



## Problem-Based Learning Module of Environmental Changes to Enhance Students' Creative Thinking Skill

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### Abstract

Creative thinking skills are important for long-term success. Empowering creative thinking skills which can be trained through problem-solving activities in learning, thereby promoting high cognitive engagement. This study aimed to test the effectiveness of the research and development product of Problem-Based Learning module of environmental changes in empowering students' creative thinking skills. The research method used was the Quasi-experiment with nonequivalent control group design. The sample of the research was the tenth-graders of a Senior High School in Karanganyar district, Central Java. The sampling was cluster sampling by involving two classes, namely the Grade X-MIA 1 with 28 students and the X-MIA 4 with 28 students. The qualitative and quantitative-descriptive approaches were used to analyze the data. The result shows the mean of creative thinking skills score of experiment group is higher than the control group. This developed module could empower students' creative thinking skills by problem-solving activities as needed for Indonesian educational goal. The study concludes that development module was constructed based on Problem-based Learning activities in the module could stimulate students solved and identified the problems with their ideas and developed their creative thinking.

### How to Cite

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**INTRODUCTION**

Mastery of 21<sup>st</sup>-century skills is crucial for future education. The application of these skills in learning is expected to trigger students to be able overcoming their challenges and competitiveness in the globalization era (Abdullah & Osman, 2010). In line with the opinion by Tuan Soh, *et al.* (2010) that in the 21<sup>st</sup>-century students are not only judged by the ability to answer questions but also to assess the extent of their ability and knowledge in using the skills they possess. The skills can be trained through cognitive activity such as problem-solving, critical thinking, and creative thinking (Syafii & Yasin, 2013).

In fact, according to the results of the Global Creativity Index, Indonesia is in lower rank of creative and innovative index (Florida *et al.*, 2015). The research by Hidayatun *et al.* (2015); Purnamaningrum, *et al.*(2012); Putra, *et al.*(2016); Saputra & Mansyur (2014) showed that the students creative thinking skills are still poor.

Creative thinking is one of the 21st-century skills that are essential for long-term success (Ford & Gioia, 2000; Li, 2016). This is in line with the opinion of Daud, *et al.* (2012) stated that creativity becomes a fundamental need for one's success. Awang & Ramly (2008) argued that creative thinking could make students look for other alternatives in a different perception, concept, and entry point. In line with the opinion of Ersoy & Başer (2014), creative thinking needs high-level thinking skills. Based on these statements, creative thinking skills are urge to be improved and enhanced so that individuals can deal with the challenges of globalization.

Learning in the 21st century according to Andone & Frydenberg (2014) should be held in a collaborative, creative, and innovative way. In other words, teachers should plan and prepare holistically to facilitate students in contextual, participatory, active, and creative learning (Muhfahroyin & Oka, 2017). Activities provided by 21st-century skills can be presented in textbooks such as learning modules. The learning module as a textbook is also appropriate with the demands of the 2013 curriculum where students are required to seek knowledge from various sources.

The use of a module that trains creative thinking skills on learning can be integrated with models that demand the activity of a problem-solving. Problem-Based Learning (PBL) is one model that enables students to be actively involved in meaningful issues (Yew & Goh, 2016). Problems in Problem-Based Learning present a complex activity in problem-solving activity the-

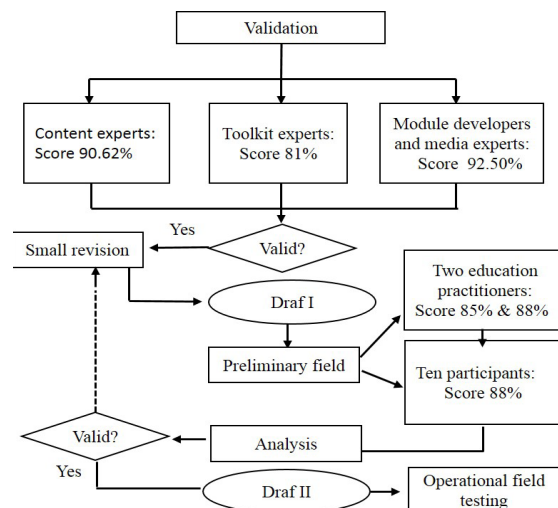
reby promoting high levels of cognitive engagement (Loyens, *et al.*, 2015).

Efforts to improve creative thinking skills by the mandate of 2013 curriculum inspired researchers to develop modules based on material that provides real problems in daily life. Developed modules are expected to support the learning process independently. The structured activities in the module could also enhance students' creative thinking skills demanded by 21st-century skills.

**METHODS**

The study was conducted in one of the Senior High Schools in Karanganyar district, Central Java in the academic year of 2016/2017 from February to July 2017. Participants were 56 students taken by Cluster Sampling, to determine the control (X MIA 1) with 28 students and experimental class (X MIA 4) with 28 students.

This research is part of Research and Development (R&D) using development stage by Borg & Gall (1983). This research begins with observations to determine the problem and analyze the situation, then develop a product problem-based learning module. The products that have been developed are then validated by experts in materials, media experts and science teachers to determine the feasibility of a problem-based learning module as a teaching material. The previously developed module is validated by experts. Module validation results can be seen in Figure 1.



**Figure 1.** The Validation Stage of Problem Based Learning Module

Based on Figure 1, the module based on Problem Based Learning environment is valid

and could be implemented in the treatment class.

Data collection employed the instrument developed by researchers based on aspects of creative thinking according to Torrance, i.e. fluency, flexibility, originality, and elaboration. Instruments in the form of creative thinking descriptions test on environmental change material consist of eight questions that were scored 1, 2, 3, and 4 according to criteria. The question item on the instrument used is valid and reliable with Cronbach's Alpha value of 0.715.

The result data were analyzed by using n-gain factor and hypothesis analysis. The improvement of creative thinking skills before and after using modules was calculated by this following formula (Hake, 2002).

$$g = \frac{S_{\text{post-test}} - S_{\text{pre-test}}}{100 - S_{\text{pre-test}}}$$

Information:

$g$  = gain factor

$S_{\text{pre}}$  = average of pre-test score (%)

$S_{\text{post}}$  = average of post-test score (%)

The N-gain criterion was normalized to the category of  $g < 0.3$  low;  $0.3 \leq g \leq 0.7$  medium; and  $0.7 \leq g$  high.

## RESULTS AND DISCUSSION

### Characteristics of Problem-Based Environmental Change with Problem-Based Learning

The result of observation in one of the State Senior High School of Karanganyar indicate that PBL model is rarely used because facility of problem solving activity tends to be less. During the learning process, teachers often dominate. It is thus necessary to use a new student teaching method, such as problem-solving modules. Learning activities will be integrated through one of the learning supplements on Problem-Based Learning Module of Environmental Changes.

The modules were developed using the five steps of the Problem-Based Learning model of learning, and integrated with the creative thinking aspect. The environmental change topic was chosen as the material in the module based on the results of the Ujian Nasional (UN) analysis which indicated that the environmental change materials were less understood by the students. The average national exam of the environmental changes concept from the academic year of 2013 to 2015 is declined. The results of UN analysis

are presented in Table 1.

**Table 1.** Average of National Examination Results in a school studied

Academic Year	School (%)	National (%)
2012/2013	45.10	56.42
2013/2014	72.53	79.00
2014/2015	53.42	57.59

Source: BSNP 2013-2015.

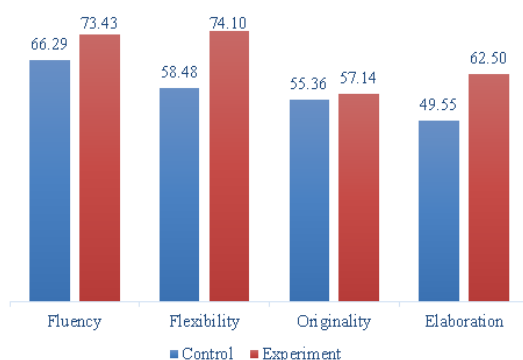
The material in the module is divided into three subchapters i.e environmental change data, environmental pollution, and waste-recycling. Environmental change materials are related to the impact and effort to deal with environmental damage in the area so that students can think creatively to solve the proposed problems.

Characteristics of the module of environmental changes based on the Problem-Based Learning environment contain a structured activity using the syntax of Problem-Based Learning. In addition, activities combined with aspects of creative thinking including fluency, flexibility, originality, and elaboration. According to Guido (2014) and Larawan (2013), the use of a fact-filled module through research results relating to learning topics can provide students with accurate knowledge.

The result of analysis of content characteristics, environmental changes is a suitable content for Problem-Based Learning to emphasis creative thinking activities. Parnonansia & Mustikaningtyas (2015) argue that material adapted to the methods, learning models and conditions of students can improve the quality of the learning process.

### Effectiveness of Environmental Changes with Problem-Based Learning Module

The module that has been developed was then implemented. Researchers collected various data to test the effectiveness of the module in improving the students' creative thinking skill. The test used concepts of environmental change with eight items description adapted to the creative thinking aspects of fluency, flexibility, originality, and elaboration. The test was done before and after the lesson. The results of the assessment on all four aspects are shown in Figure 2.



**Figure 2.** Percentage Score of Creative Thinking Skill in Control and Experimental Classes during Learning Process.

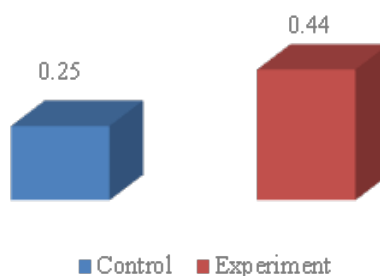
Based on Figure 2, the percentage of each aspect of the creative thinking skill are risen in both control and the experimental class. This means that the activities undertaken by students with the syntax of Problem-Based Learning in the module could train the aspects of creative thinking skills. While the results of descriptive analysis of pre-test and post-test scores from both classes are presented in Table 2.

Table 2. describes the results of the analysis of creative thinking skills before and after the treatment in both control and experimental class. The experimental class experienced an increase in the average score of creative thinking skills after treatment with learning using PBL-based modules. This is evident from the post-test average score in experimental class which is much higher than the control class. The control class showed an increase of 12.54% while the experimental class showed an increase of 19.31%. The result of the N-gain score is shown in Figure 3.

. Based on the calculation of the average score of N-gain, the control class belongs to the low category because the score is less than 0.3, while the experimental class belongs to the medium category because the score is more than 0.3.

The result of pre-test and post-test then analyzed its normality and homogeneity. The

normality of pre-test score of the experimental class was 0.070, and the post-test was 0.053, while the normality of pre-test score of control class was 0.063, and the post-test was 0.085. The result of homogeneity test of both classes was 0.390. The data of prerequisite test were all greater than 0.05, so that the data analysis was followed by ANACOVA test to determine the effectiveness of module usage.



**Figure 3.** Results of N-gain from Control Class and Experimental Class

The results of ANACOVA showed creative thinking test obtained F count of 66.33 with the value of sig  $0.00 < 0.05$ . Anacova test results obtained significance value of less than 0.05, which means that  $H_0$  is rejected. It can be concluded that there are differences in post-test score of control and experimental class.

The difference outcomes in both classes indicate that the modules developed are effective in improving students' creative thinking skills compared to the ordinary teaching materials used at school. The increase of N-gain and the difference of hypothesis test result are the impact of the learning activity using the module that contains the syntax of Problem-Based Learning, which triggers student training their skills to improve creative thinking. Lee, *et al.* (2007) argued that typical PBL processes contain unstructured issues. The students discuss issues found from open questions given by facilitators to create a dynamic and student-centered learning experience. Through open-ended questions, students will of-

**Table 2.** Results of Pre-test and Post-test of Creative Thinking Skill of Experimental and Control Class

Category	Control Class (%)		Experimental Class (%)	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Mean	51.21	63.75	57.14	76.45
Highest Score	66.00	72.00	68.75	84.38
Lowest Score	41.00	53.00	46.88	68.75
Deviation Standard	5.9	5.3	6.3	4.4
N-Gain Average	0.25		0.44	

fer many ideas and responses to think about alternative problem-solving to encourage creativity in the classroom (Gregory, *et al.*, 2013).

In line with the research by Loyens, *et al.* (2015); Yew & Goh (2016), the syntax of Problem-Based Learning has a major influence on the attainment of the level of thinking. Students activate the knowledge they gain by discussing the problems within the group so that various allegations arise over the problems encountered. Later in the syntax, it will also stimulate students to propose possible solutions based on the literature that match the raised issues (Schmidt, *et al.*, 2007).

Integration between module activities and Problem-Based Learning syntax can accommodate different students' creative thinking skills, enable students to measure their learning abilities, and achieve specific goals as expected (Gurses, *et al.*, 2015). Research by Hairida (2016) also revealed that the impact of activities on the module helps motivate students to find self-concept so that student involvement is very high.

Ersoy & Başı (2014) stated that the implementation of Problem-Based Learning activity emphasizes on problem-solving activities which are faced scientifically. This opinion is supported by Loyens *et al.* (2015) who stated that the goal of problem-solving learning triggers the knowledge raised in the discussion and promotes a deep understanding of information. This is because the problem-solving task plays an important role in constructing new knowledge from a scientific point of view.

The module developed are arranged systematically so that they can be adjusted to the character of the students. Characteristics of students that contains a planned learning experience will create an effective and conducive learning environment (Hidayatun *et al.*, 2015). Effective learning by Ridlo & Alimah (2013) could provide a learning experience to enhance thinking through creative strategies. Conducive learning according to Alimah, *et al.* (2014) could make students shape new behaviors, different attitudes, and dare to try new acquired knowledge. Students can find the concept of knowledge through activities in analyzing a problem (Petrescu, *et al.*, 2014) and pop up the creative thinking on problem-based learning model so that creative thinking skills can be improved. Siew, *et al.* (2015) in his research stated that problem-solving models provides a learning environment where problems are appeared in the form of open-ended questions, so that enabling researchers to see advanced knowledge and thinking of solutions based on their creativities i.e. fluent, flexible and original.

Problems in PBL are mostly associated with real situations that allow students to be tied up in the whole syntax, so that creative thinking and innovation opportunities come up. The research by Isti *et al.* (2014) also concluded that the use of PBL model made students more creative to think and challenge their thinking so that their curiosity grows rapidly in solving problems through the open-question problems.

Overall, based on the analysis, it has been shown that the use of the Problem Based Learning module of environmental changes is more effective in enhancing creative thinking skills. The findings in this research are the module with PBL also promoted creative discussions where each a group member had to think creatively to share useful and constructive ideas. It implies that the students could solve and identify the problems with their own ideas. It is also found that Problem-based Learning has a contribution to success of students' creative thinking skills in learning and be recommended as one of biology teaching materials, especially on environmental change material. The research can be recommended for other researchers to apply other relevant subjects to improve students creative thinking problem-solving skill in learning activities. For the future research, this study suggests that researchers should focus on selecting a combination of models, learning materials and how they can facilitate the development of student learning through module development.

## CONCLUSION

Based on the research it is found that the calculation of the N-gain the score indicates that creative thinking skills of the students in the experimental class are higher than the control class. Therefore, Problem-Based Learning module of environmental changes is effective to improve the skills of creative thinking of students. The results of this study can be used by teachers to improve students' creative thinking skills by problem-solving activities as needed for Indonesian educational goal.

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