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IMPROVING CREATIVE THINKING SKILLS AND SCIENTIFIC ATTITUDE THROUGH INQUIRY-BASED LEARNING IN BASIC BIOLOGY LECTURE TOWARD STUDENTS OF BIOLOGY EDUCATION

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ABSTRACT

Inquiry-based learning is one of the learning methods which can provide an active and authentic scientific learning process in order students are able to improve the creative thinking skills and scientific attitude. This study aims at improving creative thinking skills and scientific attitude through inquiry-based learning in basic biology lecture toward students of biology education at the Institut Agama Islam Negeri (IAIN) Jember, Indonesia. This study is included in a descriptive quantitative research. The research focused on the topic of cell transport which was taught toward 25 students of Biology 2 class from 2017 academic year of Biology Education Department at the IAIN Jember. The learning process was conducted in two meetings in November 2017. The enhancement of students' creative thinking skills was determined by one group pre-test and post-test research design using test instrument meanwhile the scientific attitude focused on curiosity and objectivity were observed using the non-test instrument. Research result showed that students' creative thinking skills enhanced highly and students' scientific attitude improved excellently through inquiry-based learning in basic biology lecture.

Keywords: *Creative thinking, inquiry, scientific attitude*

INTRODUCTION

In this globalization era, the world is changing rapidly. This change brings new requirements for education. Education needs to be developed according to the needs of the communities. They want schools to equip students with 21st-century skills such as creative thinking skills and scientific attitudes. It is expected that by having both these competencies, students are ready to be parts of a developing era.

Creative thinking skill is defined as about applying imagination in facing given problems, thinking systematically in expressing ideas and solving the problems (Coughlan, 2007; Lau, 2011). Creative thinking needs to improve the learning process because it is useful for facing big challenges in the 21st century. Halpern et al. (2012), stated that the main goal for creative thinking instruction is not only to educate students to be wise consumers of research but also to be able to apply the principles of scientific thinking in their daily interactions.

Not only creative thinking skill which should be taught in the school, scientific attitudes should be also improved during the learning process (Davies et al., 2013; Duran & Dökme, 2016; Gençi, 2015). Since those two skills are included in 21st-century skills that are totally important in facing big challenges in the globalization era (Bellanca & Brandt, 2010; Jenkins, Clinton, Purushotma, Robison, & Weigel, 2009; Kaur, 2013).

Scientific attitude can be regarded as a complex of values and norms which is held to be binding on the scientists (Pitafi & Farooq, 2012; Spronken-Smith, 2009). Scientific attitude has three basic components, they are the belief, feeling, and action (Mukhopadhyay, 2014). Several attributes of scientific attitudes are objectivity, open-mindedness, unbiasedness, curiosity, suspended judgment, critical mindedness, and rationality (Lacap, 2015). By

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having those skills, students are expected capable to enrich the learning experiences and develop their knowledge (Eady & Lockyer, 2013; Husamah & Pantiwati, 2014).

However, the result of preliminary research in this study indicates that the students' creative thinking skills and scientific attitudes were in low level since students were not used to given a learning activity which evaluates the creative thinking skill and scientific attitudes. It is also assumed that several factors lead to that problem, for instance, ineffective learning methods and only a few of authentically scientific learning activities which affect on the student' motivation and thus on students' learning achievement. It is supported as Alberta Learning (2004) stated that one of the factors leading to this problem is considered an unsuitable outdated method of teaching biology that does not motivate students.

Inquiry-based learning encourages students to be able to learn certain concepts in science actively by solving given problems themselves so they are not passively receiving the knowledge from the lecturer. Arends (2009), stated that students are able to gain knowledge, develop thinking and reasoning skills, enhance metacognitive skills, and build positive attitudes through inquiry activities.

Similiarly, Abdi (2014), also reported that students are able to learn scientific skills and enhance thinking skills through the inquiry-based learning activity. This activity provides an authentic learning environment because students can learn certain concepts actively by conducting researches which are related to complex problems occurred in the real world.

Furthermore, students taught in the inquiry-based learning class were proved very actively in learning certain topics and have good scientifically inquiry skills (Pewnim, Ketpichainarong, Panijpan, & Ruenwongsa, 2011). By implementing this inquiry-based learning activity in teaching cell transport concepts, it is expected that students are not only able to comprehend the concepts but also able to learn how to be scientists since they conduct a research by themselves that might be capable to improve their creative thinking skills and scientific attitudes.

Several previous studies related to inquiry-based learning method indicated that this learning activity provides an active learning environment that is able to increase students' learning motivation which affects on students' learning comprehension and students' thinking skills. According to those previous studies, this research aims to improve creative thinking skill and scientific attitude through inquiry-based learning in basic biology lecture toward students of biology education at the IAIN Jember.

METHOD

The study is a descriptive quantitative research conducted in November 2017. Twenty five students consisting of five boys and twenty girls at Biology 2 class, the academic year of 2017, Biology Education Department, at the IAIN Jember in same education background were the subjects in this study. The number of research subjects was determined as minimum as possible however it was assumed that it can bring a comprehensive data as the research conducted by Susiyawati, Ibrahim, Atweh, and Rahayu (2015).

Students were taught on the topic of cell transport in basic biology lecture for two meetings with two hours each. During this learning activity, the students' creative thinking skill and scientific attitudes were evaluated. Students' creative thinking skill were evaluated using one group pre-test and post-test design meanwhile the students' scientific attitudes were evaluated using observation sheet. The pre-test was given at the beginning of learning activity meanwhile post-test was given at the end of the activity. In this study, the students were given a scientifically inquiry-based learning activity, encouraged to overcome given problems, and invited to act as a researcher.

Concepts taught in the first and second meetings were about cell structure and cell transport. Students were guided to observe and identify the cell structure in the laboratory, then continued to do research about plasmolysis and deplasmolysis on the plant cells by themselves in a group. Students were given problems and asked to overcome the problems in inquiry-based activities with the guidance and assistance from the lecturer.

In this inquiry-based learning process, students' creative thinking focused on two indicators, namely: flexibility and originality were measured using test instrument. This test instrument was arranged personally by the author as the lecturer at Biology Education Department, at the IAIN Jember. Then its validity was evaluated by two experts and it

reached 3.3 thus it can be called that the instrument is valid. The criteria of validation result were based on Ratumanan and Laurens (2003). Furthermore, the reliability of the test instrument that was measured using Alpha Cronbach formula reached 0.72 which means that the instrument is reliable. The criteria of reliability instrument referred to Arikunto (Arikunto, 2006, 2010)

Meanwhile, the students' scientific attitude focused on curiosity and objectivity was measured during the activities by five observers using observation sheets in which one observer observed one group consisting of five students. The aspects of measurement in students' curiosity and objectivity were using Guttman scale which is characterized by a consistent and solid assessment (Riduwan, 2011). In every aspect of scientific attitudes, there are ten indicators of assessment in which if students are observed doing the indicator, the score is 1 however if students did not do as, on the indicator, the score is 0. Furthermore, the score for every student is summed up and the percentage on each is measured. In the end, the total percentage of all students of every aspect is also measured. The criteria of assessment are based on Riduwan (2011) in which if the classical percentage is more than 81% means that the scientific attitude is excellent.

On the other hand, the enhancement of students' creative thinking was determined using one group pre-test and post-test research design. Data of students' creative thinking skill was analyzed descriptively. The score of the enhancement was measured using a formula by Hake (1998):

$$<g> = \frac{(<S_f> - <S_i>)}{(S_{max} - <S_i>)} \quad (1)$$

Note:

$< g >$ = score of enhancement (N-gain)

$< S_i >$ = score of pre-test

$< S_f >$ = score of post-test

S_{max} = maximum score

Score of the enhancement of students' creative thinking skill obtained was categorized as the criteria as follows: 1) if n-gain score is more than equal to 0.70, the enhancement of students' creative thinking skill is high, 2) if n-gain score is more than equal to 0.30 and less than equal to 0.70, the enhancement is moderate, and 3) if n-gain score is less than 0.30, the enhancement is low.

RESULTS AND DISCUSSION

The students' creative thinking skill scores and its enhancement is shown briefly in Table 1. According to the data shown in the table above, all students of biology 2 class from biology education department reached the score of pre-test less than 65. In contrast, all students mastery the post-test by reaching score more than 65. Data on the table also shows that eight students reached moderate enhancement of creative thinking skill and the rest got the high enhancement of creative thinking skill. It also can be seen that the classical enhancement value of creative thinking skill reached 0.70 with high criteria.

Table 1. Enhancement score of students' creative thinking skills

Student	Pre-test score	Post-test score	N-gain score	Criteria
1	30	80	0,71	High
2	25	85	0,80	High
3	30	80	0,71	High
4	45	75	0,55	Moderate
5	50	80	0,60	Moderate
6	35	85	0,77	High
7	50	70	0,40	Moderate
8	60	85	0,63	Moderate
9	40	85	0,75	High
10	50	85	0,70	High
11	25	75	0,67	Moderate
12	45	85	0,73	High
13	30	80	0,71	High
14	65	90	0,71	High
15	35	75	0,62	Moderate
16	30	85	0,79	High
17	50	95	0,90	High
18	50	80	0,60	Moderate
19	55	80	0,56	Moderate
20	60	90	0,75	High
21	40	85	0,75	High
22	40	85	0,75	High
23	30	80	0,71	High
24	20	90	0,88	High
25	50	85	0,70	High
$\overline{X}$	**41.6**	**82.8**	**0.70**	**High**

On the other hand, the observation result of students' scientific attitudes focused on curiosity and objectivity is shown in Figure 1. Data from the observation result on students' scientific attitudes shown in the figure above indicates that students' scientific attitude on curiosity aspect met 87% while students' scientific attitude on objectivity reached 85%. The learning process implemented in this study

was based on inquiry-based learning method. Arends (2012), explained that phases in inquiry learning method consisted of 1) gain attention and explain the inquiry process, 2) present the inquiry problem or discrepant event, 3) have students formulate hypotheses to explain the problem or event, 4) encourage students to collect data to test the hypothesis, 5) formulate explanations and/or conclusions, and 6) reflect on the problem situation and the thinking processes used to inquire into it.

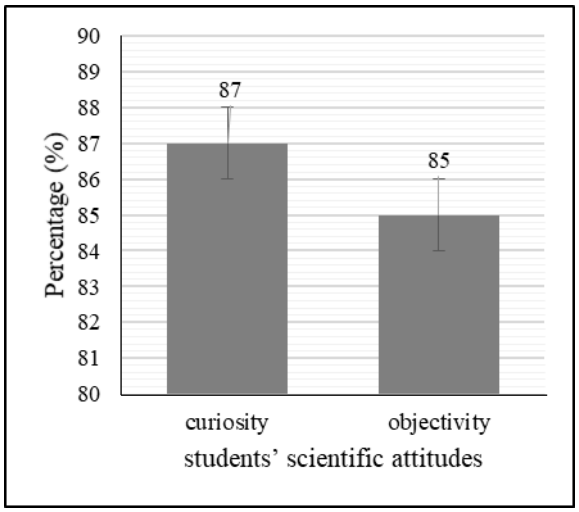

Figure 1. Classical percentage of students' scientific attitudes

According to the data shown above, students reached high enhancement of creative thinking skill. That high enhancement of creative thinking skill might be supported by students' high motivation during the learning process. It is caused by learning environment provided by this learning method was contextual and authentic that was capable to increase students' learning motivation. Sudjana and Rivai (2015), stated that students are motivated to learn if educators not only teach verbally but also give interesting and fun learning activities. Alberta Learning (2004) and Ibe (2013) also said that contextual learning environments are able to create meaningful learning experiences since students can study, build knowledge, and develop skills themselves.

This inquiry-based learning process is also proved that was capable to enhance students' creative thinking skills since they are faced several authentic problems during the learning activity by having a research about plasmolysis and deplasmolysis on *Rhoeo discolor* cells. Students were guided to compare the differences of cell structure before and after given several different solutions under the microscope. Thus it affects to high creative thinking skills on students. Similarly, Arends (2012) and Shabani, Khatib, and Ebadi, (2010) said that Vygotsky has already explained that an effective learning process can occur if students have abilities to finish the complex tasks which have not been studied yet.

However, the result of pre-test on this research indicated that students' creative thinking skill which met low criteria was caused by a learning habit. Students were not used to having pre-test before start a learning process and they were not also used to actively attain the concepts themselves. Therefore, by implementing this learning activity, it also triggered students to be active ones, build knowledge, and skills themselves.

Furthermore, the differences in enhancement scores between every student might be caused by their differences in cognitive development. Although all students undergo same learning activities, every student has the different rate of attaining the concepts. Arends (2012), reported that students grow in the same intellectual development but this growth occurs in the different rate.

Besides students' creative thinking skill, findings in this study also indicated that students' scientific attitudes were also observed excellently. In this study, the scientific attitude focused on curiosity and objectivity. Curiosity could be equated with a basic desire to know (Mukhopadhyay, 2014). A curious one asks questions, read more learning sources to find meaningful information and get ready to carry out an investigation. Curiosity is a stimulus to inquiry since each discovery raises new questions and suggests new undertakings. Therefore, students should show great curiosity for the science courses and by having inquiry-based learning, they may occur curiosity (Erdogan, 2017).

A scientist also should be objective in interpreting ideas and fair in communicating the findings (Anderson, 2010; Dudo & Besley, 2016; Pitafi & Farooq, 2012). To learn the attitude of objectivity, students may be confronted by situations which the temptation to permit personal feelings and to interfere with the recording of an observation in order capable to achieve a correct or accurate solution of a problem (Erdogan, 2017; Rafiee, Moattari, Nikbakht, Kojuri, & Mousavinasab, 2014). Objectivity also needs to improve and thus

students are able to get it through inquiry-based learning.

The implementation of inquiry-based learning on basic biology lecture provided contextual learning activities in which students are faced to have a research. They need to show their curiosity and objectivity during the activity which is proved that is capable to increase both students' creative thinking skills and scientific attitudes.

During the research conducted by students in the laboratory, students were capable to show their curiosity and objectivity. They were curious when lecturer asked about how the cell structure is if students observe under the microscope and how the cell structure is if some different solutions such as water, salt, and sugar solution added to the cell plant (*Rhoeo discolor*). Several students also argued that an active learning activity was motivated higher than a passive activity such as when lecturer only shares the knowledge by giving the speech in the class since they can study by doing and finding solutions of problems themselves. Therefore, the observation result shows that their scientific attitudes were excellent.

CONCLUSION

According to the findings obtained in this current study, it can be concluded that inquiry-based learning is able to improve creative thinking skill and scientific attitudes in basic biology lecture toward students of biology education at the IAIN Jember. Furthermore, this learning process also can be stated as an effective learning activity in regard to high enhancement on students' creative thinking skills and excellent improvement on students' scientific attitudes.

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