The Profile of Junior High School Students’ Mathematical Creative Thinking Skills in Solving Problem through Contextual Teaching

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**Abstract.** The purpose of this study was to describe the profile of students' mathematical creative thinking skills in solving problems through contextual learning based on high, medium, or low initial abilities. The method used in this study is descriptive qualitative. There were 6 research subjects of junior high school students in the border area of Malang and Blitar Regencies. Data collection was done by observation, tests, and interviews. The results of this study are (1) High-ability students can fulfill three indicators; those are fluency, flexibility, and novelty according to the material, so that they are in the very creative category. There are high ability students who fulfill two indicators; those are fluency and flexibility well based on the material, so that they are in the creative category. (2) Middle-ability students can fulfill an indicator namely flexibility according to the material, so that they are in the category of quite creative. (3) Low ability students can fulfill two indicators, namely fluency and flexibility well based on the material, so that they are in the creative category. (4) The profile of students' mathematical creative thinking skill in solving problems through contextual learning based on early mathematical abilities was different. The profile of students' creative thinking skills is expected to be a teacher's reference to determine appropriate assignments and assessments to be given to students.

**1. Introduction**

The challenges of the 21st century in the field of education require students to be able to have various abilities including creativity, critical, communication, and collaboration. As explained that education in the 21st century carries a learning paradigm that requires graduates to have high-level thinking skills those are logical, critical, creative and innovative thinking [1]. As a result, there is a change in the education curriculum in order to realize 21st century competence for each subject in school, including mathematics. Mathematics is one of the various main subjects that must be taught by teachers to students [2]. Therefore, it is proper that in achieving the learning objectives, the learning of Mathematics in schools needs to be carried out full of totality.

In the 2013 Curriculum, it is clearly written about the purpose of mathematics learning at school. The purpose of learning, especially junior high school level based on the 2013 Curriculum for mathematics subject, one of which requires students to have the ability to think creatively. Mathematical creative thinking focuses on the ability of students to produce a new variety of correct answers to solve open
mathematical problems. Lince [3] explains that if students can solve mathematical questions that are classified as non-routine questions using a different strategy than the teacher's explanation and example in the learning process is called creative. Creative thinking is also closely related to solving problems in mathematics [4]. Therefore, the ability to think creatively in solving problems is one of the abilities that must be mastered by students at every level of education.

Creative thinking shown by students in solving problems need to be developed most. Sriraman et al. [5] stated that problem solving is part of creative thinking. According to Sadijah [6] mathematics learning in schools can encourage creative thinking skills of students to solve mathematical problems and in deciding a choice. The role of the mathematics teacher is needed in developing students' creativity through learning [7].

The ability of Indonesians’ students is still not optimal if it is associated with the mathematical creative thinking skills. The results of the 2015 Program for International Student Assessment (PISA) competition with a sample of junior high school / MTs students aged around 15 years old stated that Indonesia was ranked 63rd out of 72 countries[8]. Gurria [9] added that one of the characteristics of the questions in the PISA competition is requiring basic skills in finding a variety of solutions / answers and resolution / solving strategies, and the results are surprising, that was the percentage of students who cannot solve the easiest math problems is 32%. This is in accordance with what is stated in the 2013 Curriculum, students’ achievement in the PISA competition survey report are not encouraging, because the material and questions tested in the PISA competition are not contained in the Indonesian curriculum [10].

Observations conducted at one class of junior high school in the border area of Malang and Blitar Regencies. It showed that many passive students in the teaching learning process, students' creative thinking ability was relatively low, indicated by the results of the initial test answers when given contextual problems. Among 23 students who took the initial test, all students only wrote one possible correct answer and one strategy in solving the problem.

Various ways can be done in order to familiarize the ability to think creatively. In the mathematics learning process, it is necessary to develop material and problems through contextual learning. Samo, et al. [11] states that by modifying and innovating activities in mathematics learning in the classroom can develop the ability to think creatively. Creative learning strategies encourage students to produce new ideas more deeply [12]. Sarassanti, et al. [13] also shows that the improvement of students' mathematical creative thinking skills using contextual learning is better than conventional learning in terms of initial mathematical abilities (high, medium, and low). Sugandi [14] in his research also states that contextual learning had a large effect compared to conventional learning, school level, and students' initial mathematical abilities towards achieving high level mathematical thinking skills.

The mathematical creative thinking skill of each student is not the same because they have different knowledge and experiences in solving problems in the contextual learning process based on students’ initial mathematical abilities which are high, medium, and low abilities. The existence of differences in students’ Mathematical Creative Thinking skills in solving problems through contextual learning made researchers interested in conducting a study about junior high school students' Mathematical Creative Thinking skills in solving problems through contextual learning. This research aims to describe the profile of students’ mathematical creative thinking skills in solving problems through contextual learning based on high, middle, or low initial abilities. It is based on research by Sarassanti, et al. [13] which aimed to improve mathematical creative thinking skills of junior high school students and research by Kadir & Masi [15] which discussed about creative thinking skills of the junior high school in Kendari city. Furthermore, those researches are connected to research of Sugandi [14] which aimed to determine the effects of the contextual approach to the ability of high-level mathematical thinking.

2. Method
This research is a descriptive qualitative research. The subjects of this study were students of junior high school in the border area of Malang and Blitar Regencies. Class selected was chosen because
students have a diverse ability and recommended by mathematics teacher in junior high school. Before determining the subject of the study, students are grouped based on their initial mathematical abilities on the teacher's list of scores. Then 6 research subjects were selected, those were 2 students of high skill group, 2 students of middle skill group, and 2 students of low skill group. Data collections were done through observation, tests, and interviews. The main instruments in this study were the researchers themselves and assisted with other instruments including Lesson Plan (LP), Student Worksheets (SW), Group Worksheets (GW), creative thinking ability tests, teacher’s and students’ activity observation sheets, and interview guidelines. The tests consists of a problem with two questions about number pattern based on 3 indicators creative thinking skills those are fluency, flexibility, and novelty. It is used to describe student’s mathematics creative thinking skills in solving contextual problems.

In this study, there are contextual mathematical problems that students must work on. The analysis of the students' mathematical creative thinking skill tests was done based on indicators of mathematical creative thinking skills; those are fluency, flexibility, and novelty then the categorization of students' Mathematical Creative Thinking Levels is in Table 1. Fluency indicators can be seen from how students can write various solutions / answers correctly and smoothly without difficulty. Flexibility indicators are seen from how students write one problem solving strategy or various problem-solving strategies in sequence and can explain the process of solving it. Novelty indicators can be seen from how students can write solutions / answers / mathematical problem-solving strategies that look different from those used regularly in classroom learning.

| MCTL Level | Fluency | Flexibility | Novelty |
|------------|---------|-------------|---------|
| Level 4 (Very Creative) | √       | √           | √       |
| Level 3 (Creative)      | √       | -           | √       |
| Level 2 (Creative Enough) | -       | √           | -       |
| Level 1 (Less Creative) | -       | -           | √       |
| Level 0 (Not Creative)  | -       | -           | -       |

Data analysis from the test results of students' mathematical creative thinking skills is used to categorize the level of creative thinking skill based on indicators that can be achieved. Data analysis techniques include data reduction, data presentation, and conclusions. Checking the validity of the data is using triangulation techniques.

3. Result

There are 24 students who are grouped based on their initial mathematical abilities in the teacher's list of score. The results of initial abilities grouping test is showed in Table 2.

| First Group | Percentage (%) |
|-------------|----------------|
| High        | 8.3%           |
| Middle      | 25%            |
| Low         | 66.7%          |

Table 2 shows that 8.3% of students have high ability, 25% of students have middle ability and 66.7% of students have low ability. After grouping, students are given an initial test that is used to provide initial information about students' mathematical creative thinking skills. Then contextual learning was carried out for 8 meetings by mathematics teachers. Then students were given the final test of students' mathematical creative thinking skills. Based on the results of the tests, it was selected 6 research subjects; those were group of 2 students with high skill, group of 2 students with middle skill, and group of 2 students with low skill. Then conducted the interviews with the six students based on the test results. The results of students’ work were analyzed based on indicators of students' mathematical creative thinking skills. Analysis of the data from the test results of students' mathematical creative thinking skills...
was used to categorize the level of creative thinking skill based on the indicators achieved. The following are the results of the learning process exposure and the mathematical skills of each student.

### 3.1 Data Exposure of Contextual Learning Process

Contextual learning in this study is carried out based on the lesson plan that has been made. The lesson plan consists of three main activities, those are preliminary activities, core contextual learning activities, and closing activities. There are 7 basic principles that are carried out in contextual learning, including:

#### 3.1.1 Constructivism Principle

The teacher shows the photos to students through a slide that contains the patterns in the surrounding environment, and students observe it each meeting. Then the teacher provides the opportunity for students to be able to build their own new knowledge based on the photos displayed, and even connect them with the students’ experiences and understanding in real life and previous experiences.

#### 3.1.2 Inquiry Principle

The teacher gives student’s worksheets to students. Then students work on the worksheet about finding patterns of numbers independently. In this case the teacher plays important role in planning and designing activities that focus on inquiry activities in the material of numbers patterns.

#### 3.1.3 Questioning Principle

The teacher and students do question and answer about the material of the number pattern. Students are given the opportunity to ask questions that have not been understood. Then the teacher must answer them clearly. In this case asking questions in contextual learning can be used by the teacher to encourage, guide and assess students' abilities, so students will be able to find a variety of new information that is not yet known.

#### 3.1.4 Learning Community Principle

The learning community in this study consists of a study group that conducts discussion activities to find solutions in solving contextual problems in group worksheets relating to number patterns. During the discussion, the teacher helps students work together in completing or solving contextual problems on the group worksheet if there are difficulties.

#### 3.1.5 Modelling Principle

The teacher models the number patterns that exist in everyday life by giving and explaining examples of surrounding problems related to number patterns. In this case, students more understand the relation of the material with the daily real life.

#### 3.1.6 Reflection Principle

The teacher asks students to make a reflection of today's learning about the difficulties experienced and the material that has been understood. Then let students interpret the experience independently, so that they can summarize their experiences independently.

#### 3.1.7 Authentic Assessment Principle

Teacher conducts authentic assessment by guiding students while sharing or discussing in their group and when the students present the result of their discussion in front of the class.

### 3.2 Profile of High Ability Students' Mathematical Creative Thinking Skills

Based on the results of the Subject 3's (S-3’s) work on fluency indicators, he/she can write more than one possibility answer, those are four possible sizes accompanied by the number of ceramics in each pattern correctly and well. The number of ceramics written by the S-3 on each pattern of possibilities 3 and 4 are correct, but in the possibility of 1 and 2 there is an error calculation in the number of ceramics in pattern 4 and 5. S-3 can also provide explanations and reasons stating the number of ceramics in each pattern that forms a number pattern. Furthermore, based on S-23 that can write more than one answer, those are two possible sizes completed by the number of ceramics on each pattern correctly and smoothly. Furthermore, based on observations, test results, and interviews of S-3 and S-23, the subjects fulfilled fluency indicators.
S-3, on the flexibility indicator, can write two problem solving strategies correctly, those are by writing down the whole information then using the method of dividing and manipulating objects or examples using a comparison method to find the price of each required ceramic in order and clearly accompanied by an explanation. S-23 can write one problem-solving strategy that is writing down the whole information by using the distribution method in sequence and correctly. Furthermore, based on observations, test results and interviews, S-3 and S-23 meets the indicators of flexibility.

S-3, on the novelty indicator, writes one problem solving strategy that is slightly different, that is by manipulating objects or making an example using a comparison method. Furthermore, based on observations, test results and interviews, the S-3 meets the novelty indicator. S-23 solved the problem in the final test but did not write a problem-solving strategy that was different from the others. This is because other students do not write a comparison method in solving the problem given. Furthermore, based on observations, test results and interviews, the S-23 did not meet the novelty indicator.

Based on the results of research and data analysis, the results obtained through contextual learning, high ability group students can meet the indicators of fluency, flexibility, and novelty. So, based on the Mathematical Creative Thinking Level (MCTL), he/she is in MCTL 4 which means that S-3 is including as very creative student. Furthermore, there are subjects who through contextual learning can meet the indicators of fluency, flexibility, and not yet fulfilled the novelty indicator, so the S-23 is in MCTL 3 which means that S-23 is including as creative students.

3.3 Profile of Middle Ability Students' Mathematical Creative Thinking Skills
Subject 2 (S-2) and Subject 11 (S-11) can write only one possible size answer, accompanied by the number of ceramics in each pattern correctly. However, they can provide an explanation and reason that states the number of ceramics in each pattern that forms a pattern of numbers orally. Furthermore, based on observations, test results, and interviews, the S-2 and S-11 do not meet fluency indicators.

S-2 and S-11 can write one problem solving strategy correctly, in order, and clearly. The subjects write a problem-solving strategy that is writing the entire information using a division method to find the price of each required ceramic. Furthermore, based on observations, test results, and interviews, S-2 and S-11 meet the indicators of flexibility.

On the test of students' mathematical creative thinking skill through contextual learning S-2 and S-11 do not write problem solving strategies that were different from the others, so based on observations, the results of tests and interviews showed that the S-2 and S-11 were not fulfilling novelty indicator.

Based on the results of the research and analysis of test data, it obtained that, through contextual learning, middle ability group students did not meet fluency indicators, fulfilled flexibility indicators, and did not meet the novelty indicator, so the S-2 and S-11 are in MCTL 2 which means that the S-2 and S-11 are including as quite creative students.

3.4 Profile of Low Ability Students' Mathematical Creative Thinking Skills
The Subject 5 (S-5) can write two possible answers of sizes completed with the number of ceramics on each pattern correctly and smoothly. The S-5 can also provide explanations and reasons that stating the number of ceramics in each pattern to form a pattern of number orally. Furthermore, based on observations, test results, and interviews, S-5 meets fluency indicator.

Based on the work results, it shows that the Subject 14 (S-14) can write two possible answers of sizes accompanied by the number of ceramics on each pattern correctly and smoothly. S-14 can also provide explanations and reasons that stating the number of ceramics in each pattern that forms a pattern of numbers. Furthermore, based on observations, test results, and interviews, S-14 meet the fluency indicator.

S-5 and S-14 can write one strategy correctly. The S-5 uses a strategy by writing down the entire information using a distribution method to find the price of each required ceramic. Furthermore, based on observations, test results, and interviews of S-5 and S-14, they meet flexibility indicators. On the test of students' mathematical creative thinking ability through contextual learning, S-5 and S-14 did not
wrote different problem-solving strategies with others, so based on observations, the results of tests and interviews showed that the S-5 and S-14 do not fulfill novelty indicator.

Based on the results of the research and data analysis, the results of the low ability students group meet the fluency indicator, fulfill the flexibility indicator, and do not meet the novelty indicator, so the S-5 and S-14 are in MCTL 3 which means that S-5 and S-14 are including as creative students.

4. Discussion

4.1 The result Analysis of Contextual Learning Process

The instructional strategy used in this study is contextual learning that links subject matter with real things that exist in the surrounding environment / around the students, so that students can understand better the importance of number patterns matter and the benefits of mathematics in everyday life. This arrangement aims to make effective learning because the basis of effective learning is internal and external representation [16]. Through this learning, teacher helps students to develop their analogical reasoning because they understand the matter by relating it to real life [17]. The teacher can also guide students to develop various representation forms in problem solving as suggested by Sa’dijah [18]. According to Lailiyah et al. [19], analogical reasoning can help students to improve their creativity. Evidently when contextual learning takes place students look more active, even actively in asking questions, arguing, discussing, presenting the results of discussions, and so forth. In line with Danis et al. [20] which explains that one of the learning models that actively involves students in learning is contextual learning.

Contextual learning can help students recognize non-routine problems that cannot be solved procedurally. The students’ unfamiliarity in solving problems makes it difficult for students to develop students' creative thinking skills [21]. This goal is in line with Suryawati, et al. [22] which explains that contextual learning is one of student-centered learning that emphasizes the development of high-level thinking. In contextual learning students are given Student Worksheets (SW) by the teacher to be done independently. In addition, students are also given a Group Worksheet (GW) by the teacher to work in groups. By having discussion, students are required to be able to solve contextual problems that have been given. Then, students make other contextual problems about the pattern of numbers being studied. Therefore, through the SW and GW that have been given, the teacher can train students' creative mathematical thinking skills. In an effort to train / familiarize mathematical creative thinking skills, in this learning students are required to be able to write various kinds of solutions / answers / ways of solving, especially various kinds of number patterns that are different and correct.

4.2 The Analysis Results of Students' Mathematical Creative Thinking Ability Through Contextual Learning

In this study, through contextual learning students are given contextual problems on the open tests of mathematical creative thinking skills with various answers / solutions. The test results show that high ability group students, through contextual learning, fulfilled three indicators of mathematical creative thinking skills, those are indicators of fluency, flexibility, and novelty, so they are in MCTL 4 (very creative). This result is in line with the results of research by Mustakim & Budiarto which shows that students with high mathematical abilities have achieved optimal indicators of fluency, flexibility, and novelty [23]. The results of this study agree with Damayanti & Sumardi [24] in their research which explains that indicators of fluency and flexibility can be achieved by students with high and middle abilities, but indicators of novelty can only be achieved by high ability students.

High-ability students are in the MCTL category 4 (very creative) and MCTL 3 (creative). Although the subjects of the high ability group are in the same group but have a different category of mathematical creative thinking abilities. Both of these subjects have the characteristics of different answers on flexibility indicators. This result is in line with the research conducted by Motaharah, et al. [25] where students who have the same level of mathematical skill have different creative thinking skill. Utami & Kuneni [26] stated that the higher the initial ability of students, the higher the level of creative thinking
skill. Leikin & Lev [27] also added that there is a relationship between students who have high mathematics and mathematical creative thinking skills. This can be seen in the difference of MCTL in high ability students with middle ability students. Middle ability group students, through contextual learning, based on the test result are in MCTL 2 (quite creative) by only meeting the flexibility indicators and not meeting the indicators of fluency and novelty.

Low ability group students, through contextual learning, are in MCTL 3 (creative) by fulfilling fluency and flexibility indicators. These results are in line with the results of Sarassanti, et al. [17], which states that the increase in students’ creative thinking skills using contextual learning is better than students who use conventional learning in terms of their initial mathematical abilities (high, medium, low. In addition, the results of this study are also in line with Winarti [28] which explains that effective contextual learning is used to improve mathematical creative thinking skills. The difference in the level of creative thinking skill of each student is in line with the results of Mursidik's research, et al. [29] which shows that the creative thinking skill of each student in solving open contextual mathematical problems will vary depending on the knowledge and abilities possessed by each student.

5. Conclusions and Suggestions
Based on theoretical studies, data exposure from research and discussion results, the researcher can draw conclusions as follows: (1) High-ability students can fulfill three indicators namely fluency, flexibility, and novelty well according to the material, so that it is in the very creative category. There are high ability students who fulfill two indicators, namely fluency and flexibility well according to the material, so that it is in the creative category. (2) Middle ability students can fulfill an indicator namely flexibility according to the material, so that it is in the category of quite creative. (3) Low ability students can fulfill two indicators, namely fluency and flexibility well according to the material, so that it is in the creative category. (4) The profile of students’ mathematical creative thinking skill in solving problems through contextual learning based on initial mathematical abilities is different.

The profile of students’ creative thinking skills is expected to be a teacher's reference to determine appropriate assignments and assessments to be given to students. In addition, it can be seen that even though students have the same mathematical abilities, they have different levels of creative thinking. It is hoped that there will be further research to find out the things that affect these differences.

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7. References
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