The Influence of Problem Based Instruction Model in Natural Science Learning on the Improvement of Critical Thinking Skills of Learners

Andi Saddia[1], Alimuddin Mahmud[2], Muhammad Yunus [3]

[1,2,3] Educational Science, Universitas Negeri Makassar, Indonesia
Corresponding Author: Andi Saddia

Abstract: *This study was an experimental research conducted on one experimental group and one control group (conventional), which aimed to improve students' critical thinking skills of class IX at SMP Negeri 8 Makassar. The study was conducted in two stages. The first stage was the preparatory phase of the research. It is to develop the Problem Based Instruction (PBI) model, by making the lesson plans, student books, and test of critical thinking learning. The second stage is research implementation. It determines the sample of the research, performs the initial test, implements the learning process with PBI model, and performs the final test. The subjects of the study are the students of SMP Negeri 8 Makassar taken by using random sampling techniques. The research design is Quasi-Experimental Design, designed as Non-equivalent Control Group Design. The results showed that in the descriptive analysis, the general test of critical thinking skills of learners in the experimental class is in the very high category. Meanwhile, in the control class, it is only in the high category. Thus the critical thinking skills of learners who are taught through the PBI model are superior to those conventionally taught. Similarly, through inferential statistical analysis (t-test), it is found significant differences in the level of critical thinking skills of learners in the experimental class and control class. It can be concluded that there is a positive influence of PBI model on the level of students' critical thinking skills in class IX at SMP Negeri 8 Makassar.*

Keywords: *Problem Based Instruction, Science Learning, Critical Thinking Skills.*

I. Introduction

The skills which are needed to develop 21st-century technology are cognitive skills, interpersonal skills, and intrapersonal skills. In relation to this statement, critical thinking skills are viewed as cognitive skills in interpreting, analyzing, evaluating, explaining, and self-regulating [1]**.** The critical thinking skills of learners must be grown in order to compete in this century. Developing thinking skills including critical thinking skills lies in the skills of the learner's process. The reality shows that many students have high achievement, but they have low the ability of critical thinking. It is because many learners achieve academic success, but only some of them show critical thinking skills in the learning process. It makes the learners often fail when they have to solve real problems even many learners who are incapable of solving problems in the learning process. One of the problems in the world of education is the weakness of the learning process. It is necessary to develop models of learning that can develop critical thinking skills, especially in science learning. However, the learning model is not sufficient and therefore, it must be equipped with a good assessment which can measure indicators of students' thinking skills. The classical learning models (lecturing, questioning-answering, and recitation) used by science teachers in class IX at SMPN 8 Makassar affect the low achievement of minimum completeness criteria. For example, the minimum completeness criterion in the odd semester exam in the academic year 2013-2014 is 75. However, only 63% students achieve the determined criteria. This result indicates that the innovation is needed by the teacher in learning so that the learning outcomes can be achieved optimally.

II. Literature Review

Thinking is a reflective reasoning activity to construct all concepts to the level of analysis and its problem solving is in accordance with the data and information obtained through a series of communications and directional observations based on a particular purpose. Critical thinking skills are thinking skills that involve high-level cognitive processes, namely interpretation, analysis, evaluation, and inference through scientific procedures in order to solve problems. The critical thinking is a term of cognitive skills in interpretation, analysis, evaluation, inference, explanation, and self-regulation [2]. This opinion is in line with [3] who argues that: "critical thinking is the attitude of being disposed to consider in a thoughtful way the problems and subjects

that come within the range of one's experience, knowledge of the methods of logical inquiry and reasoning, and some skill in applying those methods [4]**.** According to Dewey, critical thinking is an action that follows the scientific method to know and understand something. Critical thinking as a set of conceptual tools with associated intellectual skills and strategies useful for making reasonable decisions about what to do or believe [5]. Critical thinking is a process that emphasizes a logical and rational basis of beliefs and provides a set of standardized procedures for analyzing, testing, and evaluating. Critical thinking is a deep process by expressing a purpose with a firm reason for something of trust and activity that has been performed [6]. In addition, critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflectionreasoning, or communication, as a guide to belief and action [7]. The change in the way of the view of the learners as the object that becomes the subject in the process of learning and teaching is the starting point of finding innovative learning approaches. According to Tan (2003), problem-based learning is an innovation in learning because, in the process of learning and teaching, the students' thinking skills are optimized through group work or a systematic team. Therefore, learners can empower, sharpen, test, and develop the ability to think continuously. It is mentioned that PBI or problem-based instruction is a learning model whereby learners work on authentic issues with the intent to develop their own knowledge, develop inquiry and higher-order thinking, develop independence and confidence [8]. On the contrary, the conventional teaching method is a traditional learning method which is also called lecturing method, because this method has been used as a means of oral communication between teachers and learners in the learning process [9] It is mentioned that the learning process of the educational unit is organized interactively. It is fun and challenging, and it also motivates learners to participate actively. Furthermore, it provides sufficient space for initiative, creativity, and independence according to the talents, interests, and physical and psychological development of learners. Referring to this standard, the learning of science uses two kinds of approaches namely scientific approach and process skill approach. Each subject has special characteristics in the learning approach. Science teaching emphasizes on the application of process skills. The aspects of the scientific approach are integrated into the process skills and scientific methods approach. Scientific process skills are a set of skills that scientists use in conducting scientific investigations. This trained skill is known as the science process skill. Process skills need to be developed through direct experiences as learning experiences. Through direct experience, someone can better appreciate the process or activities that are being done. By using the process skills, eventually, there will be an interaction between concepts, principles, and theories that have been discovered or developed with the development of the process skills itself.

III. Research Methods

This study was a quantitative approach. The population in this study was the students of class IX at SMP Negeri 8 Makassar consisting of 12 study groups (297 learners). The sampling technique was a random sampling. The design was Quasi-Experimental Design which was designed as Non-equivalent Control Group Design. Based on the used approach, then data were collected using two research instruments namely primary and secondary instruments. The primary instruments consisted of the questioner, test of learning result, and treatment material. The secondary instruments consisted observation and documentation guidelines.

In this research, t-test with Paired Differences was conducted by using two parties testing. Data were analyzed by comparing the results of the experimental group and control group tests to determine whether there were differences in learning outcomes after treatment or not. Before performing the t-test, the normality of the data was tested using chi-square test, and F test to see the homogeneity of data.

IV. Results

The result of descriptive statistical analysis in the form of initial test of students' thinking skill in the experimental and control classes can be seen in table 1.

The table 1 shows that from 36 learners before learning in the experimental class, 55.55 % of them have critical thinking skills in the medium category, 16.67% students are in the high category, and 2.72 % students are categorized as low. Besides, it is also seen that the initial score in the experimental class obtained the maximum value that is 79. The lowest value from the ideal value of 100 is 36. The average value is 58.6 0, and the standard deviation is 10.30.

In the control class, the students also have critical thinking skills in the medium category that is 63.89 %. Only 2.78 % students are in the high category, and the rest are in a low category. Besides, it is also seen that the initial value in the control class obtained the maximum value that is 79. The lowest score from the ideal score of 100 is 36.In addition, the average score is 56.00, and the standard deviation is 9.00. Based on the above data it can be stated that generally, the students are in the medium category.

Table 1. Categories, Amounts, and Percentages Based on Initial Value Intervals of Critical Thinking Skills on Experimental and Control Classes

Interval	Categories	Experimental Class (IX-F)		Control Class (IX-B)	
		Frequency (f)	**Percent (%)**	**Frequency (f)**	**Percent (%)**
0 - 36	Very Low	1	2.78	1	2.78
37 - 52	Low	9	25.00	11	30.55
53 - 68	Medium	20	55.55	23	63.8 9
69 - 84	High	6	16.67	1	2.7 8
85 - 100	Very High	0	0.0 0	0	0.0 0
Amount		**36**	**100.00**	**36**	**100.00**
		Average Max Score Min SD	= 58.60 = 79 = 36 = 10.30	Average Max Score Min SD	= 56.00 = 79 = 36 = 9.00

The final results of thinking skills of learners in the experimental and control classes can be seen in table 2 below.

Table 2. Categories, Amounts, and Percentages based on the Interval of the final Score of Critical Thinking Skills on Experimental and Control Classes

Interval	Categories	Experimental Class (IX - F)		Control Class (IX - B)	
		Frequency (f)	**Percent (%)**	**Frequency (f)**	**Percent (%)**
0 - 36	Very Low	0	0.00	0	0.00
37 - 52	Low	0	0.00	0	0.00
53 - 68	Medium	0	0.00	4	11.11
69 - 84	High	18	50.00	29	80.56
85 - 100	Very high	18	50.00	3	8.33
Amount		**36**	**100 , 00**	**36**	**100.0 0**
		Average Max Min SD	=84.40 = 96 = 71 = 5.50	Average Max Min SD	= 77.00 = 93 = 64 = 6.10

Table 2 shows that the score of critical thinking skills of learners lies in two categories, namely high category (50 %) and very High category (50 %). None of them are categorized as very low, low, and medium. Besides, it also shows that the final score of thinking skills of learners in the experimental class obtained the maximum value that is 96. The lowest score from the ideal score of 100 is 71. The average score is 84.40, and the standard deviation is 5.50. It can be stated that results of critical thinking skills of learners after learning through the PBI model increased. In the control class, the students who are taught conventionally are in three categories, namely moderate (11.11 %), high (80.56 %), and very high category (8.33%). Additionally, it is also seen that the initial score in the control class obtained the maximum value that is 93. The lowest score from the ideal score of 100 is 64. The average score is 77.00, and the standard deviation is 6.10. It can be stated that the result of critical thinking skills of learners after learning through conventional learning increased. Based on these two data, it can be concluded that critical thinking skills of the learners after learning in the experimental class is higher than the control class.After the data were analyzed descriptively, the researchers then performed inferential statistical analysis in the experimental and the control class. Before the testing is conducted, the prerequisites are first tested. The first test is normality data. It shows that the learning outcome of thinking ability of learners which are taught through the problem based instruction model originated from population that is distributed normal is on real level that is $\alpha = 0.05$. The second test is homogeneity testing by using *Levene Statistics Test. I*n the experimental and the control class, it is obtained the result that the data come from population that is distributed normally or homogeneously on real level that is $\alpha = 0.05$.

Based on t test (*Paired Samples Test)*, it is obtained that t count is 8.098 while t table (α =0.05) = 1,691 in which the degree of freedom is 35. Therefore, it can be stated that there is a significant difference in the level of critical thinking skills of students in class IX at SMP Negeri 8 Makassar who learned through learning *Problem Based Instruction* and the students who leaned using conventional learning.

The results showed the calculation of critical thinking skills of experimental and control class. The students who are taught using the problem-based instruction model are more excellent than the students who are taught conventionally. In the experimental class, the score of critical thinking skills of learners is in the high category

(50%) and very high category (50%). Meanwhile, in the control class, the critical thinking skills of learners are in the medium category (11.11 %), high (80.56), and very high (8.33 %). Based on these criteria, then in the experimental class taught by the Problem Based Instruction model is confirmed more excellent than the students in control class who are taught conventionally.

V. Discussion

The results of the research in relation to critical thinking skills of students indicate that the use of problem-based instruction model can improve the critical thinking skills of learners. The increasing skills are characterized by an increased average and percentage of completeness score of critical thinking skills in the classroom experiment. Critical thinking skills are one of the indicators that can be seen to determine the success of the learning process of the learners. This finding is in the opinion of some experts on the concept of critical thinking skills and their relationship to the Problem-based instruction model. The critical thinking is a high-level thinking skill such as analysis, synthesis, understanding, inference, and problem-solving [2], [4]. According to Bayer, critical thinking is a disciplined way of thinking that someone uses to evaluate the validity of statements, ideas, and arguments. Seven critical thinking keywords have been identified [7]. The first is the identification of problems. The second is definitely defined issues. The third is finding alternative solutions. The fourth is identifying concepts. The fifth is showing identification facts and evaluation. The sixth is making implicit basic assumptions. The seventh is assessment and possible conclusions. The test results through t-test confirm that there is a significant difference in the level of critical thinking skills of learners in class IX at SMP Negeri 8 Makassar who learn through Problem Based Instruction model and those who learn through conventional learning. Furthermore, through the provision of student worksheets, it is obtained that there is an increase in the quantity and quality of learning groups. The form of group learning enhancement is the existence interaction learners in the group that gives positive effect to the results their critical thinking skills. In the interaction, the learners will share knowledge each other, so that all member group gains knowledge that is almost same. This finding is in line with the concept of Problem Based Instruction in relation to critical thinking skills in which thinking skill involves high-level processes, namely interpretation, analysis, evaluation, and inference through scientific procedures in order to solve problems.

VI. Conclusion

There is a positive influence of learning model of Problem Based Instruction to the level of students' critical thinking skills in class IX at SMP Negeri 8 Makassar. It means that the higher problem-based instruction is applied, the higher the level of critical thinking skills of learners.

References

[1]   S. Bailin, R. Case, J. R. Coombs, and L. B. Daniels, "Common misconceptions of critical thinking," *J. Curric. Stud.*, vol. 31, no. 3, pp. 269–283, 1999.
[2]   P. A. Facione, "Critical thinking: What it is and why it counts," *Retrieved June*, vol. 9, p. 2004, 1998.
[3]   J. Dewey, *How we think*. Courier Corporation, 1997.
[4]   A. Fisher, *Critical thinking: An introduction*. Cambridge University Press, 2011.
[5]   J. Rudinow and V. E. Barry, *Invitation to critical thinking*. Cengage Learning, 2007.
[6]   R. H. Ennis, *Critical thinking*, vol. 14. Prentice Hall Upper Saddle River, NJ, 1996.
[7]   M. L. Kennedy, R. Jones, and D. Wallace, "Critical Thinking," *Retrieved Dec.*, vol. 30, 2011.
[8]   R. Arends, *Learning to teach*. McGraw-Hill Higher Education, 2014.
[9]   S. B. Djamarah and A. Zain, *Strategi belajar mengajar*. Jakarta: Rineka Cipta, 2006.