IOSR Journal of Research & Method in Education (IOSR-JRME)
e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 5 Ver. VI (Sep. – Oct. 2017), PP 32-37
www.iosrjournals.org

The Effect of Problem Based Learning Model for Student Learning Outcomes on Materials Temperature of Heat and Heat Transfer in Class X Semester II SMA N 16 Medan

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Abstract: *The data of this research was collected at SMAN 16 Medan. the aim of this study is therefore 1) to analyze the difference of physics learning outcomes with high level of critical thinking skill taught by problem based learning model and direct learning model, 2) to analyze the difference between physics learning outcomes and low level of critical thinking skill taught by problem based learning model and direct learning model. Population in this research is the second semeter of X grade students, which consist of four classrooms. Sampling was done by cluster random sampling where X-Mia3 class as experiment class and X-Mia2 class as control class. The instrument used for data collection of learning outcomes is 10 number essay, and critical thinking test is 10 number essay. The two instruments were validated by 4 validators to produce a more valid instrument. The two Instruments have been validly applied to the students before the activity of teaching and learning activities (ujiawal). The result of student test data analysis in test with t test, showed the students' initial ability was the same. Critical thinking instruments were applied to students where the Instrument material is already taught by the teacher. The goal was to distinguish students who were high or low in critical thinking. The researcher's guide to distinguish critical thinking high and low refered to the minimum school completeness criteria (KKM). At the end of teaching and learning activities, test results was conducted and then the data are analyzed. The results of data analysis from the two classes, tested in Anova Univaraiate resulted that, there are differences of students' physics learning outcomes with high critical thinking ability taught by the problem-based learning model and the ones taught by direct learning model. On the other hand, the students with low level of critical thinking ability taught by learning model based problem and by direct learning model resulted no difference in learning outcomes. In this case, the learning model is more dominant than the level of critical thinking ability.*

Keywords*: - Problem Based Learning, Learning Outcome, Critical Thinking.*

Date of Submission: 07-10-2017 Date of acceptance: 18-10-2017

I. INTRODUCTION

Students are generally hard to understand physics materials taught by teacher. The difficulties are not merely about the teachers, but also on students, along with school infrastructure. Physics as a branch of science field is one of the subjects related to nature so that in learning it required an investigation in the form of an experiment against such knowledge. The process of developing a field of physics requires supporting facilities and infrastructures such as laboratories with adequate equipment and experimental materials, adequate libraries to develop students' thinking base, and other learning support in schools.

Based on preliminary studied on January 8th, 2015 conducted by researchers in one of the class X Senior High School 16 Medan, researchers found that the students were low in critical thinking skills and finished tasks in physics lessons. Questionnaire were distributed to students, to find out the way of the students responded the subject of physics. Based on the questionnaire instrument distributed to 42 students of class X in SMA Negeri 16 Medan, it is found that students were still difficult in finishing their tasks and hard to determine the appropriate procedures for something new or new problems in physics.

The conclusion reinforced by the statement through interviews with one of the physics teachers of SMA Negeri 16 Medan, was that the learning of physics taught by conventional model consisting of lecture method and percentage. In the percentage method the teacher presented the material through the laptop then explained to the student. Teachers tended to transfer the knowledge they have to the students, teaching page by page without discussing the interrelationships between concepts or problems, concerned with the outcome of the process. Students became passive and less involved in teaching and learning process. Schools have laboratories but learning were more likely to conduct in the classroom, so most students were less able to connect between what is learned and how to apply it to real situations.

Responding to the above problems it is necessary to have a learning model that can create student involvement in teaching and learning process to develop thinking skill and foster student problem solving abilities. Familiarize scientific work is expected to foster habits of thinking and acting that reflect, mastery, knowledge, skills and scientific attitudes possessed by students, so that the learning model will increased knowledge, skills and scientific attitude of students as a result of learning.

According to Arends [1] the problem-based learning model is a learning model that organizes learning around questions and problems, through the submission of authentic and meaningful real life situations that encourage students to investigate and inkuri, avoiding simple answers , and allow for a variety of solutions to the situation. In the learning based on the issue student activeness is preferred because the activities in learning based on problems include observation of the problem, formulating the hypothesis, planning research until the workshop, to get a conclusion to answer or solving problems given.

Several studies have demonstrated the positive impact of the implementation of problem-based learning models. In the journal Implementation of Problem-Based Learning (PBL) in the Foundation Physics Subject by Ahmad Hadi Ali, Problem-based learning is assumed be the foundation of success physics learning seen from some generic skills or skills developed among students such as leadership, interpersonal and self-reliance learning skills. Likewise in the Journal of Research by Yunita Kustyorini and Mohan Taufiq Mashuri teaching problem-based learning resulted the effect on student activity and learning outcomes. This can be seen from the average posttest value in the experimental class 78,30 whereas in the control class 71,64.

One of the hallmarks of the problem-based learning model is its ability to develop critical thinking skills. Critical thinking is the process of making sensible decisions about what to believe and what to do, Robert H Ennis [2].

According to Paul, Fisher and Nosich [3] critical thinking is a model of thinking about what matter, substance or problem, where the thinker enhances the quality of his thinking by handling skillfully the structures inherent in thought and setting standards intellectual to him.

Essentially, critical thinking skills are developed into indicators of critical thinking consisting of five major groups: (1) Provide a simple explanation, (2) Build basic skills, (3) summarize, (4) Provide further explanation, (5) Setting strategies and tactics, Blom in Filsaime, [4].

The purpose of this research are 1) to know the result of study of student of class X SMA Negeri 16 Medan on subject matter of Temperature, Calor and Heat Transfer after learning by using model of study based on problem, 2) to know result of student learning of class X SMA Negeri 16 Medan on the main subject of Temperature, Heat and Heat Transfer after learning by using conventional model, 3) to know the effect of learning model based on problem on student learning result on the subject matter of Temperature, Heat and Heat Transfer in class X IPA SMA Negeri 16 Medan even 2014 / 2015, 4) to know the effects of critical thinking to the students' learning outcomes in the experimental class and in the control class.

II. RESEARCH METHODOLOGY

This research is quantitative research with quasi-experiment research method (quasi experiment). The research descriptions use 2 x 2 factorial to compare the effect of learning model based on the problem and direct learning model to the result of high school physics study, in terms of students' critical thinking ability level. Problem-based learning model as the independent variable and student learning outcomes as dependent variable, the level of thinking ability is a high level of thinking ability and low level of thinking ability as a moderator variable. These variables are further incorporated into the study design as can be seen in Table 1.1.

Table 1.1 Matrix of 2x2 Factorial Design Research Design

Thinking Ability Level (B) Critical	Learning Model (A)	
	Based on the problem (A1)	Directly (A2)
High Level (B1)	$\mu A_1 B_1$	$\mu A_2 B_1$
Low Level (B2)	$\mu A_1 B_2$	$\mu A_2 B_2$

Information :

A1 = group of students who are taught by the problem-based learning model

A2 = group of students who are taught by direct learning model

B1 = group of students who have high level of thinking ability.

B2 = group of students with low-level thinking skills

μ A1 B1 = average learning outcomes of physics students of SMAN who have high level of thinking ability, in teaching with learning model based on problem.

μ A1 B2 = the average result of physics study of SMAN students who have low level of critical thinking ability, taught by model of learning based on problem.

μ A2 B1 = average learning outcomes of physics students of SMAN who have high level of thinking ability, in teaching with direct learning model.

μ A2B2 = average learning outcomes of physics students of SMAN who have low level of thinking ability, in teaching with direct learning model.

III. RESULTS AND DISCUSSION

After the two classes are declared homogeneous, then it is proceed with a two-lane anava. The result of the two-lane anava test using spss 16.0 obtained class significance equal to 0.002 where this value is smaller than the significant level of 0.05. This shows the model of learning in the experimental class that is Problem Based Learning model is better than the control class learning model that is direct learning model as in table 4.11.

Table 1.2. Output of ANAVA Two Line calculation
Difference-Subject Influence Test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2195.398[a]	3	731.799	4.329	.007
Intercept	334075.712	1	334075.712	1976.316	.000
Class	1749.868	1	1749.868	10.352	.002
CT	19.116	1	19.116	.113	.738
Class * CT	130.522	1	130.522	.772	.382
Error	13185.090	78	169.040		
Total	367050.000	82			
Corrected Total	15380.488	81			

a. R Squared = .143 (Adjusted R Squared = .110)

The critical thinking skill section obtained a significant value of 0.738 where this value is higher than the significant level of 0.05. This suggests that problem-solving skills of students with high critical thinking skills does not differ from low-critical thinking skills. Part of class * critical thinking obtained significant value of 0.382 where this value is greater than the significant value of 0.05. This shows that there is generally no significant interaction between the learning model and the level of critical thinking skills on students' physics problem solving skills.

However, the graph of the interconnection between the learning model and the level of critical thinking skills on Problem-solving abilities indicates the interaction can be seen in Figure 1.

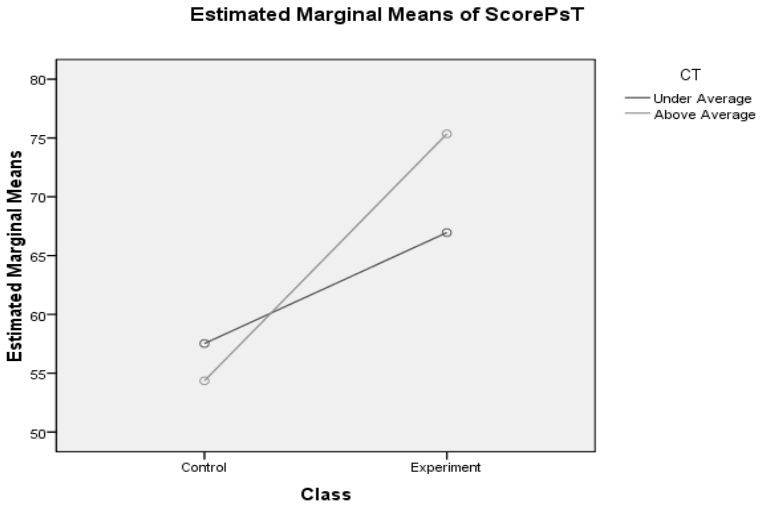

Figure 1.1 Interaction Chart of Learning Model and Critical Thinking

From Figure 1.1. the result of the interaction between the learning model and the level of critical thinking is shown directly by using Post Hoc Test analysis with Scheffe test.

Table 1.3. Different Interpersonal Problem Solving Skills.

(I) Interaction	(J) Interaction	Mean Difference (I-J)	Std. Error	Sig.
Direct Learning-Below Average	Live Learning-Above Average	3.17	3.555	.850
	PBM-Below Average	-9.43	3.511	.074
	PBM-Above Average	-17.83*	3.555	.000
Live Learning-Above Average	Direct Learning-Below Average	-3.17	3.555	.850
	PBM-Below Average	-12.60*	3.555	.008
	PBM-Above Average	-21.00*	3.598	.000

*. The mean difference is significant at the 0.05 level.

Table 1.3. shows the difference test results between the critical thinking skill groups taught by high and low Critical learning and learning models. Based on Scheffe test, there are some interaction differences between groups as follows: 1). The significance for the control class group with high critical thinking skills to the experimental class with low critical thinking skills is 0.008 lower than 0.05 then the two classes significantly different. Experimental classes with low critical thinking skills are better than control classes with high critical thinking skills. This shows the role of PBM model dominates learning more than students' critical thinking skills. This is because the use of PBM is trained the students in solving problems in each phase of learning compared to students' critical thinking skills. 2). The significance for the control class group with high critical thinking skills to the experimental class with high critical thinking skills is 0.000 less than 0.05 then the two classes are significantly different from the experimental class interaction with higher critical thinking skills than the control class with the high critical thinking skills. It also shows the dominant influence of PBM model on learning. 3). The significance for the control class group with high critical thinking skills to the control class with low critical thinking skills is 0.850 highher than 0.05 then the two significant classes are not different with the both groups. In this case the two independent variables do not occur dominance between the use of learning models and students' critical thinking skills. 4) The significance for the control class group with low critical thinking skills toward the experimental class with low critical thinking skills is 0.074 greater than 0.05 then the two significant classes are no different. Experimental classes with low critical thinking skills are better than control classes with low critical thinking skills. This shows that both independent variables do not maintain dominance between the use of learning model and students' critical thinking skill. 5) The significance for the control class group with low critical thinking skills on the experimental class with high critical thinking skills is 0.000 less than 0.05 then the two classes are significantly different from the experimental class interaction with higher critical thinking skills than the control class with the low critical thinking skills. It also shows the dominant influence of PBM model on learning. It can be concluded that there is a positive interaction between problem based learning model and critical thinking in influencing students' problem solving skills predominated by the use of PBM learning.

1.Exects Critical Thinking Skills Against Troubleshooting Skills Problems

This study shows that there is generally no difference between students who have high and low thinking skills on problem solving skills. However, if it is specifically reviewed there is a difference in the attainment of problem-solving skills at the critical level of students' thinking in the control class. This suggests that critical thinking skills are more dominant in conventional learning in gaining results which consistent with some previous research. This is because the critical thinking is very less visible and leads the student on problem solving. The results obtained are consistent with the opinion of Astika, et al (2013) who said that there are differences in critical thinking skills between students who learn to use problem-based learning model with students who learn to use expository learning model. Similarly, Masek et al (2011) stated that certain processes in PBL theoretically support the development of students' critical thinking in accordance with the designs applied, some predictors also influence the relationship of PBL with critical thinking such as age, gender,

academic achievement and background of establishment. The studies of Sulaiman et al. (2014) and Eldy et al. (2013) found that the results indicate that there is a significant difference in the inference criteria (sig2-tailed, t = -5.57, p = .00 <* .05) which supporting the first postes and results indicate that there are significant differences in the two criteria of the WGCTA test; inference (sig2-tailed, t = -3,478, p = .001 <*. 05) and interpretation (sig2-tailed, t = -5,53, p = .00 <* .5). The critical thinking skills tests show that almost 32% of students' thinking styles are grouped into balanced thinking styles. According to Johnson (2002); Krulik and Rudnick (1996) mentioned that high-level thinking consists of critical thinking and creative thinking. Critical thinking is a mental activity in terms of solving problems, making decisions, analyzing assumptions, evaluating, rationalizing. and conduct an investigation. While creative thinking is a mental activity that produces ideas that are original, creative, and able to apply ideas. Critical thinking is nothing but the ability to solve problems through an investigation so as to produce a very rational conclusion or decision. Critical thinking referred to in this study is an organized process in solving problems or analyzing problems involving mental activities that include the ability to: formulate problems, provide arguments, deduction and induction, to evaluate and make decisions. Thus the better one's critical thinking skills the better the problem solving skills in solving a problem. It can be concluded that students with high critical thinking skills acquire better problem-solving skills from students with low critical thinking skills.

2. Interaction Between Learning Models and Level of Critical Thinking Skills on Problem Solving Skills

Problem Based Learnig (PBL) is a learning model oriented to theoretical framework of constructivism. In the PBL model the focus of learning is the chosen problem so that students not only learn the concepts related to the problem but also the scientific methods to solve the problem. Therefore, students must not only understand the concepts relevant to the issues that are at the center of attention but also acquire learning experiences related to the skills of applying scientific methods in problem solving and fostering critical thinking patterns.

Critical thinking is a skillful activity, which can be done better or vice versa, and good critical thinking will collaborate various intellectual standards such as clarity, relevance, adequacy, coherence and so on. Critical thinking clearly requires interpretation and evaluation of observation, communication, and other sources of information. It also demands skills in suggesting assumptions, asking relevant questions, drawing its short implications, contemplating and debating issues constantly.

Critical thinking is nothing but the ability to solve a problem through an investigation resulting in a very rational conclusion or decision. So students who have high critical thinking skills taught with problem based learning model will acquire high problem-solving skills. Students who have low critical thinking skills taught with problem based learning model will acquire low problem-solving skills as well. Then it can be concluded that the problem Based Learning model interacts with critical thinking skills in influencing problem solving skills. In conducting the research, researchers have followed all the procedures that have been made in the planning phase as carefully but there are some obstacles found which are the limitations of researchers that will affect the conclusion. Various weaknesses felt by researchers during this study are: (1) the number of students from each of the sample classes studied is large enough so that the students get less attention and supervision maximally in doing the activity. (2) learning support sections such as the availability of practicum and media equipment are not proportional to the number of student groups in each class. Improvements to the weaknesses in this study are expected to provide a better picture of the effects of problem solving skills and critical thinking skills of students who are taught by learning problem based learning. Thus the findings of this study in accordance with the results of research conducted by previous researchers and in accordance with the theory that problem-based learning is one model of learning designed primarily to help students develop thinking skills, problem-solving skills and intellectual skills. (Arends; 2008; 43). The findings of this study are similar to the work of Folashade et al. (2009) that low-ability physics students taught with problem-based learning are significantly better than those taught by conventional learning. Furthermore Tasaglu (2014) says that the PBL model is more effective than traditional learning methods in improving students' conceptual understanding. The same thing is also expressed by Hartono (2013) that the problem solving ability of physics students using problem-based learning model is better than those using direct learning.

IV. CONCLUSIION

The data retrieval for this research was conducted at SMAN 16, Jalan Kapten Muslim No. 72 Medan for 4 times teaching learning attachment. Based on the results of data analysis and the results of hypothesis testing in this

study, it is concluded: 1) there are differences in the results of physics study of high school students with a high level of critical thinking skills taught with learning models based on problems and high school students with high critical thinking ability taught with model direct learning. 2). there is no difference in the result of physics study of high school students with low level of critical thinking ability which is taught by model of problem based learning and high school students with low critical thinking ability which is taught by direct learning model.

V. SUGGESTION

Based on the study conducted, there are some suggestions considered matter as follow: 1) if the class is large, the study should done by using interactive media in order to have the class being condusive while doing ghe experiment. 2) Time management is required so that the whole material of learning is delivered well. 3) Since the PBM model does not acquire the procedures of experiment on students work sheet, the researcher should guide the students while doing independent and group tasks.

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Ratelit Tarigan . "The Effect of Problem Based Learning Model for Student Learning Outcomes on Materials Temperature of Heat and Heat Transfer in Class X Semester II SMA N 16 Medan." IOSR Journal of Research & Method in Education (IOSR-JRME) , vol. 7, no. 5, 2017, pp. 32–37.