The Improvement Creative Thinking and Problem Solving Ability Senior High School Students Through Project Based Learning (Organic Waste Treatment)

Tani Ismawati, Taufik Rahman, Minni Nurlahni Kuansustini,

1Department of Biology Education in Indonesia University of Education

Abstract: The aim of study to explore the information about the effect of project-based learning about organic waste treatment in improving the creative thinking and problem solving ability. The method used in this research was weak experiment with One-Group Pretest-Posttest Design. The subject of the research was student of XI-IPA class of Madrasah Aliyah in Sumberding. The data collection got with the test instrument consist of creative thinking and problem solving ability test equipped with observation sheet, questionnaires and interviews to explore the responses of teachers and students regarding the implementation of project based learning. Based on the results of data analysis can be concluded that creative thinking ability of the students have increased after implementation of project-based learning in the medium category. The highest increased on elaboration while the lowest on flexibility aspect. Problem solving ability of the students have increased after implementation of project-based learning in the high category. The highest increased in the capability to plan the problem solving while the lowest on capability to check back. The response of teachers and students are generally positive towards the implementation of project-based learning.

Keywords: project based learning, organic waste treatment, creative thinking, problem solving ability

INTRODUCTION

The role of biology education was very important to create quality human resources. Students as human resources should have the ability to think creatively and problem solving ability. This ability was necessary so that students understand the biology concepts being studied and can apply it in daily life, so that could be part of the solution to the existence problems.

In Pauduan Kurikulum Tingkat Satuan Pendidikan (2006), the aims of Biology subjects to make the students have the following capabilities among others: (1) Develop the research proposed and tested hypotheses through experiments, and communicate the results of the experiment orally and in writing. (2) Develop the ability to think analytically, inductive and deductive using the concepts and principles of biology. (3) Apply the concepts and principles of biology to produce a simple technology work related to human needs (4) Raise awareness and participate in preserving the environment in curricula any students required in order to explain the link between human activities with the problem of damage / pollution of the environment and preservation of the environment.
then analyze the types of waste and recycle of waste to make products from waste. One of the problems faced today was the problem of environmental pollution.

Project-based learning provide complex tasks based challenging questions or problems that involve students in activities to solve problems, make decisions, investigation and reflection involving teachers as facilitators (Sautika, 2013). Project-based learning focused on the drive the students to use concepts and principles through the experience to ask the question. This project-based learning required a process of supervision (monitoring) of teachers that will lead to the development of competencies that students must have. With project-based learning students learn from experience and then apply them in daily life.

Based on the introduction above, the design of learning was thought to facilitate the students in order to improve the creative thinking ability and problem solving ability through project-based learning. Problem solving ability was an action to resolve the problem in this case is a problem to solve waste problems through project based learning about organic waste treatment, while the creative thinking abilities required in project based learning in order to produce the best work.

METHOD
The method used in this study was weak experiment with The One-Group Pretest-Posttest Design (Fraenkel, Wallen, and Hyun 2012).

a. The Subject
Subject of this study was the class X - IPA One of Madrasah Aliyah in the district of Sumedang. Subject collection technique by purposive sampling.

b. Instrument
Data were collected with instrument about creative thinking ability question, problem solving ability question, project worksheets about organic waste treatment that accompanied with assessment rubric, product assessment, questionnaires, and interviews.

PROCEDURE AND ANALYSES
Research procedures summarized as follow: (1) Research started with pretest, (2) implemented project-based learning, (3) implemented posttest. Data analysis techniques used in this study calculated the gain index for essay question about creative thinking ability and problem solving ability. Analysis of Originality aspect, observation sheets, performance tests, and product assessment analyzed by calculate the percentage.

RESULT
Improvement creative thinking ability in this study was obtained from the difference between pretest and posttest and the ideal score of creative thinking ability that is expressed in the gain index. Here presented descriptive statistic about pretest, posttest, and the gain index score in Table 1.

Table 1. Descriptive Statistics About Pretest, Posttest Score, And Gain Index Of Creative Thinking Ability

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>40</td>
<td>2.00</td>
<td>7.00</td>
<td>9.05</td>
<td>3.02</td>
</tr>
</tbody>
</table>

Bandung, October 15th, 2016
The original thinking ability scores obtained from the observation during project planned to implementation of organic waste treatment. Summary the value of original thinking ability can be seen in Table 2.

<table>
<thead>
<tr>
<th>Result of Organic Waste Treatment</th>
<th>Name of product</th>
<th>Indicator Score 1</th>
<th>Indicator Score 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nugget Banana Peel</td>
<td>Kopas Alu Lynn</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Eggshell Brownies</td>
<td>Brown</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Eggshell Cookies</td>
<td>Cookies Simas</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sweet of wastewater</td>
<td>Marian Kulit Semangka</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Eggshell Caligraphy</td>
<td>C.C. (Calamansi Chips)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Liquid Organic Fertilizer</td>
<td>POC Top Bgt</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Eggshell Cake</td>
<td>Bocah</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Eggshell Cup Cake</td>
<td>CSE</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ice Cream Banana Peel</td>
<td>Ice Capas Demuros</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Pudding Banana Pool</td>
<td>Pudding</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Chispay chips Banana peel</td>
<td>KKP</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
Based on the data in Table 2, showed that the average original thinking ability of students was 92.59%. The average of the project-based learning could improve the original thinking ability.

Improvement problem solving abilities in this study was obtained from the difference between pretest and posttest and the ideal score problem-solving ability expressed in the gain index. Here presented a descriptive statistic pretest, posttest score, and the gain index in Table 3.

Table 3. Descriptive Statistics Score Of Pretest, Posttest, And Gain Index Problem Solving Abilities

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>40</td>
<td>1.00</td>
<td>13.00</td>
<td>6.62</td>
<td>0.51</td>
</tr>
<tr>
<td>Posttest</td>
<td>40</td>
<td>11.00</td>
<td>18.00</td>
<td>16.22</td>
<td>0.33</td>
</tr>
<tr>
<td>g</td>
<td></td>
<td>0.19</td>
<td>1.00</td>
<td>0.84</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 3 showed that an improvement in the average score of problem-solving abilities between pretest and posttest results. The average score of posttest is 16.22 while the average pretest score was 6.62. The difference between the pretest and posttest scores was 9.6. From Table 3, above showed gain average problem-solving ability 0.84 included in the high category (Meltzer, 2002). It showed that the problem solving ability of students increased after the implemented project-based learning.

**DISCUSSION**

Here presented the improvement data of creative thinking ability and problem solving ability after implemented project-based learning. Summary of data showed in Table 4.

The data in Table 4, showed that creative thinking abilities of students increased after the implementation of project-based learning. That was in line with the ideas expressed by Lai (2013). Project based learning could also improved problem-solving abilities. This is in line with the views expressed by Elkovoquiv (2010), Hamza (2015) and Lopes (2014). Through this project-based learning students expected creative ideas to find solutions to organic waste in the environment so that it could be a solution for the treatment of organic waste problems that exist in their environment.

Table 4. Data of Improvement Creative Thinking and Problem Solving Ability

<table>
<thead>
<tr>
<th>Ability</th>
<th>Average of Pretest</th>
<th>Average of Posttest</th>
<th>Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative Thinking</td>
<td>6.63</td>
<td>16.53</td>
<td>0.88</td>
<td>High</td>
</tr>
<tr>
<td>Problem Solving</td>
<td>22.2</td>
<td>22.2</td>
<td>0.63</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Table 4 showed that all students got the score in creative thinking ability. In other words, there was no student with the zero creative thinking ability. This was accord with idea expressed by Susinivadi (1994) that there was no one who did not have the creativity.
The results of data analysis showed that the project-based learning could improve the creative thinking ability. This study required students to found new ways that they have never done to treat organic waste. One phenomenon observed by researchers when the study is that there was new idea. In general, each group showed curiosity, want to try to produced product that they have never done (Porter & Hernacki, 2015), although the product they produce not immediately successful in executed practical use.

Project-based learning could improve the creative thinking ability with an mean index 0.66 in medium category (Meitzen, 2000). This is in line with the opinion of Lukovs (2011) which stated that the project-based learning was an excellent way to improved the creative thinking ability, because the learning process required students to produced a product that required active participation of students and demanded a high-level thinking skills. During the process of project-based learning, students did not follow strict guidelines, but directed to improve in the face of problems they were faced to find alternative ways to did the task, working together, take risks, developed effective communication skills, evaluate themselves and their colleagues.

Nolan (2003) said that problem solving was a process that involved the use of certain measures (heuristics), which was often referred as a model or problem solving steps, to find a solution to a problem. Based on these definitions, a student said to have problem solving ability when passed through the problem solving steps. Steps of problem solving, among others, the ability to understand the problem, the ability to plan completion, ability to solve problems according to plan, and the ability to check back. Based on the research data, the average scores of the student increased for each stage of this capability so that it concluded that students have problem-solving abilities.

Peng (2004) and Pramana (2006) said that problem-solving ability defined as the ability to recognized and eliminated the gap between reality and the ideal state of a phenomenon or matters related to biology subject. Weih, Ozan (2013) said, the problem solving was the knowledge, sensitivity, and the person’s behavior to found effective ways to solved daily problems. Prior to this study, there is a gap between expectations and reality. Around the school environment are banana chips factory where the waste is often thrown away, after the implementation of project-based learning such waste processed into useful products. In other words, after received a briefing students have the sensitivity to treated waste that they encountered in their daily life.

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Proceedings
International Seminar on Mathematics, Science, and Computer Science Education

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Published by:
Faculty of Mathematics and Science Education
Universitas Pendidikan Indonesia
Jl. Dr. Setiabudhi No. 226 Bandung, 40154, West Java Indonesia
Official website: http://fpmipa.upi.edu

ISBN: 978-602-95549-4-6