and posttest data, the calculation is done using the formula g factor so that the gain score is obtained for problem-solving skills.

Table 1. Two Group Pretest – Posttest Design

Class	Pre-test	Treatment	Post-test
Experiment 1	T_1	X	T_2
Experiment 2	T_1	Y	T_2

With:

X = Treatment by using the Project-Based Learning model

Y = Treatment using the Problem Based Learning model

T_1 = Pretest in experimental class (1) and experimental class (2) before being treated

T_2 = Postes in experimental class (1) and experimental class (2) after being treated

The instrument used in this study was problem-solving skills. The instrument of problem-solving skills is a modification of Nezu (2007) and Polya (1985). The data obtained first are analyzed by hypothesis testing, after first tested normality and test homogeneity of data. The normality test is conducted to find out whether the research data is normal for each research variable, the test used is the Shapiro-Wilk One sample test on the SPSS 21 program, then the homogeneity test to find out the two samples are from a homogeneous population, by distributing data to SPSS 21 into the column. One Way Anova. This process will produce the output of the Test of Homogeneity of Variances. Hypothesis testing is done by t-test two parties test similarity average pretest and t-test one party (test similarity average posttest). The two-party t-test was used to determine the similarity of students' initial abilities in the two sample groups. At the 0.05 level of significance. A one-party t-test is used to determine the effect of a treatment that is a learning model based on the problem of student learning outcomes. The hypothesis was tested using SPSS 21 at a significant level $\alpha = 0.05$, then the testing criteria are if the significance value is> 0.05 then the two classes have the same ability. And if the significance value is <0.05, the two classes have different abilities

The results of the pretest-posttest of students' physical problem-solving skills were then analyzed using Gain-test to determine the increase. The following formula for calculating the gain value of student problem-solving skills:

$$g = \frac{Post.test\ score - Pre.test\ Score}{Max.score - Pre.test\ score}$$

With:

$g < 0,3$	low category
$0,3 \leq g \leq 0,7$	medium category
$g > 0,7$	high category

(Hake, 2007)

From the results of the pre-test and post-test data, calculations are performed using the formula g factor (normalized gain value) so that the student benefits problem-solving skills gain scores.

RESULTS AND DISCUSSION

The Experimental class (1) applied project-based learning and experimental class learning models (2) applied problem-based learning models. The research took place for three meetings both in the experimental class (1) and in the experimental class (2) based on three Learning Implementation Plans (RPP). The material is loop, telescope, and periscope. Each student meeting is given a Student Activity Sheet (LKS) in the experimental class with a problem-based learning model and the provision of Project Worksheets (LKPP) in the experimental class with project-based learning models that have been prepared based on indicators of problem-solving skills. Posttest given after the treatment for three meetings were completed to see the improvement of students' physics problem-solving skills in the experimental class (1) and the experimental class (2). The following Figure 1 shows the post-test average value of students' physics problem-solving skills.

Table 2. Postest Data Experimental Class 1 and Experimental Class 2

	Class	N	Mean	Std. Deviation	Std. Error mean
Posttest	PjBL	40	67,375	2,71451	,42920
	PBL	40	63,450	3,32782	,52617

Table 2 shows the posttest average PjBL class is 67.37 and the PBL class average value is 63.45.
The results obtained from the post normality, homogeneity, and similarity of two mean tests (t-test) were tested.

The Gain test results for the control class and experimental class for each student are presented in each figure 1 and figure 2. gain test is a test that can provide a general picture of increasing the score of learning outcomes between before and after the model is applied. Observation datasheet students' physics problem-solving skills were analyzed using descriptive statistics and gain score. From the results of the pretest and posttest data, the calculation was done using the g factor formula (normalized gain score) so that the gain score of students' physics problem-solving skills was obtained. For this test, SPSS 21 is also used. The Gain test results for the experimental class with the PjBL

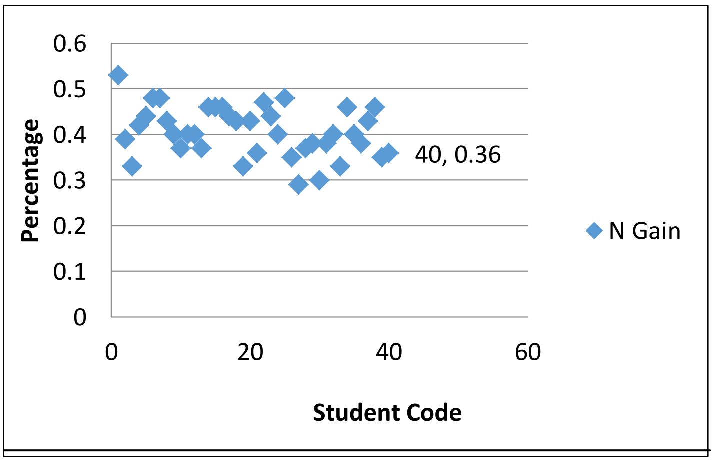

Figure 1. N Gain Class Diagram Experiments Using the Project-Based Learning Model

Based on the results obtained in the Experimental class by using the Project-Based Learning model, the gain of each student in the medium category was obtained with the lowest gain value of 0.29 and the highest gain value of 0.53 gain average in the medium category. While the Gain test results for PBL Classes are presented in Figure 2 below:

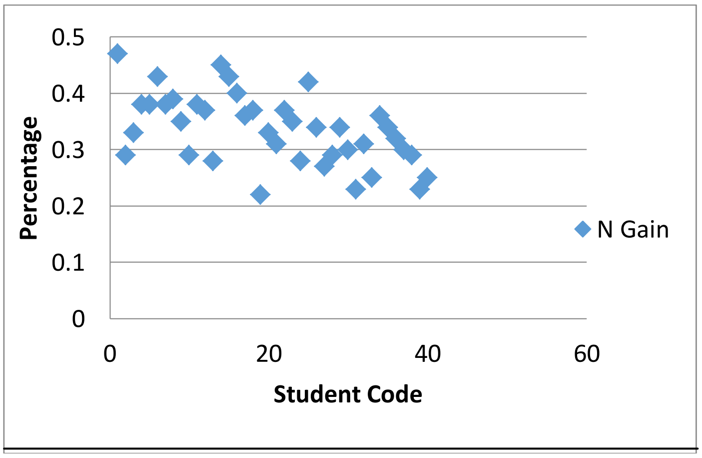

Figure 2. N Gain Diagram of Class Experiments Using the Problem Based Learning ModeL

Based on the results obtained in the experimental class the gain of each student was obtained in the category of Low to High with a gain average in the Medium category. This shows that there is an increase in student learning after the Project-Based Learning Model is applied when compared to the class given treatment with the Problem Based Learning model through the two-party t-test with the results of the same initial student abilities.

There is a Difference in the Problem-Solving Skills of Physics Students who are Learning Using the Project-Based Learning Model with the Learning Model of Problem Based Learning

Physics problem-solving skills of students who are taught with the Project-Based Learning model with problem-based learning models are different. Where problem-solving skills with 67.37 project-based learning models and physics problem-solving skills students with 63.45 problem based learning models. This shows that students ' problem-solving skills taught with PjBL models are better than students' problem-solving skills taught with problem-based learning models. This is in line with the research of previous researchers (Inpafi, 2014). concluded that experimental class learning outcomes in the realm of knowledge with 78.8 posttest average using Project Based Learning (PjBL) are higher than the learning outcomes of control classes that do not use PjBL with grades average of 69.6. states that project-based learning can help students develop on aspects of their knowledge. Students who participate in project learning tend to learn more about something. Students can make the information they get into real knowledge. Increased aspects of student knowledge using the PjBL model are also proven by previous researchers Christine with conclusions. Using the PjBL model on the experimental class has a significant influence on student learning outcomes inseparable from the activities students follow during the learning process (Mihardi et al., 2013).

Furthermore in understanding the concepts and scientific attitudes of high school students who were taught by problem-based learning and project-based learning models, the results showed that (1) increasing understanding of chemical concepts and scientific attitudes of students taught with PjBL learning model is higher than the students taught with PBL; (2) an increase in understanding of the chemical concepts of students who are taught with the learning model of the PjBL is higher than the students who are taught with the PBL learning model; (3) improvement of scientific attitudes of students who are taught with the PjBL learning model is better than students taught PBL (Curtis-Bey, 2009)

Several learning models are considered to have the potential to empower problem-solving skills including the project-based learning model (PjBL) and the problem-based learning (PBL) model. Both of these models can guide students to find solutions to an existing problem, except that the difference between them is in the project-based learning model students are given a project that can guide students to solve the problem so that they can complete the project according to the time specified (Meita et al., 2018)

A model of project-based learning is a learning model that involves students in an activity (project) that produces a product. The involvement of students starts from planning, designing, implementing, and reporting the results of activities in the form of products and implementation reports so that students actively construct their knowledge and develop creative thinking skills, solve problems, and intellectual skills, and make students independent (Yusoff, 2006). In applying the project-based learning model, teachers and students determine the time limit given in completing the tasks (activities) in the project-based learning that they have done so that the learning opportunities and project completion activities will be even better (Gunawan et al., 2017). Problem-solving skills need to be optimized in the learning process. Problem-solving is seen as one of the main skills that students must have when leaving school level and will enter the real world (Wibowo, 2014).

The purpose of learning science so that students can have mastery of concepts, process skills, and attitudes, this applies universally. Learning activities must be designed or chosen so that they can relate to students' daily needs and experiences, to foster curiosity by involving them actively in learning and trying to overcome problems that occur in real (Komyadi & Nasution, 2015).

CONCLUSION.

The students' problem-solving skills in physics with the PjBL model have gained 0.406 with the medium characteristic category. Physics problem-solving skills of students who are taught by the PBL model have a gain of 0.335 with a moderate characteristic category. The physics problem-solving skills of students who are taught with the PjBL model are better than the physics problem-solving skills of students who are taught with PBL models.

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