BioEdu
Berkala Ilmiah Pendidikan Biologi
Vol. 8 No.2
Mei 2019
ISSN:
2302-9528
http://ejournal.unesa.ac.id/index.php/bioedu

EFFECTIVENESS OF STUDENT WORKSHEET BASED ON PROBLEM BASED LEARNING TO TRAIN CREATIVE THINKING ABILITY IN MATERIALS OF ENVIROMENTAL CHAGE

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Abstract

Student worksheet is a teaching materials which used to help learning in the classroom and to increase student creativity. The student worksheet was designed using problem based learning to train creative thinking. Result of the interview with biology teacher in SMAN 18 Surabaya showed that the students' creative thinking skills are low, lesson plan didn't show that trained creative thinking, the student worksheet was used by the teacher still contains cognitive questions, and didn't train creative thinking. Creative thinking which was trained includes 4 aspects namely fluency, flexibility, originality, and elaboration. This research aimed to describe the effectiveness of student worksheet based on problem based learning to train creative thinking ability in materials of enviromental change. Enviromental change is material that presents authentic problem in life. The development students worksheet conducted with 4D models by define, design, develop without disseminate. The research was conducted in August 2018-March 2019 and student worksheet trials limited test for 20 students in class X SMAN 18 Surabaya. The data collection techniques used test method and response. The result of research were analyzed by quantitative. Student worksheet expressed very effective with the completeness of learning outcomes obtaining 90%. Student worksheet expressed very effective based students' responses obtaining 93,75%.
Keyword : student worksheet, problem based learning, enviromental change, creative thinking.

INTRODUCTION

Creative thinking is one of the important abilities to be developed in the field of education (Turkmen, 2015). Putra et al. (2016) said that students could use their knowledge to show new solutions for solving problems with different ways of thinking by creative thinking. Creative thinking has 4 aspects namely fluency, flexibility, originality, and elaboration (Munandar, 2012).

The level of creative thinking in Indonesia is still relatively low (Sugiyanto et al., 2018). This is supported by the results of Purnamaningrum's research (2012) that showed 4 aspects of creative thinking (fluency, flexibility, originality, and elaboration) still below 60% by giving students creative thinking tests. The results of Sugiyanto's et al. research (2018) which explained that the creative thinking skills of students in two senior high schools espsecially in biology matter were classified as low with an average percentage 28.66% in category A (high grade) and 13.71% in category B (low grade).

The data that has been presented show the creative thinking ability needs to be trained in order to change the mindset of students to think creative and innovative so that they can compete globally in the future. Creative thinking is one of the skills that must be mastered in 21st century learning (PSMA Directorate , 2017). The 21st century learning demands can be achieved by students through the application of learning that matches the current curriculum, namely the curriculum of 2013. Learning activities in schools that implemented the curriculum of 2013 was requiring students to be active while the students are learning in class.

The results of interviews with Biology teachers at SMAN 18 Surabaya showed that the students' creative thinking skills were still low. The student worksheet which was used in learning still general and has not reflected the syntax of detailed learning models. In addition, the lesson plan (RPP) which was made by teachers have used a scientific approach but do not reflected the existence of aspects creative thinking which was taught to students. Creative thinking can be trained through learning in the classroom by applying the problem based learning because through problem based learning that are given orientation authentic problems will trigger them to be creative in providing diverse solutions.

Problem Based Learning is a model that able to make students active, make students as independent

learners and able to improve students' abilities in understanding the material being studied. Moreover, the problem based learning can improve the learning activities of students because the increased activity of students can provide opportunities for students to improve their ability to think creative. This is supported by research on the development worksheet based on PBL by Khusnia and Susantini (2018) that showed the student worksheet effective to train students' creative thinking skills in materials of waste recycling with learning outcomes reaching 90%.

Besides materials of waste recycling, the development worksheet based on problem based learning can be used in materials of environmental change because it is suitable with Basic Competence 3.11 which analyzes data on environmental change and causes, and the impact of these changes for life and Basic Competence 4.11 formulates ideas for solving change problems environment that occurs in the surrounding environment. The purpose of this research was to describe the effectiveness of student worksheet based on problem based learning to train creative thinking ability in materials of environmental changes.

METHOD

This type of research is a development research using a 4D model, namely define, design, develop, and disseminate. The stage is carried out only until develop without disseminate. The subjects in this research was the student worksheet based on problem based learning to train creative thinking ability in materials of environmental change. The research was limited test for 20 students in senior high school class X for 3 meetings. The first meeting for worked 1st student worksheet about the effect of acid rain on plants and the second meeting for worked 2nd student worksheet about water purification. Then last meeting worked posttest and response questionnaire. Data collection used includes test methods and response. The data analysis technique used the analysis of posttest results of creative thinking abilities by calculating participants' learning outcomes and response questionnaires. The learning outcomes of students were calculated using the following formula:

$$\text{Score of students} : \frac{\textit{Number of scores obtained}}{\textit{Maximum number of scores}} \; x\; 100\%$$

Students are said to be complete if they get the percentage score obtained ≥ 74% according to the minimum standard of completeness (SKM) used at SMAN 18 Surabaya. Then, the learning outcomes are interpreted in Table 1 to find out the level of the students' creative thinking abilities.

Table 1. Students' Creative Thinking Abilities Category

Average Score Interval	Categories
81,6%-100%	Very creative
61,2%-81,5%	Creative
41,8%-61,1%	Enough creative
20,4%-40,7%	Less creative
0,00%-20,3%	Not creative

(Khanafiyah & Rusilowati, 2010)

While the achievement of creative thinking indicators can be calculated using formulas:
Achievement indicators of creative thinking of students:

$$\frac{\textit{Number of students who reach each indicator of creative thinking}}{\textit{Total number of students}} \; x\; 100\%$$

Then, the results of the indicators' achievements are interpreted in Table 2.

Table 2. Categories of Achievement Indicators Creative Thinking

Avarage of score interval	Categories
80%<K≤100%	Very complete
60%< K≤ 80%	Complete
40%< K≤ 60%	Enough complete
20%< K≤ 40%	Less complete
0% ≤K≤ 20%	Not complete

(Widiyoko, 2009)

Furthermore, student response results are calculated based on the formula as follows:
Positive response:

$$\frac{\textit{The number of students who answered yes}}{\textit{The total number of students who respond}} \; x\; 100\%$$

Then, the results of positive response are interpreted in Table 3.

Table 3. Interpretation Categories of Student Response

Percentage (%)	Categories
0-24	Not positive
25-50	Less positive
52-75	Enough positive
76-100	Positive

(Khanafiyah dan Rusilowati, 2010)

The development worksheet is said to be effective if the results of the response percentage of students get a minimum of quite positive categories.

RESULT AND DISCUSSION

The results of the research that have been done producing student worksheet based on problem based learning to train creative thinking ability in materials of environmental change. The development student worksheet contains materials of air pollution and water pollution, completed with problem based learning syntax and 4 aspects of trained creative abilities, namely fluency, flexibility, originality, and elaboration. The effectiveness of student worksheet can be seen from the results student tests of creative thinking abilities, achievement of indicators, and the results of the questionnaire responses students which will be described as follows.

The results of the student tests creative thinking ability were seen from the results of the posttest which was seen its completeness, the categories of creative thinking

of students and the achievement of indicators of creative thinking.

The posttest results that have been followed by 20 students showed that the students were complete got percentage of 90% and the students were not complete got 10%. The students who complete got a score of ≥ 74 (SKM of SMAN 18 Surabaya) as many as 18 students and the students got less value from the SKM as many as 2 students. The existence of not complete students were due to the different abilities, knowledge of each student, and the cognitive level of each individual was different. Every student had a difference that includes the initial ability, intellectual level, talent, potential, interest, motivation to learn, social ability, emotion, learning style, special needs, learning speed, cultural background, norms, values, and / or environment (Permendikbud No. 24 of 2016). In addition, 2 students whose values were not completed were caused by paid less attention from the students to the teacher and they did not work student woksheet actively when the teacher was learning in class. Nevertheless, the completeness of student learning outcomes reached 90%. This showed that student worksheet based on problem based learning was able to train students' creative thinking ability. Sahida (2018) stated that the steps in problem based learning that involve students directly in all activities were able to guide students in mastering the material.

Learning outcomes was obtained by students also reflected the category of students creative thinking. Overall students got a creative category because the score obtained ≥ 61. If the scores were categorized in the category of creative thinking interpretation, 60% of students got creative categories and 40% of students got very creative categories. The difference level creative thinking of students was caused by different cognitive levels and students were not accustomed to working on open-ended questions. Various cognitive psychological factors and the external environment could grow or inhibit the creativity of each individual (Fields and Bischoff, 2013). The results of this study were accordance with the results of research conducted by Khusnia (2018) which showed that students' creative thinking abilities reached 80% creative after being trained with LKPD (student worksheet) based on problem based learning.

Besides learning outcomes, effectiveness was also seen from the achievement of indicators that will be presented in Figure 1 as follows.

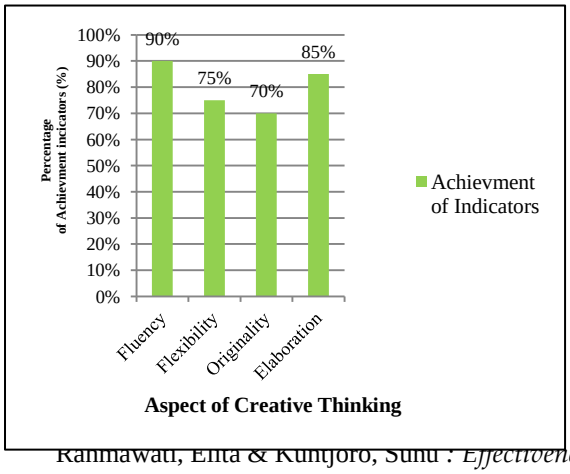

Figure 1. Achievement Indicators of Creative Thinking

In Figure 1. it can be seen the average achievement of indicators that are adjusted to 4 aspects of creative thinking (fluency, flexibility, originality, and elaboration). The indicators tested in the posttest question include: (1) making questions related to pollution cases that occur in the environment, (2) predicting the kinds of causes of environmental pollution, (3) analyzing the impact of pollution occurring in the environment, (4) identifying pollution problems that occur in the environment, (5) formulating solutions to solve problems that occur in the environment, and (6) implementing experiments that have been made.

The first aspect is fluency which was found in indicator 1, indicator 3, and indicator 4. The three indicators were included in the aspect of fluent thinking which obtained 90% with a very complete category. The percentage obtained in this aspect showed that aspects of creative thinking (fluency) were taught to students thoroughly. It was caused almost all of students could work on the problems contained in indicators 1, 3, and 4 correctly. Fluency is indicated by producing many answers / ideas in solving problems, fluent in answering questions and giving more than one answer. This aspect was trained in the problem orientation stage and guiding students in study groups. During the trial using student worksheet, students were required to be able to identify problems based on articles that contain authentic problems in 1st student worksheet "air pollution" and 2nd student worksheet "water pollution". Students were required to be able to identify problems more than one answers of identification. In addition, students were asked to be able to make questions to formulate a problem that contains 2 variables (manipulation variables and response variables). The steps to identify problems and determine problems can bring up indicators of creative thinking aspects of fluency (Sahida, 2018).

The second aspect is flexibility, was found in indicator 2, which got 75% with complete categories. The percentage obtained in this aspect showed that the aspect of flexibility was taught to students thoroughly. Flexibility is indicated by producing varied answers in answering questions, using various perspectives in solving problems and look for many alternatives from different directions. This aspect was trained at the stage of guiding students in study groups. During the trial using student worksheet, students were required to hypotheses and determine tools and materials. The students make hypotheses that were accordance with the formulation of the problem that has been determined in 1st student worksheet and 2nd student worksheet. In addition students determine the tools and materials by modifying the pH used in watering the plants in 1st student worksheet and modifying materials and

equipment according to the water purification method that has been they are arranged according to their creativity in water pollution 2nd student worksheet. Besides that the aspect of flexibility also trained at the stage of analyzing and evaluating the problem where students were asked to provide various solutions to the problems that occur. Susantini et al (2017) stated that modification of instruments, materials, and laboratory procedures can develop the ability to think creative in terms of flexibility. Flexibility aspects could be raised when finding solutions to problems (Sahida, 2018).

The third aspect is originality was found in indicator 5 which got 70% with a complete category. Originality was indicated by producing unusual ways to solve problems and produce something new and unique. The aspect of originality is trained when the phase guides individual and group investigations. During the trial using student worksheet, students are required to be able to formulate different problems from the others and provide solutions to problems that occur. The creative thinking can be seen based on the problem formulation ideas that will be examined according to the students' ideas and determine what unique methods were used to purify water in the 2nd student worksheet. In addition, aspects of originality were also trained at the analysis and evaluation of problems where students were given questions that require students to give original ideas from problems presented in 1st and 2nd students worksheet. Creative thinking was showed by a unique solution that is submitted when given environmental pollution problems contained in the discussion questions. These steps in the LKPD can lead to creative thinking of students and increase students' insight. Through the preparation of a simple practicum design students are trained to express original ideas (Purnamaningrum et al, 2012).

This originality aspect got the lowest percentage from other aspects of creative thinking. Most students still answer a lot with solutions that still used in general, not unique. This was due to the ability of students to solve problems with unique ideas varying. Widiastuti and Putri (2018) states that each student has various abilities in understanding and constructing their ideas. Intensive motivation in children was very necessary in helping to realize creativity because the interest of children to do something must grow from within themselves (Munandar, 2012).

The fourth aspect, namely elaboration, was found in indicator 6 which got 85% with a very complete category. The percentage obtained in this aspect showed that aspects of elaboration have been taught to students thoroughly. The elaboration aspect was indicated by detailing or adding details of an object, idea, or situation. This aspect was trained in the stages of guiding individual or group investigations in designing simple experiments. During the student worksheet trial, aspect of elaboration were shown by the ability of students to make experimental designs about Influence of pH on the growth of chilli plants" in 1st student worksheet and "The effect of water purification methods in purifying water" which was used to solve water pollution problems in 2nd student worksheet. Munandar (2012) stated that elaboration indicators were detailing or adding detail to an object, idea, or situation that was more interesting. After designing the experiment, students will do practical work in accordance with the experimental design for each student worksheet. This was accordance with one of student worksheet based on problem basaed learning was contained the practices that students could do (Luckynita, 2012).

The effectiveness of student worksheet also can be seen from the results of student responses. Questionnaire for students' responses was given after conducting student worksheet trial activities. The results of the student questionnaire were presented in **Table 4**.

Table 4. The Result of Students Responses

No	Statements	Response percentage (%)		Categories
		Yes	No	
1.	The instructions for working on this student worksheet are easy to understand	100	0	Positive
2.	The experimental procedure described in student worksheet is easy to understand	100	0	Positive
3.	The picture presented in this PBL is clear	100	0	Positive
4.	Student worksheet based on PBL helps students to master the concepts easier	85	15	Positive
5.	Students are happy with PBL which contains real problems (authentic)	100	0	Positive
6.	Presentation of authentic problems or problems in everyday life makes it easier for you to understand the concept	100	0	Positive
7.	Student worksheet based on PBL can solve problems in the environment	80	20	Positive
8.	Students are happy with Student worksheet based on PBL	100	0	Positive
9.	Student worksheet based on PBL is good	90	10	Positive
10.	Students become the spirit of learning after solving problems that exist in Student worksheet based on PBL	85	15	Positive
11.	Student worksheet helps students understand the material	95	5	Positive
12.	Kegiatan dalam student worksheet dapat melatih peserta	90	10	Positive

No	Statements	Response percentage (%)		Categories
		Yes	No	
	didik terampil membuat rumusan masalah			
13.	Activities in the student worksheet can train skilled students to formulate problems	95	5	Positive
14.	Activities in student worksheet based on problem based learning can train students to solve problems in daily life	90	10	Positive
15.	Language in student worksheet is easy to understand	90	10	Positive
16.	The writing in the student worksheet can be read clearly	100	0	Positive
	Avarage respons	93,75	6,25	Positive

The results of the percentage of response questionnaires include in the category of positive responses. The average percentage gain from student responses was 93,75%. Positive responses from students showed that students respond well to the learning that has been done and students were enthusiastic about the learning that was done (Damayanti, 2017). The highest percentage of student quistionnaires was 100% in statement number 2, 3, 5, 6, 8, and 16. This showed that problem based learning can improve learning activities, help the process of understanding problems in students and creating a pleasant learning environment (Wulandari, 2013). Positive response with the lowest percentage of 80% on statement number 7 about student worksheet based on PBL can solve problems in the environment. This is because in the 1st student worksheet , students were given authentic problems but that the solution given was directed to find out the impact of air pollution that was watering water with acid solution while in the 2nd student woksheet, students were given authentic problems and they solved the problem water pollution with water purification. But on the whole student worksheet based on problem based learning could solve problems in the environment got a positive response from students.

CONCLUSION

The research on the effectiveness of student worksheet to train creative thinking ability in materials of environmental changes, it can be concluded that the student worksheet was said to be effective with obtained of learning outcomes 90% and the students questionnaire got 93,75%.

ACKNOWLEGMENT

The researcher would like to thank for Prof. Dr. Muslimin Ibrahim, M.Pd as a device validator, Dra. Winarsih M.Kes as a device validator and article reviewer, Prof. Dr. Endang Susantini, M.Pd., as an article reviewer, and Rusdiyanto S.Pd as the device validator and research coordinator at SMAN 18 Surabaya so that this article can be finished on time.

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