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Improving the Students' Creative Thinking Skills Through The Implementation of Controversy – Based Integrated Science Learning Tools

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(Received: 09-10-2021; Reviewed: 10-11-2021; Accepted: 25-11-2021;

Available online: 20-12-2021; Published: 22-12-2021)



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Abstract. This study aimed to measure the improvement of students' creative thinking skills after using Controversy-based integrated science learning tools. The study employed a pre-experimental design with one group pretest-posttest. The research subjects were 20 students of the Science Education Program, The State University of Makassar selected using the Nonprobability sampling technique (saturation sampling). The instrument was an essay test that had been validated. The findings show a significant difference in students' average creative thinking skills before and after learning using Controversy based Integrated Science learning tools. It shows that the improvement of students' creative thinking skills after being treated with Controversy based Integrated Science learning tools was in high category and significant. Students were able to develop their knowledge, predict some limited information, formulate a solution to a problem, and analyze information from different perspectives.

Keywords: Learning Tools; Integrated Science; Controversy; Creative Thinking Skills;

INTRODUCTION

Teachers should develop students' ability to understand the learning material (Wahyuni & Hidayati, 2020) by directing them to interact with the problem and investigate the learning materials so that their cognitive skills like creative thinking skills can be stimulated and developed (Mardhiyana & Sejati, 2016). Students with creative thinking skills will be more interested in solving problems and educational gaps, making conclusions, formulating hypotheses, modifying, and even re-

investigating material they have learned (Torrance, 1974).

Creative thinking skills refer to the ability to develop or find out ideas which are original, various, novel (Baer, 1993), esthetics, constructive (related to the views, concept), focusing on intuitive and rational thinking, especially in responding information to explain the original perspective of the thinker (Klentien & Wannasawade, 2016; Syahrir, 2016; Yildiz & Guler Yildiz, 2021). Parkin (1995) defined creative thinking as thinking that creates creative and original products. Five aspects of

creative thinking include: (1) creativity is closely related to willingness and effort, (2) creativity can produce novel things; (3) creativity needs more internal evaluation rather than an external evaluation that is to rely on the standard set by ourselves; (4) the idea is not limited, and orients on a new and proper solution; (5) creativity emerges when we are currently doing something (Marzano *et al.* 1988). Therefore, in thinking, a creative person will involve various things like thinking habits, behavior, personality, and problem-solving skills (Baer, 1993). Also, creative thinking skill improves intelligence, widens the knowledge, strengthens motivation, helps people get support from society, and directs proper way to think (Sudarto & Tawil, 2019). Creative students will be motivated to initiate and perform different things (Marbun, 2020; Munis, 2018); students should create new things or modify old things to be more useful (Wasiran & Andinasari, 2019).

Students' creative thinking skills were still in the medium and low categories (Doa *et al.*, 2018; Sari & Wulanda, 2019) because the learning approach tends to focus on how to deliver all materials to the students (Budiarti, 2016). The method hardly involves students in the learning activities to not stimulate their creativity and independence (Rosanti & Nurekawati, 2018). Even most students cannot correlate between the concept they learn at school and the implementation in daily life (Olinan & Sujatmika, 2017). Therefore, teachers should provide material that can improve students' thinking skills, especially in the subject which integrates more than one material like Science education.

Material is an important component in teaching (Gustiawati *et al.*, 2020) which helps the teacher to run the learning activities (Sani Abdullah, 2020) (Muhaimin, 2008). The availability of learning tools should be based on the students' competence and developmental stage (Rokhman & Yuliati, 2010). The effectiveness of learning is supported by the learning tools that can contribute to the learning process (Abdullah *et al.*, 2015) using various methods, including the media for the learning material (Apino & Retnawati, 2017; Jack & Lin, 2017) according to students' needs (Kurniawan *et al.*, 2020).

Science should fully combine the materials with improving students' thinking skills. The integrated science material is designed by first integrating the core

competencies of some topics in Science that have been mapped. Thus, a particular model is needed in developing the learning tools. One of the learning material models that can be designed is the Controversial model. A Controversy model is a strategy that can stimulate someone to think creatively in learning. Learning tools for Science that are Controversially designed can drive the readers to be involved in exploring Controversial topics like academic conflict emerging when reading the material because it is different from readers' prior ideas (Supriyono Kus, 2003). Controversial science material is developed in such a way to cover Controversial themes or topics.

Integrated learning tools for Science improve students' creativity using Controversy strategies (Sudarto & Tawil, 2019). Controversy-based learning tools for Science uses Controversial topic and is developed by paying attention to the three aspects, namely *connected*, *integrated*, and *shared*, and always include the materials of physics, chemistry, and biology (Sudarto & Tawil, 2019). Furthermore, Sudarto & Tawil stated that the Controversy-based integrated Science material could improve the thinking skills and trigger creative ideas.

The learning tools discussed above is appropriate to be applied in today's era since 4C skills, including creativity, are highly demanded. Learning tools based on Controversy patterns can stimulate creativity because the materials trigger higher-order thinking skills when the readers explore the content (Sudarto & Tawil, 2019). One of the characteristics of creativity is effective time usage. Moore *et al.* (2015) stated that implementing a Controversy strategy could accelerate students to achieve the goals of activities because the method triggers them to think. Bruen *et al.* (2016) argued that teaching with a Controversy approach could develop creative thinking. Furthermore, S. Liu (2000) stated that debating Controversial issues can enhance creativity.

The implementation of Controversy-based learning material is a creative strategy to stimulate creativity. It is an important step to create creative students. It is in line with D. Simonton (2012) that we should not only think about how to teach creativity, but we should also consider how to teach creativity creatively. Teaching Controversy based Science material contributes to students' and teachers' understanding improvement (L. Dunlop & F.

Veneu, 2019) since to understand Science, creative thinking is required. D. Johnson & R. Johnson (2014) stated that many studies found that Controversy can significantly increase the creativity. Cooperative controversy can boost the number and the quality of ideas to solve problems that need creativity (Suciati, 2016). The development and application of Controversy-based learning tools in science subjects will improve students' creative thinking. Indicators of creative thinking discussed in this study included the ability to produce two or more ideas (fluency) and answer a question or solve a problem with various solutions (flexibility).

METHOD

It is a pre-experimental study with one group pretest-posttest design that aims to measure the improvement of students' creative thinking skills after using Controversy-based learning tools for Integrated Science subject developed. The research samples were 28 students of the Science Education Department (regular class), Faculty of Math and Science, The University of Makassar batch 2014. They were selected using *Nonprobability Sampling* (saturated sample). Data were gathered using essay tests to measure students' creative thinking skills. N-gain and average difference tests were employed to analyze the data.

RESULTS AND DISCUSSION

Results

Results include N-gain score of respondents' creative thinking skills after using Controversy based Learning Material in Integrated Science class. The N-gain score was determined from analyzing the comparison between the score before and after the treatments and the maximum data of the ideal score (Hake, R. R. 2007). The criteria were: N-Gain $> 0,7$ (high); $0,3 < \text{N-Gain} \leq 0,7$ (medium), and N-Gain $\leq 0,3$ (low). The description of N-gain of respondents' creative thinking skills after using Controversy based material for integrated science subjects can be seen in Table 1.

Based on data presented in Table 1 above, it can be seen that the average N-gain score of students' (respondents) creative thinking skills after using Controversy-based integrated science material is in the high category. Furthermore, to see the significance of The

difference between pretest and post-test scores was that we performed an average of different tests using SPSS program version 21 for correlated samples. The test was to prove whether H_0 was accepted or rejected. H_0 states that: There is no difference on the students' average creative thinking scores before and after using Controversy-based integrated science material. H_0 is accepted if $\text{sig} > \alpha$ with $\alpha = 0.05$ (S. Syofian, 2012). Results of the different tests can be seen in Table 2.

Table 2 above shows that the sig value = $0.000 < 0.05$. It means that H_0 was rejected and H_1 was accepted. Thus, there is a significant difference in students' creative thinking skills before and after learning integrated Science using Controversy-based materials.

Based on table 2, it can be seen that the N-gain score of respondents' creative thinking skills was in the high category. It indicates that the developed Controversy-Based Integrated Science Material can stimulate students' creative thinking skills to a high level. Furthermore, based on the different tests, there was a significant difference in students' creative thinking skills before and after using Controversy-Based Integrated Science Material. It means that the N-gain score of the respondents' creative thinking skills significantly improved.

Discussion

Creative thinking skills can rapidly develop when trained using Controversy learning material. The study's findings show that students' thinking skills improved due to the implementation of science material that facilitates the emergence of all respondents' skills. The skills referred to developing the knowledge they had before, making a prediction based on limited information, formulating a problem, and analyzing information from many different perspectives. Those abilities are related to creative thinking skills. It is in line with Krulik and Rudnick (1996) that creative thinking skills are the ability to solve a problem faced by someone involving new original ideas. Based on those definitions, presenting integrated and Controversial science material can improve respondents' ability to solve problems by implementing or creating new ideas. This skill triggers higher creative thinking skills. Those abilities improve when they read the Controversial and integrated science material.

By reading Controversial material, respondents will be stimulated to discover much information related to the material. This activity stimulates the emergence of ideas that will help solve problems or anything which needs various answers or responses. It is in line with the study, which found that implementing the Controversy strategy in learning helps students solve problems and improve their understanding more comprehensively (Thompson et al., 2003).

Furthermore, (Steiner et al., 2003) found that most students they taught had their knowledge developed due to the implementation of the Controversy strategy. Debates arising in the learning activities implementing clinical controversy strategies can help students achieve the learning goals (Moore et al., 2015). Controversial learning tools effectively improves students' creative thinking skills because when learning, students need to think logically and

divergently. This process triggers the improvement of students' creative thinking skills, especially in learning integrated Science. It has been clearly explained that creative thinking combines logical thinking and divergent thinking based on aware intuition (Pehkonen, 1997; (Béres & Fook, 2019). Skills to think creatively (multiperspective) can develop when the teaching model applies the Controversy approach (Bruen et al., 2016). The divergent thinker will produce many ideas when reading integrated and controversial material. Controversial learning tools has uniqueness. It is interesting to read because the idea is presented as a story and contains characters, including humans (Sudarto & Tawil, 2019); thus, it simultaneously involves the right and left brain. It causes students to think more freely and accurately in solving a problem.

Table 1. N-Gain scores of Respondents' Creative Thinking Skills

| Respondents' Numbers | Creative Thinking Skills | | N-Gain |
|----------------------|--------------------------|-------|-------------|
| | Before | After | |
| 001 | 1 | 4 | 1,00 |
| 002 | 0 | 4 | 1,00 |
| 003 | 0 | 4 | 1,00 |
| 004 | 0 | 4 | 1,00 |
| 005 | 0 | 4 | 1,00 |
| 006 | 0 | 4 | 1,00 |
| 007 | 0 | 4 | 1,00 |
| 008 | 0 | 4 | 1,00 |
| 009 | 0 | 4 | 1,00 |
| 010 | 0 | 4 | 1,00 |
| 011 | 0 | 3 | 0,75 |
| 012 | 0 | 4 | 1,00 |
| 013 | 0 | 4 | 1,00 |
| 014 | 1 | 4 | 1,00 |
| 015 | 0 | 4 | 1,00 |
| 016 | 0 | 4 | 1,00 |
| 017 | 0 | 4 | 1,00 |
| 018 | 0 | 4 | 1,00 |
| 019 | 0 | 4 | 1,00 |
| 020 | 0 | 4 | 1,00 |
| 021 | 1 | 4 | 1,00 |
| 022 | 0 | 4 | 1,00 |
| 023 | 0 | 4 | 1,00 |
| 024 | 0 | 4 | 1,00 |
| 025 | 0 | 4 | 1,00 |
| 026 | 0 | 3 | 0,75 |
| 027 | 0 | 4 | 1,00 |
| 028 | 0 | 4 | 1,00 |
| Average Score | | | 0,98 (High) |

Table 2. Sig Test Scores on Related Samples

| | | Paired Differences | | | | | T | df | Sig. (2-tailed) |
|--------|----------------------|--------------------|-------|------|---------|--------|---------|----|-----------------|
| | | Mean | Stdev | SEM | 95% CID | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pre test – post test | -3.821 | .390 | .074 | -3.973 | -3.670 | -51.846 | 27 | .000 |

CONCLUSIONS AND SUGGESTIONS

The improvement of students' creative thinking skills after using Controversy-based integrated science learning tools was in the high category. There was a significant difference in the average of students' creative thinking skills before and after using the Controversy-based integrated science learning tools. It shows that students' creative thinking skills improved after using Controversy-based integrated science material was in the high category and significant. Students could develop their prior knowledge by predicting various limited information, formulating answers to questions, and analyzing information from different perspectives.

Controversy-based learning material has a big impact on students' ability; thus, the study suggests that educators, including lecturers or practitioners at school, apply the Controversy – based learning model not only in integrated Science but also in all subjects.

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