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### RESEARCH ARTICLE

#### EFFECTIVENESS OF SCIENCE TEXTBOOKS BASED ON SOCIO-SCIENTIFIC ISSUES IN BIOTECHNOLOGY MATERIALS TO IMPROVE CREATIVE THINKING ABILITY

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#### Abstract

This aims of research to determine the effectiveness of science textbooks based on Socio-scientific Issues to improve students' creative thinking abilities. Creative thinking in 21st-century learning is very important and must be trained. Based on several observational samples, the average creative thinking ability of junior high school students is less optimal, especially for aspects of fluency, flexibility, originality, and elaboration. This may be because the textbooks used in learning have not optimally loaded content that trains creative thinking. This research uses the form of one group pretest-posttest design so that the N-Gain value is obtained, the results of which are used to represent the effectiveness of science textbooks based on Socio-Scientific Issues used on learning in biotechnology materials in junior high schools.

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#### Introduction:-

Education is now experiencing rapid changes along with the development of science and technology. 21st-Century learning has characteristics including teaching students to have the ability to creative thinking, critical thinking, collaborative, and communicative. One of the important abilities that must be trained in 21st-century learning is creative thinking (Kemenristekdikti, 2018; Syaibani, et al. 2017). Creative thinking is defined as thinking that allows students to apply their imagination to produce ideas, questions, hypotheses, experiment with various alternatives, evaluate ideas, and make solutions to a problem independently (Kampylis, et al., 2014). Creative activity results from one's tendency to think and behave creatively (Silver, 1997). Creative thinking ability is one of the important characteristics that must be possessed by humans (Syaibani et al, 2017). This emerging view of creativity provides a strong foundation to be applied in education.

Characteristics of creative thinking abilities related to cognition include fluency, flexibility, originality, and elaboration (Torrance, 2000; Munandar, 1999). Creative thinking can be trained through the presentation of social issues in the student environment or is known as the socio-scientific issue approach (Firdaus, et al., 2016). One of the main targets developed through the study of science-based on Socio-scientific issues is the creative thinking ability (Zeidler, et al. 2009; Callahan, 2009). Socio-scientific issues are representations of problems in social life that are conceptually closely related to science (Anagün et al, 2010). Social-scientific issues are also related to controversial problems that are not yet clear and without definite answers or solutions (Hadjichambi et al, 2015; Tekin et al, 2016).

The existing problems indicate that the conditions of students' creative thinking abilities in several junior high schools in Jember, East Java cannot be said to be optimal. The results of a preliminary study through a questionnaire

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showed that of the 22 junior high school science teacher respondents, stated that 58.8% of students' creative thinking skills were in the medium category, and another 41.2% stated less than maximum. In general, the creativity of some students in Indonesia is still not optimal. This can be seen from the Global Creativity Index survey which shows that Indonesia's creativity ranks at number 115 out of 139 countries (Martin Prosperity Institute, 2015).

Many factors may influence, one of them is the lack of content that trains students' creative thinking ability in the textbooks used. Especially on biotechnology material that is considered quite difficult for some junior high school students (Mardiana, 2015; Zetkas, et al. 2016). Biotechnology material contains a lot of content on socio-science issues, including cloning, genetic engineering products, vaccines, and transgenics which are considered controversial. Therefore, we need a book that is easy to understand and able to train students' creative thinking abilities. Based on this view, this research has the main goal of testing the effectiveness of integrated science textbooks with the approach of socio-scientific issues in biotechnology materials.

### Research Method:-

Data collection methods used were questionnaires and written test. The research design used is Pre-Experimental Design in the form of one group pretest-posttest design. One sample group of 44 students who were deliberately selected was then given a pre-test ( $O_1$ ), proceed with the treatment (X), and at the end of the sample learning is given a post-test ( $O_2$ ). This design is used to determine the effectiveness of science textbooks based on socio-scientific issues in biotechnology materials to improve the creative thinking ability students at class IX in Integrated Islamic Junior High School Al-Ghozali Jember. Simply stated, the research design used can be described as follows:

$O_1$  ----- X -----  $O_2$

#### Information:

$O_1$  : Pre-test (before treatment).  
 X : Treatment  
 $O_2$  : Post-test (after treatment).

After data collection, the results of the pre-test and post-test were analyzed using the formula gain score (N-gain) which is described as follows:

$$N - \text{gain} = \frac{\text{Postest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}} \times 100 \%$$

The criteria for the gain score can be seen in Table 1, below:

**Table 1:-** The N-Gain score criteria.

Value Range	Qualitative Criteria
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Medium
$g < 0,3$	Low

The test questions provided are in the form of written test instruments that cover four aspects of creative thinking, including fluency, flexibility, originality, and elaboration. The measured level of creative thinking is illustrated in Table.2.

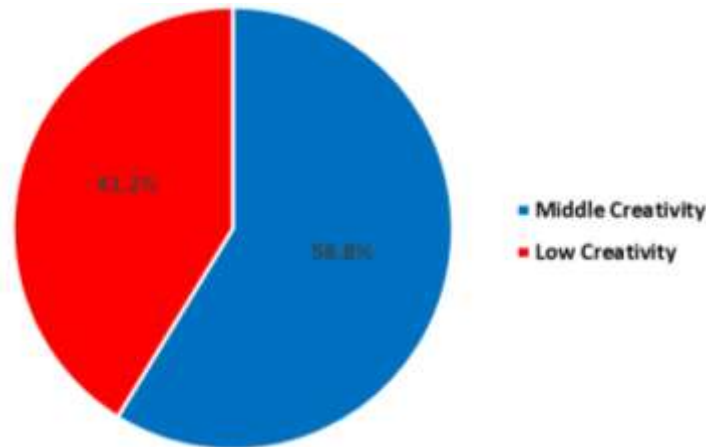
**Table 2:-** Indicators of Creative Thinking Ability.

Aspects of Creative Thinking	Score Level of Each Indicator			
	1	2	3	4
Fluency	Lists a limited number of ideas and responses	Lists a sufficient number of ideas or responses	Lists many ideas or responses	List very much different ideas or responses
Flexibility	Perceives or approaches the problem in a	Perceives or approaches the problem in a	Perceives or approaches the problem in a	Use a variety of different approaches to solving problems

	different way with assistance	different way	number of different ways	and without assistance
Originality	Generates few clever, unique or unusual ideas	Generates several clever, unique or unusual ideas	Generates many clever, unique or unusual ideas	Generate ideas that are numerous, unique, intelligent, different from usual, and innovative.
Elaboration	Adds details, expands or embellishes ideas with assistance	Expands, develops and embellishes ideas by adding details	Expands, develops and embellishes ideas by adding details and making changes	Expanding, develops, and arrange ideas in great detail, and different from the others

**Results and Discussion:-**

The results of observations through a questionnaire of 22 science teacher respondents related to the condition of the creative thinking abilities of students from several junior high schools in Jember are illustrated in the following diagram.



**Figure 1:-** Condition of Creative Thinking Ability of Middle School Students.

The diagram in Figure 1 shows that from 22 science teacher respondents in several junior high schools, it was stated that 58.8% of the students' creative thinking conditions in the middle category, another 41.2% expressed less creative, and no one states the creative thinking ability of students in a maximum or high condition. This data is enough to describe the conditions of junior high school students' creative thinking that need improving to be better. Many factors can influence, including the lack of content that trains students' creative thinking skills in the textbook used, the conditions of the learning environment are less conducive, learning media used, and others.

The results of measuring students' creative thinking abilities through pre-test and post-test activities in classes IX-B and IX-C are illustrated in Table. 3 and Table. 4, the following.

**Table 3:-** Results of Students' Creative Thinking Ability Tests in Class IX-B.

Meeti ngs	X̄Pre-test scores for every aspect of creative thinking				X̄Post-test scores for every aspect of creative thinking				X̄Pre-test scores for all aspects	X̄Post-test scores for all aspects	X̄ N-Gain Score
	a	b	c	d	a	b	c	d			
1 <sup>st</sup> Meeting	64.6	43.8	41.7	45.8	95.8	75.0	81.3	79.2	49.0	82.8	0.67

2 <sup>nd</sup> Meeting	58.3	43.8	45.8	39.6	95.8	75.0	87.5	83.3	46.9	85.4	0.73
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**Table 4:-** Results of Students' Creative Thinking Ability Tests in Class IX-C.

Meetings	$\bar{X}$ Pre-test scores for every aspect of creative thinking				$\bar{X}$ Post-test scores for every aspect of creative thinking				$\bar{X}$ Pre-test scores for all aspects	$\bar{X}$ Post-test scores for all aspects	$\bar{X}$ N-Gain Score
	a	b	c	d	a	b	c	d			
1 <sup>st</sup> Meeting	61.2	31.0	34.5	40.5	88.8	62.9	69.0	69.0	41.8	72.4	0.53
2 <sup>nd</sup> Meeting	50.0	36.2	32.8	32.8	80.2	63.8	64.7	80.2	37.9	72.2	0.55

**Information:** $\bar{X}$ : Average

a: Fluency

b: Flexibility

c: Originality

d: Elaboration

Base on Table 3 shows that there is an increase in the creative thinking ability on Class IX-B on each aspect between before and after being taught with science textbooks based on socio-scientific issues in biotechnology material. At 1<sup>st</sup> meeting, the average pre-test score for all aspects was 49.0 and the average post-test score for all aspects was 82.8, and the N-Gain score was 0.67 which means there was an increase in the medium category. At 2<sup>nd</sup> meeting, the average pre-test score for all aspects is 46.9 and the average post-test score for all aspects is 85.4 with an N-Gain value of 0.73 which means there is an increase in the high category. 2<sup>nd</sup> meetingshows an increase in the creative thinking ability higher than 1<sup>st</sup> meeting. This means that science textbooks based on Socio-scientific issues are effective in increasing students' creative thinking ability in class IX-B.

In Table 4, also shows almost the same results as Table 3, there is an increase in the creative thinking ability in Class IX-C. At 1<sup>st</sup> meeting, the average pre-test score for all aspects was 41.8 and the average post-test score for all aspects was 72.4, and the N-Gain score was 0.53 which means there was an increase in the medium category. At 2<sup>nd</sup> meeting, the average pre-test score for all aspects is 37.9 and the average post-test score for all aspects is 72.2 with an N-Gain value of 0.55 which means there is an increase in the medium category. Based on these results, science textbooks based on socio-scientific issues have proven to be effective in improving students' creative thinking abilities in class IX-C although in the medium category.

In general, studies between class IX-B and class IX-C generally show almost the same results, namely an increase in the creative thinking ability after being taught by using a science textbook integrated with Socio-scientific issues in biotechnology material. On biotechnology material, there are indeed many issues related to social science, for example, human cloning, GMO products, Invitro fertilization, vaccine manufacturing, and genetic engineering. These materials cause controversy in the community, so students are encouraged to provide ideas or creative ideas for these problems. Social-scientific issues are also related to controversial problems that are not yet clear and without definite answers or solutions (Hadjichambi et.al, 2015; Tekin et.al, 2016). Students are trained to create creative ideas, find solutions to problems, think original and rational. We need to provide learning media or science textbooks that contain materials to hone the ability to think creatively (Syaibani, et al. 2017). The goal is that students can develop their creative thinking ability and survive in the rapid development of education.

**Conclusion:-**

The results of research on the effectiveness of science textbooks based on Socio-scientific issues of this biotechnology material have indeed proven to be quite effective in improving the creative thinking abilities of junior high school students. But further trials need to be carried out on a broader scale and diverse student conditions. It also needs to be done research related to the validity and practicality of science textbooks based on socio-scientific issues so that the results are more optimal.

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