THE EFFECT OF PROBLEM BASED LEARNING LEARNING MODEL ON PROBLEM SOLVING AND CRITICAL THINKING ABILITY OF CLASS VIII STUDENTS IN SMPN 1 SINGARAJA OF SCIENCE

P C P Santuthi¹, N Suardana², N Wijana³
¹Department of Science Education, Faculty of Mathematic and Science, Universitas Pendidikan Ganesha, Bali, Indonesia – 81116

E-mail: clarissaputu@gmail.com

Abstract. This study aimed to describe and explain the effect of the Problem Based Learning (PBL) model on students’ problem solving and critical thinking skills. The study used a quasi-experimental research method with a non-equivalent pre-test post-test control group design. The population of the eighth grade students of SMP N 1 Singaraja were 222 students. The research sample was taken 2 classes using cluster random sampling techniques, namely Eighth grade A3 as the experimental class and Eighth grade A4 as the control class. Data collection used tests of problem solving abilities and critical thinking skills. the data were analyzed using MANCOVA (Multicovariate Analysis of Variance) with a significance level of 5%. The results of the study showed that there are differences in problem solving abilities and simultaneous critical thinking skills between students who follow the Problem Based Learning (PBL) model and students who follow the Guided Discovery Learning (GDL) model. There are differences in problem solving skills between students who follow the PBL learning model and students who follow the GDL learning model. There are differences in critical thinking skills between students who follow the PBL model and students who follow the GDL model. The average score of problem solving ability in PBL is higher, namely 83.06 compare to the average score of problem solving ability on GDL, which is 74.34. The average score of critical thinking skills in PBL is higher at 82.56 compare to the average score of critical thinking skills on GDL, which is 73.28.

Keywords: Problem Based Learning, Problem Solving Ability, Critical Thinking Ability

1. Introduction

In Curriculum 2013 (K-13) Science Education is one of the important sectors in produce critical skills and highly competitive human resources. One of the purposes of Curriculum 2013 is prepare students who are able to contribute her education to solve
the problem are often found in everyday life. Kemdikbud [1]. Hasanah and Surya [2] presented that science education must be given to all students, starting from elementary school until post graduate level to develop problem solving abilities and critical thinking skills. Johnson [3] presented in achieving these objectives, we need a scientific approach and contextual learning approach. Contextual learning is an educational process that aims to help students see meaning in learning materials and learn by connecting science with the context problem of everyday life. So in this case, learning by doing is achieved, which means that every student really does the stages of the scientific approach from formulating the problem, analyzing, evaluating and creating the right solution. Furthermore, Wilhem [4] applied in the scientific approach students required to have more abilities than usual, and students must also read, write, gather information from various source, discuss and engage in problem solving. When discussing proses students actively participate in self based learning in the learning process not only on test results, so the process of learning learning science will be fun and enjoyable. Unfortunately, Yuliasari [5] presented the results of the Program for International Students Assessment (PISA) and The Trends of the International Mathematics and Science Study (TIMSS) survey in 2007 and 2011 showed that students’ problem solving skills in Indonesia were still low, the results were low this can be seen from the decline of 21 points in the field of science. The fact of problem also occurs in the Junior High School 1 Singaraja, where the results of problem solving abilities and critical thinking skills are still to be low.

As the initial observation on Thursday 14 februrary 2019, science teachers at Junior High School 1 Singaraja have implemented the Guided Discovery Learning model. In the process of identifying problems students do not find themselves the problem to be studied, but problems have been provided in the textbook. The discussion process is still teacher center and the discussion material carried out by the teacher is still theoretical. In the training session the teacher’s questions still emphasize the mathematical calculations that are already in the textbook without examples and application of science concepts in real life every day. Teachers do not accommodate the ability of students and teachers to provide less opportunities for students to improve students’ abilities, so students’ problem solving and critical thinking abilities are low developed. Cemal and Yavuz [6] showed The low problem solving ability is caused by the low level of meaningful learning activities in school. Students are only required to solve mathematical equations, and teachers not to give problems related to problems in everyday life that are often encountered by students. This causes students to memorize and guess formulas and memorize examples of problems that have been done to work on other problems.

Johnson [3] The importance of teaching and developing problem solving and critical thinking skills is seen as something urgent to prepare students to face natural problems in everyday life. Critical thinking ability is not enough to be used as a mere education demand, but also as a fundamental process that allows students to overcome problems in the future. The need for efforts to facilitate students so that students’ critical thinking skills are more developed in solving problems becomes very important to be done as early as possible. Everyone has a problem that is not to be avoided but to be solved, so students must have critical thinking skills and problem solving skills, so students can think about what steps to take to solve the serious problems they face in their daily lives.

Seeing the problems above, so that students have problem-solving skills and critical thinking skills needed by an education system oriented to problem solving, the ability to think critically, creatively, systematically and logically [1]. Therefore, it is necessary to apply the Problem Based Learning model to stimulate high-level thinking of students in problem-oriented situations. In accordance with the objectives of Problem Based Learning, which is to help students develop the ability to think critically, solve problems and intellectual skills, students are expected to be able to explore and discover themselves from solving the problems given, so as to provoke student learning. Torp and Sage [7]
showed that Problem Based Learning focuses and is organized on the investigation and discovery of real problems in everyday life. Students are challenged as problem finders and root problem seekers, so that the learning situation and conditions as much as possible support student activities in the independent learning process.

The purpose to be achieved in this study include: (1) Describe and explain the differences in problem solving skills and critical thinking skills between students who follow the Problem Based Learning learning model and students who follow the Guided Discovery Learning learning model. (2) Describe and explain the differences in problem-solving abilities between students who follow the Problem Based Learning learning model and students who follow the Guided Discovery Learning learning model. (3) Describe and explain the differences in critical thinking skills between students who follow the Problem Based Learning learning model and students who follow the Guided Discovery Learning model.

2. Method

The research method used in this study is a quasi experiment. The design of this study used a non-equivalent experimental design pre-test post-test control group design. The population in this study were class VIII2, VIII3, VIII4, VIII5, VIII6, VIII7, VIII8 as many as 222 students at Junior High School 1 Singaraja. Sampling in this study was carried out using cluster random sampling techniques, namely the class of samples taken randomly through the draw and each class has the same opportunity. Based on the drawing technique it is known that class VIII3 as the experimental class and class VIII4 as the control class. The data needed in this study are (1) the score of problem solving ability and (2) the score of critical thinking skills. The problem solving ability data is in the form of 10 questions and the critical thinking skills data is in 5 essays. Analysis of statistical data in this study using MANCOVA (Multicoariate Analysis of Variance) using SPSS 16.0 for Windows. Before testing hypotheses, the research data must meet the analysis requirements which include test data distribution normality test, homogeneity test and collinearity test. Data distribution normality test using Kolmogrov-Smirnov statistics Candiasa [8]. Homogeneity Test The variance between groups using leven's test of equality of error variance Linearity test using product moment correlation test.

3. Results And Discussion

3.1 Results

Based on the descriptive analysis of the data from the results of the problem solving ability and critical thinking of the students in this study sample, the results are as follows.

Table 1. Summary of Statistics on Problem Solving Capability Values

| Variabel Statistik | Problem Based Learning (PBL) | Guided Discovery Learning (GDL) |
|--------------------|------------------------------|---------------------------------|
|                    | Pretest          | Posttest         | Pretest            | Posttest           |
| Mean               | 64.28           | **84.44**        | 66.00              | **75.19**          |
| Median             | 65.50           | 87.00            | 67.00              | 78.00              |
| Modus              | 75              | 90               | 62                 | 85                 |
| Standar Deviasi    | 9.812           | 6.839            | 6.919              | 12.945             |
| Varian             | 96.273          | 46.770           | 47.871             | 167.577            |
| Total              | 2057            | 2702             | 2112               | 2406               |
From the summary of the table above it can be described that the Posttest value of problem solving ability in Problem Based Learning is higher than that of Guided Discovery Learning, so that in this case Problem Based Learning can be said to be superior and participative.

The same thing happened to the posttest value of critical thinking skills in the Problem Based Learning model and Guided Discovery Learning model, where the average posttest value of students who followed the categorized Problem Based Learning model was higher compared to students who followed the Guided Discovery Learning model.

Table 2. summary of statistic on critical thinking skills

| Variabel Statistik | Problem Based Learning (PBL) | Guided Discovery Learning (GDL) |
|--------------------|-----------------------------|-------------------------------|
|                    | Pretest | Posttest | Pretest | Posttest |
| Mean               | 64.72   | 82.56    | 61.31   | 73.28    |
| Median             | 70.00   | 85.00    | 60.00   | 75.50    |
| Modus              | 40      | 90       | 56      | 70       |
| Standar Deviasi     | 14,811  | 7,890    | 11,558  | 7,755    |
| Varian             | 219,370 | 62,254   | 133,577 | 60,144   |
| Total              | 2071    | 2642     | 1962    | 2345     |

Based on this data, it can be described that the Posttest value of students' critical thinking skills in the Problem Based Learning model is higher than the Guided Discovery Learning model. So that in this case it can be concluded that the Problem Based Learning model is superior and varied compared to Guided Discovery Learning.

The results of the study showed that there were differences in problem solving abilities and simultaneous critical thinking skills between students who followed the PBL model and students who followed the Guided Discovery Learning (GDL) model. There are differences in problem solving skills between students who follow the PBL learning model and students who follow the Guided Discovery Learning model. There are students who follow the PBL model and students who follow the Guided Discovery Learning model. The average score of problem solving abilities in PBL is higher, namely 83.06 compared to the average score of problem solving abilities on Guided Discovery Learning model, which is 74.34. The average score of PBL's critical thinking skills is higher at 82.56 compared to the average score of critical thinking skills on Guided Discovery Learning model, which is 73.28.

3.2 Discussion

Based on the calculation of the first hypothesis test using Multicovariat Analysis of Variance (MANCOVA) shows that the value of Pillai's Trace, Wilks' Lambda, Hotelling's trace, Roy's Largest Root men is F = 1.279 with a significance level of 0.000 (p <0.05 ) Based on the results of these calculations, it can be decided that the first null (Ho) hypothesis in this study is rejected with the support of data, so that it can be concluded that there are differences problem solving abilities and critical thinking skills together between students who follow the Problem Based Learning model with students who follow the Guided Discovery Learning model. This significant difference can also be shown from the average value of the post test results in this study, where the average problem solving ability in PBL amounting to 84.44 and on GDL of 75, 19; and the average value of ability critical thinking on PBL is 82.65 and on GDL is 73,28. Based on data and analysis of this data it can be said that the Problem Based Learning model is
higher than Guided Discovery Learning model, or it can be decided in this study that the Problem Based Learning model can improve problem solving skills and students' thinking abilities.

The results of the descriptive analysis partially showed that the average problem solving abilities test posttest PBL class obtained a value of 84.44 higher than the GDL class which scored 75.19. The second hypothesis test can be explained that, the results of statistical tests show the significance of the value of t that is 0.000 or (p <0.05), thus it can be concluded that there are significant differences in problem solving abilities between students who follow the Problem Based Learning model and students who follow the Guided Discovery Learning model. This significant difference is shown from the average value of the post test results in this study, where the problem solving ability of students who follow the Problem Based Learning model is higher than the value of students who follow the Guided Discovery Learning model. Based on data and analysis of this data it can be said that the Problem Based Learning model is higher than Guided Discovery Learning model, or it can be decided in this study that the Problem Based Learning model can improve students' problem solving skills.

The third hypothesis test partially it can be explained that, the results of statistical tests show the significance of the value of t which is equal to 0.000 or (p <0.05), thus it can be concluded that there are differences in critical thinking skills between students who followed the Problem Based Learning model and students who followed the Guided Discovery Learning model. This significant difference is shown that the critical thinking skills in students who follow the Problem Based Learning model are higher than who follow the Guided Discovery Learning model. Based on this data analysis it can be said that the Problem Based Learning model can improve students' critical thinking skills.

Arends [9] showed that Theoretically the superiority of the Problem Based Learning model is based on the concept of constructivism developed by Jean Piaget and Lev Vygotsky. Jean Piaget is well-known for his learning theory which is commonly called human mental development or cognitive development theory or also called the theory of intellectual development with regard to the readiness of children to be able to learn. This theory asserts that knowledge is built into the child's mind. The link between constructivism and PBL's views on the principles of PBL is in line with the views of constructivist learning theory. Students actively construct their own understanding, by interacting with their environment through the process of assimilation and accommodation in solving problems in a day-to-day life. Vygotsky's learning theory is in line with Piaget's learning theory which believes that intellectual development occurs when individuals face new and challenging experiences, and when they try to solve problems that are raised.

The findings in this study show similar results from Yuliasari [5] study that Problem Based Learning is higher than Guided Discovery Learning. This kind of thing is because the Problem Based Learning model is more accommodating to the improvement of problem solving skills and students' critical thinking abilities. The syntax of Problem Based Learning models guides students in fostering a scientific attitude in solving and solving problems. Then it was also revealed in the study, that one of the weaknesses of Guided Discovery Learning is that in the exploration phase teacher guidance is still very dominating so that students are less independent in formulating problems. So this is the kind of thing that causes students' problem solving abilities and critical thinking skills to be lower than students who follow Problem Based Learning.

Smith [10] revealed that PBL provides opportunities for students to take advantage of the knowledge they have had while developing critical thinking skills and evaluation skills through analysis of real world problems. As suggested by Redhana [11] that the problem of ill structure (unstructured) can act as a starting point to start learning and stimulate students' curiosity and spur students to think critically. In addition, based on
the opinion of Downing [12], the Problem Based Learning model can lead to critical thinking skills and new knowledge that is useful for the long term. Students are challenged as problem finders and root problem seekers, so students think critically in finding solutions and learning conditions become active.

4. Conclusion

Based on the results of the research and the discussion that has been described, it can be summarized as follows.

1. There are differences in problem solving abilities and critical thinking skills of students who learn with the Problem Based Learning model and Guided Discovery Learning models.

2. There are significant differences in problem solving abilities of students who follow learning with Problem Based Learning rather than Guided Discovery Learning. Further testing using descriptive statistics showed that the Problem Based Learning model scored 83.06 higher in improving problem solving skills than the Guided Discovery Learning model which scored 74.34.

3. There are significant differences in students' critical thinking skills between groups of students who study with Problem Based Learning models rather than Guided Discovery Learning. Further testing using descriptive statistics showed that the Problem Based Learning model scored 82.56 higher improving critical thinking skills compared to the Guided Discovery Learning model which scored 73.28.

Suggestion

Based on the results obtained in this study, some suggestions can be proposed to improve the quality of junior high school science learning.

1. For teachers, especially science teachers, it is recommended to implement the Problem Based Learning model in the learning process, considering that problem solving skills and critical thinking skills are needed in facing the era of globalization.

2. For schools, implementing the Problem Based Learning model for the first time will certainly experience several obstacles, such as inadequate practical tools and materials. Therefore, schools should help the successful implementation of the Problem Based Learning model by providing supporting facilities and infrastructure. Not only that, schools also need to conduct training for teachers in implementing the Problem Based Learning model.

3. For other researchers, who want to conduct research on the application of the Problem Based Learning model in addition to reviewing problem solving skills and critical thinking skills, research needs to be done on other variables such as student character in learning styles, learning outcomes, science process skills and student motivation.

References

[1] Ministry of education and culture 2013 Basic framework for curriculum 2013. Ministry of education and culture directorate general of basic education. Jakarta.

[2] Hasanah M and Surya E 2017 Differences in the Abilities of Creative Thinking and Problem Solving of Students in Mathematics by Using Cooperative Learning and Learning of Problem Solving. International Journal of Science Basic and Applied Research. 34(1)

[3] Johnson E B. 2009 Contextual Teaching and Learning (Bandung: Mizan Learning Centre)

[4] Wilhelm J T B and Wilhelm R 2007 Creating Constructivist Physics for Introductory University Classes. Electronic Journal of Science Education 11(2)
[5] Yuliasari E 2017 Experimentation of problem based learning models and guided discovery learning models of problem solving abilities is viewed from the learning independence. *Jurnal ilmiah pendidikan matematika*. 6(1)

[6] Cemal and Yavuz 2011 The Effect of Problem Based Learning on Student Motivation Towards Chemistry Classes and on Learning Strategies. *Journal of Turkish Science Education*. 9(1)

[7] Torp and Sage 2002 Problem Based Learning Theory. *Indivual journal*. New York.

[8] Candiasa I M 2003 *Statistik Multivariat Disertai Aplikasi dengan SPSS* (Singaraja: Unit Penerbitan IKIP Negeri Singaraja)

[9] Arends R I 2012 *Learning To Teach, Ninth Edition* (Amerika: McGraw-Hill)

[10] Smith R 1995 *Chemical Process Design* (Singapore: Mc Graw Hill International Book Company)

[11] Redhana 2012 Problem Based Learning Models And Socratic Questions To Improve Students Critical Thinkin Skills. *Cakrawala Pendidikan Jurnal Ilmiah Pendidikan*. 3(31)

[12] Downing K N F and Shin K 2011 Impact of Problem-Based Learning on Student Experience and Metacognitive Development. *Multicultural Education & Technology Journal*. 5(1)