

The Effect of Problem-Based Learning on Students' Critical Thinking Skill in Animal Diversity Course

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Abstract—The aim of this study is to assess the effect of problem-based learning on students' critical skills. It was quasi-experiment with post-test design only. Seventy-seven 2nd semester pre-service biology teacher from two full classes were involved in the study. Classes were randomly assigned as control groups and post-tested to determine their critical thinking skills after the treatment. The experimental group was taught with problem-based learning while the control group received traditionally-designed biology instruction. Results showed that students instructed with problem-based learning earned higher scores than those instructed with traditionally designed biology instruction-in terms of critical thinking skills. Students in the experimental group appeared to be more proficient in giving a simple explanation, building basic skills, making an inference, and setting the strategy. It showed that problem-based learning was able to use biology learning because of its positive influence on students' critical skills in animal diversity courses.

Keywords—*problem-based learning, critical thinking, animal diversity.*

I. INTRODUCTION

Various attempts have been made by improving the quality of national education. One is to enhance the quality of teachers in a planned, purposeful, and sustainable. Teachers must have academic qualifications gained through higher education degree programs or diploma programs. Teachers are also expected to have a range of competencies that support the profession to improve and develop the academic qualifications and competence in science, technology, and art.

The efforts of being made by the government in improving the quality of teachers have yet to produce maximum results. This one can be seen by the average teacher competency test (UKG) both in 2012 and 2013. Based on the UKG value, the average value of teachers in North Maluku needs special attention. According to the Ministry of Education and Culture, UKG results in 2012 showed that the average grade teacher in North Maluku was 38.02. This is the lowest value nationally and below the national average (45.82). UKG results in 2013 showed the same thing, namely teachers in North Maluku are at the bottom with an average value of 36.19, and below the national average (47.84). In addition, the average math score was also the lowest nationally, 35.26.

Based on the average value, the teachers especially those in North Maluku are obliged to continue to improve and develop the quality of education especially the teachers. One

way to improve the quality of teachers in North Maluku is to improve the quality of pre-service teacher training. Biology education study program at Khairun University is one of the institutions that can take a role to improve the quality of teachers through improving the ability of their students. One skill that supports the ability of prospective teachers in dealing with development is the ability to think critically.

Biology is a subject that is difficult to learn. The difficulty affects student achievement. In addition, difficulty makes students less motivated to learn the subject. As a result, it is hard for them to achieve them [1]. One approach that can be used as a tool of learning in the learning activities for improving students' critical thinking skills is problem-based learning (PBL). Problem-based learning (PBL) was used systemically in learning activities at the University of Delaware since 1992 in the department of medicine [2]. PBL is an instructional approach in which the focus is more on learning rather than the content of the problem situation. Students learn in small groups, and they are facilitated by a teacher [3].

The role of teachers as facilitators in PBL suggests that PBL is a learning approach that is expected at this time, namely learning approach to student-centered learning activities. Thus, PBL is expected to improve critical thinking skills. So, that students can analyze and solve complex problems and they' everyday problems, search, analyze, and use appropriate learning resources, learn in groups large or small, demonstrate skills and communicate effectively both verbally and in writing, and use knowledge and skills acquired to lifelong learning [2].

The characteristics of the problem in PBL are ill-structured, i.e., situations in everyday life where there are many problems that exist in each of these situations. In addition, problems in PBL require both information and problems cannot be solved easily and have many correct answers [4]. There are some characteristics of PBL, namely: (1) the complex problems, real situations that have more than one correct answer is to focus on learning, (2) student works in groups in solving problems, (3) students acquire new information through direct instruction, (4) the teacher acts as a facilitator, and (5) the development of clinical problem solving abilities is shown in the learning [5].

PBL was begun with the presentation of the problem and organizing students into study groups [6]. Furthermore, students are directed to conduct an investigation and proceed with plans to study and conclude with reflection. The steps in the PBL outline are as follows: (1) Students are given a problem; (2) Students ask questions, which are learning

issues are a portrait of the things that they have not understood; (3) Students record the things that are important; and (4) Students explore learning issues and integrate their new knowledge into the context of the problem [2]. The steps in the PBL are: (1) Students are given a problem; (2) Students discuss the problem and work on problems in small groups, as well as gather useful information to solve problems; (3) All students gather together to compare findings and discuss conclusions, new problems may arise from the discussion in the case being discussed; and (4) Students return to work on new problems, and the cycle begins again [7].

II. METHOD

The research method used is quasi-experimental. The main difference of this study with true experimental research lies in placing individuals into groups. In experimental studies, individuals were chosen randomly to minimize bias. If the individual selection is perceived as impossible or impractical, quasi-experimental research is the right choice. Because the quasi-experimental design does not provide full control, it is very important for researchers to pay attention to factors that affect internal and external validity to interpret the results of his research.

The variables in this study consist of independent variables namely problem-based learning and the dependent variable are critical thinking. The quasi-experimental design used in this study is Posttest-Only Design with None Equivalent Groups as shown below.

$$\frac{NR \times O_1}{NR \times O_2}$$

Information :

NR : Non Random (Not Random)

X : Problem Based Learning

$O_1 = O_2$: Critical Thinking Ability Test

The dashed line between two sample classes, namely the experimental class and the control class indicates that the two classes are not formed by randomly placing individuals or research subjects into sample classes. The research subjects were Seventy-seven 2nd semester pre-service biology teacher from two full classes. Students who are subject to the experimental class are taught with problem-based learning while students who are used as the research subject in the control class are taught conventionally. At the end of the learning activities, students in both sample classes were given a final test ($O_1 = O_2$), which is a test to measure their critical thinking skills.

III. RESULTS AND DISCUSSION

This study of critical thinking was in animal diversity courses. Description of students' critical thinking skills can be seen based on the average and standard deviation. There were two groups of treatment and three levels of prior knowledge. Description of students' critical thinking ability is in Table 1.

Both of problem-based learning and conventional classes were 33 and 34 students, respectively. The leverage of students' critical thinking skills in the PBL class was 4.89 with a standard deviation of 2.471. In the other hand, the average students' critical thinking abilities in the

conventional classroom were 4:06 with a standard deviation of 2.155. The average of both groups was 4.47, and the standard deviation is 2.324. Students' critical thinking ability to have a range of values between 0 - 12, so students' critical thinking abilities in the PBL and conventional class be able to be classified in the low criteria.

TABLE I. DESCRIPTION OF STUDENTS' CRITICAL THINKING ABILITY

Treatment	Level of PK	Mean	Std. Deviation	N
PBL	High	6.00	2.236	11
	Moderate	3.60	2.793	12
	Low	4.67	2.251	10
Conventional	High	3.17	2.041	13
	Moderate	4.33	2.582	11
	Low	4.67	1.862	10

Note. PK = Prior Knowledge

Normality test of the data based on learning approach showed that both the PBL and conventional classes have p-value > 0.05 by Kolmogorov-Smirnov test. Based on the Shapiro-Wilk test, the PBL class has a p-value of < 0.05 and conventional class has p-value > 0.05. Test of homogeneity of variance showed that PBL and conventional class have a p-value > 0.05. Normality test of the data based on the level of students' prior knowledge d indicates that the three-level has a p-value > 0.05 either on the Kolmogorov-Smirnov and Shapiro-Wilk test. Test of homogeneity of variance between the three levels indicates p-value > 0.05. Therefore, it can be concluded that both of Test based learning approach and the level of the students' prior knowledge that data of students' critical thinking ability came from normal distributed population and abilities of students' in critical thinking were homogeny based learning approach and the level of students' prior knowledge.

Statistical tests of effects of the method of learning and students' prior knowledge to students' critical thinking used the Two Way ANOVA. The output of the test is in Table 2.

TABLE II. TESTS OF BETWEEN-SUBJECTS EFFECTS

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	30.939 ^a	5	6.188	1.175	0.345
Intercept	692.129	1	692.129	131.389	0.000
Approach	4.368	1	4.368	0.829	0.370
Level of MPA	3.316	2	1.658	0.315	0.732
Approach * Level of MPA	21.690	2	10.845	2.059	0.145
Error	158.033	30	5.268		
Total	909.000	36			
Corrected Total	188.972	35			

a. R Squared = 0.164 (Adjusted R Squared = 0.024)

Table 2 showed a factor of learning approach that has a p-value > 0.05. It means learning approaches that factor has not to Affect the ability of students' critical thinking. The factor of levels of prior knowledge of students has p-value > 0.05. This means that the factor of prior knowledge of students has not affected students' critical thinking ability at a significant level of 5%. The interaction between learning factors and factors of prior knowledge of students showed a p-value > 0.05. Thus, it means that the two factors together have not to affect students' ability for critical thinking.

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, reflection, reasoning, or communication, as a guide to belief and action. Different interpretations may arise in this study. Researchers categorize critical thinking skills of students in the low category. It may be felt by students that what they convey through their giving a simple explanation, building basic skills, making an inference, and setting the strategy.

The results also show that problem-based learning has not affected the ability of students' critical thinking. Other reviews on the effect of students' prior knowledge also have no impact on the ability of students' critical thinking. The interaction between these two factors has not affected the ability of students' critical thinking. The expectation of this study is the impact of problem-based learning on students' critical thinking because PBL has a more effective influence in biology compared to conventional learning. This is evident in the participation of students in the classroom and positive attitude towards biology, as well as improved learning outcomes. However, the results of this study have been shown.

IV. CONCLUSION

The fundamental critical thinking skills can show the ability to identify the elements in a reasoned case, especially reasons and conclusions; identify and evaluate assumptions; clarify and interpret expressions and ideas; the acceptance of the acceptability, especially the credibility of claims; evaluate arguments of different types; analyze, Evaluate, and the make decisions; analyze, evaluate, and produce explanations; draw inferences; and produce arguments. Critical thinking components is using inductive reasoning to formulate hypotheses; using of inductive reasoning in formulating hypotheses; deductive reasoning to draw conclusions based upon analysis of results; synthesis, evaluation, and application of information learned in class; construction of an argument; evaluation of claims; synthesis of information; application of information; s thesis and evaluation of research related to the topic; and deductive reasoning to generate a solution.

Critical thinking has a very important role in helping students to explore biology ideas. An environment that Allows students to think critically about biology can be

created to give students the opportunity to think and reason about what they are doing to their environment. Some of the skills of critical thinking include identifying the argument's main ideas, evaluating sources of information, evaluating the evidence, and evaluating the claims. Improving students' critical thinking is one of the indicators of teacher's success in managing the learning activities. However, the students' critical thinking should not just occur in the classroom, but it occurs in the broader social environment. For example, students should still be able to think critically in a forum or activities do homework together. Homework can be used as tools of critical thinking and can be used as a source for improving students' skills.

This study shows that the factors of learning methods and the levels of prior knowledge have an influence on the ability of students' critical thinking. In addition, there is no interaction between both factors. Therefore, it is necessary to find other alternatives and appropriate approaches to the subject matter of thinking and achievement of learning goals. Students in the experimental group appeared to be more proficient in giving a simple explanation, building basic skills, making an inference, and setting the strategy. It showed that problem-based learning was able to use biology learning because of its positive influence on students' critical skills in animal diversity courses.

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