



THE EFFECT OF PROBLEM BASED LEARNING MODEL ON STUDENT'S LEARNING OUTCOMES ON  
GEOMETRY OPTIC TOPIC

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ABSTRACT

This research have purpose to know the effect of problem based learning model on student's learning outcomes and student's learning activity on geometry optic topic. This research is a quasi experiment using control group pre-test-post-test design. The sampel of theses research consisted of two classes, each contains 30 students. By using total sampling, one class is made as experiment class that uses problem based learning model, and one class is as control that uses conventional learning model, so class XI science -1 as control class and class XI science -2 as experiment class. The instrument used was a test of learning outcomes in the form of students learning outcomes in the form of 7 essay test. In the experimental class the average activity of students in the three meeting, are 62.44, 70.67 and 77.78. The learning activity have increase during three times meeting and have average value 70.33 and have good category. The data obtain so problem based learning model can increase learning activity on geometry optic topic of SMA Negeri 2 Lintongnihuta class XI science second semester A.Y. 2017/2018. The value of the average post-test experimental class was 75.13 and control class was 67.10. Hypothesis with t-test shows the result there was a significant effect of problem based learning model on student's learning outcomes on geometry optic topic of SMA Negeri 2 Lintongnihuta class XI science second semester A.Y. 2017/2018.

**Keywords:** Problem based learning model, conventional learning model, learning outcomes, quasi experiment, learning activity.

PENDAHULUAN

Student's competence in comprehending the concepts in physics at school greatly determines their learning achievement. Their success in learning could be known from the results of their learning achievement evaluation, whose objective is to know the learning outcome that they obtain after the teaching and learning process is carried out. When they already comprehend physical concepts well, they would overcome problems related to the said concepts in daily life or

overcome similarly complex problems. Council for the Advancement of Standards in Higher Education (CAS) in Komives states that there are six domains of students' learning outcomes expected from learning, namely, those respectively of (1) knowledge acquisition, construction, integration, and application, (2) cognitive complexity, (3) intra-personal development, (4) interpersonal competence, (5) humanitarianism and civic engagement, and (6) practical competence. Learning outcomes could not fully assist students in comprehending

something. It is in line with what is delivered by Hussey and Smith by suggesting that learning outcomes can never fully capture the open, creative, and dynamic process of learning and, instead, they may lead to a narrowing of students' learning and tutors' delivery around the predetermined outcomes (Argaw, 2017).

Based Tarigan (2017) students are generally difficult to understand the physics material taught by the teacher. The difficulties are not just about the teacher, but also the students, along with the school infrastructure. Physics as a branch of science is one of the subjects related to nature so that in the learning required a research in the form of experiment on such knowledge. The process of developing the field of physics requires supporting facilities and infrastructure such as laboratories with sufficient equipment and experimental materials, adequate libraries to develop students' thinking bases, and other learning support in schools.

Based on the results of preliminary studies at SMAN 2 Lintongnihuta by conducting interviews with physics teachers SMAN 2 Lintongnihuta obtained information that during the learning process, students are less active in following the learning process takes place, resulting in student learning outcomes is low and does not reach a value criterion mastery minimum, while the value criterion mastery minimum determined by school for physics in class XI was 72. He said that about 70% of students can not reach the criteria value minimum which has been determined by the school. Based on the description above, it can be said that the average value of students in the learning of physics is still relatively low.

The low learning outcomes of students due to the student's learning interest of the students towards physics is still lacking. This is relevant to the data obtained from the questionnaire results to 60 students, indicating that 30% of students said they liked physics lessons, 43% of students said normal, 20% of students said they did not like physics lessons and no students said they liked physics. 73% students said sometimes repeat the taught

physics lessons, 8% of students repeat the taught physics lessons and 73% of students said sometimes read physics lessons before they are taught, 11% of students who read physics lesson before taught and 6% of students never read a physics lessons before being taught. The lack of student interest in learning of physics for students considered physics as a subject that is difficult and unattractive, especially when confronted with formulation and calculations. Activity of students in working on the problems of physics given by the teacher in the process of teaching and learning takes place is still lacking.

According to UNESCO learning outcomes can be contained in the four pillars of learning, ie learning to know, learning to do, learning to life together, and learning to be. Based on Argaw (2017) good learning outcomes is characterized by durable learning and it used the data from the original and authentic knowledge. In Bloom's taxonomy of learning outcomes it can be grouped into three domains, namely cognitive, affective and psychomotor. The results of the cognitive domain of learning aims to measure students' knowledge. Affective domain measures the attitude during and after the study is done, whereas psychomotor skills cover learning achievement.

Learning activities is very important in the learning process because learning is an activity or a process to acquire knowledge, develop skills, improve behavior and attitude and strengthen personality. In addition to acquiring knowledge, interactions between students, students and teachers need to be designed and build the idea of learning to develop the activity and creativity of students. So to achieve the learning objectives, it was favorably affected by the overall process of learning activities involving teachers and students who are fully active in learning activities. Learning activities are all activities performed by the students in learning activities including activities, oral activities, listening activities, writing activities, drawing activities, the motor activities, mental activities and emotional activities. Learning activities assessed

in this action include visual activity, oral activities, listening activities, writing activities, and mental activity. Students' learning activities affect students' learning outcomes after learning activities. The learning activities are going well when it obtains maximum learning outcomes so that the learning objectives that have been formulated can be reached. High learning activity shows a high motivation to learn and it enables students to master the subject matter better, so they can achieve better learning outcomes. Generally, conventional learning activities are centered on the teacher (teacher center) which makes students passive in learning activities (Ningsih, et al, 2017).

The learning process is still teacher centered to make students passive and inactive. Teachers often use the lecture method, notes, work on the problems, and sometimes create a demonstration method, although only on a certain matter. This makes students less in developing creativity in them. The learning process is done by recording and working on the problems also make some students feel bored and not motivated to learn physics, students who sit in the front is still seriously follow the learning, but students who sit behind many do not pay attention to the teacher in front when explaining the lesson. Student activity is still less active, because during the learning process students are less likely to experiment with, so that students become passive and uncreative to be able to understand, implement, and analyze the concepts of physics in everyday life.

To solve the problems is necessary to partly by changing the conventional learning model into a model of learning centered on student activity, where there are many models of learning student centered in the learning process. So with a model student-centered learning, students become more active, and students are trained to think creatively in learning.

One of the models are applied is problem based learning model. By applying the learning model problem based learning is expected to resolved these problems, because problem based learning model is a natural way

of learning that uses problem to motivate, focus and initiate students' learning. It is an approach that enables students to become active participants in solving problems and answering questions. Problem based learning is a teaching strategy where students are confronted with problems that require critical thinking and analysis of ill structured problems through development of hypotheses and analysis of data linking the new knowledge into their thinking and decision making. It is one of the innovative teaching strategies that can help students understand difficult concepts. Problem based learning is a student-centred teaching approach that enables students to become active participants in solving problems, answering questions and doing more to explore knowledge. It helps students to become familiar with a scientific reasoning process that facilitates critical thinking as it provides answers to fill gaps in students' knowledge (Etiubon, & Anthonia, 2016).

Problem-based learning is a student-centered approach that organizes curriculum and instruction around carefully crafted "ill-structured" and real-world problem situations. Learning is active rather than passive, integrated rather than fragmented, and connected rather than disjointed. As in cooperative learning, students work in small groups, share responsibility for learning together, and in the process develop critical thinking and problem-solving skills and skills for collaboration and project management (Arends and Kilcher, 2010).

Therefore, problem based learning model to learn has a positive impact on improving student learning outcomes. This is proved by several studies that have been carried out include research of Selcuk, et al, (2013) said that there is the the differences of achievement in physics learning and increasing the participation of learners in the learning using problem based learning model compared to the traditional model of use.

The purpose of these research is to know the effect of problem based learning model on student's learning outcomes on geometry optic topic of SMA Negeri 2

Lintongnihuta class XI science second semester A.Y. 2017/2018.

**METHOD OF RESEARCH**

This research will be held in SMA Negeri 2 Lintongnihuta at Desa Siponjot, Kecamatan Lintongnihuta, for academic year 2017/2018 class XI Science. The population in this research is all students class XI science of SMA Negeri 2 Lintongnihuta academic year 2017/2018 which consists of 2 classes that is class XI science -1 and class XI science -2. Sample in this research consists of two classes. By using total sampling, one class is made as experiment class that uses problem based learning model, and one class is as control that uses conventional model. So, class XI science -1 as control class and class XI science -2 as experiment class.

Design research in the form of two group pre-test-post-test design as shown on Table 1.

**Table 1.** control group pre-test – post-test design

Class	Pre-test	Treatment	Post-test
Experiment	T <sub>1</sub>	X <sub>1</sub>	T <sub>2</sub>
Control	T <sub>1</sub>	X <sub>2</sub>	T <sub>2</sub>

Note:

- T<sub>1</sub> : Pre-test is given to experiment class and control class before treatment
- T<sub>2</sub> : Post-test given to experiment class and control class before treatment
- X<sub>1</sub> : Treatment for problem based learning models
- X<sub>2</sub> : Treatment for conventional learning model

Data have obtained tested of normality to know data of both sample was normal distribution used Liliefors test. Then homogeneity test to know what is both of sampel homogen used same varians test. Hypothesis test used t tail one test. If  $F_{count} > F_{table}$ , so can concluded that both of sample have not homogen varians with  $\alpha = 0,05$  ( $\alpha$  significant level).

**RESULT AND DISCUSSION**

**Result of Research**

The result of research doing in SMA Negeri 2 Lintongnihuta show that the average pretest value in experiment class was 34 and control class was 33.57. According the normality test and homogeneity test obtained that the population have normal distribution and homogen. Data of both sampel is normal and homogen so that wortly do hypothesis test and the result show on Table 2.

**Table 2.** Initial ability of students

Class	Average	T <sub>count</sub>	t <sub>table</sub>	Conclu- sion
Experi- ment	34	0.19	2.002	There is no signifi- cant effect
Control	33.57			

Based on Table 2 can concluded that  $t_{count} < t_{table}$  so,  $t_{count}$  on area  $H_0$  so  $H_0$  accepted it means initial ability of students on experiment class have the same with control class on geometry optic topic.

**Table 3.** Result of hypothesis test

Class	Average	T <sub>count</sub>	t <sub>table</sub>	Conclusion
Experi- ment	75.13	1.29	1.65	There is significant effect
Control	67.10			

Based on Table 3 can concluded that  $t_{count} < t_{table}$  that  $1.29 > 1.65$  it means  $H_0$  accepted so the value of learning outcomes of students on experiment class greater than control class it means there is the effect of problem based learning model on students learning outcomes on geometry optic of SMA Negeri 2 Lintongnihuta class XI Science second semester A.Y. 2017/2018.

Problem based learning model also nothing have the effect on student’s learning outcomes but also have the effect on student’s learning activity.

Distribution data of activity on experiment class by using problem based learning model show on Table 4.

**Table 4.** Data of activity on experiment class using problem based learning model

Meeting	Percentage (%)
Meeting I	62.44
Meeting II	70.67
Meeting III	77.78

Based on table 4 for experiment class activity of students meeting I 62.44%, have less active category, meeting II have increase was 70.67% have active category and meeting III also have increase 77.78 and have active category.

Data increase of student's activity using problem based learning model show for experiment class from meeting I to meeting III , learning activity of students using prolem based learning model have increase.

### Discussion

The results showed that there is the effect of problem based learning model on students learning outcomes on geometry optics topic of SMA Negeri 2 Lintongnihuta class XI science second semester A.Y. 2017/2018. This is reinforced by the difference between the pre-test and post-test average of values in the experiment class and control class. The average value of pre-test experiment class was 34 and the post-test value was 75.13. The average pre-test value of control class was 33.57 and post-test value was 67.10. And also based hypothesis test showed that  $t_{count} < t_{table}$  was  $1.29 > 1.65$  it means  $H_0$  accepted so the value of learning outcomes of students on experiment class greater than control class .

Differences students learning outcomes using problem based learning model with conventional learning model because the problem based learning model has five learning phases that make students' knowledge better and improve. The first phase is to orientation students to the problem, at the first meeting the students are still not understood to determine the prolem and provide a hypothesis of the problems given by researchers, students are still a lot of silence, after being briefed at the second meeting and third meeting the students become more active and some students ask questions about the problem. But, there are obstacles faced by researchers in this phase, namely that

there are still many students playing around to create an atmosphere that is not conducive in the classroom.

In the second phase of organizing students to research. In this phase students connected the problems contained in worksheet with the concept geometri optic. Each group discusses about the problems in worksheet. The results of the group discussion become hypothesized on the problem and written on the student worksheet that represented by notulen from each group. In this phase students are still confused in determining the hypothesis of the given by problem. At the second meeting, the researcher explained to make hypothesis of from the problem, so that student can understand and determining hypothesis of problem found in student worksheet.

The third phase is organizing students to research and assist independent investigations and groups of students. In this third phase students collect literature brought by each group member as material for information or references from books and from the internet. At the first meeting there was some students make o noisy when the practicum takes place, some students were still confused in carrying out the practicum, there was no collaboration between students in the group. But after the second and third meetings when practicum students are already getting used to carrying out the practicum that has been given by researchers and have begun to establish cooperation in groups in the implementation of the practicum. But there are obstacles faced by researchers in this phase, that is when the practicum takes place, researchers still have difficulty in guiding the full group, therefore, it is recommended for further researchers to guide students in working and applying the model of problem based learning should be done with the team teach.

The fourth phase develops and presents artifacts and exhibits, analyzes and evaluates the process of overcoming the problem. In this phase students develop information obtained by students from relevant sources related to the problems that exist in student's worksheet. Each group gave each other opinions related to the problems in the practicum so that good

communication was created between fellow students and in this phase it could also create the students' self-confidence and mentality to be brave enough to stand up and express their opinions orally in front of the class. At the first meeting students could not analyze the experimental data and compile the results of the lab work and there were still many of them who did not believe in issuing opinions regarding the problems found in the student's worksheet. At the second and third meetings students had begun to be confident in presenting the results of their group discussions and had begun to dare to express their opinions.

In the fourth phase is developing and presenting artifacts and exhibits, analyzing and evaluating the problem-solving process. In this phase students develop information obtained by students from relevant sources related to existing problems in student's worksheet. Each group gives each other opinion related to the problem in practicum so as to create good communication among fellow students and in this phase also can create students' confidence and mentality to dare to stand and express opinion orally in front of class. At the first meeting the students have not been able to analyze the experimental data and compile the results of experiment and still many of them are not confident to issue opinions related to problems contained in worksheet. At the second and third meetings students have started to believe in presenting the results of group discussion and have started to dare to express them opinion.

In the fifth phase connect the problem with the concept of optical geometry so that at the making conclusions not in accordance with the problems contained in student's worksheet and the students are also still less active to speak in presenting the results of the practicum and giving the opinions of each group, so that researchers re-explain to students the conclusion must be in accordance with the problem. At the second and the third meeting the students are getting better and the conclusions are almost appropriate for the purpose. By paying attention to activities at

each phase, students will be better trained in discussing problems, formulating hypothesis, determining facts from relevant information and defining the content of the learning. This means that every students in the group is responsible for building his knowledge based on group analysis of the problems given in student's worksheet in each practicum. Through the five phases of the problem-based learning model, students are enabled to analyze and define problems, hypothesis and make references by collecting and analyzing information from various sources, and drawing their own conclusions. So that the students find and experience it themselves will automatically remember longer and better understanding. Because of this understanding, students are better able to solve physics problems better.

The results of this study are in accordance with the results of previous research that is the research of Celik, et al, (2011) said that the results of research show average score in the experimental class using problem-based learning model is 78.85 while in the control group using the traditional model of just 61.45. Selcuk, et al, (2013) said there is the difference in learning achievement in physics and increasing participation of learners in the learning using problem-based learning model as compared with the use of traditional models.

Based on the research conducted, there are differences in learning outcomes between the students of the experimental class and the control class. Problem Based Learning model can improve student learning outcomes in physics learning. This is supported by Arends (2012) Problem Based Learning model is a learning approach where students do authentic problems (real) with the intent to compile their own knowledge. The advantages of problem based learning is that students are encouraged to have problem solving skills in real situations (authentic), students have the ability to build their own knowledge through learning activities, students can understand the material because the material presented in the form of problems in everyday life. This is caused by the experimental class students using problem based

learning model. Problem based learning model of learning can provide an opportunity for students to explore collecting and analyzing data to solve problems, so that students are able to think critically, express opinions, have a curiosity in finding alternative solutions to problems other than that have a curiosity in finding alternative solutions to problems other than it is also one of the innovative models that can provide active and enthusiastic learning conditions to work with one group's friends in solving existing problems. By studying in groups can give students more possibility to absorb and understand the learning materials because students experience and discover their own concepts of physics are learned. Problem-based learning suppresses students' awareness in thinking, solving problems by engaging students in reality (authentic inquiry) and sharing knowledge with others where students are invited to exchange ideas through presentations and frequently asked questions.

In the activity assessment illustrates there are three meetings, has five phases namely formulating the problem, collecting verification data, analyzing experimental data, and formulating conclusions. Based on the five phases of the problem based learning model conducted by researchers, the application of the problem based learning model also has a good impact on increasing student learning activities in the experimental class observed from the first meeting to the third meeting in the study, that is in first meeting, student's learning activity was 62.44, the second meeting was 70.67 and the third meeting was 77.78. Especially in the third and fifth assessment aspects, namely independent and group investigations of proof of hypothesis by conducting experiments and proving hypotheses. Researchers provide motivation to students in the form of media tools and materials and functions of each tool and materials used in the doing the experiments.

Increased student activity in experimental class by using problem based learning model in every meeting because motivation given by teacher in the form of media like as tools and materials of practicum

used in experiments. This makes it easier for students to experiment. Students also become more skilled and more motivated in experimenting. This is consistent with research Maysara (2016) said that students activity from the first meeting until the fourth meeting tends to showed an increase in all aspects observed. It is classified very well and Sari, et al, (2018) said that implementation of problem based learning model are it can improve more student's creativity than direct learning model. Moreover, also the problem based learning model can make the learning process become more active, creative and fun.

The use of problem-based learning models can improve student learning outcomes, but there are still general weaknesses encountered during learning. These weaknesses include: 1) The division of groups of students in the study group takes a long time plus the presence of students who do not have good relations with their group friends, so researchers must try to reconcile group members who are not harmonious first. 2) Time is too short so students cannot carry out practicum to the fullest.

## CONCLUSION AND SUGGESTION

### Conclusion

Based on the result of research can concluded that there is the effect of problem based learning model on student's learning outcomes on geometry optic topic of SMA Negeri 2 Lintongnihuta class XI science second semester A.Y. 2017/2018 and can increase learning activity of students.

### Suggestion

Based on research result and discussion before, researcher give suggestions as follows : For the next researcher, the formed group of problem based learning is carried out before the learning activities are carried out. So that learning activities do not have time wasted for group formation and try to use this problem based learning model in learning process by team teaching, because of it is hard to control

all activity of student by using this model lonely.

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