

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

Tuti Ismawati<sup>1,a)</sup>, Taufik Rahman, Mimin Nurjhani Kusumastuti,

<sup>1</sup>Department of Biology Education in Indonesian University of Education

<sup>a)</sup>ummidea@yahoo.com

**Abstract**The aim of study to explored 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 The One-Group Pretest-Posttest Design. The subject of the research was student of X- IPA class one of Madrasah Aliyah in Sumedang. The data collection got with the test instrument consist of creative thinking and problem solving ability test equipped with observations 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, and 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 existed problems.

In Panduan Kurikulum Tingkat Satuan Pendidikan (2006), the aims of Biology subjects to make the students have the following capabilities, among others: (1) Develop the experience 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 preserve 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 (Sastrika, 2013). Project-based learning focused on the drive the students to use concepts and principles through the experience to aks 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 was 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.

#### PROSEDURE AND ANALYSES

Research procedures summarized as follows: (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

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	40	2.00	17.00	9,05	3,02

Posttest	40	12,00	29,00	22,20	3,53
$\bar{x}$		0,36	0,92	0,63	0,02
Category				Medium	-

Table 1. showed that there are differences in the average score of creative thinking ability between pretest and posttest. Posttest average score was 22.2 while pretest average score was 9.05. The difference between pretest and posttest scores was 13.15. From Table 1. above showed gain index of creative thinking ability was 0.63 included in the medium category (Meltzer, 2002). It showed that the creative thinking ability of students has increased after the implemented project-based learning.

Data of improvement creative thinking ability every aspect presented in figure 1.

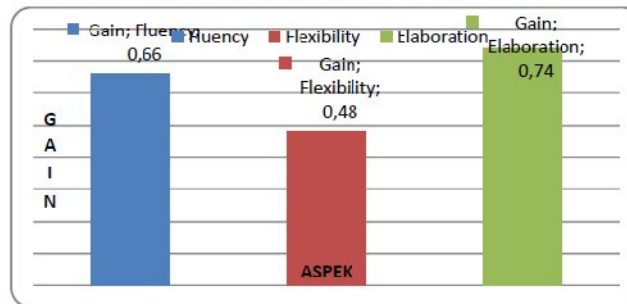


Figure 1. Data Improvement Creative Thinking Ability Every Aspect

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 2. Values of Originality Aspect

Number	Result of Organic Waste Treatment	Name of product	Indicator Score 1	Indicator Score 2
1	Nuget Banana Peel	Kupis Ala Iyam	3	3
2	Eggshell Brownis	Browse	3	3
3	Eggshell Cookies	Cookies Sanas	3	3
4	Sweets of watermelon waste	Manisan Kulit Semangka	2	1
5	Eggshell Calligraphy	CCT (Cinta Cangkang Tehur)	3	3
6	Liquid Organic Fertilizer	POC Top Bgt	3	2
7	Eggshell Cake	Bocah	3	3
8	Eggshell Cup Cake	C3E	3	3
9	Ice Cream Banana Peel	Ice Capis Denmros	3	3
10	PuddingBanana Peel	Pudkupas	3	2
11	Chrispy chips Banana peel	KKP	2	1

Average	2,89	2,67
Percentage of Average Score (%)	92,59	

Based on the data in Table 2 showed that the average the original thinking ability of students were 92.59% categorized very good (Purwanto, 2009). This proved that 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**

	N	Minimum	Maximum	Average	Std. Deviation
Pretest	40	1,00	13,00	6,62	0,51
Posttest	40	11,00	18,00	16,22	0,33
g		0,59	1,00	0,84	0,01
Category				High	

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 idea expressed by Lai (2015). Project based learning could also improved problem-solving abilities. This is in line with the views expressed by Eskrootchi, (2010), Kemendikbud (2013) and Lopes (2014). Through this project-based learning students asked to think of creative ideas treted organic waste in the environment so that it could be a solution for the treatment of organic waste problems that exist in their environmet.

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

Ability	Average of Pretest	Average of Posttest	Gain	Category
Creative Thinking	9,05	22,2	0,63	Medium
Problem Solving	6,63	16,23	0,88	High

Data showed that all students got the score in creative thinking ability in other words there was no students with the zero creative thinking ability. This was accord with idea expressed by Supriyadi (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 one.

Project-based learning could improve the creative thinking ability with an gain index 0.66 in medium category (Meltzer, 2009). This is in line with the opinion of Lakovos (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 improvise in the face of problems they werw face to find alternative ways to did the task, working together, take risks, developed effective communication skills, evaluate themselves and their colleagues.

Nakin (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 accorded 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. While, Ozus (2015) 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 environmentwere 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.

## REFERENCES

1. Departemen Pendidikan Nasional. (2006). Kurikulum 2006 KTSP. Jakarta: Pusat Kurikulum, Balitbang. Depdikbud.
2. Eskrootchi, R. dan Oskrochi, R.G. (2010) A Study of the Efficacy of Project-based Learning Integrated with Computer- based Simulation – STELLA. *Educational Technology & Society*, 13 (1), hlm. 236–245.
3. Fraenkel, R.J., Wallen, E.N., dan Hyun, H. (2012). *How to Design and Evaluate Research in Education*. Sanfransisco : Mc Graw Hill.
4. Kementerian Pendidikan dan Kebudayaan RI. (2013). *Project Based Learning*. Jakarta.
5. Lai Feng Chin, et. al. (2015) *Influence of Integrating Creative Thinking Teaching into Project- based Learning Courses to Engineering College Students*. 43rd Annual SEFI Conference June 29 - July 2, 2015 Orléans, France

6. Lakopos Tsiplakides (2011). Critical and Creative Thinking in the English Language Classroom. *International Journal of Humanities and Social Science*. 1 (8)
7. Lopes Pinho, M. (2014). Project Based Learning to Promote Higher Order Thinking Skill and Problem Solving Skill Geotechnical Course. *International Journal of Engineering Pedagogy* 4 (5)
8. Meltzer D. E. (2002). The Relationship between Mathematics Preparation and Conceptual Learning Gain in Physic: A Possible Hidden Variable in Diagnostic Scores. *American Journal Physic*. 70 (2), hlm. 1259-1267
9. Nakin, J. B. N. (2003). *Ceativity and Divergent Thinking in Geometry Education*. *Disertasi University of South Africa*. [Online]. Tersedia di : <http://etd.unisa.ac.za/ETD-db/theses>. Diakses tanggal 16 Februari 2016
10. Peng, C.N. (2004). *Successful Problem-Based Learning for Primary and Secondary Classrooms*. Singapore: Federal Publications.
11. Pramana, B. (2006). *Problem Solving*. [Online]. Tersedia di : <http://sarengbudi.web.id/wpcontent/uploads/problem-solving.doc>, diakses 14 Juli 2016
12. Sastrika Kade, I.A., dkk. (2013). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Pemahaman Konsep Kimia Dan Keterampilan Berpikir Kritis. *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA* 3 (1).
13. Supriadi Dedi. (1994). *Kreativitas, Kebudayaan & Perkembangan Iptek*. Alfabeta, Bandung.



FPMIPA UPI



QITEP  
IN SCIENCE

msceis  
2016

# Proceedings

International Seminar on  
Mathematics, Science, and Computer Science Education

**“Harnessing Local Wisdom to Build Competencies  
of Excellence in Research and Collaboration  
in The New Era of The ASEAN Economic Community”**



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