

# Analysis of Critical Thinking with Problem Based Learning in Physics Class

Ratelit Tarigan

Universitas Negeri Medan

Jalan Willem Iskandar Psr V, Medan 20221, Indonesia

\*tarigan\_unimed@yahoo.com

**Abstract**— Based on the theory of constructivism learning the application of Problem-Based Learning model is directed to the activities and actions of a person, each knowledge controls an interaction with experience. Without interaction with objects, one cannot construct knowledge. In this case learning as an operative process, not figurative. Operative learning is learning to acquire and find a more general structure of thought that can be used in a variety of situations. The situation is directed at critical thinking skills that will not occur if the goal of the student is only to get a value to enter a higher level. By applying Problem Based Learning to Physics learning, there are four basic components of the definition of critical thinking: basic skills, knowledge base, willingness to ask and self-reflection. Learning outcomes show the achievement Critical thinking Students experience improvement with the application of Problem Based Learning.

**Keywords**—Critical Thinking, Problem Based Learning, Physics Learning

## I. INTRODUCTION

Increasing teachers through teacher certification programs, providing and improving the quality of teaching materials, provision and equipment of laboratory facilities and infrastructure, developing relevant and effective learning innovations to achieve the goals of physics learning.

One alternative that can be used to overcome these difficulties is to create an atmosphere of learning that is directly related to everyday life. Learning model based on computer-based media problem is one of the solution effort, this learning model is a model of learning based on the many problems that require authentic investigation of the investigation that requires a real settlement of the real problem (Atan, Hanafi. 2005). This learning model helps students develop the ability to think and develop the ability to solve daily life problems, so that students better understand the concept of physics related to everyday life (Anderson, L. W., Krathwohl, D. R., (2010)).

Therefore, students are required to think critically, creatively and to be able to solve problems. Making children think critically, creatively and able to solve problems is not easy. Critical thinking means thinking quickly and rationally as a form of response to the surrounding environment so as to solve problems well and bring benefits. Making children think critically is by way of education and learning that explores the ability of students owned (Astika. 2013; Elena V, F., and Natalia A., L. (2015)). To make children think critically and

creatively then the learning is done not only provide the knowledge and skills needed but also required teaching the nature, attitude, values and character.

To achieve the objectives of the curriculum and the critical and creative nature of the teacher to innovate learning to produce quality graduates. One way approach in learning to be able to realize the students can think critically and creatively that is with the model of learning based on the problem.

## 1. Problem Based Learning Model.

According to Dewey (Trianto, 2011: 91) study based on the problem is the interaction between the stimulus with the response, is the relationship between the two-way relationship of learning and the environment. According to Arends (2008), problem-based learning is a learning approach in which students work on authentic issues with the intent to develop their own knowledge, develop inquiry and higher-order thinking skills, develop self-reliance and self-confidence. This learning model also refers to other learning models, such as "project-based instruction", "experience-based instruction", "authentic learning" and "meaningful learning (anchored instruction)".

Problem-based learning consists of five major steps that begin with the teacher introducing the student to a problem situation and ending with the presentation and analysis of student work. These five steps are described based on the steps in Table 1.

Tabel 1. Syntax of Problem Based Learning Model

Stage	Teacher Behavior
Phase-1 Student orientation on the problem	The teacher explains the learning objectives, explains the logistics required, proposes phenomena or demonstrations or stories to raise issues, motivation of students to engage in the problem solving chosen.
Phase-2 Organize students to learn	The teacher asks students to define and organize learning tasks related to the problem
Phase-3 Guiding individual and group investigations	Teachers encourage students to gather appropriate information, carry out experiments, to gain explanations and solve problems
Stage-4 Develop and present the work	Teachers assist students in planning and preparing appropriate works such as reports, videos, and models and helping them to share tasks with their friends
Stage-5 Analyze and evaluate troubleshooting process	Teachers help students to reflect on or evaluate their inquiry and the processes they use

## 2. Benefits of Problem Based Learning Model.

Problem based learning is developed to help students develop thinking skills, problem solving, and intellectual skills; learning the various roles of adults through their involvement in real-life experiences or simulations; and become autonomous and independent learners. According to Sujana (Trianto: 2011) the specific benefits derived from the Dewey method are problem-solving methods. The teacher's job is to help students formulate lesson tasks. Lesson objects are not learned from books, but from problems around them (Graaf Erik De and Anette Kolmos, 2003).

## 3. Critical Thinking

Glaser (Fisher, 2009) defines critical thinking as: A willingness to think deeply about the problems and things that are within the reach of one's experience. Knowledge of methods of checking and logical reasoning (Gelerstein, D., Río, R. d., Nussbaum, M., and Chiuminatto, P., 2015); Rusdi, S. H., and Umar, I. N. (2015)). It is a skill to examine any assumptions or assumptive knowledge based on the supporting evidence and the subsequent conclusions it brings.

According to Tan (2004) critical thinking skills are not natural events, which come automatically, critical thinking skills require process, continuous instruction and practice in developing them to the fullest.

Table 2. Indicators of Critical Thinking Skills

No	Aspects of Critical Thinking Ability	
1.	Ability to analyze	Ability to decipher a structure into components in order to know the organizing of structures.
2.	Ability to synthesize	The ability to synthesize is an ability that is contrary to the skill of analyzing. Synthesizing skills is the skill of echoing parts into a new form or arrangement
3.	Ability to recognize problems and solutions	This ability is an ability apply of the concept to some new understanding. This skill demands the reader to understand the reading critically so that after the reading activity is finished the student is able to capture some of the main thoughts of reading, and is able to pattern a concept. The purpose of this ability is to enable the reader to understand and apply the concepts to new issues or scope
4.	Ability to conclude	Ability to conclude is the activity of the human mind based on the understanding / knowledge (truth) it possesses, can move to reach the understanding / knowledge (new truth). This capability requires the reader to be able to describe and understand various aspects gradually to arrive to a new formula that is a conclusion. The process of human thought itself, can take two ways, namely inductive and deductive. So the conclusion is a thought process that deceives his knowledge in such a way as to produce a new thought or knowledge.

## II. METHOD

This research is quantitative research with quasi-experiment research method (quasi experiment). The research design uses 2 x 2 factorial to compare the influence of learning strategy based on problem and direct learning strategy to Senior High School Problem Solving Ability, in terms of students' critical thinking ability level. Data analysis technique

used in this research is descriptive analysis and inferential analysis.

## III. RESULTS AND DISCUSSION

This study shows that in general there is 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 showing results that are 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 are show that the results there is a significant difference in the inference criteria (sig2-tailed,  $t = -5.57$ ,  $p = 0.00 < * 0.05$ ) which supporting the first postes and results indicate that there are significant differences in the two criteria of the WGCTA test; inference (sig2-tailed,  $t = -3.478$ ,  $p = 0.001 < * 0.05$ ) and interpretation (sig2-tailed,  $t = -5.530$ ,  $p = 0.00 < * 0.05$ ). The critical thinking skills tests show that almost 32% of students' thinking styles are grouped into balanced thinking styles (Martincova, J., and Lukesova, M. (2015); Sternberg, R. J., Roediger, H. L., & Halpern, D. F. (eds.), 2007).

According to 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, analyze 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.

Problem Based Learnig (PBL) is a learning model that is oriented to the theoretical framework of constructivism. In the PBL model the focus of learning is on the chosen problem so that the students not only learn the concepts

related to the problem but also the scientific method 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 skill-full activity, which can be done better or vice versa, and good critical thinking will meet a variety of intellectual standards such as clarity, relevance, adequacy, coherence and others. Critical thinking clearly requires interpretation and evaluation of observation, communication, and other sources of information. It also demands skills in thinking up assumptions, in asking relevant questions, in 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 if 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.

The various weaknesses obtained during this research are: (1) the number of students from each of the sample classes studied is large enough so that the students get less attention and maximum supervision 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 those 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.

#### IV. CONCLUSION

There are differences in the results of physics study of high school students with a high level of critical thinking skills was be studied with learning models based on problems and

high school students with high levels of critical thinking skills studied by direct learning model.

#### V. ACKNOWLEDGMENT

We would like to thank the Universitas Negeri Medan who have worked together on the research execution, and the faculty of mathematics and natural sciences of the Universitas Negeri Medan.

#### REFERENCES

- [1] Anderson, L. W., Krathwohl, D. R., (2010), Kerangka Landasan untuk Pembelajaran, Pengajaran, and Assessment Revisi taksonomi Pendidikan Bloom, Yogyakarta, Pustaka Pelajar. <http://www.ericfacility.net/ericdigest/ed 309049.html>.
- [2] Arends. R. I. 2008. *Learning To Teach Edisi Ketujuh*, Yogyakarta: Pustaka.
- [3] Astika. 2013. Pengaruh Model Pembelajaran Berbasis Masalah terhadap Sikap Ilmiah dan Keterampilan Berpikir Kritis. *e-Journal Program Pascasarjana Uniersitas Pendidikan Ganesha Program Studi IPA* vol. 3.
- [4] Atan, Hanafi. 2005. "The effectiveness of problem-based learning in the webbased environment for the delivery of an undergraduate physics course". *International Education Journal*, 2005, 6(4), 430-437.
- [5] Elena V, F., and Natalia A., L. (2015). *International Students' Alleged Lack of Critical Thinking*. *Procedia - Social and Behavioral Sciences*, 215, 2-8.
- [6] Fisher, Alec. 2009. *Berpikir Kritis*. Erlangga: Jakarta
- [7] Folashade, Afolabi, Akinbobola, A. O. 2009. Constructivist Problem Based Learning Technique and the Academic Achievment of Physics Students with Low Ability Level in Nigerian Secondary Schools. *Eurasian Journal of Physics and Chemistry Education*, 1 (1): 45—51.
- [8] Gelerstein, D., Río, R. d., Nussbaum, M., and Chiuminatto, P. (2015, February 5). *Designing and implementing a test for measuring critical thinking in primary school*. Accepted Manuscript, 1-32.
- [9] Graaf Erik De and Anette Kolmos. 2003. "Characteristics of Problem-Based Learning", *International Journal Engine/ Vol. 19, No. 5*, 657-662. 2003.
- [10] Krulik, S., & Rudnick, J. (1996). The new sourcebook for teaching reasoning and problem solving in junior and senior high school. Needham Height, Massachusetts: A. Simon & Schuster Company.
- [11] Martincova, J., and Lukesova, M. (2015). Critical Thinking as a Tool for Managing Intercultural Conflicts. *Procedia - Social and Behavioral Sciences*, 171, 1255 – 1264.
- [12] Masek, Alias & Yamin, Sulaiman. (2011). The Effect of Problem Based Learning on Critical Thinking Ability: A Theoretical and Empirical Review. *International Review of Social Sciences and Humanities*. Vol.2, No.1 (2011), pp. 215-221
- [13] Rusdi, S. H., and Umar, I. N. (2015, February 05-07). Students' Levels Of Critical Thinking, Supportive Behaviors And Types Of Questions In An Online Forum Learning Environment. *Procedia-Social and Behavioral Sciences*, 1752 – 1758.
- [14] Sternberg, R. J., Roediger, H. L., & Halpern, D. F. (eds.),. 2007. *Critical Thinking in Psychologi*. America: Cambridge University Press.
- [15] Sulaiman, F. 2011. The Effectiveness of Problem-Based Learning Online on Students' Creative and Critical Thinking in Physics at Tertiary Level in Malaysia. University of Waikato: PhD Thesis.
- [16] Tan, Oon-Seng, 2004. Enhancing Thinking Through Problem Based Learning Approaches. Cengage Learning: Singapura.
- [17] Trianto. 2011. *Mendesain Model Pembelajaran Inovatif Progresif*. Jakarta: Kencana.