Profile of senior high school students’ creative thinking skills on biology material in low, medium, and high academic perspective

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Abstract. Creative thinking is one of the most important skills of the 21st Century. Students are demanded not only be able to solve the cognitive problems but also to face the life problems. The aim of this study is to determine students’ creative thinking skills in biology class for XI grade of three Senior High Schools in Ngawi regency. The approach used to categorised the three schools into low, medium and high academic rank was a norm-referenced test. The study involved 92 students who completed a test. Guilford’s alternative uses task was used to measure the level of students’ creative thinking skills. The results showed that in the school of high academic rank, 89.74% of students had low creative thinking skills and 10.25% of them are in moderate category. In the medium academic rank school, 85.71% of students had low creative thinking skills and 14.29% of them are moderate. In the school of low academic rank, 8% of students had very low creative thinking skills, 88% are low, and 4% are moderate. Based on the finding of the research, the creative thinking skills of students in the three school was categorised as low level, therefore the learning design should be developed which can improve the students’ creative thinking skills.

1. Introduction
Twenty-first century is an era which is dominated by knowledge of brain development. Humans rely on their brain as a source for thinking skills, for developing life skills, life competencies, or specific skills in solving global problems, such as science learning. Science learning in 21st century, according to National Science Teachers Association [1], is to be able to prepare students with certain skills and abilities like creative thinking, innovative, critical thinking, problem-solving, communicative, collaborative, ICT literacy, and leadership. Rotterdam and Willingham [2] noted that the success of students depend on possessing the abilities required in 21st century and they must learn how to gain those abilities.

Creativity is a key to all competencies because using creativity an individual can makes something better, even new [3]. Creative thinking refers to a high-level thinking process because the highest cognitive competence are needed to be mastered by students in a class [4]. Creative thinking is a style of thinking that allows individuals to produce new and authentic products, discover new solutions, and achieve synthesis. Creativity means being critical in thinking and proposing new ideas [5]. The ability to think creatively is a required skill in this global era of global because of the complexity of problems in all aspect of modern life. The students are demanded to not only be able to solve the cognitive
problems in the school but also to prepare themselves to face the real life problems in their environment.

Creative thinking is viewed as a combination of logical and divergent thinking in order to create something new [4]. This statement is supported by Guilford [6] who says that the one thing which related to creativity is divergent thinking skills. The divergent thinking is a thinking process towards all angles and creating many alternative ways to solve a problem. Using the skills, an individual is able to give many possible answers based on the given information.

Creativity is an important ability for students and it can improve the quality of education in Indonesia [7]. According to Munandar [8], teachers have an important role in developing students’ creativity especially in learning. However, teachers pay less attention on creative thinking skills. The fact shows that learning in a school only focuses and orients to the intelligence development than creativity development although these two aspects are on the same level of importance in gaining success in learning and life. Therefore, students, when learning biology at school, should practice their thinking skills in obtaining, choosing, and analyzing information to be able to survive in the dynamic and competitive environments.

Generally, students’ creative thinking in Indonesia is low because students are not required to involve in thinking process during the learning activities. According to Florida, et.al [9] in *The Global Creativity Index*, Indonesian’s creativity level is placed on rank 81 of 82 countries. The fact is proved by Prianggono [10], Indonesian students’ creative thinking skill is zero (not-creative) in solving mathematic problems. The same finding is also proved by Siswono [4], there are many students who have low level of creative thinking skill in solving geometry problem. The low level of creativity is caused by schools’ curriculum which merely focuses on convergent thinking process that is limited to verbal reasoning and logical thinking. Consequently, students get used to convergent thinking, and if any problems are given, they will have difficulties in solving the problem creatively. Besides, learning process at school focuses on memorization because of the vast amount of learning materials. This type of learning process will not develop students’ creative thinking skill. According to Guilford [6], the combination between two thinking skills including convergent and divergent thinking skills can help students to develop creative thinking skills.

Creative thinking skills can be developed using active and creative learning that enables students to practice their skills in problem-solving from every angle. It is later expected that the students are able to face complex situations and problems in everyday life. To achieve this goal, the attitude, a way of thinking, and creative behavior should be nurtured from the early years of formal education. This statement is supported by Treffinger in Alexander [11] that every individual has their own potency of creativity.

One of strategies to measure creative thinking skills possessed by students is using Guilford’s alternative uses task. Guilford in Siraman [12] measures creativity skills using divergent–thinking skill tests. Guilford [13] states there are 4 aspects of creative thinking such as 1) fluency is the skill to create many ideas, 2) flexibility is the skill to propose several approaches and/or ways to solve the problems, 3) originality is the skill to create authentic ideas as a result of their own thinking and not cliche, 4) elaboration is the skill to elaborate something in detail. Therefore, this study used open-ended test with 4 aspects of creative thinking such as fluency, flexibility, originality, and elaboration. Based on the explanation above, this study aims to understand the level of creative thinking in biology learning of students in senior high schools with high, medium, and low academic rank in Ngawi regency. The study is important because creative thinking skill is essential for students to be able to answer the challenges in the future professional life.

2. Research method
This type of study was descriptive qualitative which means this research aimed to find out and described creative thinking skill of XI grade students in biology learning in Ngawi regency. *Guilford’s alternative uses task* was used to measure the students’ creative thinking skill. The sample for this study were Senior High School students of high, medium, and low academic rank in Ngawi regency.
These schools were chosen based on the results on the national exam using a norm referenced test [14]. Three school were selected, namely MAN 1 Ngawi represented high academic rank, MAN Paron represented medium academic rank, and MAN Ngrambe represented low academic rank. Table 1 shows the criterion used in choosing the schools.

Table 1. Criterion of high, medium, and low academic rank.

| Score Range (X)               | School Rank |
|------------------------------|-------------|
| \( X > \mu + 0.5 \sigma \)   | High        |
| \( \mu - 0.5 \sigma \leq X \leq \mu + 0.5 \sigma \) | Medium     |
| \( X < \mu - 0.5 \sigma \)   | Low         |

The results on final exam of the semester were analyzed using one-way analysis of variance (ANOVA), at \( \alpha = 0.05 \). The results show that all of classess selected from the three schools are homogeneous. Simple random sample technique was used to choose the classes and there were 3 classes chosen as research subject, namely 39 students of XI Science 2 in MAN 1 Ngawi, 28 students of XI Science 1 in MAN Paron, and 25 students of XI Science 1 in MAN Ngrambe. The total amount of students which involved in this study was 92 students. The test used to measure the creative thinking skills was Guilford’s alternative uses task. The test contained 8 essays questions that had been validated by the experts. The test was developed following 4 aspects of creative thinking that is fluency, flexibility, originality, and elaboration.

Technique of data analysis was done by checking students’ answers to the test followed by giving the score for each answer. The data was analyzed using the formula below:

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\%_{thi} = \frac{\text{ obt }_{t}}{s} \times 100 \%
\]

Next, the scores were interpreted using a criterion for creative thinking skills that was adopted from Riduwan [15] as shown in Table 2.

Table 2. Criterion for creative thinking skill.

| Score Interval | Creative Thinking Skill Level |
|----------------|-----------------------------|
| 0% - 20%       | Very low                    |
| 21% - 40%      | Low                         |
| 41% - 60%      | Moderate                    |
| 61% - 80%      | Creative                    |
| 81% - 100%     | Very Creative               |

3. Result and discussion
In this research, the students answered the essay questions which were developed based on the creative thinking aspects, namely: fluency, flexibility, originality and elaboration. The test used in this research have been validated. The example for multiple essay questions is shown in Table 3.
Table 3. The example for essay question.

| Aspect    | Creative Thinking Indicators | Question Indicators | Questions                                                                 | Answer Key and Score                                                                                      |
|-----------|-------------------------------|---------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Flexibility | Students produce varying idea. | Analyze interactions of inter-species within communities. | In a garden ecosystem, there are found roses, orchids, trees, peanut plants, parasites, caterpillars, bees and butterflies. Based on your understanding of the ecosystem, what identification of interactions might be occurring in the ecosystem? | Students mention the answers to 4 kinds of interaction (symbiotic) that is mutualism, commensalism, parasitism, and predation 4 keywords = 4, 3 keywords = 3, 2 keywords = 2, 1 keyword = 1 |

Based on the results of the Guilford’s alternative uses task, it can be seen the average score for creative thinking aspects based on school academic rank (high, medium, and low). Data analysis was calculated using SPSS, and the results are presented in Table 4.

Table 4. Average score for creative thinking aspects based on school academic rank (high, medium, low).

| School Rank | Average Score for Creative Thinking Aspects | Average Score for 4 Indicators |
|-------------|--------------------------------------------|--------------------------------|
|             | Fluency         | Flexibility  | Originality | Elaboration |                             |                             |
| High        | 26,28%          | 23,40%       | 34,29%      | 62,82%      | 36,67%                       |
| Medium      | 29,46%          | 24,10%       | 28,57%      | 51,78%      | 32,92%                       |
| Low         | 25,00%          | 13,60%       | 27,00%      | 57,00%      | 30,56%                       |

Whereas the percentage of students’ creative thinking skills based on the amount of sample can be seen in Table 5.

Table 5. The percentage on students’ creative thinking skill based on the amount of sample.

| Creative Thinking Skill Level | High | Medium | Low |
|------------------------------|------|--------|-----|
| N %                          | N %  | N %   | N %|
| Very Low                     | 0    | 0      | 2   |
| Low                          | 35   | 89,74% | 24  |
| Moderate                     | 4    | 10,25% | 4   |
| Creative                     | 0    | 0      | 0   |
| Very Creative                | 0    | 0      | 0   |

From Table 4, it can be seen that students from schools of high, medium and low academic rank have low level creative thinking skills. The possible reason of this results is that students merely focus on gaining one correct answer for a problem (convergent) and have not used to think divergently. This result is further strengthen by what Guilford in Munandar [8] said about the development of creative thinking skill that creative thinking skill is underestimated in formal education although creativity is
meaningful to develop children’s potential. All this time, formal education only appreciates
that basically, every individual has a potential to be creative. Students’ creative thinking skill
creativity, academic rank her herd be seen that in
school high, medium, and low academic flexibility 20 moderate creative aspect, though
fluency 2]. Who solve biology problems shows who have moderate is with their
who have fluency, flexibility, originality, are to a problem
Flexibility moderate adequately creativity at Work: developing Right Practices to Make
knowle are who have high and needs. These two rather were not all correct, but the
Lead a people has difficulty in solving the problems school and
creative thinking skills. In it is NSTA Board of Directors. suggestions to result
wn ways to solve the problems using divergent thinking, highest with, there is
creative thinking skill. In elaboration. According to Djupanda, Kendek, and
Darmadi [17], in flexibility level, people has difficulty in solving the problems adequately. Basically,
people in this category will try to find the answers without giving troubles for themselves. An
Emotional barrier is one of the factors that inhibit creative thinking which is seen as the obstacles of
creativity, such as lack of tolerance and over self criticism [18].

Originality aspects has a higher score compared to fluency and flexibility aspects. This result indicates that the students has sensitivity and care towards everyday problems. Woolfolk [19] stated that broad knowledge is a basic for creativity. The wider one’s knowledge, the wider the possibility to create new ideas and to give an authentic solution to a problem.

Elaboration aspect has the highest score compared to three aspects. According to Djupanda, Kendek, and Darmadi [17], someone who has good skill in elaborating is prone to solve the problem systematically and orderly, giving more detail and explanation. This supports what the results shows, although the respondents’ answers were not all correct, but the score is the highest when compared to the three aspects.

From Table 5, it can be seen that in the school with high academic rank, there are 35 students (89.74%) who have low creative thinking skills and 4 students (10.25%) who have moderate creative thinking skills. In a school with medium academic rank, there are 24 students (85.71%) who have low creative thinking skills and 4 students (14.29%) who have moderate creative thinking skills. In a school with low academic rank, there are 2 students (8%) who have very low creative thinking skills, 22 students (88%) who have low creative thinking skill, and 1 student (4%) who has moderate creative thinking skill. Treffinger [20] stated that basically, every individual has a potential to be creative. According to Munandar [7] creative thinking skill can be nurtured by giving chances for the students to think and states the new ideas bravely and work according to their interest and needs. These two statements show that every individual have their own creative thinking skill level and this skill can be developed from one level to the higher level of school.

4. Conclusion
The students from the schools with high, medium, and low academic rank have low creative thinking skill. Based on the results, it is suggested that [1] the students are given a chance to practice their problem-solving skills and to use their own ways to solve the problems using divergent thinking, [2] the teachers apply learning model that will develop and increase students’ creative thinking skill, and [3] other researchers conduct more studies on creative thinking skill.

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