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# A Study of Student's Misconception on Light Material and How to Reduce it Using LKS-Assisted PBL at Islamic Junior High School (SMP IT) Bina Amal Semarang

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## Abstract

The existence of misconceptions could affect students' problem solving ability in physics subject. The source of misconceptions could be derived from the text books that used by the students, from the students itself, as well as from the teachers. One of the learning models that might reduce the misconceptions on the topic of light was worksheets-assisted by problem based learning model. The purpose of this study was to identify the misconceptions experienced by the students of SMP IT BinaAmal on the topic of light, to analize misconceptions on the topic of light, to identify the descriptions of the students' improvement on the concept of light, and to identify the worksheets-assisted problem based learning could develop the students' scientific attitudes. The research method used mixed methods research using sequential explanatory design with pre-test and post-test Control Group Design. The sample of this research was the IX grade students of Hafshoh bint Abu Bakar class, and the IX grade students of Zaenab bint Jahsyi at SMP IT BinaAmal Semarang. The instruments that used in this study were questions and observation sheets. Based on the calculation of problem-solving test, in the experimental class obtained a gain factor of 0.553 with medium criteria, while the control class produces a gain factor of 0.249 with low criteria. The initial t-test shows thitung (-1.55) <t table (1.68) that the experimental class is no better than the control class. The final t test shows thitung (2,481)> t table (1.68) that the experimental class is better than the control class after the LKS-assisted PBL learning model is used. A very strong relationship between conceptual mastery and the reduction of misconceptions. LKS-assisted PBL learning influenced the results of the decrease in student misconceptions from 55.1% to 19.5% in the experimental class and a decrease in misconception from 59.4% to 31.9% in the control class. Based on the results of cognitive tests, obtained a qualitative data analysis, misconception that occurred in SMP IT Bina Amal on the concept of light, among others: regular reflections and diffuse; shadow formation, shadow space and shadow properties, light propagation; light sources and human processes can see things; and the law of refraction. Based on the result of the research, it is found that the LKS-based problem-based learning model is effective to reduce light misconception.



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## INTRODUCTION

Misconception is a serious problem because it is difficult to change. Identifying and defining misconceptions in a lesson is paramount in order to select methodology and prepare an effective curriculum. Misconceptions can hamper the learning process and sometimes can be dangerous (Mondal & Chakraborty, 2013). Misconceptions are not only caused by the students themselves but can be caused by unsuitable methods and learning materials, so called school-made misconceptions (Barke et al, 2009). Empirical research shows that students have preconceptions that are inconsistent with today's concept of science.

Some students have misconceptions about the process of light travel in shading (Suparno, 2005: 21). Aisah (2010), describes that the frequent misconception of light is that light can not pass through a small crack on the screen made of cardboard, the reflected angle is on the left, light propagates faster in the water, the light coming from the sun directly into the eye so the eyes can see things, the coins on the bottom of the glass appear larger because it is closer to the water surface, the critical angle is the bend and reflection of the coming light, and the prism follows the rainbow color that reflects the base color. Furthermore, to reduce the reduced misconceptions is remediation. Remediation is an improvement activity directed to overcome student learning errors by altering, improving or clarifying the students' frame of mind (Sutrisno et al., 2007).

In Suniati study (2013), one of the universal causes of low learning outcomes of science achieved by students is the occurrence of misconception in students. Preconception or prior knowladge of students over the concept of science IPA students over the concept of science built by students themselves through informal learning in an effort to give meaning to their daily experience has a very big role in the formation of scientific conception. Preconception that can continuously disrupt the formation of scientific conception.

Some students do not succeed in mastering the concept of physics despite studying hard. One reason for this is the misunderstanding of basic physics concepts. They can not learn the concept of physics that was built before. Teachers need time to know the cause of these misconceptions, can be done by interacting with students by interviewing and providing quisioner (Sarikaya, 2007). From previous research, it is necessary to develop not only the cause of misconception, but also how to reduce the misconception for light matter.

Based on the results of quisioners and interviews to some students of class IX SMP IT Bina Amal Semarang 2015/2016 school year found students have some misconception on the concept of light. The misconceptions include white paper can be seen in a dark room (50%), a flashlight when directed to a flat mirror then the light partially enters the mirror and partly bounces on the glass (40%), the shadow formed on the rearview mirror is enlarged (45%), the virtual image can not be captured by the screen (60%), the direction of light vapor when viewing the car is always perpendicular to the sun (65%), the light coming from the sun directly to the eye so that it can see the object (70% , the shadow of the candle is blocked by another object then the object behind it can not see anything (80%), the money at the bottom of the glass looks bigger because it is closer to the water level (60%) and the brighter light will run faster (70% ).

The source of such misconceptions comes from the source book used by the students themselves, and from the teacher factor. Science subjects in junior high school consist of Physics, Chemistry, and Biology, which are taught in an integrated manner. It requires adjustment, and the ability to adapt. Moreover, most science teachers in junior high school have a specific scientific background, such as education Physics, Chemistry, or Biology. Therefore often teachers in conveying IPA materials are not in accordance with their scientific background so as to experience misconception. Therefore in the learning required media and methods that can help teachers in conveying a concept correctly.

Some steps can be used to overcome misconceptions in students by finding or uncovering misconceptions that students have, trying to find the cause of misconceptions, and seeking appropriate treatment to overcome misconceptions that occur (Suparno, 2005: 55). One way to overcome misconceptions by using conceptual change approach and PDEODE (Predict Discuss Explain - Observe Discuss Explain). Through this approach, understanding science becomes better and can eliminate alternative conceptions to students (Mondal & Chakraborty, 2013).

Problem-Based Learning (PBL) is a learning model that presents contextual problems that stimulate students to learn. PBL frees students to learn in their own way. Students gather information, then bring back to the discussion group as resumes to solve problems and reflect on the data already obtained. The teacher's role changes from the informant's role to the facilitator in thinking, reflecting and collaborating on discovery, but the one who decides is the student (Christina, 2014). Sumarli (2018) conducts research on learning CPS (Creative Problem Solving) inquiry approach includes the stage of defining the problem. At this stage the teacher first presents the problem with the basic concepts already known by the students. This is done so that students are really ready to follow the learning so that they can understand the new knowledge to be learned.

PBL learning model can also be combined with Student Worksheet (LKS). LKS is used to trigger and assist students in learning activities in order to master an understanding, skill, and or attitude (Majid, 2012: 363). LKS is one learning resource that can be developed by teachers as a facility in learning activities. LKS prepared can be designed and developed in accordance with the conditions and situations of learning activities encountered. LKS is also a learning medium, because it can be used together with learning resources or other learning media, depending on the designed learning activities (Rohaeti, et al., 2009). The presentation of problem-based materials in the LKS sheet encourages them to solve the problems that arise in the lab. Students are trained to determine what is used in some of the labs along with the entry steps entirely included in their performance appraisal questionnaire. Through this LKS-assisted learning, students will be more actively involved in learning, the curiosity of finding new things that have never been met, and motivated to ask for more information (Sriatun, 2018).

The main advantage of LKS-based method is to improve the students' creative thinking ability (Bakirci et al, 2011: Mihardi et al., 2013). The purpose of this research some misconceptions that occur on the students of Islamic Junior High School (SMP IT) Bina Amal Semarang. Furthermore, to find out how effective enough way to reduce the misconception that occurred through the application of PBL model equipped with LKS in the process of light material physics learning.

## METHOD

The method that is applied in this study is the combination among some research methods (Creswell, 2012). The Sequential Explanatory Design with pretest-posttest control group is used in this research. The subjects of this study are the students of class IX SMP IT Bina Amal Lesson Year 2017/2018 amounted to 46 people divided into class control and experiment class. Independent variable and dependent variable in this research is PBL learning and misconception level in students of SMP IT Bina Amal.

Data processing is done by means of tests and questionnaires. Furthermore, for data analysis technique is t-test, N-gain test and questionnaire test. Normality testing is performed to see if the population used has a normal distribution or not. In this study, the data used in the test is the pretest and posttest values in the experimental class and control class in SMP Islam Terpadu Bina Amal.

**RESULT AND DISCUSSION**

Based on the analysis, the result of normality test as shown in Table 1

Table 1 Test Results Normality Data Pretest and Posttest Value

| No | Class | *Pretest* | | *Posttest* | |
|---|---|---|---|---|---|
| | | $\chi^2_{hitung}$ | $\chi^2_{tabel}$ | $\chi^2_{hitung}$ | $\chi^2_{tabel}$ |
| 1 | E | 2,722 | 7,81 | 1,5144 | 7,81 |
| 2 | K | 2,3342 | 7,81 | 1,4035 | 7,81 |

where E = Experiment, K = Control

Table 1 shows the normality test results for the experimental and control classes obtained that $\chi$ 2 count <$\chi$ 2 tables with 5% significant level, it can be said that pretest and postest value data are normally distributed. Next, a homogeneity test was conducted to determine the variance of the end result of both samples whether the same or not. The homogeneity test data of pretest and posttest values are shown in Table 2.

Table 2 Homogeneity Test Results Data Pretest and Posttest Value

| No | Class | *Pretest* | | *Posttest* | |
|---|---|---|---|---|---|
| | | $F_{hitung}$ | $F_{Tabel}$ | $F_{hitung}$ | $\chi^2_{Tabel}$ |
| 1 | E | 1,9986 | 2.05 | 1,6788 | 2,05 |
| 2 | K | | | | |

where E = Experiment, K = Control

From Table 2, it appears that F count <Ftable for pretest and postest data. This means that the two classes have a homogeneous variant. To know the student's ability to solve the problem after being given treatment, both control and experimental class are done with normalized gain as in the following equation;

$$\langle g \rangle = \frac{\%\, postest\ score - \%\ pretest\ score}{\%\ maximum\ score - \%\ pretest\ score} \ldots \quad (1)$$

Based on the equation calculation (1) obtained n-gain for the control class and the experiments were 0.249 (low category) and 0.553 (medium category).

Table 3 Profile of Misconceptions and their Changes to Each Concept-Related Indicator

| Indicator | Sub Material | EC | | CC | |
|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post |
| 1.1 | Regular and Baur Reflection | 34,8% | 17,4% | 52,2% | 26,1% |
| 1.2 | Shadow and Shadow space | 60,9% | 21,7% | 65,2% | 52,2% |
| 1.3 | Light in The Dark Room | 78,3% | 13,1% | 26,1% | 4,4% |
| 1.4 | Light Propagation | 69,6% | 30,4% | 73,9% | 34,2% |
| 2.1 | Refraction Law | 52,2% | 21,7% | 87,0% | 74,9% |
| 2.2 | Shadow Formatioun | 34,8% | 13,1% | 52,2% | 26,1% |
| | **Average:** | 55,1 % | 19,5 % | 59,4% | 36,3 % |

where EC : Experimental Class, CC : Control Class

Table 3 shows that most students already have misconception on every light-related sub subject at an average of 55.1% in the experimental class. In the control class students who misconception on the knowledge of students in school. After getting on the initial knowledge is 59.4%. After obtaining learning with LKS-assisted PBL model, some students have succeeded in decreasing the level of misconception they experience. The decrease in student experimental class still misconception of 19.5% and 36.3% for the control and experimental class.

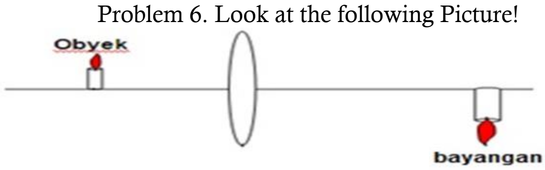
In addition to quantitative data, from the results of research can be analyzed qualitative data in the form of light concept analysis that most students still experience misconception. The identification of misconceptions experienced by students of SMP IT Bina Amal on the concept of light, among others (1) students have not been able to distinguish between regular reflection events and diffuse reflections, which assume that rough surfaces can not reflect light, (2) the formation of shadows by convex lens, when asked early (3) students assume that the propagation of light by candles in a dark space eg in a cinema is limited to the very first audience only, (4) students assume that the candle is not a source of light because it is ignited by a match, (5) misconceptions about the viewing process include: the student has not understood that if there is no light there will be no visible objects even though the object is white and how an object will be captured by the eye when there is sunlight, (6) the law of refraction of light that causes an object in different media to refract, students understand that it is close to the surface of the water not because of the fact that the refraction of light.

Misconceptions that occur in students occur because students have not understood the concept correctly. As a result, students may experience false positive misconceptions or false negative misconceptions (Fitrianingrum, et al., 2017). If students understand concepts, false negative misconceptions, and false positive misconceptions. A false negative is defined as the wrong answer given by a student who has a scientific and correct understanding to answer the question correctly, while a false positive can be defined as the correct answer given by a student who has no true scientific understanding (Hestenes & Halloun, 1995).

The cognitive aspect most often leads to the misconception of the recall aspect (C1) and expects the teacher to devise a learning method that can improve the cognitive aspect especially the recall aspect. Teachers can use tools to improve those aspects. This is in accordance with the research that has been done by the researcher is by designing the learning model of LKS-assisted PBL. It is evident that this model can reduce misconceptions involving the remembering aspects of the concept of light.

As an example of a change of misconception into a correct physics concept, it can be seen in Figure 1. About the answer to the problem in indicator 1.2 on Shadow and Shadow Space, the second question is about B6. Students in the experimental class experienced a considerable increase from 39.1% to 78.3%, while the control class only slightly increased from 34.8% to 47.8% as in Figure 2. This is due to different treatment by using LKS. In the experimental class conduct a discussion to solve the problems in the LKS about the special ray of convex lens, while the control class does not use LKS.

Problem 6. Look at the following Picture!




Based on the Picture, the object is in ....

A. Focal point of the lens

B. more than 2 times the focal distance of the lens

C. between the focal point and the lens center point

D. between the focal point and the radius of lens curvature

Pretest replied

Figure 1. Answer Question B6 by student code E8 when Pretest and Postest

Students with E8 code in the experimental class, able to analyze the problem well at the time of doing posttest so that change in answer the problem with the right reason as seen in Picture 1. The following explanation with the form of the form of graphs, as in Figure 2.

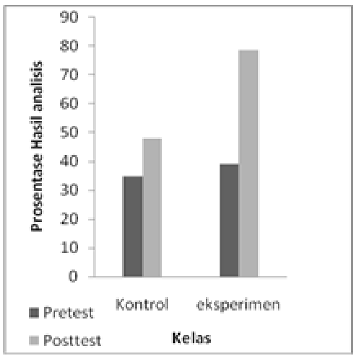



Figure 2. Percentage of Indicator Analysis Results 1.2 Item Problem B6

After treatment, students experience increased mastery of the concept of light with the following description: (1) reflection regularly and diffuse: it can distinguish light when the rough surface remains bounced but irregular reflection. The improvement of mastering the concept on the control class from 47.8% to 73.91% while the experimental class 65, 22% to 82.61%, (2) the formation of shadow, shadow space and shadow properties that occur in the convex lens: it can determine the exact results, but the control class increase in mastery is still small from 34.78% to 47.8% while the experimental class is good enough that from 39,13% to 78,26%; (3) light propagation in wax increased mastery of the concept both in control class from 26,09% to 65,21% and experiment class from 30,43% to 69,56%, (4) students who initially considered candles instead of light sources then understood that included a light source with an increase in concept mastery from 56.52% to 69.56% while the experimental class from 69.56% to 91, 30%, while the human process could see an object also experienced a considerable increase from the control class initially 21.73% to 86.96% and the experimental class 73, 91% to 95.65%, and (5) the refraction laws that occurred on objects such as money placed in glass , he explained ta in the control class only slightly increased from 13.04% to 26, 09% while in the experimental class increased from 47.82% to 78.26%.

Implementation of LKS-assisted PBL model can reduce misconceptions. This is because in the learning process students better understand the problems based on the concept of support. The process of understanding involves tapping into new information and integrating it with existing knowledge to construct new meanings. Thus the ability to understand the concept is one level of thinking skills, namely basic thinking (Santyasa, 2004).

Based on this, students experienced a decrease in misconceptions after the treatment of light concepts such as the use of PBL models, the use of LKS, discussions, and presentations. The results of the study showed that students experienced a decrease in misconceptions after being treated.

Data on the effectiveness of peer assessment were obtained from student questionnaires. The peer assessment criteria use 4 options, ie strongly agree, agree, disagree, and strongly disagree. The number of students who fill each criterion is converted in percentage form. Peer assessment is effective when the percentage of each item is ≥ 70%, and is said to be ineffective when <70% (White, 2009).

Learning activities are more varied, making students more able to understand the concept than the control class. Understanding concepts in students in experimental classes that apply learning with more learning activities provide opportunities for students to interact with both teachers and students. In the experimental class, students are required to solve problems through discussion and students try to find themselves under the guidance of teachers to find solutions in solving problems (Sarwi, 2016). In another study, Triyanto (2007) also stated that the discussion is the ability to develop cognitive growth, so that discussion-based learning can develop students' cognitive abilities. In this LKS-assisted PBL learning using discussion method when solving the problems presented in the LKS. This suggests that experiments and discussions can develop students' cognitive understanding. The steps in the Dwijananti study (2016) that combine discussion and experiment models can improve cognitive learning outcomes with the help of the Geiger Muller detector, also on the LKS-assisted PBL learning. Discussions were also made during group discussions in LKS making, and class discussions when reporting the results of group discussions by means of report presentation (Figure 3).

Figure 3. Presentation Results of Discussion Groups on Problem-Based LKS

In this study, also performed with several experiments such as reflection experiments flat mirrors, and reflections on the lens, as in Figure 4.

Figure 4. Light Experiments Using Optical Kit

With the learning model applied in this research such as discussion, experiment, presentation, and using the help of LKS showed result that students' cognitive ability about the concept of light increased (misconception about light matter decreased).

## CONCLUSION

Learning model of PBL-assisted LKS gives a significant influence on the decrease of misconception of the concept of light in the students. Most of the students had initial knowledge that misconception on each sub subject related to light averaging 55.1%, while control class 59.4%. After obtaining learning with LKS-assisted PBL model, some students have succeeded in decreasing the level of misconception they experience. The decrease in student experimental class still experienced misconception 19,5% and control class 36,3%.

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