Profile of Students’ Creative Thinking Skills using Open-ended Multiple Choice Test in Science Learning

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Abstract. This study aimed to know the profile of students’ creative thinking skills in grade VII of junior high school during the process of science learning. This study was carried out using quantitative-descriptive method. Data collection were done by using open-ended multiple-choice tests based on students’ creative thinking skills indicators. The test was previously validated by learning evaluation experts. Validity of test items were determined using Karl-Pearson formula related to product moment correlation coefficient. Reliability of tests were determined using Alpha-Cronbach formula. Difficulty level and discriminating power were also used as item parameters development of test instruments in this study. The sample taken in this study was 256 students which consisted of all seventh grade students in SMP Negeri 1 Jaten selected through purposive sampling technique due to identify students’ creative thinking skills. The results of this study showed that students’ creative thinking skills on each indicator were 49% of fluency which was in the low category, 72% of flexibility which was in the medium category, 34% of originality which is in the low category, and 35% of elaboration which is in the low category. The conclusion from this research is that creative thinking skill of the students still was in low category, so that needed a way to enhance it on some indicators.

1. Introduction
Science has experienced rapid development and progress. It was in line with the development of increasingly sophisticated human thinking. Indonesia is one of the developing countries as this country will not be able to progress rapidly as long as it has not improved the quality of human resources. The quality of life of the nation can increase if it is supported by an established education system. In the 21st century, high-level thinking skills have strategic values to be applied. Skills in the 21st century skills rainbow knowledge that learning and innovation skills [1]. Learning and innovation skills include critical thinking, collaborative skill, communication, and creative thinking. All countries from poor, developing, and developed categories need the ability to develop creative thinking [2]. The ability to think creatively has a strategic role towards the advancement of science and technology. This is based on the development of times that require individuals to be able to face global competition, so that an individual has the ability to create new ideas or ideas obtained from the ability to think creatively. Within the 21st century competency framework, it shows that students must have life and career skills, learning and innovation skills, the ability to use information and communication [3]. Creative thinking skills are defined as skills needed in most or almost all subjects [4]. The importance of each individual to enhance creative thinking skills. Thus important creative thinking skills are possessed by students from learning activities to complete the learning objectives.

Creative thinking skills are defined as a thought process that allows students to apply their imagination to generate ideas, questions and hypotheses, experiment with alternative conceptual and to
evaluate ideas, processes and products implications [5]. Creative thinking skills is related to think and find something, about things that produce something new by using something that already exists [6]. The results of these thoughts can be given in the form of real and abstract ideas. Creative thinking skills are always associated with a unique or different from the others because creative thinking skills is purely the result of a persons’ thinking, therefore, creative thinking skills are synonymous with originality [7]. Sub dimensions to the creative thinking skills in learning process are introduced by Guilford, which includes fluency (ability to generate lots of ideas, answers, problem solving, or questions), flexibility (ability that produces ideas vary from the information that has been obtained), originality (generating ideas or ideas that are new and different from before) and elaboration (the ability to develop and add ideas in detail that seems more interesting) [8]. The creative thinking skills can be formed through divergent thinking stages. The process stage in creative thinking includes preparation, incubation, illumination, and verification or evaluation [9]. Creativity can be maintained by teachers and learning environments that encourage questions, open to new ideas, and learn from mistakes and failures [1].

The study of measuring creative thinking skills has not been done much. Studies related to creative thinking skills in the countries of India, Israel, Hong Kong, Germany, and Romania were still relatively low, so it is important to conduct further studies as the contribution to educators, students, and education [10]. Although it is difficult to assess creativity, there are several instruments and assessments that have been designed to measure creativity in a particular field [11]. Studies to find out the initial profile of students can be done in various ways depending on the category or dimension to learn. The study to find out students’ creative thinking skills as a initial profile is very important as it has strong connection with the existence of strategic contributions. An initial assessment of student competence in overcoming learning difficulties can be done by analyzing the initial profile of students’ creative thinking skills. The data obtained can be used as a consideration in evaluating the learning process in class, especially in science learning for seventh grade students in SMP Negeri 1 Jaten in Karanganyar, Central Java, Indonesia. The low level of students’ creative thinking skills can be caused by one of indicators because the learning process is not even optimal. Science is a subject that is difficult to learn for students because science are consisted of branches namely biology, physics, and chemistry. Science learning difficulties are also caused by difficulties in finding relationships between concepts and misconceptions that occur regularly. The aim of this study was to know the initial profile of students’ creative thinking skills in science learning.

2. Research Method

This research is a quantitative-descriptive method. The test method was chosen to describe the percentage to the ability to think creatively in seventh grade students of SMP Negeri 1 Jaten in Karanganyar, Central Java, Indonesia. The sample taken in this study was 256 students which consisted of all seventh grade students in SMP Negeri 1 Jaten selected through purposive sampling technique due to identify students’ creative thinking skills. Students are given tests to analyze their ability to think creatively, especially in science learning. The test form is open-ended multiple-choice test and the questions have been developed by indicators of creative thinking skills that previously performed the validation of evaluation learning experts. Validity of test items were determined using using Karl-Pearson formula related to product moment correlation coefficient. Reliability of tests were determined using Alpha-Cronbach formula. Difficulty level and discriminating power were also used as item parameters or the test used. Science topics in the problem include everyday life phenomena regarding temperature and heat. Scoring from open-ended multiple-choice test and rubric that has been validated by experts from each indicator. Furthermore, the test data were analyzed with percentage to find the indicator creative thinking skills which the student has not passed by using the formula:

$$\text{Percentage (\%)} = \frac{\text{score of each indicator}}{\text{total score of each indicator}} \times 100\%$$
The data obtained in the form of the results of creative thinking skills tests are processed by calculating the percentage of scores obtained by students on each indicator of creative thinking skills and then the percentage is interpreted according to the criteria of the level of students’ creative thinking skills as it can be seen on Table 2.

3. Results and Discussion

3.1 Results

This research has been conducted to analyze the initial profile to students’ creative thinking skills. The initial profile of students’ creative thinking skills is represented by four indicators contained in the questions, including fluency, flexibility, originality, elaboration. The test questions used in the form of open-ended multiple-choice test based on creative thinking skills that have been validated by the expert team of evaluation. Validity of test items were determined using Karl-Pearson formula related to product moment correlation coefficient. Reliability of tests were determined using Alpha-Cronbach formula. Difficulty level and discriminating power were also used as item parameters. The results of the students’ initial profile test are presented in Table 1 while analysis of the test results refers to the creative thinking level criteria presented in Table 2 [12].

| Table 1. Profile of Students’ Creative Thinking Skills |
|--------------------------------------------------------|
| Indicator     | Percentage (%) | Criteria |
|----------------|----------------|----------|
| Fluency       | 49%            | Low      |
| Flexibility   | 72%            | Medium   |
| Originality   | 34%            | Low      |
| Elaboration   | 35%            | Low      |
| Mean          | 47.5           |          |

| Table 2. Criteria of Students’ Creative Thinking Skills Level |
|---------------------------------------------------------------|
| Percentage (%) | Criteria      |
|----------------|---------------|
| < 55           | Low           |
| ≤ 55 - < 75    | Medium        |
| ≥ 75           | High          |

Figure 1. Percentage of the Students’ Creative Thinking Skills
This is a sample of answer.

![Image of a sample answer](image)

**Figure 2.** Sample of students’ answer on creative thinking skill test

3.2 Discussion

Table 1 showed the level of achievement of students’ creative thinking skills in each indicator. Results showed that students have medium and low creative thinking skills due to the creative thinking skills of Table 2. Fluency indicator has been owned by 49% of students who have been able to answer the test by getting the maximum score on this indicator so that it is interpreted low. Flexibility indicator is still being interpreted with a percentage of 72%. The interpretation of the originality indicator is still low because students who are able to answer with a maximum score of only 34%. Elaboration indicator has gained 35% of the percentage so it is interpreted low. The achievement of indicators of students’ creative thinking skills in SMP Negeri 1 Jaten is still low, especially in the indicators of fluency, originality, and elaboration. Based on the results of the initial profile test, the ability to think creatively has not reached an ideal score. This finding is in line with some of the previous studies’ results that showed the low category of students’ creative thinking skills in Indonesia. Meanwhile, low category of students’ creative thinking skills has apparently not only appeared on a national scale. The other study has also found a decrease of students’ creative thinking skills in France [13]. The assessment of the ability to think creatively using the Guilford indicator shows that most students almost reach the target in flexibility indicator as it can be seen in the results of the initial profile test of students within percentage of 72%. In contrary, the percentage of achievement of students’ creative thinking skills that is very far from the target is originality indicator. According to previous research, limited or unsatisfactory achievement on the other three criteria includes flexibility, elaboration, and originality were passed by originality [14]. In addition, the most important indicator of creative thinking skills is originality [15]. Originality is the ability to produce new and different ideas or ideas. Students can achieve originality indicators if they are accustomed to practicing their creative thinking skills with different points of view because these sub-dimensions depend on several factors [14]. Based on these results indicated, there is a result that the way students think have not been optimally trained, especially when they are asked to think creatively. Therefore, it is important to empower creative thinking skills in learning, especially in natural science subjects as it has been given the strategic value.

4. Conclusion

The conclusion of this study is the initial profile of the creative thinking ability of class VII SMP N 1 Jaten in science learning which is still relatively low. The results of this study showed that students’ creative thinking skills on each indicator were 49% of fluency which was in the low category, 72% of flexibility which was in the medium category, 34% of originality which is in the low category, and 35% of elaboration which is in the low category. These results indicate that students’ creative
Thinking skills need to be empowered. Efforts to empower creative thinking skills are important to be considered given the low percentage of each indicator.

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