Creative thinking profile of junior high school students on learning science

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Abstract. Creative thinking is one of thinking skills such as facilitating individuals to learn to realize their imagination, providing opportunities to think, express their ideas, and get new information. Middle school students must be trained in the ability to think from the beginning of learning science. Creative thinking is needed through new ideas. The purpose of this study is to identify the ability to think creatively through Torrance indicators consisting of fluency, flexibility, originality and elaboration. This type of research is a quasi-experimental with one group pretest-posttest. Data collection methods use questions and questionnaires for creative thinking skills. Data analysis techniques using quantitative descriptive. Results Show that creative thinking on the Fluency profile indicator (X1) is 75%, Flexibility (X2) is 70%, Originality (X3) is 60%, Elaboration (X4) is 62%. The percentage of originality indicators (X3) has the lowest score compared to other creative thinking indicators. The culture of learning, especially science, still relies on how to understand concepts, principles, and theories and has not become a means to empower students' creative thinking skills. Therefore for further research needed a creative problem solving model that can empower creative thinking skills. One of them is the creative problem solving (CPS) model.

1. Introduction

The development of the science of the 21st century requires students to be able to compete to develop higher-level thinking skills [1] [2]. Upheld by Heong showed that high-level thinking skills are the ability to use new information or previous knowledge and manipulate it to achieve new dismutase possible answers [3]. Learning on the curriculum in 2013 aimed to develop the character of 4C or 21st-century skills (Communication, Collaboration, Critical Thinking, and Problem Solving, and Creativity and Innovation).

Objectives and results of using the curriculum in 2013, not just the transfer of the material but pupils to develop skills 4C. One of the skills developed is thinking creatively. According to Fisher creative thinking in education because it adds valuable human knowledge, even if the value of new ideas is not recognized when it involves solving problems by using certain aspects of intelligence, such as linguistic, mathematical and interpersonal [4] [5]. Besides creative thinking skills is an important aspect for the students to solve problems and find ideas for solving the problem [6] [7] and to train students to develop ideas and arguments, asking questions, acknowledging the truth of the argument, even make students able to be open and responsive to the different perspectives [8].
Learning science should be hands-on and minds on [9]. In learning science, a teacher required to develop and foster the creative development of students and curiosity. Given the importance of creative thinking skills in science teaching, many studies have been conducted in various countries to know how much the creative thinking ability of students.

Results of an international study Global Creativity Index (GCI) in 2015 showed that an index of creativity Indonesia was still very low with a value of 0.202, which ranks 115 out of 139 participating countries [10]. A previous study on creativity and creative thinking skills also show that creative thinking skills, especially in the field of education can be said is still very low [11] [12].

Various studies carried out to improve the ability to think creatively. In fact, some studies indicate there are problems empowering creative thinking in students, namely: In the process of learning, especially science, still relies on how to understand the concepts, principles, and theories, and not as a means to empower the creative thinking skills of students [13], an approach learning is used to develop creative thinking skills too hard on students who have the knowledge and creative thinking skills are limited [14], creative thinking skills have not been dealt with well in learning, therefore, the skills of creative thinking is essential is integrated in every subject [15].

Torrance identifies four component indicators of creative thinking are: Fluency, Flexibility, Originality, Elaboration. Measurements using the Torrance Test of creative thinking (TTCT) published by E. Paul Torrance and his colleagues in 1966 [16]. As well as revised in 1974, 1984, 1990 and 1998. The study, experimentation, and instructional planning and determination of the strength of the students become an early goal TTCT. There are two forms (A and B) form TTCT-Verbal and there are two (A and B) of TTCT-figural. TTCT gives educators ways to identify the talent of children. This ability can be practiced by everyone regardless of age, as individuals evolve creatively foster ideas.

From various research studies that have been done before this research is to describe the profile of students' skills in the creative thinking of students of secondary school (SMP) in Science Education. The research is expected to provide information and images to researchers so that researchers can develop a model of learning that can improve the ability to think creatively by the needs of students.

2. Materials and Methods

This type of research is this research using Quasi Experimental Designs that is by using One-Group Pretest-Posttest Design as a research design. According to Sugiono, One Group Pretest-Posttest Design is a research design that has a pretest, before being treated [17]. Data collection methods using tests in the form of a description and questionnaire were used to determine the creative thinking skills of junior high school students in learning science. The sampling technique in this study uses a non-probability sampling technique that is convenience sampling technique. The subjects of the research were VII grade students of SMP in Bengkulu City with a total sample of 32 people. The research instrument tested was the Torrance Test of Creative Thinking (TTCT) to measure the creative thinking of junior high school students in science learning. Data were analyzed using quantitative descriptive and normalized average gain percentage. Data from the initial test and the final test of students' ability to think creatively then calculate the increase are expressed in terms of n-gain[18].

| Equation                                      | value Gain | Category   |
|-----------------------------------------------|------------|------------|
| $< g > = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$ | $< g > \geq 0,7$ | High       |
|                                              | $0,3 \leq < g > < 0,7$ | moderate |
|                                              | $< g > < 0,3$ | Low        |

Spost = average value posttest  
Spre = average value of pretest  
Smax = maximum Score
The test results were analyzed based on the criteria of the creative thinking abilities indicator using the TTCT instrument. Indicators of creative thinking can be seen in Table 2.

### Table 2, Indicators of Creative Thinking

| Indicator                  | Commentary                                                                                                                                 |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Fluency (fluency),        | Fluency refers to the quantity or the ability to produce a large number of ideas in response to open-ended questions or refers to a person's thinking process. |
| Flexibility (flexibility),| Flexibility refers to the ability to change the course of a person's thoughts or change the viewing angle.                                  |
| Authenticity (originality),| Originality refers to the ability to generate new ideas and unusual. Originality associated with generating options that are unusual or statistically rare, making the combination of parts or elements are unusual, unique, novel that had not occurred to anyone else |
| Of detail (elaboration),  | Elaboration refers to the ability to add detail and to expand the idea. Elaboration involves making the idea of a richer, more exciting, or more complete |

Scoring level of creative thinking abilities of each student answers the results can be seen in Table 3 [19].

### Table 3, Creative Thinking Ability level

| Depth capability | characteristics                                                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| level 4 (Very creative) | Learners can solve the problem with more than one solution and can develop other ways to solve it. One solution fulfills the originality (newness). Some aspects of the problem are built to meet originality, flexibility, and fluency. |
| level 3 (Creative) | Learners can solve the problem with more than one solution, but can not develop other ways to solve them. One solution meets the originality aspect. At this level, learners can develop other ways to solve the problem (flexibility), but has no way different from the others (Originality). |
| Level 2 (Simply Creative) | Learners can solve a problem with the solutions that are different from the others (Originality) but do not meet the fluency and flexibility aspects or learners can solve problems by developing solutions (flexibility) but it is nothing new and nor answer smoothly. |
| level 1 (Less Creative) | Learners can solve problems with more than one solution (fluency) but not able to develop a solution and do not meet the novelty aspect. |
| level 0 (Not Creative) | Learners are not able to solve problems with more than one solution and can not develop other ways to solve them. As well as learners also can not generate new solutions. |

Based on the description in Table 3. Then the equation used to calculate the value of creative thinking abilities based indicators can be seen in the following equation:

\[ S = \frac{R}{N} \times 100 \]

Information : S is Score Creative Thinking Ability; R is Correct Score; and N is Maximum Score
3. Result
This research was conducted to provide a pretest to see the equality of students' initial knowledge after science learning was done with a conventional approach of 4 meetings, then posttest administration to see and measure students' creative thinking abilities in junior high school students. Science learning. Grade VII students' creative thinking skills in learning science are different. This is because the development of creativity is based on the potential that exists in individuals and is supported by experience when interacting with the environment. Through science learning, students are facilitated with open-ended questions to develop creative thinking skills through practical questions contained in the Student Workbook.

The results showed a low level of creative thinking due to some weaknesses of students, including: considering the sentences in the problem, not being able to distinguish questionable information and requesting questions, not using the knowledge or ideas needed, changing data or diagrams into sentence or vice versa, using different ways or strategies in solving problems, doing calculations, and drawing conclusions or fixing the problem being sought. If the weakness is narrowed is the student's ability to overcome problems and difficulties. Understand a problem by understanding what is known and asked. Was discussing the problems associated with organizing information or existing data creatively by using specific strategies to find what was needed. Mastery of divergent thinking skills in students will make it able to take decisions as a form of convergent thinking [20] that is in accordance with the creative thinking process that is lateral. Different thinking (also called creative thinking) is to provide a variety of possible answers based on the information provided with an emphasis on diversity in number and suitability. The pretest and posttest results of students' creative thinking abilities can be seen in Table 4.

| Table 4, Results from pretest and posttest Students Creative Thinking Ability |
|-----------------------------------------------|
| **Experiment** | **Pre-test** | **Post-test** |
| N | 32 | 32 |
| Average value | 32.34 | 51.25 |
| lowest Rated | 15 | 30 |
| The highest score | 55 | 80 |

After getting the results of Prestet and subsequent posttest to see an increase in students' ability to think creatively then calculating the value of N-gain. The test results of N-gain increased value can be seen in Table 5.

| Table 5, Test Results Improving the ability of Creative Thinking seen from the N-gain |
|-----------------------------------------------|
| **Pre-test** | **Post-test** | **N-gain** | **Criteria** |
| Average | 32.34 | 51.25 | 0.3 | moderate |

The N-gain value obtained from the calculation of the increase in pre-test and post-test is 0.3 which is in the middle of the criteria of creative thinking ability in teaching junior high school students. After calculating the N-gain then analyzed with TTCT creative thinking ability instruments. Creative thinking skills will continue to develop in accordance with stimuli in the surrounding environment. During interacting with the environment, different thinking skills can develop because they face problems in the environment. Creative thinking skills are important aspects for students to be able to solve problems [21] and find ideas to solve these problems [22] and the ability to generate new and appropriate ideas and cognitive activity in finding solutions to solve a problem [23]. Thus, the need for encouragement of internal factors within students and external factors, namely the learning environment to be able to empower students' creative thinking skills. Analysis is carried out for each indicator, namely; Fluency, Flexibility, Originality, and Elaboration. The results are based on the Torrance indicator can be seen in Figure 1.
Figure 1, Graph Creative Thinking Results-Based Torrance indicators Junior High School Students In Science Learning

Profile of students' creative thinking skills for each indicator, based on the Torrance Test Creativity can be seen in Figure 1, the average value of the percentage of each student's creative thinking abilities are different. Characteristics of creative thinking with the highest average percentage value is Fluency thinking skills with a percentage value of 75%, while the characteristics of creative thinking that have the lowest average percentage value are originality skills with a percentage value of 60%. The average percentage gain for fluency skills is 70% and elaboration skills are 62%.

Fluency
Science learning is done is to make questions that can improve the ability (fluency) consists of five questions that identify the ability of fluency, namely: 1) have many ideas about a problem, and 2) answer with a number of answers if there are questions. The ability to think fluency is the ability to stimulate the production of ideas that will become novel and provide useful quality opportunities. Fluency ability assessment is not only based on results alone, but involves the process when students solve a problem given by the teacher. Example problems mentioning what components are in the picture below!

Figure 2, Wetland ecosystem

From the data obtained the ability fluency 75% of students considered to be able to answer the questions that explain a lot of ideas on an issue, and some students have been able to answer smoothly and precisely on the question. In providing ideas about a problem, students can think broadly in line with the understanding and ability. Creative thinking ability may be obtained from the experience of everyday life, is derived from information contained in the television or newspapers, as well as other learning resources so that students can respond smoothly to a question, in line with (Hennesey & Amabile) identifying, defining, and solving problems an important aspect of creative thinking [24].

3.1.1. Flexibility
Flexibility is a skill that involves openness to test an idea or experience in an unexpected way or a variety of possibilities. Based on data obtained Flexibility ability of junior high school students in
learning Science is 70%. Ability flexibility of students classified as moderate means students can solve the problems that used to think flexibility with the matter, namely: Provides various interpretations of a problem, Example question, Give some ideas (maximum of 3) can you suggest that contamination of rice paddy ecosystem can overcome!

How to overcome the rice field ecosystem, based on examples of student answers are:
1. Applying the use of technology to the management of natural resources that can or cannot be renewed
2. Involving the community in order to tackle environmental problems
3. Management of natural resources and ecosystem

Based on the responses of students, some students were able to give a different interpretation of any problems, then students can classify a variety of answers or write down the ideas of the problems posed in the matter.

At this stage of creative thinking is part of the cognitive skills to propose a solution to a problem or make something useful and novel than usual [25], as well as problem-solving activities, can develop cognitive skills common that can be used to develop the ability to think creatively [26].

3.1.2. Originality

Originality is the ability to remove the phrase, idea, or an idea to solve a problem or make a combination of parts or elements are unusual, unique, novel that had not occurred to anyone else or the ability to produce a definition of rare and original of ideas, ability to generate original ideas, techniques or design of the expression that is rarely encountered. Based on the data generated in the research showed the ability Originality is 60% is the result of low ability at this stage of creative thinking that has been done. Problem is given the ability to think the original is a matter that requires thinking about something unusual, example problems are to create an ecosystem of rice fields with a combination of patterns or shapes as below:

![Patterns](image)

The assessment criteria are 1. Using all the patterns/shapes provided. 2. The combination made showed a drawn ecosystem 3. 4. annotated accordingly. Originality on the ability of students is still relatively low.

![Image of student work](image)

*Figure 4, Answer Problem Originality Students*

Based on the students' alternative answers about student originality has not been able to use all the given patterns to be combined which shows a rice paddy ecosystem, an explanation of the caption is still unclear. Pictures of students are almost equal in the classroom, there is no novelty, it is possible the student still can not create something original or original by the criteria specified. show making extensive know-how, the more likely bring up new ideas, so that it can affect one's ability to think original.
3.1.3. Elaboration

Elaboration is an ability that makes the idea of a richer, more developed and able to specify in more detail the idea. From the data collected, it appears that the ability of students in the detailing is still lacking, namely 62%. This is due, not all students can pay attention to the details of the matter in question. Questions are made on the ability of elaboration is like, explain to you in detail some of the possible interactions between components of ecosystems that occur in fields or water ecosystems. In the elaboration ability to do activities encourage the emergence of a lot of ideas, receptive to ideas that are not familiar and develop it but did not directly criticize the students' ideas and develop creative thinking [27].

Based on the students' answers to some students can not specify the details of an idea. Upon asking the student to answer why it happens, in general, they did find it difficult to discuss the answer and make a chart in detail. Chances are this is due to their habit of relying on friends, so that in this state usually only students who are interested and serious in doing who know their duties in detail.

4. Conclusion

Based on the results of research conducted concluded that the ability to think creatively obtained an average pretest value of 32.34 and posttest of 51.25. Students' creative thinking skills have increased although not significantly included in the medium category with an N-Gain score of 0.3 using conventional approaches. Whereas in the assessment using the TTCT Instrument 4 (four) indicators, it was found that student fluency was worth 75%, flexibility 70%, originality 60% and elaboration 62%. Of the four indicators, originality is the lowest indicator. This is because at this stage students do not yet have broader knowledge about the material provided so they have not been able to produce original and original ideas from each given problem.

To be able to empower students' creative thinking, then in future research can use learning models that are able to empower creative thinking skills. One of the creative problem solving learning models namely Creative Problem Solving can be used to improve students' creative thinking skills. The Creative Problem Solving Learning Model (CPS) which has an organized system with the use of the system involves productive thinking to deal with problems and opportunities, generating many varied and unusual ideas. In addition, science learning can utilize the surrounding environment which is an effective way to focus student attention throughout the learning process, gathering information and learning tools without end, so that students' initial knowledge will help them understand certain knowledge optimally, guiding students to investigate science and ask questions based on their environment, utilizing local resources available in the environment, making direct observations of the surrounding environment, creating a good collaboration environment and actively learning to bring out creativity, innovation and curiosity as the basis for learning science.

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