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The effects of problem based learning model on problem solving skills in the subject matter of momentum and impulses

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Abstract. The aim of this study was to determine the effects of the Problem Based Learning (PBL) model on problem solving skill in physics at SMA Negeri 1 Lubuk Pakam. Problem solving skill by Heller consisted several stages : focus to the problem, describe problem in physics, plan the solution, execute the solution, evaluate solution. This study used quasi experiment method with two group pretest-posttest design. The samples of research was chosen by random sampling method, X MIPA 2 as experimental class using PBL model and X MIPA 6 as control class using conventional learning. Data collection was done through problem solving tests and observations. The result of the analysis shows that the student facilitated with PBL model get the highest score average compare to the control class. The conclusion of this study, there is a significant effect of the problem based learning model on problem solving skills in the subject matter of momentum and impulses.

1. Introduction

The demands of current globalization era is high quality human resources. Human resource issues being as central to every policy initiative in education around the world. Education is one of the way to develop the mind and skills of student. Education can be made more effective with effective teaching. It makes teacher is the key of the succes learning. Teaching is a way to improve knowledge, skills and behavior of students

Currently, these new technologies bring new challenges. Problem may point as challenges. Problem usually indicates as a challenge, which is require problem solving skill. Several studies focus the change in knowledge and skill levels that occur with problem-solving technique. States problem-solving as the process used to solve a problem that does not have an obvious solution [1]. Educators want their student acquire problem solving skill during learning activities so they can address complex problems in their everyday lives.

Physics is one of science subsidiary that related with daily life. Students lean to learn physics as an unclear knowledge and full of formulas instead of connect physics with the real world. Poorly in fact physics is taught with traditional way. Learning is focus to the teacher as a subject called as “teacher-centered” whereas learning should make student as a ‘doer’. Futhermore, based on the observation known problem solving skill students is 54% students can not identified the problem, 33% students can identified problem but they can not solve the problem and others can identified and solve the problem. Based on the introduction above this study has focused on student learning to know the



effectiveness of problem based learning on problem solving skill in subject matter momentum and impulses.

1.1 Problem based learning on problem solving skill

Question will be a problem if the question shows a challenge that cannot be solved by a procedure (routine procedure) that is known to the perpetrator. This definition implies that a problem must have a "challenge" and "no known routine procedures". The routine procedure here is the problem in which the solution is predictable, the formula is known. Not all questions are a problem..

PBL provides opportunities for students to become responsible for their own learning, and the teacher becomes a facilitator of the learning process. Problem Based Learning is an effective approach to high-level thinking process. This learning helps students to process the information that has been made in their minds and compiles their own knowledge about the social world and its surroundings. PBL is implemented to improve students' problem solving skill [2]. Revealed that when PBL was applied, engineering students were better able to solve problem [3]. PBL is a learning that starting with autentic problem to motivate students into the learning. Autentic problem is a problem related to daily life. PBL includes student-centered learning for problem solving. The mission of this approach is to guide and facilitate the students rather than provide information. Therefore, teacher should teach these problem solving skill to their students in order to enable their success.

There are 5 phases indicated PBL process by Arrends.

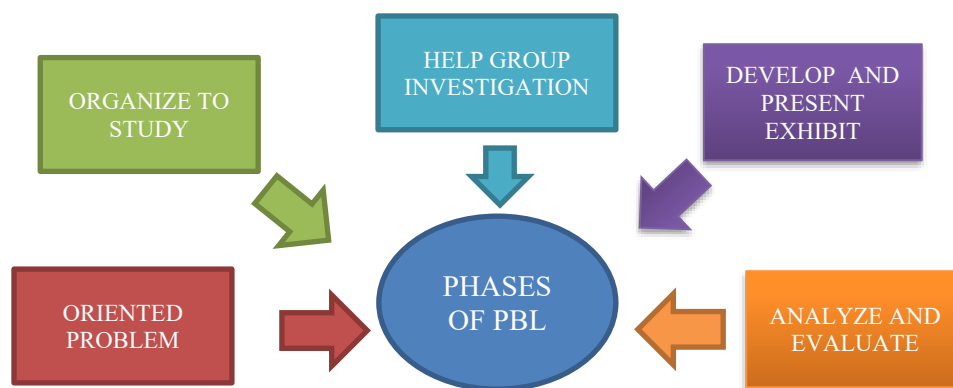


Figure 1 : Phases of PBL

PBL provides opprtunities for students to become responsible for their own learning, and the teacher becomes a facilitator of the learning process. Problem based learning is an instructional model that assumes the centrality of problems to learning [4]. PBL has three outcomes such as problem solving skills, social skills, and skill for independet learning Problem solving skills strategy by Heller [5] follows these steps :

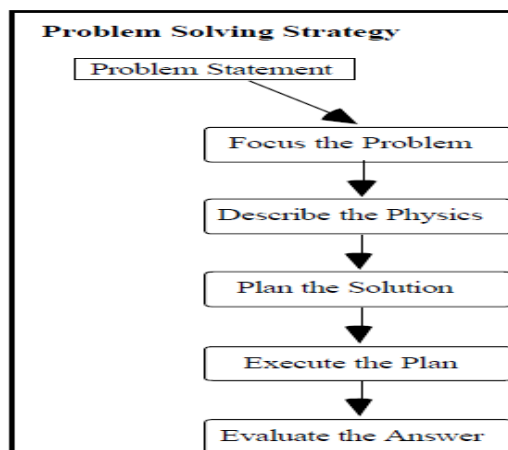


Figure 2. Steps of problem solving

On figure 2, there are 5 steps of problem solving technique by Heller. The very first step to solve a problem is focus the problem. In this step you must get the qualitative description of the problem, visualizing the events in the problem. On describe the physics is using the quantitative solution, describing the problem situations by describing with a diagrams and mathematical quantities. The third step is plan the solution, in this step we translate the physics description and represents with formulas if needed, we create an outline how to arrive at a solution. The fourth step is execute the problem, we use our outline solution to be executed. Plug all of the known quantities. The last step is Evaluate the answer, this step to validate your work is properly stated and not unreasonable.

1.2 Problem authentic in subject matter momentum and impulses

Momentum and impulses is one of many topics on physics. This topic is so related with students daily life. There are so many daily problem related momentum and impulses. Therefore, it will fit to use problem based learning to deliver this topic. So student will be given authentic problem such as why they should use helmet while driving, and why safety belt is so important and how does it works to trigger their capability.

Example : “ You are a motorcycle rider. There are so many kind of helmet available to use. Now you should choose which one the helmet is safety, and describe why the helmet is safety with physics concept. Those are the picture below”



Figure 3. Kind of Helmets

2. Method

2.1 Research Design

The quasi experimental research design of this study included two group pretest post test design. This design which include a control group, was structured as follows the figure 4 :

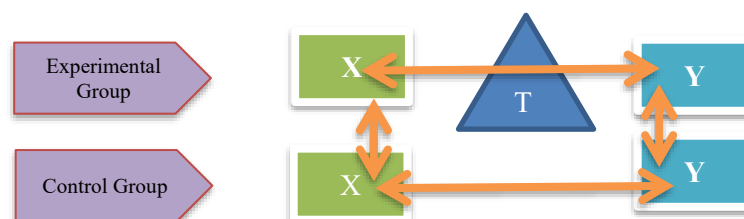


Figure 4. Design of the study

2.2 Participants

The participants of this study consisted all of students in 10th grade of the SMA Negeri 1 Lubuk Pakam. The population of this study involved 204 students. X MIPA 2 and X MIPA 6 as samples were collected by cluster random sampling.

2.3 Data Collection

This study used test as instrument to collected data. The test involved 7 items form of problem solving skill test. These items plaster 2 items of momentum, 2 items of impulse, 1 item the law of momentum conservation, and others is collision.

V of tests was checked by 2 validators. The test was also checked by construction validity follows : validity, reability. These items of problem solving skill used problem solving skill technique by Heller [6].

2.4 Procedure

Pre-test and post-test was involved to sample 33 students experimental class and control class contain 32 students. After test researcher got the score of the pretest then processed by statistical test. Then, the control class gave conventional learning and other class was taught by problem based learning.

The experimental class was taught by the steps of problem solving technique by Heller. This study used 3 encounters for each class. Immediately, after the treatment ended, posttest given to each classes. Score achieved by pretest and posttest were provided in figure and tabular form which being as commentation. Statistic of the study used means, standard deviation and difference of means were computed for each class. T-test at 0,05 was using to get the significance of difference between the mean scores of both classes either pretest nor post-test

3. Results

Based on the data obtained from the research that has been done on classes can be seen through the following table:

Table 1. Significance of difference between Pre-Test Mean Attainment Scores of Experimental and Control Class

Class	N	Mean	S.D	L _{count}	L _{tabel}	F _{count}	F _{tabel}	t _{count}	t _{tabel}
Experimental	33	22,60	5,00	0,1373	0,1498	1,150	1,760	1,014	1,997
Control	32	21,42	4,69	0,0872	0,1477				

Table 1 above shows that the pretest value in the experimental class and the control class does not differ much, meaning that both classes have the same initial ability and the acquisition of the values of the two classes evenly.

Table 2. Significance of difference between Post-test Mean Attainment Scores of Experimental and Control Class

Class	N	Mean	S.D	L _{count}	L _{tabel}	F _{count}	F _{tabel}	t _{count}	t _{tabel}
Experimental	33	66,90	5,77	0,1321	0,1498	1,520	1,760	19,069	1,668
Control	32	43,30	4,60	0,1436	0,1477				



Figure 5. The effect of problem based learning on problem solving skill

From the graphic above it can be concluded that the class given treatment (exeperimen) has a higher value than the class without treatment (control) through the provision of final ability test questions (post test)It can indicated that students who taughte by problem based learning having much betterachievment about problem solving skills compared to the controll class that taught by conventional learning

Figure 5 is a graph of the difference in value between the control class and the experimental class. in the picture clearly shows that the blue line (experimental scores) increases more sharply than the red line (control scores). On pre-test both of experimental and control get score closely, on post-test experimental got higher scores than control

4. Discussion

Education can be effective with right learning which is has effective teaching. There are so many ways for effective teaching such as model of teaching. Model of teaching is one of the key succes learning. Model of teaching can drag class become an active class and to shape instructional material. Teacher ought to prepare 'tools' before get into class instead of giving lesson to students as informative which we called conventional learning. It is good to see students as talkative than teacher do. So it is necessary to develop a program of teaching and to build up problem solving skill by using problem based learning model [7]. Physics is natural science which there are so many problems in, and problem solving skill can help student to solve the physics problem.

The results of this study points out that problem based learning more effective compare conventional learning. Momentum and impulses were taught by the problem based learning model, students achivement in problem solving skill were improved as compared to the conventional learning [8-11].

During the experiment, the researcher noticed that the basic concept of phtysics were so hard for them. Connecting physics with students daily life is one of way to get them easier to understand how physic works. Student who are lacking in growth of capabilities and skills would definitely face problems in the next class, as they are not equipped with the base they need [12].

5. Conclusion

Based on the statistical test and the finding of study, the conclusions were drawn, the problem solving skills of both experimental and control group increased, but there is significant effect on experimental group which used problem based learning on problem solving skill in subject matter momentum and impulses.

To the future researcher it is highly recomended to make observation which has many indicators. This instrument will used during experiment, to check the teacher/researcher follow the phase of problem based learning as well.

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