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Improving students' creativity using cooperative learning with virtual media on static fluida concept

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Abstract. Creativity is an important component of global competition in the 21st century. Therefore, learning innovation is needed to make students more creative. This research was conducted to improve students' creativity through cooperative learning using virtual media for the static fluid concept. This study was a quasi-experiment through a pre-test post-test design. The samples were chosen using cluster random sampling technique to obtain two groups, namely experimental group and control group. Data were collected using a creativity test in the form of an essay consisting of verbal and figural tests. The data were analyzed using t-test and N-gain test to determine the improvement of creativity in both groups. The results showed that the improvement of students' creativity in the experimental group was higher than the control group. The difference in the improvement of students' creativity in both group is significant. Students become more creative especially related to indicators of fluency and elaboration. We conclude that the application of cooperative learning model using virtual media has a positive effect on students' creativity.

1. Introduction

Creativity is an important component of global competition in the 21st century. Increasing students' creativity is a great challenge for every educational institution. Education should be able to stimulate student creativity. Through learning process, each individual can be prepared to be superior in global competition. Education should be able to help students to find and solve problems. The learning environment should be able to help students to develop their creativity so that students are able to optimize their ability.

Students must be prepared to survive in real life. Therefore, students need communication, action and creativity skills [1]. According to Jackson et al. [2], creativity is a mental process involving the development of new ideas and concepts, or new relationships between existing ideas or concepts. Based on scientific point of view, the product of creative thinking is usually considered to have originality and conformity.

Creativity can be developed through an exploration of relationships between sciences. The relationship has many similar features such as creativity to be understood and taught through education [3]. Munandar [4] stated that creativity is the ability to create new combinations based on data, information or elements that have already exist. The results are not always new, however they can be combined through existing technology. Creativity can be measured through several approaches: direct measurement; indirect measurements, by measuring the elements that characterize these traits; measurement of personality traits; and some non-test types.

Creativity is divided into two components namely verbal and figural creativity. Verbal creativity is the ability to define, describe, and create a verbal solution of a problem, whereas the figural ability is interpreted as the ability to analyze, create, and describe the idea using images [4]. Both types of

creativity are measured using Verbal Creativity Test (TKV) and Figural Creativity Test (TKF). The test indicators consist of fluency, flexibility, originality, and elaboration [5].

According to Lau [6], when discussing creativity, we often think of great scientific discoveries or a famous artworks. In fact, creativity is not just about scientific or artistic. We need creativity to solve problems in life. "Creativity is a matter of coming up with new ideas that are useful". It means that creativity is something that arises from new ideas that will be called creative if it is new and useful. Creativity is a complex process of individual relationships, processes, products, and socio-cultural contexts relevant to the knowledge domain. Creativity, can be enhanced using teaching models and strategies [7].

Efforts to improve creativity can be done with various innovations in learning. This is important because traditional learning has proven to be less effective in improving conceptual understanding and its application [8]. Traditional learning only helps students memorize and remember facts but unable to improve students' understanding of the concepts being learned and creativity optimally.

One of learning innovations vg M is the combination of cooperative type student teams-achievement divisions (STAD) and virtual media. This blend is expected to increase students' creativity after studying physics. According to Slavin [9], the application of STAD type cooperative learning model can improve students' creativity. This model is used to give flexibility to students in developing creativity in physics learning. This model encourages students to be able to solve a common problem, achieve goals that have been agreed previously, and each group has members with different cognitive levels. In each group, a student can assist other members in solving problems, giving ideas, and understanding shared concepts. Students work in teams and ensure that all members have mastered the lessons that have been delivered. The cooperative learning model involves students' discussion for solving problem, comparing answers, and correcting misconceptions. The cycle of this model consists of five main components: *first*, teaching the subject matter; *second*, learning in team consisting of 4-5 members that have different cognitive levels, race, and culture. All activities are carried out in cooperative groups / teams; *third*, the test is an individually answered quiz; *fourth*, the scoring of individuals in accordance with the performance of students and teams; and *fifth*, team recognition by rewarding the groups based on their score [9].

While Oidov et al [10] stated that students' creativity can be enhanced by the use of virtual media. Zacharia & Constantinou [11] stated that virtual media is divided into two types: virtual labs and virtual video. Both types of media are able to improve students' ability because of its effective and interesting presentation.

Visualization with virtual media allows students to create ideas and understand complex theories. Virtual labs provide control tools to express ideas in solving problem and design solutions [12]. The use of virtual laboratories helps students become actively performing numerical measurements, to improve thinking and creativity, to provide opportunities in learning, to offer interesting discoveries, and to find new ways of writing physics formulas appropriately [10].

This article discusses the application of cooperative learning using virtual media to improve students' creativity. This article provides empirical evidence of an effort to improve student creativity.

2. Research method

This quasi experimental research used pre-test post-test control group design. The population was all students majoring in science in one of secondary schools in Mataram. The sample was chosen using cluster random sampling method and two groups were obtained consisting of 32 students of experimental group and 34 students of control group. The experimental group was treated with STAD type cooperative learning model with virtual media and the control group was taught using conventional learning model.

Virtual media used in this study was in the form of virtual labs and video. Learning process in the experimental group was conducted in five stages: first: conveying the learning objectives; second: delivering material with virtual simulation; third: organizing students; fourth: team working with virtual labs and virtual video; fifth: evaluation; and sixth: appreciation or rewarding. The learning topic used in the research was static fluid. Both group were given tests before and after the treatment. The instrument of this research was creativity tests in the form of essay. The creativity tests included tests of verbal and

figural creativity. Each type of tests included four aspects, namely fluency, flexibility, originality, and elaboration. The collected data in this study was analyzed using one-part t-test with 5% significant level. The analysis began with statistical analysis of normality and homogeneity of test data. The improvement of students' creativity was determined using N-gain test in order to avoid misinterpretation of the improvement of creativity of each student.

3. Result and discussion

After the learning process, both groups of students were given a final test to measure the effectiveness of the learning that has been implemented to improve student creativity. Students' creativity measured in this study included verbal and figural aspects. Figure 1 shows the differences in the improvement of verbal, figural, and total creativity aspects in both groups. From Figure 1 can be seen the increase of creativity in both group, generally, and the improvement in every aspect. In both group, the increase in verbal creativity is higher than figural creativity because students are able to understand and describe concepts verbally with different elaborations. It can be seen from the different answers that students provided to the given quiz. In addition, static fluid is a physics concept demanding students to outline new ideas in solving problems in static fluids, some laws concerning static fluids, and the equations used. Students are more interested in answering questions in the form of theory and application of static fluid than to describe the problem in figural form. This finding is in line with research conducted by Gunawan, et al. [13] which concluded that in learning using virtual media, students showed an increased divergent thinking skills to combine ideas verbally compared to assuming their ideas in the form of images. Cooperative learning model assisted by virtual media proved to improve student physics creativity. It can be seen from the average achievement of the experimental group that higher than the control group. The use of virtual media evoked the enthusiasm of learners to participate actively during the learning process.

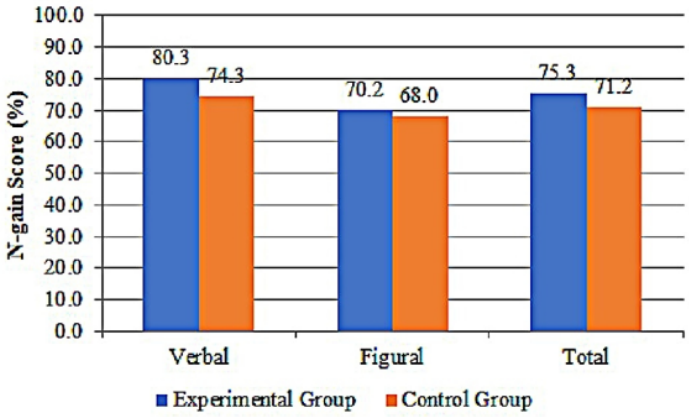

Figure 1. Comparison of verbal and figural creativity.

The average increase in creativity of both group is in the high category. In verbal and figural creativity, the ability of the experimental group is higher than the control group. It can be seen from the increase in the experimental group that is equal to 80.3% for verbal creativity and 70.2% for figural creativity. This increase is due to the effectiveness of the treatment provided. The applied model provided an opportunity for students to enhance their creativity at the cooperative learning stage assisted by the virtual media. This result is in line with the research of Nisrina, Gunawan & Harjono [14] which revealed that students who conducted laboratory activities using virtual media had better understanding and were able to evaluate the learning.

In addition, students are able to discover new relationships between the equations given and the question of verbal creativity test that ask students to give a new form of equation. Similarly, the experimental group students were able to find new methods of static fluid problem in the question of verbal creativity test. The result can be seen from the improvement of the ability of students experimental group that better than the control group in elaborating the problem and providing a new way of flexible and original.

The virtual media provides greater resolution capacity because it contains many variables. Virtual media becomes a stimulus for students in learning. Students become highly motivated in solving problems. Virtual-assisted cooperative learning model provides an opportunity for students to work together with their group cooperatively. Learning will be effective when students are actively involved in sharing ideas and working cooperatively so they can discuss the answers to each problem, thus, improving their creative thinking skills [1]. According to Kongcharoen, et al. [15], students who work in a group perform better than students who solve the problem by her/himself.

In addition, the existence of virtual media help to increase students' creativity because students are interested in the learning process so they can create creative ideas. According to Henriksen, et al. [16], technology has dramatically altered the work and creative processes in every domain of human activity. Gunawan G et al [17] found that the application of virtual labs has a positive effect on students' problem solving ability. The increase in problem solving skills of the two group is different. However, the experimental group problem-solving capability is higher than the control group.

Figure 2 shows that the fluency aspect is higher than the other aspects. Both experimental and control group students are fluent in giving new ideas even though the idea is sometimes beyond the solution of the problem. The aspect of fluency in creativity only requires students to give many new ideas but does not consider the difference of ideas among members of a group. The most important thing of this aspect is that students are able to give as many ideas as possible. Aspects of flexibility means that students are able to create ideas that are different from their friends in the group and be able to apply the idea in a simple problem. The experimental group students were better in expressing different ideas than the control group after being taught using virtual media-assisted cooperative learning models. The originality aspect of creativity is also strongly influenced by the teaching model. The cooperative learning model provides opportunity for every student to know whether the idea is the same or different. In addition, students are able to know the authenticity of the idea by comparing and discussing with the group members. Moreover, virtual media helps students in applying their ideas in their virtual practice. Once the students are able to create new ideas, students who have learned virtual-assisted learning are able to elaborate or describe the solutions of static fluid problems in detail. This finding is evident from the elaboration aspect in Figure 2, where the experimental group has a higher level of elaboration than the control group.

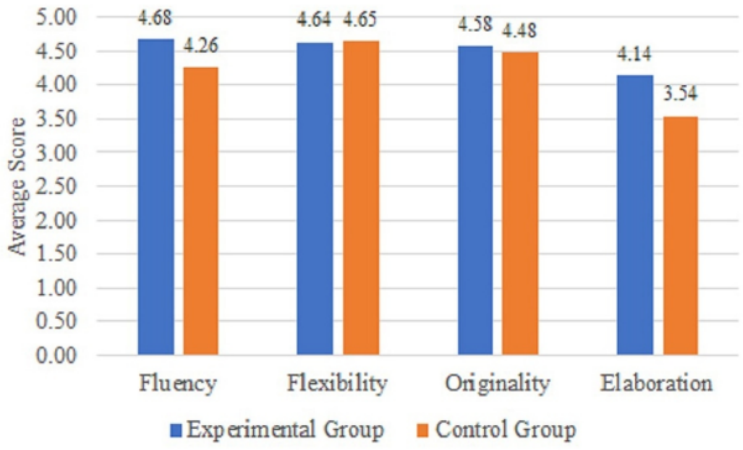

Figure 2. Comparison of students' ability on each indicator of creativity.

For figural ability, students are not required to interpret the concept through different images because static fluid concept focuses on the fluid that is stationary in a vessel. Students are more directed towards the formation of ideas applied in the form of images of hydrostatic pressures, the laws of Archimedes, and Pascal's law. Application of virtual media learning can improve students' figural creativity. Students are more interested in the images in the virtual lab media hence they do not get bored quickly in learning compared to conventional learning.

4. Conclusion

The implementation of cooperative learning model with virtual media has positive effect on student creativity on static fluid concept. After the treatment, there is an increase in creativity of both groups in verbal and figural aspects. The improvement of creativity in experimental group is higher than control group. The difference in the increase of both group is significant. Virtual-assisted cooperative learning helps students to be more creative, particularly for the aspects of fluency and elaboration. In contrast, the ability of both group for the aspects of originality and flexibility is almost the same.

Acknowledgement

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