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The Effect of Problem Based Learning Assisted ICT and Critical Thinking Toward Student's Problem Solving Ability

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Abstract: *This study aimed to know the effect of problem based learning assisted ICT to student's problem solving ability, to know the effect of critical thinking to student's problem solving ability, and to know the interaction of problem based learning assisted ICT and critical thinking skill toward student's problem solving ability. This study used a quasi experiment with two group pretest posstest design. The population of this study was all the students grade X in Senior High School YAPIM Medan academic 2016/2017. The sample selection by cluster random sampling, that is experiment class implemented problem based learning assisted ICT and control class implemented conventional learning. The instruments of the research were valid essay test of problem solving ability and critical thinking. From result of study was student's problem solving ability taught by problem based learning assisted ICT better than conventional learning. Student's problem solving ability have high critical thinking better than student's problem solving ability have low critical thinking. Problem based learning assisted ICT and critical thinking have interaction to student's problem solving ability.*
Keywords: *Problem Based Learning, critical thinking, Problem Solving Ability*

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I. Introduction

Education is one step to change attitudes, behavior and even a person's mindset to be more advanced than before a person is getting an education. A person can get an education from the family environment, community, and school environment. Education in school or so-called formal education, not only aims to provide course material, but emphasizes how to invite students to find and build their own knowledge so that students are ready to find solutions in the face of problems.[1]. One indicator of educational development is influenced by the development of the curriculum. Nowadays, curriculum development focuses on student competencies, including attitudes, knowledge, skills competencies which will provide learning experiences such as observing, questioning, gathering information, associating, and communicating.[2]. Indicators of the quality of education in schools can be seen based on student learning outcomes on each subject studied in school. One of these subjects is science.

Science plays a dominant and important role as the spearhead of technological advancement, promoting national wealth, promoting health and the acceleration of industrialization that fosters development in many countries.[3]. Physics is one branch of science that explains how nature works using mathematical language. Physics, in essence, is an interesting lesson because it can be observed from natural phenomenas that occur in everyday life directly. Physics has a very close relationship with the problems in daily life. Concrete examples of temperature and heat matter. Everyday, in everyday life students are exposed to events or circumstances that are closely related to temperature and heat, so that students are expected to solve daily problems associated with temperature and heat matter. This is in fact not supported by good learners' learning outcomes. Physics learning outcomes are low in value compared to other lessons.

Based on the interview result of the writer with one of the teachers in a high school in Medan stated that about 20% of students from each class still follow remedial due to the unfulfilled value of students meet the minimum mastery criteria (KKM) of 70. Most of the students are also unable to relate what is learned to how the knowledge will be used. Of course it tends to make students accustomed to use only a small part of the potential or ability to think and make students lazy to think and accustomed to lazy independent thinking. Khanifiyah said that the study of physics is expected to encourage students to become active learners and critical thinking in analyzing and applying concepts to solve problems found in everyday life.[4].

Selection of appropriate learning models can enhance students' problem-solving abilities to be better. Based on the objectives can be understood that through physics learning is expected that students not only master the knowledge alone but become individuals who have the skills and ability to solve problems found in

everyday life. One of the learning model that can improve problem solving ability is problem based learning (PBL) model. The problem-based learning model is a learning model that poses problem situations to students and instructs students to investigate and find their own solutions.[5]. Problem-based learning models are not designed to help teachers deliver large amounts of information to students, but rather to hone thinking skills and problem-solving skills. Hartono stated the problem solving ability of students by using model problem based learning better than those taught by using conventional learning.[6]. Activities undertaken by students in problem based learning are built in nature. Based on prior knowledge and experience, students build their own learning goals. Students are also involved in questioning, investigating, and seeking links between the facts found to build their own understanding based on the information gathered and applying it to the problems at hand. This section shows how the use of technology to improve the constructivist attributes of problem based learning.

Information and Communication Technology (ICT) is all media or tools in obtaining knowledge between one to others.[7]. ICT includes not only all things related to the process, use as a tool, manipulation, and information management, but also all things related to the use of tools to process and transfer data. Technology in this regard includes computers, the Internet, broadcasting technology (radio and television), and telephones.[8]. Dircknick and Holmfeld say that the problem-based learning model can be integrated with ICT to produce a better form of learning model. This is because what is the problem in the model, in learning, can be visualized using ICT.[9].

In fact, based on the results of interviews with one of the teachers in high school was found the teacher is still using a very simple media, namely white board, so students feel bored and sleepy. Dwi explained that there are significant problem solving abilities among students who are learning with problem based learning model with ICT and problem based learning model.[10]. The author also sees teachers have not measured students' critical thinking skills. In fact, the problem-based learning model with ICT can be applied more effectively and able to optimize problem solving especially if followed by the ability of critical thinking of good students. Dwi stated problem solving ability of student using problem based learning model with high critical thinking ability better than direct learning. Critical thinking ability is a reflective and reasoned way of thinking that is focused on making decisions to solve problems.[11]. Through research journals as conducted by Wulandari said there is an interaction between the learning model with significant critical thinking ability and affect student problem solving abilities. Dirckink - Holmfeld stated that PBL with the help of ICT able to build good learning condition. Argaw said the PBL model is a more effective learning model for physics lessons as compared with conventional learning.

II. Method

This research is a quasi experimental research with two group pretest-posttest design design. The independent variable of this research is problem based learning model assisted ICT, moderator variable of this research is critical thinking ability, while the dependent variable is problem solving ability. Population in this research is all student of class X SMA YAPIM Medan. The sample in this study was taken by cluster random sampling. Instruments used for data collection is an essay test problem-solving skills of 5 questions and critical thinking tests as many as 7 questions. The material was essay test of Heat for second semester of class X. The data were analyzed by using prerequisite and hypothesis test. The normality test were analyzed by Kolmogorov-Smirnov Test. The homogeneity test were analyzed by Levene's Test of equality error variance. Hypothesis test were analyzed by using 2x2 factorial design for technical analysis of two way variance (ANOVA)with the level of significance 0.05.

III. Results

Student's problem solving ability on control class and experiment class shown in Table 1.

Table 1. Pretest and Posttest Data of Student's Problem Solving Ability

Class	Average Student's Problem Solving Ability	
	Pretest	Posttest
Experiment	23.91	76.94
Control	23.97	69.38

Based on Table 1, the explanation of the average of pretest and postes problem solving abilities in conventional class and class with problem-based learning model with ICT is as follows: For the conventional class preview and class with problem-based learning model with ICT are 23.97 and 23.91. For the result of postest control class and experiment class were 69.38 and 76.94. Analysis of problem-solving abilities in posttest is useful for viewing the student problem-solving indicators that become difficult for students. Grain analysis of student problem solving items from each postes item given to the experimental class and control class can be seen in Table 2.

Table 2. Average Grade of Student Answers on Posttest

No	Indicator of Problem Solving Ability	Average of Achievements	
		Control	Experiment
1	Recognize the problem	12.97	15.38
2	Describe the problem	14.53	16.59
3	Plan a solution	14.13	15.75
4	Execute the plan	14.09	15.50
5	Evaluate the solution	13.66	13.72

Based on Table 2, the average of student answer on posttest who answered correctly in the experiment class is higher than the control class. The highest average of achievement for each indicator lies in describe the problem, where the average of the control class is 14.53 and in the experiment class is 16.59. Data posttest of problem solving ability of experiment class and control class are grouped by high critical thinking group and low critical thinking group can be seen in Table 3.

Table 3. Two-way ANOVA

Critical Thinking of Student (B)	Learning Model (A)		Average
	Experiment (problem based learning assisted ICT) (1)	Control (Conventional) (2)	
High (1)	76.87	70.27	73.57
Low (2)	55.00	58.00	56.50
Average	65.94	64.14	

Table 3 shown that the student's problem solving ability is based on the level of critical thinking in the experiment and control class. In the experiment class it can be seen that the average value of the problem solving ability of low critical thinking of student is lower than the problem solving ability of high critical thinking of student. After the two classes were declared homogeneous, then continued on a two-way ANOVA test. Hypothesis testing in this study using two-way ANOVA to see whether or not interaction between problem based learning assisted ICT and critical thinking is shown in Table 4.

Table 4. Calculation of Two-way ANOVA

Learning Model	Critical Thinking	Mean
Conventional Learning	Low Group of Critical Thinking	69.47
	High Group of Critical Thinking	69.23
	Average	69.38
Problem Based Learning	Low Group of Critical Thinking	72.44
	High Group of Critical Thinking	78.70
	Average	76.94
Average	Low Group of Critical Thinking	70.43
	High Group of Critical Thinking	75.28
	Average	73.16

Based on the posttest result, we can analyze the interaction between problem based learning model assisted ICT and critical thinking on student problem solving ability as shown in Figure 1 below.

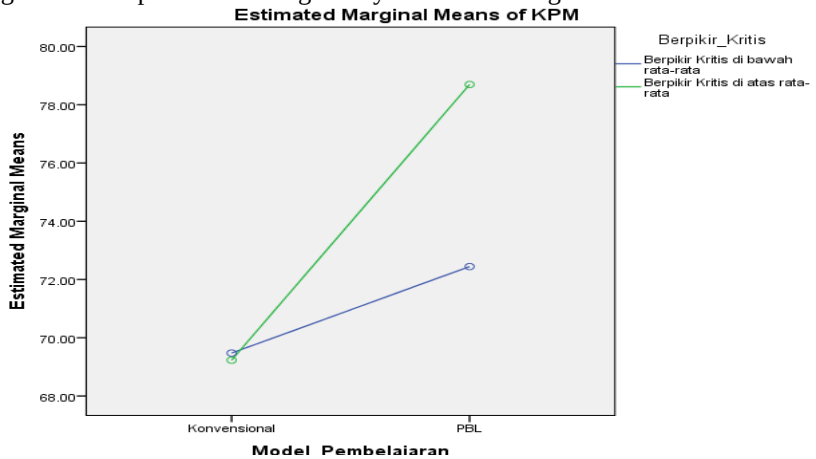

Figure 1. Interaction Model Learning and Critical Thinking

Figure 1. shows the interaction results between project based learning with conventional learning and high self regulated learning and low self regulated learning.

IV. Discussion

4.1. The effect of problem based learning assisted ict toward students' problem solving ability

Based on the results of the first hypothesis states that the problem solving ability of physics students using problem based learning model is better than conventional learning. This is in line with research conducted by Nasution.[13], which concludes that the problem solving ability of physics students using problem-based learning model is better than conventional learning. And in accordance with the research Dewi states that by using problem-based learning model can improve the understanding of concepts and ability problem solving physics students.[14]. The process of learning problem based learning is characterized by the problems encountered in everyday life, then the students deepen their knowledge of what is known and how to solve problems in groups to help each other so as to be able to collaborate in solving problems. This allows students to exchange ideas , work together to solve problems that can ultimately improve students' physics problem solving abilities

The first hypothesis proposed Ha accepted, that is there are differences in the ability of problem solving physics students between groups of students who are given by problem based learning assisted ICT with groups of students given conventional learning, because the value of sig. $0.001 < 0.05$, in other words the ability of problem solving physics students with ICT-based problem-based learning model is better than conventional learning.

4.2. Problem solving ability of students who have high critical thinking better than low critical thinking

The second hypothesis proposed Ha accepted, that is there are differences in the ability of problem solving physics students between groups of students who have critical thinking value of the upper and lower groups, because the value of sig. $0.000 < 0.05$, in other words the ability of physics problem solving students who have above-average critical thinking value better than the ability of problem solving physics students who have value critical thinking below the average. This is in line with Wulandari's research which argues that there is a significant difference in learning achievement between students who have high critical thinking and students who have low critical thinking. The same thing is shown by Nasution stating that students who have high critical thinking, there are differences in problem-solving abilities between students who follow the problem-based learning model with students who follow the direct teaching model.

Thus the better one's critical thinking ability will be better at solving a problem. The findings of this study fit the theory that critical thinking skills can improve students' problem-solving abilities.

4.3. Interaction between problem based learning assisted ICT and critical thinking on problem solving ability

The third hypothesis proposed Ha is accepted, that there is interaction between the model of problem based learning and conventional learning with critical thinking in improving students problem solving skills, because the value of sig. $0.004 < 0.05$, in other words there is an interaction between problem based learning assisted ICT and conventional learning with critical thinking in improving students' physics problem solving abilities. There is an interaction in this research because critical thinking plays an important role in improving students' physics problem solving abilities. Where problem based learning assisted ICT also provides a better effect on students who have critical group thinking above. This is because problem based learning assisted ICT with critical thinking of the upper group causes the students more effort in solving problems given from collecting data, analyzing and evaluating data. So the students are actively involved in the learning process.

V. Conclusion

Based on the result of analysis and discussion, it was obtained some conclusions as the following.

1. Student's physics problem solving ability using problem based learning assisted ICT is better than students' physics problem solving ability using conventional learning. Based on the average score of students on problem based learning assisted ICT 76.94 and for conventional learning 69.38. There is an influence of problem based learning assisted ICT on problem solving abilities.
2. The students 'physics problem solving skills in the upper class critical thinking group is better than the students' physics problem solving skills in the lower class critical thinking group. It can be shown from the data of research result that problem solving ability on upper class critical thinking equal to 76.87 and in lower class critical thinking group is 55.00 There is influence of student's critical thinking to student problem solving ability.
3. There is an interaction between problem based learning assisted ICT and conventional learning with critical thinking in improving students' physics problem solving abilities. In this research, critical thinking has an

effect on improving students problem solving ability of physics on problem-based learning assisted ICT, while in conventional learning has no effect.

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