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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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 ($O_1$), proceeded 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:

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

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                                          |
| 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 |
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.

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.

| Meetings | XPre-test scores for every aspect of creative thinking | XPost-test scores for every aspect of creative thinking | XPre-test scores for all aspects | XPost-test scores for all aspects | XN-Gain Score |
|----------|------------------------------------------------------|------------------------------------------------------|--------------------------------|---------------------------------|--------------|
| 1st Meeting | 64.6 | 43.8 | 41.7 | 45.8 | 95.8 | 75.0 | 81.3 | 79.2 | 49.0 | 82.8 | 0.67 |
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 1st 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 2nd 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. 1st meeting shows an increase in the creative thinking ability higher than 1st 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 1st 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 2nd 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 (Syabani, 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.

References:

1. Anagün, Ş. S., & Özden, M. 2010. Teacher candidate’s perceptions regarding socioscientific issues and their competencies in using socio-scientific issues in science and technology instruction. Procedia Social and Behavioral Sciences. 9, 981–985. https://doi.org/10.1016/j.sbspro.
2. Callahan, B.E. 2009. Enhancing Nature of Science Understanding, Reflective Judgment, and Argumentation Through Socio-Scientific Issues. Dissertation. Florida: University of Florida.
3. Firdaus, As’ari, A.R., Qohar, A. 2016. Improving Students’ Mathematical Creative Thinking Abilities Through Open Ended Learning on SPLDV Material. Mathematic Journal. Vol. 1. No 2.
4. Hadjichambi, D. P., A. C., dan K. Korfiasis. (2015). How students’ values are intertwined with decisions in a socio-scientific issue. International Journal of Environmental & Science Education. 10 (3), p.493-513.
5. Kampylis, P. & Berki, E. 2014. Nurturing Creative Thinking. International Academy Of Education.
6. Kemenristekdikti. 2018. 21st Century Forms and Learning Methods. https://lp3munud.ac.id/img/admin/download/279839edac8bc5e9e515fb663e7f5d9.pdf. [Accessed 19 March 2019].
7. Mariana, M.A., Praginda, W. 2009. Nature of Science and Science Education. Jakarta: PPPP4TK.
8. Martin Prosperity Institute. 2015. Global Creativity Index. http://martinprosperity.org/content/the-global-creativity-index-2015/. [Accessed 19 March 2019].
9. Munandar, U. 1999. Developing Talent and Creativity School Children. Guidance for Teachers and Parents. Jakarta: Grasindo.
10. Syaibani, H. A., Dafik., Hobri. 2017. The Analysis of Student’s Creative Thinking Skills in Solving "Rainbow Connection" Problem through Research Based Learning. The International Journal of Social Sciences and Humanities Invention. Vol 4. Issue 8.
11. Silver, E. A. 1997. Fostering Creativity Through Instruction Rich In Mathematical Problem Solving and Problem Posing. ZDM International Reviews on Mathematical Education. 29 (3).
12. Tekin, N., O. Aslan, dan S. Yılmaz. 2016. Research trends on socioscientific issues: a content analysis of publications in selected science education journals. Journal of Education and Training Studies. 4 (9): 16-24.
13. Torrance, E. P. 2000. Research review for the Torrance Tests of Creative Thinking: Verbal and Figural Forms A and B. Bensenville, IL: Scholastic Testing Service.
14. Zeidler, D.L., Nichols, B.H. 2009. Socioscientific Issues: Theory and Practice. Journal of Science Education. Vol.21. No.2.
15. Zetkas, E., Harahap, F., Edi, S. 2016. Analysis of Students' Understanding and Learning Difficulties in Biotechnology Material Based on Indicators of Class IX SMP Padang Sidempuan City. Journal of Biological Education. Vol.5. No.3.