

The Effect of Problem Based Learning (PBL) Model toward Student's Problem Solving Ability and critical thinking Ability in Junior High School

Elly Mahrani¹, Nurdin Bukit², Karya Sinulingga³

¹(Post Graduate, State University of Medan, Medan, Indonesia)¹

²(Lecturer, State University of Medan, Medan, Indonesia)

³(Lecturer, State University of Medan, Medan, Indonesia),

Corresponding Author: Elly Mahrani1

Abstract: This study aimed to analyze the effect of learning model problem based learning on problem solving ability and critical thinking ability of the students. This research is a quasi experimental research with two group pretest posttest design. The population of this research is all students of class VIII Junior high school 2 Kotanopan. The sample selection is done by cluster random sampling that is class VIII-1 as experiment class applied problem-based learning model and class VIII-3 as control class applied conventional learning. Instrument used in this research is instrument of problem solving ability and critical thinking ability in the form of essay test which have been declared valid by expert team. From result of research concluded that problem solving ability in student applying model of learning problem based learning better than student with conventional learning and critical thinking ability in student applying problem based learning model better than critical thinking ability to student with conventional learning.

Keywords: problem based learning model, problem solving ability, and critical thinking ability

Date of Submission: 09-07-2017

Date of acceptance: 25-11-2017

I. Introduction

The era of globalization today, encouraging a tight competition between nations in the world that can bring many problems. This competition is called free competition. A nation capable of mastering a number of knowledge, technology, and skills will be the winner (the winner) [1]. Qualified human resources who master the science, technology and a number of absolute abilities including the ability of a person in the face of problems, necessary to win the competition in the global era. In addition, quality human resources are also needed to drive industrial sectors.

Preparation of qualified human resources can be done through quality education. Education is a conscious and planned effort to create an atmosphere of learning and learning process so that learners actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble character, as well as skills needed him, society, nation and state. Realizing quality human resources should be explored in all aspects of the field of study including the field of natural science the learning process so far is still dominated by teachers so it has not provided an opportunity for students to develop independently through discovery and thought processes. The way teachers teach only one direction (teacher centered) causes the accumulation of information or concepts are less useful for students. Teachers are always demanding students to learn, but not teaching how students should learn and solve problems [2]. Professional educators are expected to be able to manage learning models that fit the character of all students as learning strategies, so that learning will appear more interesting. One of the subjects taught in Junior High School is the subject of natural science, which is very instrumental in the development of science and technology, therefore the lessons of natural science need to be developed and considered. Natural science is an interesting lesson because it can be observed from natural phenomena and phenomena that occur in everyday life directly. The nature of natural science as a process, product and attitude.

The fact is based on the experience of researchers who served in junior high school 2 kotanopan in the academic year 2016/2017 odd semester that obtained a student score of 45. This value is relatively low when compared with the minimum criterion value of 65. This is influenced by the less effective learning used By the teacher, the learning seems monotonous over time. The lack of effectiveness of this learning leads to a lack of student interest in learning. Besides, it is also caused by many things, one of the factors that exist in students such as their attitude towards natural science that they think that science lesson is more difficult, so students first feel saturated before studying the science. This is a negative trait that causes the drive to learn to be low, so

students become passive. Based on interviews with science science colleagues who served in junior high school 2 Kotanopan, in the academic year 2016/2017 that, natural science learning in schools tend to use conventional models so that students are only emphasized on memorizing aspects of the formula of natural science. This shows that the aspect of critical thinking skills of natural science in students is still lacking. The same is true that students in these schools rarely undertake lab work because of incomplete laboratory equipment, which may hinder students' problem solving abilities. The learning process without going through the experiments in advance to make students feel bored and tired during the lesson. This resulted in the students' process skills becoming passive and less formed.

Responding to the problem needs a model that involves active learning. Teachers as teachers should be able to apply appropriate learning models using different strategies and teaching methods so that teaching and learning activities become more interesting and not boring. Through the philosophical basis of cognitive psychology, the problem-based learning model is promoted to be an alternative to the new learning model. According to [3] the learning model is a plan or a pattern used as a guide in planning the classroom learning or tutorial learning. the problem based learning model is one of the learning models that critical thinking ability and problem solving ability, studying adult roles by experiencing various real situations or simulated situations and becoming independent and autonomous students. The syntax of problem based learning is five: 1) Provide orientation about the problem to the students, 2) organize students to research, 3) assist independent and group investigation, 4) develop and present artifacts and exhibit and 5) analyze and evaluate the process of solving the problem [4]. Students not only understand concepts that are relevant to the issues that are at the center of attention but also gain learning experiences related to the ability to apply scientific methods in problem solving and fostering critical thinking patterns

Problem based learning fits very well with current curriculum demands. Development of problem solving skills, this approach also emphasizes the achievement of competence that is critical thinking, creative, and productive. The same is also stated [4] "it is strange we expect students to learn yet seldom teaching then about learning, expecting students seldom teach about problem solving", which means, in teaching teachers always demands students to learn, teachers also demand students Solve problems, but rarely direct how students should solve problems.

The problem based learning model is a learning approach that uses real-world problems as a context for students to learn about critical thinking and problem-solving ability, and to acquire essential knowledge and concepts from subject matter. According to [4] the core of problem based learning is the presentation of an authentic and meaningful problem situation to students that can be the basis of inquiry and inquiry. [5] states that implementing problem solving in the learning process is important, because in addition to trying to answer questions or solve problems, students are also motivated to work hard. Problem based learning is not designed to help teachers deliver large amounts of information such as conventional learning and lectures. Problem based learning is designed to help students critical thinking and problem solving abilities. Problem solving is a high level thinking process conducted through systematic stages including visualization of problems. Troubleshooting indicators. Dewey explains the six steps of problem solving techniques that are 1) formulating the problem is the step of determining the problem to be solved, 2) analyzing the problem that is the step of reviewing the problem critically from various point of view, 3) formulating the hypothesis that is the step of formulating various possibility of problem solving In accordance with the knowledge possessed, 4) collecting data that is the steps to find and describe the information needed to solve the problem, 5) testing the hypothesis of the steps to take or formulate the conclusion in accordance with the acceptance or rejection of the proposed hypothesis, 6) Recommendations that can be made in accordance with the formulation of the results of hypothesis testing and the formulation of conclusions, [6].

Another vehicle that grows on natural science learning is to train students to develop students' critical thinking skills. The ability to think critically is a disciplined process that is intellectually active and skilled. Indicators of critical thinking ability are: 1) provide a simple explanation, 2) build basic skills, 3) conclude, 4) further explanation 5) strategy and tactics [7]. Based on research result [2] that to improve critical thinking ability of junior high school student of class VIII through model of learning problem based learning more effective than conventional learning. This shows the problem based learning model has implications for learning in the classroom. According to [8] there are differences in students' critical thinking ability between students taught by problem based learning models with students taught using conventional learning models. In addition [9] on the results of his research concluded that applying the problem based learning model can improve students problem solving skills.

1.1 Problem based learning

Problem based learning is a learning approach that begins with solving a problem, but to solve the problem students need new knowledge to be able to solve it. This problem based learning model has been known since the time of Jhon Dewey. Learning model Problem based learning consists of presenting to students,

from authentic and meaningful problem situations, which can make it easier for them to conduct inquiry and inquiry. Problem based learning involves students in an active, collaborative, student-centered learning process that develops the problem-solving and self-learning skills needed to meet the challenges of life and careers, in today's increasingly complex environment. Problem-based learning can also be started by doing group work among students. Students investigate on their own, find problems, then solve the problem under the guidance of the facilitator (teacher). Problem based learning suggests to students to find or determine relevant sources of knowledge. Problem based learning provides students with a challenge to learn on their own. Students are more invited to form a knowledge with little guidance or teacher direction while on traditional learning, students are more treated as recipients of knowledge given in a structured manner by a teacher. Achieving optimal learning outcomes, learning with a problem based learning approach needs to be well designed from the preparation of problems that are in line with the curriculum that will be developed in the classroom, raises student issues, the equipment that may be required and the assessment used. This learning helps students to process the ready made information in their minds and develop their own knowledge of the social world and its surroundings.

Table 1. Syntax of learning model Problem based learning

Phase	Teacher Activity
Phase 1 Student orientation on the problem	Teachers discuss learning objectives, describe important logistical needs, and motivate students to engage in problem-solving activities.
Phase 2 Organize students to learn	Teachers help students define and organize learning tasks related to the problem
Phase 3 Guiding individual and group investigations	Teachers encourage students to get the right information, carry out experiments, and seek explanations and solutions
Phase 4 Develop presents the work	Teachers assist students in planning and preparing appropriate artifacts, such as reports, videotapes, and models, and helping them to pass it on to others
Phase 5 Analyze and evaluate the problem-solving process	Teachers help students to reflect on their investigations and the processes they use

1.2 Problem Solving

[10] defines the problem as the difference between the outcome to be achieved and the existing reality. Furthermore, Newell and Simon describe when a person is faced with a problem when someone wants something but does not know how to act to achieve it. In more detail, a problem is defined as a situation in which a person solves a problem that has not been worked out yet and does not understand how to solve it explains that the problem is something new to him even if the process or knowledge he possesses can be used as an experience to solve it. In general, a problem occurs when someone realizes there is a gap between hope and reality, and there is a desire to resolve but not knowing what action to take.

A person's ability to solve a problem is determined by his understanding of the problem. In general, a problem is a situation that meets the following requirements: 1) the situation indicates a gap between expectation and reality, 2) the situation generates motivation to find a solution, 3) not available in a flash tool that can be used to find way out. [11] defines the waking problem of mental references and the context of the gap between reality and hope. This explains the problem can not only be viewed from one side of the course but should be examined in depth in order to obtain appropriate troubleshooting efforts.

Various efforts can be made to solve problems faced by someone, this is a challenge for him so that there is a thought process to find the right way or procedure in terms of solving the problem. This is in line with [12] that the problem solving uses the thought process to solve known difficulties, collects facts about the difficulties and determines the additional information required. Furthermore [13] states if the problem is known then the breaking of problem is a sequence of cognitive processes directed to finding the right solution. According to [14], thinking ability is divided into basic thinking and complex thinking. The basic thinking process is a picture of a rational process of thinking that involves successive processes from simple to complex. The complex thinking process is known as a high level thinking process. The process of complex thinking can be categorized into four groups, including: problem solving, decision making, critical thinking and creative thinking

Various notions of problem solving skills, among others, according to [15] suggest that problem solving is one type of high level learning because students must have the ability to combine rules to achieve a solution. According to [16] states that problem solving is a high-level thinking process that includes analytical, synthetic and evaluation processes. Solving problems means finding the right way to bridge the existing gap or in other words finding a way out to solve the problem at hand [17]. Furthermore, [18] declaring problem solving is finding a way out of a difficulty, a way around an obstacle, achieving a certain goal or using multiple solutions to solve a problem. Through these definitions it can be concluded that problem solving ability is a high-level thinking process carried out through systematic stages including the process of understanding the problem, analyzing the problem and arriving at the outcome of problem solving as the evaluation process.

Some of the properties of cognitive process activity in problem solving are: 1) rarely using random, try-and-error approaches, and blasphemous ways, but otherwise typically show remarkable flexibility; 2) outlining the problem into the problem component and creating a plan and strategy for each component and 3) using a specific strategy to obtain a relatively easy solution applied [17]. This explains that to solve a problem, the approach used is related to thinking operations and using prior knowledge through steps, phases or phases that are tailored to the characteristics of the problem at hand.

John Dewey introduces a problem-solving method called the reflective method. The reflective method in problem solving is an active and careful thinking process based on the process of thinking toward definitive conclusions [3]. Dewey explains the six steps of problem solving techniques that are 1) formulating the problem is the step of determining the problem to be solved, 2) analyzing the problem that is the step of reviewing the problem critically from various point of view, 3) formulating the hypothesis that is the step of formulating various possibility of problem solving In accordance with the knowledge possessed, 4) collecting data that is the steps to find and describe the information needed to solve the problem, 5) testing the hypothesis of the steps to take or formulate the conclusion in accordance with the acceptance or rejection of the proposed hypothesis, 6) Recommendations that can be made in accordance with the formulation of the results of hypothesis testing and the formulation of conclusions, [6]. The problem solving in this study is based on Dewey's theory.

1.3 The Ability of Critical Thinking

[7] Critical thinking ability is a reflective and reasoned way of thinking that is focused on making decisions to solve problems. This mental process will generate the critical thinking ability of students to be able to master the science of nature in depth. According to [19] critical thinking is the ability to give reasons in an organized manner and evaluate the quality of a reason systematically. The idea that this regular and systematic reasoning originated from the discovery he had experienced. The ability to think critically is a person's ability to use his thought process to analyze arguments and provide interpretations based on valid perceptions through logical assumptions and interpretations [20]. The ability to think is basic in a learning process [21]. Critical thinking allows students to analyze their thoughts in making choices and draw conclusions intelligently. Children are given the opportunity to use higher-level thinking at each grade level, in the end they will be accustomed to distinguish between truth and lies, appearance and reality, facts and opinions, knowledge and beliefs.

Understanding the material of natural science requires thought and reasoning in order to solve the problem of natural science. At a high level of critical thinking critical thinking includes: 1) understanding the argument and believing it, b) critically evaluating the argument and believing it, and c) developing and maintaining the argument by supporting strongly and faithfully. Critical thinking is not a teaching material but a process or activity that should be incorporated in the learning of any material at a given level of education. Solving the problem of natural science is required to think logically and procedural thinking because the problem of natural science derived from natural phenomena and complex material requires the thinking phase from basic thinking to high level thinking. Critical thinking skills are developed into indicators of critical thinking consisting of five groups according to Ennis: 1) providing elementary clarification, 2) building basic capabilities, 3) Make further explanations (advanced clarification), and 5) implement strategies and tactics (strategies and tactics)

II. Method

2.1 Population and sample

The population in this study is all students of VIII grade of junior high school 2 Kotanopan, 2016/2017 academic year as many as 4 classes, each class of 30 people then the population of 120 people. Sampling is done by cluster random sampling where each class has the same opportunity to be a research sample. This research consists of two classes, one class as an experimental class that is taught with problem based learning model and one class is taught with conventional learning.

2.2 Data collection techniques

This research includes quasi experimental research that is a research that aims to determine the presence or absence of a result of "something" imposed on the "subject" students ie students. The study involved two different sample classes treated. In experimental class with problem based learning model and control class with conventional learning. The research design is two group pretest-postest design. The following research design can be seen in Table 2.

Table 2. Research design

Class	Pretest	Treatment	Posttest
Experiment	Y ₁	X ₁	Y ₂
Control	Y ₁	X ₂	Y ₂

2.3 Information

X1: Learning using problem based learning model using on pressure material.

X2: Learning by using conventional learning on pressure materials.

Y1: Pretest given prior to treatment in the experimental class and control class.

Y2: Postest given after treatment in the experimental class and control class.

Data collection techniques is the most important step in the research, because the main objective of the research is to obtain the instrument data used to obtain data in this research in the form of problem solving skills of students' natural science critical thinking ability. Both of these instruments are validated by the lecturers of Graduate State University of Medan, as panel of experts in determining the suitability of the test indicators. After the process of revision and improvement of the suggestions provided by the expert, it is concluded that the test has been able to be used to determine student learning outcomes and student confidence.

Data collection is done in two stages, the first step is collecting data about problem solving ability and second stage collecting data about critical thinking ability. Data obtained in the study were analyzed descriptively and inferentially. Inferential statistical analysis, to test the hypothesis. Before testing the hypothesis is tested the requirements of the test normality of research data with Liliefors technique, then continued with homogeneity test.

III. Results

Data obtained after postest

Table 3. Summary of pretest - postest problem solving skills and critical thinking skills of the control class and experimental class.

Dependent variable	Class	Mean Pretes	Mean Postes
The ability of Problem solving	Control	17,93	71,62
	Experiment	18	75,67
The ability of critical thinking	Control	18,08	66,4
	Experiment	19,87	75

Table 4. Post-t test Postest The ability of Problem solving

Post test Equation Test	t _{counted}	t _{table}	Sig	Information
Test- t	2,63	2,00	0,012	Significantly different

Based on Table 4, this result indicates that $t_{counted} > t_{table}$ and significance value are smaller than 0.05. Based on these results can be concluded that there are differences in problem-solving ability of students in the class that taught with conventional learning and classes that taught with problem-based learning model, with the results obtained problem-solving ability of classroom students with problem-based learning model is better than the classroom with learning Conventional.

Table 5. Test-t Postest critical thinking ability

Post test Equation Test	t _{counted}	t _{table}	Sig	Information
Test - t	4,17	2,00	0,07	Significantly different

Based on Table 5, this result indicates that $t_{\text{counted}} > t_{\text{table}}$ and significance value greater than 0.05. Based on these results can be concluded that there are differences in students' critical thinking skills in classes that are taught by conventional learning and classes that taught with problem-based learning model, with the results obtained class critical thinking skills with problem-based learning model is better than the classroom with conventional learning .

IV. Discussion And Conclusions

4.1 Discussion

4.1.1 Problem solving skills of students who are taught with problem based learning model is better than students who are taught by conventional learning

The problem based learning model according to [22] is a series of lessons that focus on the critical thinking and analysis process to find and find answers themselves from a physical problem. The effect is that the problem based learning model will increase understanding of science, productivity in creative thinking, and skills in acquiring and analyzing information.

In this study obtained a corroborative evidence that Problem Solving Ability that get treated learning problem based learning model was more significant difference with students who get treatment of conventional learning model. This is in line with research conducted by [23] which concludes that there is a difference in Problem Solving Ability between students taught with problem based learning assisting concept maps and conventional learning, where problem based learning aids concept maps better than conventional learning. In line with research [24] explains that learning outcomes using problem-based learning models are more effective than conventional learning.

Increased Problem Solving Ability with problem based learning model is caused because students are more free to communicate the findings obtained during the learning activities. This is in line with research conducted by [25] which concludes that with the problem based learning model students will more freely communicate the findings obtained during the learning activities. Communication between friends provides a quick solution for students to complete their ignorance of the subject matter learned.

When observed from both classes, it is found that students in the experimental class play an active role in conducting the experiments provided and able to solve the given physics problems. Increased problem solving ability of students on the problem based learning model caused by students in the process of learning becomes more creative.

4.1.2 The ability of critical thinking of students who are taught by model problem based learning better than students who are taught by conventional learning.

The critical thinking skills of students who are taught by the problem based learning model show better results. Students are able to answer the critical thinking skills test with an average of 75. When compared with the learning outcomes of students taught with conventional learning obtain an average of 66.4. So it can be concluded that the critical thinking skills of students who are taught with the problem based learning model is better than that taught by conventional learning

Based on the results of the analysis of each indicator of critical thinking ability is obtained in the first indicator provides a simple explanation, build basic skills, conclude, further explanation and strategies and tactics that are taught with the model of problem based learning and conventional learning have different results. The problem based learning model is the development of independent learners, the community method of active participation of students in problem settlement activities. Students actually have a curiosity and a great desire to grow flowers. The problem based learning model utilizes the exploration of students' natural passions, giving students specific directions so that students can explore new fields effectively.

V. Conclusions

Based on the results of research and discussion it can be concluded as follows:

1. Problem solving skills of students who are taught with problem based learning model is better than students who are taught by conventional learning.
2. The ability of critical thinking of students who are taught by model problem based learning better than students who are taught by conventional learning.

References

- [1] Redhana, W. 2012. Model pembelajaran berbasis masalah dan pertanyaan socratic untuk meningkatkan keterampilan berpikir kritis siswa.
- [2] *Jurnal FMIPA Universitas Pendidikan Ganesha*. 351-365.
- [3] Setyorini U, Sukiswo dan Subali. 2011. Penerapan model *problem based learning* untuk Meningkatkan kemampuan berpikir kritis siswa SMP. *Jurnal Pendidikan IPA Indonesia*. 7(12), 18-24.

- [4] Trianto. 2007. *Model-model pembelajaran inovatif berorientasi konstruktivistik*, Jakarta: Prestasi pustaka
- [5] Arends, R. I. 2013. *Belajar untuk Mengajar Learning to Teach*. Jakarta: Pustaka Pelajar
- [6] Sagala. 2011. *Konsep dan Makna Pembelajaran*. Bandung: IKAPI.
- [7] Sanjaya,W .2008. Strategi pembelajaran berorientasi standar proses pendidikan. Jakarta: Prenada media
- [8] Ennis, R.H. 1985. *A Concept Of Critical Thinking*. Harvard Educational Review.
- [9] Urip Astika, Suma dan Suastra. 2013. Pengaruh model pembelajaran berbasis masalah terhadap sikap ilmiah dan kemampuan berpikir kritis.
- [10] Jakarta: *Journal Program Pascasarjana Universitas Pendidikan Ganesha , Program Studi IPA*. 5(13),12-22.
- [11] Suprpti, 2012. *Pengaruh Penerapan Problem Based Learning terhadap Kemampuan Pemecahan Masalah IPA Ditinjau dari Motivasi Belajar Siswa SMAN 4 Banjarbaru*. S2 thesis, UNY.
- [12] Jonassen. 2004. *Learning to solve problem, an instructional design guide*. San Fransisco: John Wiley ,Sons, Inc.
- [13] Petrina, S. 2007. *Advanced teaching methods for the tecnology classroom*. Canada: information Science Publishing.
- [14] Liliasari.1996. *Beberapa pola berpikir dalam pembentukan pengetahuan kimia oleh siswa SMA*. Disertasi PPS IKIP Bandung: tidak diterbitkan.
- [15] Anderson Orin dan Krathwohl David. 2010. *Pembelajaran, Pengajaran dan Asesmen*.Yogyakarta: Pustaka Pelajar.
- [16] Costa, A.L. 1988. *Developing Minds : A. Resource Book for Teaching Thinking*. Alexandria : ASCD. 54-57.
- [17] Dahar, R.1996. Teori-teori belajar. Jakarta: Erlangga.
- [18] Eric. 2003. *Teaching problem solving secondary school science*.
- [19] Matlin, M. E. 2009. *Cognitive psychology, Sevent edition*. International student version:John Wiley dan Sons, Inc
- [20] Polya, G. 1985. *How to solve it 2nd ed*. Priceton university
- [21] Hassoubah, Z. (2007). *Mengasah Pikiran Kreatif dan Kritis: Disertai Ilustrasi dan Latihan*. Bandung : Nuansa Cendia.
- [22] Hamzah, Uno. 2007. *Model Pembelajaran Menciptakan Proses Belajar Mengajar yang Kreatif*. Jakarta : Bumi Aksara.
- [23] Heong, Y.M., Yunos, J M., Hassan, R. B., Othman, W. B., dan Kiong, T .T. 2011. The Perception of The Level of Higher Order Thinking Skills among Technical Education Students. *International Conference on Social Science and Humanity journal*. 5(2), 281-285.
- [24] Joyce Bruce, Well Marsha, dan Calhoun Emily. 2009. *Model of Teaching (Model-Model Pengajaran) edisi kedelapan*. Yogyakarta: Pustaka Pelajar.
- [25] Suprpti, 2012. *Pengaruh Penerapan Problem Based Learning terhadap Kemampuan Pemecahan Masalah IPA Ditinjau dari Motivasi Belajar Siswa SMAN 4 Banjarbaru*. S2 thesis, UNY
- [26] Lirirs. 2007. *Pengaruh Keikutsertaan dalam Program Pengembangan Pribadi Terhadap Rasa Percaya Diri Siswa Sekolah Pengembangan Pribadi*. Tesis. UPI
- [27] Nduru, J.K. 2016. Efek model *problem based learning* dan berpikir kritis terhadap kemampuan pemecahan masalah IPA siswa. Thesis. Tidak Dipublikasikan. Medan: PPS UNIMED.

Elly Mahrani The Effect of Problem Based Learning (PBL) Model toward Student's Problem Solving Ability and critical thinking Ability in Junior High School.” IOSR Journal of Research & Method in Education (IOSR-JRME) , vol. 7, no. 6, 2017, pp. 62-68.