The implementation of authentic assessment through project-based learning to improve student’s problem solving ability and concept mastery of environmental pollution topic

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Abstract. This study aims to obtain the information about improving of student’s problem solving ability and concept mastery after the implementation of authentic assessment through project-based learning of environmental pollution topic. The subject of the study were 10th grade students consist of 40 students in a senior high school in Bandung. The research method was weak experiment with the one-group pretest-posttest design. The instruments used for this research are the test of problem solving ability and concept mastery, completed with observation sheet, questionnaire as student’s responses, product assessment and student’s worksheet. Student’s problem solving ability was measured by pre-test and post-test questions referred to the problem solving aspect of Marzano while concept mastery was measured by pre-test and post-test referred to Revised Bloom’s Taxonomy. Data were analyzed using quantitative way with N-Gain value. Student’s problem solving ability showed the point of N-Gain 0.72 while the concept mastery N-Gain 0.70. The results of the study shows that the implementation of authentic assessment through project-based learning can improve student’s problem solving ability and concept mastery with high category.

1. Introduction

The implementation of learning activities cannot be separated from the assessment. Assessment is very important to be done by the teacher during the learning process [1]. Assessment is central to teaching and learning [2]. Assessment is part of learning to assess learning process, learning progress and student learning outcomes. Assessment that can develop student’s ability is authentic assessment. Authentic assessment is the best assessment that can be done because it determines the students can get the result that they want [3]. The use of authentic assessment can improve the quality of the learning process because it is able to measure students’ abilities properly and clearly [4]. Authentic assessment can measure students’ understanding [5], knowledge, ability, thinking skills such as critical and creative thinking [6].

In the 2013 curriculum one of ability that students must is problem-solving ability. The implementation of the 2013 curriculum is expected that knowledge is not a transfer from teacher to student but students are encouraged to work to solve the problem, find something, understand and can apply their knowledge [7]. This demands is in accordance with OECD (Organization for Economic
CO-operation and Development) is one of the ability that must be mastered today is the problem solving ability [8].

In the learning process beside using good assessment to improve the ability of students can be done by applying the appropriate model of learning. One of the learning models that is able to develop student’s ability is a project-based learning model. Project-based learning can help develop individual knowledge [9], skills, and attitudes [10,11,12], improve concept mastery, enhance creativity [13,14], create active students and student’s motivation [15,16,17]. Project-based learning not only can improve the students’ motivation but also it can facilitate the ability to solve student’s problem [18]. There are many studies showed project-based learning is a strategy to help students engage in learning activity [19,20,21]. Project-based learning emphasizes student’s activities to solve open-ended problems and apply knowledge to create products [22]. Project-based learning is a learning model that gives opportunities for students to do tasks so students can choose based on their interests [23].

Project-based learning can be used on the topic of environmental pollution. Environmental pollution is one of the concepts studied in biological subjects [7]. Environmental pollution contains a variety of problems in the environment. In understand concept and have problem-solving abilities students must think of the solutions to environmental pollution problems.

In this study the students carry out learning assessed by using authentic assessment through project-based learning. The use of project-based learning has a function to train students in solving a problem so it is expected that student’s comprehension can be seen and assessed in real terms.

2. Method
The method in this study was a weak experiment with one-group pretest-posttest design [24]. This study was conducted at (senior high school) SMA Negeri 1 Cileunyi. The population were all students grade tenth of senior high school SMA Negeri 1 Cileunyi. The samples were taken by purposive sampling technique with total sample 40 people. In this study there are authentic assessment applications so that there are instruments such as task and rubrics consisting of task 1, task 2, task 3 completed with peer assessment sheets, observation sheets, questionnaires as student responses and product ratings. The main instrument used in this study is a written test that is the problem solving ability and concept mastery tests. The instrument used was first tested into one of the tenth grade class senior high school Negeri 1 Cileunyi to determine the eligibility of instruments such as validity, reliability, distinguishing test items and level of difficulty of items. To obtain information about the improvement of problem solving ability and mastery of student concepts the data were analysed using average normalize gain test (N-Gain). Calculated by the following equation.

\[ N-Gain = \frac{S_{posttest} - S_{pretest}}{S_{max} - S_{pretest}} \]

Category of N-gain score is shown in the following table 1 [25].

| N-gain Score | Category |
|--------------|----------|
| N-gain < 0.30| Low      |
| 0.30 ≤ N-gain <0.70| Medium |
| N-gain ≥ 0.70 | High    |

3. Result and discussion
In this study there are 3 tasks that must be done by students. One of the assessments is to use peer assessment because it becomes an alternative in assisting authentic assessment. Application of peer assessment in learning is an alternative solution for doing authentic assessment because of the process
of authentic assessment and ways of thinking assessed by students and teachers [26]. Peer assessment is one right way to make students participate actively to do project [27].

3.1. Task
Task 1 is a student’s worksheet that consist of environmental pollution problem in Bandung. The questions are arranged in the student’s worksheet follow aspects of problem-solving abilities from Marzano those are; identifying obstacles to the goal, identifying alternative ways to accomplish the goal, evaluating the alternatives and selecting and executing the alternatives [28]. Based on the data analysis showed the groups VI and VII who scored the lowest average of 79,2 with good category. Group IV and V had an average score of 83,3 with a good category, group I and II had an average score of 87,5 with a very good category while group III who get the highest average score of 91,7 with a very good category.

Task II for each group design project creation (to solve environmental pollution problem). Assessment made on task II is assessment of project design and product. The product assessment is made based on aspects contained in Permendikbud No 81 year 2013 [7]. Based on data analysis showed that group III got the highest average score 88,9 with very good category while group that got the lowest average score 77,8 was group V with good category and for group I,II,IV,VI and VII is in good category.

Task III for each group presents the results of the product made. Based on the result of analysis group III who score the highest average of 90 with very good category while group VII who scored the lowest average score of 80 with good category. The other group is in a good category.

3.2. Peer assessment
Students are assigned to assess the attitude of 2 friends in their group during the learning process. The existence of peer assessment is expected that performance not recorded by teacher can be assisted by peer assessment. Based on the data analysis the average score of students’ honesty is 3,33 with very good category, the average score of students’ discipline is 3,81 with very good category, the average score of students’ responsibility is 3,15 with good category, the average score of mutual cooperation is 3,51 with a very good category and the average tolerance score of 3,18 with a good category.

3.3. Data pretest, posttest and N-gain student’s problem solving ability
Here is result of the data analysis of the pre-test score, post-test score, N-gain score of student’s problem solving ability.

Table 2. Pre-test, post-test, and N-gain data

| Aspect | Pre-test | Post-test | N-gain |
|--------|----------|-----------|--------|
| Average | 36,97    | 81,87     | 0,72   |

Table 2 shows that the average N-gain student’s problem solving ability is 0,72 with high category [25]. This means that the implementation of authentic assessment through project-based learning on environmental pollution topic can improve students’ problem-solving ability. The following graph shows the average score of pre-test and post-test problem-solving abilities.

Figure 1. Graph of increase student’s problem solving ability.
Figure 1, it is shown that after the implementation of authentic assessment in project-based learning, student’s problem solving ability has increased.

3.4. Data pretest, posttest and N-gain student’s concept mastery
Here is result of the data analysis of the pre-test score, post-test score, N-gain score of student’s concept mastery.

| Aspect         | Pre-test | Post-test | N-gain |
|----------------|----------|-----------|--------|
| Average        | 39.88    | 81.31     | 0.70   |

Table 3 shows that the average N-gain student’s concept mastery is 0.70 with high category [25]. This means that the implementation of authentic assessment through project-based learning on environmental pollution topic can improve students’ concept mastery. The following graph shows the average score of pre-test and post-test concept mastery.

![Graph of increase student’s concept mastery](image)

3.5. Students responses to the implementation of authentic assessment through project-based learning
Based on the average percentage of all indicators; the questionnaire responses of students on the implementation of authentic assessment Through Project-Based Learning categorized as high with an average score 61.9.

3.6. Data hypothesis test
After doing data analysis and hypothesis test toward the outcome student's problem solving ability, it is obtained that the value of $t_{calculated} > t_{table}$, this means that there is difference of student’s problem solving ability significantly between before and after implementation of authentic assessment through project-based learning.

After doing data analysis and hypothesis test toward the outcome student's concept mastery, it is obtained that the value of $t_{calculated} > t_{table}$, this means that there is difference of student’s concept mastery significantly between before and after implementation of authentic assessment through project-based learning.

4. Conclusion
The implementation of authentic assessment through project-based learning is increasing student’s problem solving ability and concept mastery in environmental pollution topic in the high category.
Hypothesis test showed there are difference of student’s concept mastery significantly between before and after implementation of authentic assessment in project-based learning. Students’ responses to the implementation of authentic assessment through project-based learning have an average score 61.9 with the high category.

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