Students’ Creative Thinking Skills of Learning Cell Metabolism Using Stim-Hots Model

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Abstract. Creative thinking skills are high-level thinking skills that have a large impact on the progress of students in particular. The importance of creative thinking skills is a major concern for training it to students. This study aims to train students’ creative thinking skills on the material in cell metabolism by using modules based on stimulating higher order thinking skills (Stim-HOTs). This research uses quantitative descriptive methods. The instrument used was a creative thinking test instrument on cell metabolic material that had been integrated with aspects of creative thinking. The research subjects were 64 students of 12th grade high school in Surakarta including 32 control class students and 32 module class students. The results showed that the creative thinking skills of students who were trained using modules based on stimulating higher order thinking skills on metabolic material had increased. It showed in the eksperimen class, namely in the aspects of fluency 70.31, originality 71.48, and flexibility 62.5 are at the high category level.

1. Introduction

Education in the 21st century requires every individual to have the skills and abilities in dealing with technological developments and the rapid flow of information. 21st-century education accommodates every individual, especially students, to be able to think critically when confronted with various information, innovate creatively, and be able to work together or independently and students can solve problems encountered in everyday life. 21st-century demands that must be mastered by students to be successful in life, namely learning and innovating skills, digital literacy skills, life and career skills [1]. In 21st century education, student-centered learning, interactive learning processes, the need for teacher and student skills, referring to processes, referring to questions and problems, collaborative, focused on the global community, web-based and learning for life [20].

Skills that are 21st-century demands include critical thinking, creative thinking, communication skills, problem-solving, collaborative skills, scientific literacy, and global awareness [12]. Creative thinking skills are one of the skills needed to meet the demands of the 21st century. Creative thinking skills are important to develop in education [6][7][11]. Creative thinking skills are one important factor in learning objectives. Creative thinking skills enable discoveries in science and technology. Creative thinking processes can produce a variety of ideas and ways of solving problems [14]. Technological advancements require individuals to adapt creatively. Indonesia as a developing country needs creative individuals who can contribute to developing science and technology. Creative students have confidence and can develop themselves independently [4].
Creative thinking skills are part of the learning process to help students become successful learners, confident individuals and responsible citizens, so it is important to develop various subjects to help students develop their creativity, and be creative in solving problems [5]. Cell metabolism is a subject of biology in high school (SMA) that requires skills. Besides the chemical processes and reactions in cell metabolic material, there is also an investigation or discovery activity, so it requires students to have creative thinking skills in solving problems. In line with the opinion of Tendrita, Mahanal, & Zubaida [19] which states that biology, including metabolic material, is teaching material that can develop creative thinking skills.

Based on the results of observations in the first grade of Surakarta State High School it was shown that the results of the initial profile test carried out showed the achievement of a percentage in the aspect of fluency by 33.24, the aspect of flexibility by 40.16, the aspect of originality by 11.61 and the aspect elaboration by 46.94. The average percentage achieved was 32.98%. E. Rahayu, H. Susanto [9] stated that the ability to think creatively is said to be low if the percentage is shown is <33%, and it is said to be sufficient if the percentage shown is 33% -67% while said to be creative is shown by 68% - 100%.

Creative thinking skills that are not normally taught to students when learning, then students will have difficulty in generating ideas or ideas, developing ideas, generating ideas varying and difficulty in solving problems in daily life and globally. The curriculum 2013 prepares students to be faithful, productive, creative, innovative and effective individuals. The ability to think creatively can be improved by using appropriate teaching materials such as modules, which contain learning material systematically so it can encourage students to be actively and creatively involved in the learning process [3].

Integrating modules on a model basis can help to learn be more effective. As in the research of Putra & Vionanda [14] and Ersoy & Başer [10] which uses a project base and PBL as a learning model that is applied in schools. Model stimulating higher order thinking skills (Stim-HOTS) is a learning model that was developed based on the theories of learning and review of the literature supports. The Stim-HOTs model has the potential to improve creative thinking skills because it contains syntax that can train students in active and creative learning activities. The stages of the stimulating higher order thinking skill (Stim-HOTs model) are orientation, asking, exploring information through laboratory activities or literature review, group discussion, explanation, and reflection on learning outcomes [1]. The integration of the Stim-HOTs model into the module aims to maximize the process of learning activities for the achievement of learning objectives. This is in line with the opinion of Aryani, Ima, Mohammad Masykuri [3] that creative thinking skills can be improved by using models and teaching materials that have been adapted to the characteristics of the material being taught. Module-based stimulating higher order thinking skills (Stim-HOTs) contains learning activities that can train students to have creative thinking skills. Based on existing problems and observations made by researchers at high schools in Surakarta, researchers need to identify students' creative thinking skills in metabolic material.

2. Method
The method used in research is a qualitative descriptive method. The instrument used to measure students' creative thinking skills is a biology description test that is integrated into aspects of creative thinking. The aspects of creative thinking include aspects of fluency, flexibility, originality, and elaboration. The description test will be tested in class XII IPA before learning using the stimulating higher order thinking skill (pre-test) module and after learning using the module stimulating higher order thinking skill (post-test). The sample used in this study consisted of two classes, namely the experimental class and the control class. The total sample is 64 students, with each class consisting of 32 students. The research design used is the pretest-posttest non equivalent control group design. As for the field test design adapted from Sugiyono [17]. The Quantitative data are in the form of the results of students 'creative thinking skills tests that use the Stimulating Higher Order Thinking Skills that has been developed and the results of students' creative thinking skills tests that are not treated with the
developed modules. Post-test and pre-test data were then analyzed using SPSS 23. To find out the statistical test used was Kolmogorov Smirnov with the correction test, the test Liliefors. A homogeneity test is performed to determine whether there are differences in the classes treated (module) and not (control class). test performed is the test Homogeneity statistical Levene. If the calculation data is known to be normal and homogeneous then a parametric test is used, and if the calculation data is known to be abnormal and homogeneous then a nonparametric test is performed. The significance level used is 0.05 (α = 0.05).

The formula used to calculate the n-gain score is:

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N-Gain = \frac{\text{post-test value - pre-test value}}{\text{Ideal value-pre test value Normalized}}
\]

Gain calculation results are interpreted with the gain level criteria (Melzer, 2002) in Table 1 below:

| N-Gain  | Remarks  |
|---------|----------|
| 0.7 <g <1  | High     |
| 0.3 <g <0.7 | Medium   |
| 0 <g <0.3  | Low      |

Furthermore, the data obtained were analyzed quantitatively. The improvement of creative thinking skills in the material of cell metabolism is calculated using the formula N-Gain score. Indicators of creative thinking skills consist of fluency, flexibility, originality, and elaboration. The results of the analysis of each indicator of creative thinking skills have increased in the experimental class. The level of students' thinking skills was assessed by referring to the category by Riduwan [15] which is shown in Table 2 as follows:

| Table 2 Categories of the levels of students' creative thinking skills |
|-------------------------|---------|
| Percentage (%)          | Categories |
| 81-100                  | Very high |
| 61-80                   | High     |
| 41-60                   | Sufficient |
| 21-40                   | Low      |
| 0-20                    | Very low |

3. Result and Discussion

This Creative thinking skills are high-level skills that train students to become successful learners. This is in line with the opinion of Chang, Li, Chen, & Chiu [8] which explains that creative thinking skills are one of the higher-level thinking skills used in problem-solving. In this study, aspects used to refer to the creative thinking skills of Guilford and Munandar [13] which are expressed in four aspects. The aspects of creative thinking skills in question are fluency, flexibility, originality, and elaboration. The module used has been integrated by the Stim-HOTS model, which in each activity is expected to be able to practice creative thinking skills.

The module used to train creative thinking skills is a STIM HOTS-based module on cell metabolism material. The Stim Hots based module contains several activities, namely the orientation stage, asking questions, information exploration, discussion, explanation and reflection. The orientation stage is the stage where students learn the basic concepts of the material provided by the teacher. Like giving a discourse or an image. At the orientation stage, it is expected to provide understanding to students and trigger higher thinking processes. In the asking stage, students make a number of questions related to the orientation stage. The use of these questions will stimulate students to think so that students can think creatively. The information exploration stage, students conduct information and knowledge search activities to get answers to a number of questions asked. The discussion stage, students are directed to
exchange information about the findings of information seeking results. This activity aims to train students to be able to communicate using available data from extracting information. In the explanation stage, students explain the findings of information seeking and answer the problems posed. In the reflection stage, students are expected to instill scientific attitudes, moral values and be able to explain the weaknesses and strengths of the learning process. The learning activities in the module aim to train students' creative thinking skills. After students learn to use the STIM HOTS module, students are asked to work on several questions. This description question is made to determine the level of creative thinking of students. Students are asked to do description questions on cell metabolism material.

Students in the experimental class and the control class before starting the learning were carried out posttest first, to determine the level of students' thinking skills. After that, the experimental class students were given the HOTS STIM module, and the teacher guided the students to work on and carry out activities in the module. Learning using modules is carried out as long as the provision of metabolic material is complete. After completing the learning, the experimental and control class students were given questions of creative thinking skills, this aims to determine the creative level of students after learning was carried out using the STIM HOTS module and those that did not use the module.

The results of the analysis of the calculation of the creative thinking skills of students can be seen in Table 3 and Table 4, as follows:

**Table 3. Results of Analysis of Creative Thinking Skills of Students in the Control Class**

| Aspect of   | Pre-test | Post-test | Category of |
|-------------|----------|-----------|-------------|
| Fluency     | 44.14    | 58.98     | Sufficient  |
| Flexibility | 31.25    | 52.34     | Sufficient  |
| Originality | 24.21    | 60.54     | Sufficient  |
| Elaboration | 21.87    | 47.26     | Sufficient  |

The assessed aspects of creative thinking are fluency, flexibility, originality and elaboration. In the aspect of fluency, students are required to be able to produce many ideas or answers when given a question within a predetermined time. Students who answer questions correctly and are able to mention many ideas, students are said to have fulfilled the fluency aspect. On the flexibility aspect, students are trained to be able to solve problems with several approaches or several different ways. So that when answering questions, students can provide flexible answers. In the aspect of originality, students answer with original ideas or ideas that are rarely given by many people. Students can explore answers without being tied to one source or one answer. In the elaboration aspect, students are able to answer in detail and detail. Increase in pretest scores in the control class can be seen in Figure 1 as follows:

**Figure 1. Student Achievement pretest and posttest scores in control class**
Based on the analysis on the pretest and posttest in the control class, it can be seen in Figure 1 that it has increased. However, in the control class, namely the class that does not use modules, aspects of fluency, flexibility, originality and elaboration are still in the category level. In the aspect of fluency, the increase in value is 14.84 in the quite low category. Students who do not use modules, one of which contains activities that trigger creative thinking skills, namely fluency at the orientation stage, will find it difficult to be able to generate ideas or ideas that are relevant to the problem. On the flexibility aspect, namely an increase of 22.09. In this aspect, the student's ability to generate varied ideas or ideas is quite low. Likewise with other aspects, namely originality and elaboration. The difficulty of students in generating new ideas or developing ideas in their own language will have an impact on the low aspects of originality. Students who have not been able to develop ideas in detail or describe ideas in detail, then the elaboration aspect can be categorized as low. Therefore, activities that train creative skills need to be done to support students' creative thinking abilities. Then by referring to the category level of creative thinking skills, it is concluded that the control class is classified as a sufficient category level.

The results of the analysis of creative thinking skills in the experimental class can be seen in Table 4, as follows:

| Aspect    | pretest | post-test | Category |
|-----------|---------|-----------|----------|
| Fluency   | 32.81   | 70.31     | High     |
| Flexibility | 29.68   | 62.5      | High     |
| Originality | 26.56   | 71.48     | High     |
| Elaboration | 28.90   | 58.59     | Sufficient |

Students who have used the STIM HOTS module that have integrated creative thinking skills show good results that their creative thinking skills have increased. When the teacher carries out orientation activities by providing discourse or pictures and accompanied by questions, students are expected to respond by answering or asking questions related to the problem being discussed. After that the teacher guides students to be able to find solutions to answer existing problems. Exploration of information can be done by collecting reading sources such as journals, articles or from other books. Students who have found solutions or answers to the questions asked then have discussions with other friends. This discussion is carried out so that students get relevant information and train students to be able to think flexibly. During the learning process the teacher guides the students. The teacher stimulates the students' way of thinking by giving students space to think by expressing their findings to other friends. The stages of learning activities that have been carried out can stimulate students' creative thinking abilities. Learning conditions in class with a conducive learning environment and teachers who have good teaching abilities can also support students to develop creative thinking skills [19][20]. The increase in the score of students' creative thinking skills using the module can be seen in Table 4, which shows an increase in the aspects of fluency, flexibility and originality. While in the sufficient category, namely in the elaboration aspect.

The increase in score in the stimulating higher order thinking skill module class can also be seen in Figure 2, below.
Based on the analysis that has been done, the percentage of the experimental class is higher than the control class. This can be seen from the level category Riduwan refers to. Based on Figure 2, the aspects of creative thinking that have a high category in the experimental class are fluency and originality, which are then under the flexibility aspect. While in the sufficient category, namely in the elaboration aspect. It can be concluded that the findings, namely the creative thinking skills of students on cell metabolism material using a stimulating higher order based module experienced different thinking skills.

4. Conclusion

This research showed that creative thinking skills that are trained using modules based on stimulating higher-order thinking skills on metabolic material have increased. The existence of this increase is shown in the post-test experimental value, namely in the aspects of fluency, originality, and flexibility which are at the high category level. The statistical analysis data also shows that the use of stimulating higher-order thinking skills modules on metabolic material is better than learning that does not use modules.

Students’ creative thinking skills in the future will be very useful. Therefore that need to be trained by using right learning models, which are able to stimulate student’s creative thinking ability. Teacher coaching in the process is really necessary, as well as teachers can also provide habits in doing creative thinking problem. The results of this research can be a reference for other researchers to develop learning models that enhance student creativity.

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