Develop a student's critical thinking skills

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Abstract. The purpose of this research is to reveal: (1) the effect of Problem-based Learning (PBL) on the critical thinking skills; (2) the effect of Project-based Learning (PjBL) on the critical thinking skills; and (3) differences of critical thinking skills between the group taught using PBL and the group taught using PjBL. This study was a quasi-experiment the non-equivalent comparison group design. The population was 54 students. The data analysis used t-test and Univariate Analysis of Variance at the significant level of 5%. The results are as follows: (1) PBL improved positively and significantly on the critical thinking skills; (2) PjBL improved positively and significantly on the critical thinking skills; and (3) there is a significant difference on the critical thinking skills between the group taught using PBL and that taught using PjBL.

1. Introduction

Critical thinking is one of the competencies that students need in dealing with the times. Critical thinking is very important to obtain information, manage, and utilize information in order to solve various problems faced so that students can survive in a situation that is always changing, challenging, and competitive as it is today. This critical thinking needs to be trained so that students can optimize their intellectual development so that they can solve problems in everyday life. Critical thinking in students will play a role in finding the right way to solve the problems they are facing.

Critical thinking is an activity that aims to review, evaluate, or assess something in drawing conclusions about something in a rational and reasoned way [1]. Critical thinking can be defined as the ability and tendency to make and assess conclusions based on evidence [2]. Critical thinking is an important component of the decision-making process that includes a perspective system and produces adaptive solutions for real and sustainable change [3].

The learning model that is assumed to be able to create an atmosphere that can develop students' critical thinking skills is problem-based learning and project-based learning. The learning model teaches students to recognize problems, formulate problems, find solutions, test temporary answers by conducting an investigation, and ultimately draw conclusions and present both verbally and in writing.

The problem-based learning model is a learning model that provides opportunities for students to learn through the problems they find in everyday life. Problem-based learning can provide opportunities for students to work in finding solutions to real-life problems [4]. Problem-based learning is the presentation of authentic and meaningful problem situations to students that can be the basis of inquiry and inquiry [5]. In the problem-based learning approach, students are presented with situations that guide them to a problem that must be solved. Students learn through actions to solve these problems [6].
Problem-based learning is a learning model that uses problems in the real world as a basis for learning. Through the problems in daily life that are given, students will construct their own knowledge in finding solutions to solving these problems. This learning model requires students to be more active in finding information and conducting investigations to solve problems and the teacher acts as a mentor or facilitator. This learning model will shape higher order thinking skills and enhance student’s Critical thinking skills.

Project-based Learning (PjBL) model is a model that uses projects as a means of implementing learning. Project-based learning is authentic learning that involves real projects and provides interesting and productive experiences for students [7]. Project-based learning is a teaching and learning strategy that involves students to work on a project that is useful to solve community or environmental problems [8]. Project-based learning is an approach that requires all classes or some students to take responsibility for their decisions [9].

Problem-based learning and project-based learning models are learning models that both move from the problem, but what distinguishes them is the output of the two models. The output of problem-based learning is a solution to the problem, while the output of project-based learning is in the form of a product. Problem-based learning and project-based learning models, both of them also make students the center of learning. In both models, students are required to seek, find and process information themselves to find concepts in accordance with learning objectives that depart from a problem related to daily life. The problem-solving process that starts from identifying problems until finally evaluating the results of problem-solving encourages students to do the process of analysis or evaluation of the problem so that critical thinking students are possible to be more trained.

Based on the explanation above, the implementation of the problem-based learning model and project-based learning is assumed to influence critical thinking skills. But in fact, the application of the problem-based learning model and project-based learning has not been optimal in facilitating students' critical thinking skills. This is evidenced by the results of the pre-survey through observation.

This is certainly not in accordance with the steps of applying problem-based learning and project-based learning models that should provide opportunities for students to construct their own knowledge rather than just listening to the teacher's explanation. As a result, students’ critical thinking skills that should be developed through the implementation of the learning model will not develop optimally.

From the explanation above, there can be a gap in the learning process at school. An important aspect of learning such as critical thinking skills still cannot be developed by the teacher. Therefore, this study is intended to determine the effect of problem-based learning and project-based learning on critical thinking in elementary students.

Based on the study of the problem, the purpose of this study is to find out: the influence of problem-based learning on critical thinking skills; the effect of project-based learning on critical thinking skills; and differences in critical thinking skills of groups who learn to use problem-based learning and groups that learn to use project-based learning.

2. Methods
2.1. Research Methods
This study uses a quantitative approach with the type of quasi-experimental research with nonequivalent comparison-group design. Pretest-posttest is used to strengthen empirical evidence that there is indeed a positive influence from pretest and posttest and to know the difference between the results of experimental class 1 and experimental class 2. Therefore the research sample will be divided into two different classes, namely experimental class 1 and Experiment class group 2. The experimental class 1 group uses the problem-based learning (PBL) model and the experimental class 2 group uses the project-based learning (PjBL) model. This research was carried out in grade V elementary school.
2.2. Research variable
The variables in this study are independent variables and dependent variables. In this study, the independent variable (X1) is PBL and the independent variable (X2) is PjBL, and the dependent variable (Y) is critical thinking skill.

2.3. Data collection technique
Data collection techniques in this study use tests and scales. In this study, tests are used to measure students' critical thinking skills before and after being treated.

2.4. Data analysis technique
Before testing the hypothesis, the data must meet the analysis prerequisite test, namely the normality test and homogeneity test. Testing normality by using the Kolmogorov-Smirnov normality test statistic to find out whether the data is normally distributed or not. Homogeneity tests using the Levene test statistic used to find out the data comes from a homogeneous population or not. Data is said to be normally distributed and homogeneous if the significance value is > 0.05. Furthermore, if the data is normally distributed and homogeneous, hypothesis testing can be carried out. Hypothesis testing uses t-test and Univariate Analysis of Variance.

3. Results and Discussion
3.1. Result
The following will be presented the results of the hypothesis testing that has been carried out.

Table 1. T-test Results from Critical Thinking Skill with PBL

|       | Mean | t-test | P   |
|-------|------|--------|-----|
| Pre-test | 57.8921 | 41.819 | 0.000 |
| Post-test | 87.1289 |        |      |

These data indicate that the average value of critical thinking skills pre-test and post-test with problem-based learning there are changes. These changes can be seen from the average value after the treatment has increased.

Table 2. T-test Results from Critical Thinking Skills with PjBL

|       | Mean | t-test | P   |
|-------|------|--------|-----|
| Pre-test | 57.9327 | 20.872 | 0.000 |
| Post-test | 79.8085 |        |      |

These data indicate that the average value of critical thinking skills pre-test and post-test with project-based learning there are changes. These changes can be seen from the average value after the treatment has increased. This shows that there is an effect of project-based learning on critical thinking skills.

Table 3. Univariate Analysis of Variance Post-test Test Results of Critical Thinking Skill

| Kelas | Mean | F-count | P   | R² |
|-------|------|--------|-----|----|
| PBL   | 87.1289 | 14,482 | 0.000 | 0.218 |
| PjBL | 79.8085 |        |      |    |

The data shows that the average value of critical thinking skills between problem-based learning groups and project-based learning has differences. These differences can be seen from the
student's critical thinking skills in the problem-based learning group compared to the project-based learning group.

3.2. Discussion

3.2.1. Problem-based Learning (PBL) on Student’s Critical Thinking Skills

The results showed that problem-based learning (PBL) had an effect on students' critical thinking abilities. This happens because students' critical thinking skills are trained through the provision of problems in problem-based learning. This is consistent with the opinion of Daryanto "the goal of problem-based learning (PBM) or problem-based learning (PBL) is to expand thinking skills and problem-solving skills[10]. This problem-based learning is intended to develop higher-order thinking skills. Problem-based learning that begins with giving problems. Through this problem, students get different learning experiences. In its implementation students are not given knowledge related to problems but students are required to find their own knowledge needed to solve problems. The problem studied in this learning is a problem that is close to students' lives. Student activities in analyzing problems, gathering information and finally finding solutions to these problems familiarize students in developing critical thinking skills.

This activity facilitates students in developing thinking skills. In accordance with Hung's opinion, problem-based learning provides a learning environment where learning starts from giving problems[11]. Students work in small groups and direct their own learning by being guided by the teacher to apply problem-solving skills independently. Problem-based learning emphasizes reflective learning, which is designed to foster students' thinking skills and habits. Activities in problem-based learning facilitate students in developing students' critical thinking skills.

3.2.2. Project-based Learning (PjBL) on Students' Critical Thinking Skills

The results show that project-based learning has an effect on students' critical thinking skills. This finding is in line with Iakovos opinion, Project-based learning is a very good way to improve creative thinking because the learning process not only leads to the completion of the product but also requires student involvement and higher-order thinking skills[12]. Further, Wurdinger & Qureshi states that with project-based learning approaches students design and complete projects that require solving problems during the learning process[13]. Strevy adds that defining the project and determining the starting point investigations are important steps in project-based learning[14].

Through project-based learning, students build knowledge from analysis, synthesis, and application of information allowing students to have meaningful learning. This is in line with the opinion of Ilter that projects carried out by students support them to improve research skills, scientific thinking, creative and critical thinking, communicate, and presentations by working in groups according to their respective abilities[15].

Project-based learning is a learning model that uses projects as a learning tool to achieve competencies in attitudes, knowledge, and skills. This is in line with the opinion of Krauss & Boss which explains that in project-based learning, students gain important knowledge, skills, and dispositions by investigating open questions to make learning more meaningful[16]. Learning is more emphasized on activities to solve the problem by applying the skills of researching, analyzing, making, presenting learning products based on real experience. This opinion reinforces that project-based learning can improve students' critical thinking skills.

3.2.3. Differences in Critical Thinking Skills of Learning Groups Using Problem-based Learning (PBL) and Learning Groups Using Project-based Learning (PjBL)

The results showed that there were differences in critical thinking skills in groups that learned to use problem-based learning and groups that learned to use project-based learning. The results also showed that the critical thinking skills between the problem-based learning group were higher than the critical thinking skills of the project-based learning group students.
Critical thinking skills of problem-based learning groups are higher than critical thinking skills in project-based learning group. The results of this study are in line with the theory of Boud and Felleti which explains that problem based learning is a way of learning by forming and using problems as a stimulus and focus of students in carrying out activities[17]. In line with one of the indicators of critical thinking that is focusing on questions, learning with problem-based learning models can also increase students' focus both in carrying out activities and in answering a question.

Problem-based learning is a learning model that provides opportunities for students to construct their own knowledge to obtain solutions to problems that become references in learning. This is consistent with the statement of Anindya and Suwarjo that the PBL model is seen as an innovative learning model that emphasizes student-centered learning activities with problems as a reference in the learning process[18]. The same thing was also expressed by Ferreira and Trudel that problem-based learning reflects how problems are solved in the real world and shifts learning from previously teacher-centered to student-centered learning because learning focuses on understanding and applying knowledge [19].

The implementation of problem-based learning is carried out in small groups, in which groups students conduct investigative activities that can develop students' critical thinking skills. This is in line with the opinion of Kodariyati and Astuti which reveals that students' thinking ability can be optimized through group work processes in PBL so that students can empower, hone, test, and develop their thinking skills on an ongoing basis [20]. Then there is the activity of presenting the results of the investigation conducted in front of the class. In presenting the results of the investigation there are discussion activities related to analyzing and evaluating the results of the problem solving given by each group. Through this activity students,' thinking skills are more developed.

4. Conclusion
Based on the results of testing hypotheses and discussions that have been explained, it can be concluded that (1) problem-based learning affects critical thinking in fifth grade students; (2) project-based learning affects critical thinking in fifth grade elementary school students; and (3) problem-based learning and project-based learning have different effects on critical thinking in fifth grade elementary school students.

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