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Analysis of Mathematical Creative Thinking Abilities in Primary Schools

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Abstract: One of the goals of Indonesian education in the 21st century is the development of students' potential in order to become creative human beings. The ability to think creatively mathematically has not received special attention. This is because there are still many students who solve math problems just like the example given by the teacher, so they are still having difficulties in alternative solutions to problem-solving in a creative way. The purpose to analyze the creative thinking abilities of elementary school students to solve various mathematical problem. The research approach uses descriptive qualitative. The sample in this study is fourth-grade students in elementary school. Techniques in collecting data are tests, observations, and interviews. Data analysis is done by flow model technique with the stages of data reduction, data presentation, verification or conclusion. The results showed that mathematical creative thinking skills in fourth-grade students reached the third level (creative) that can be achieved by students with high levels of ability. Students with abilities are on the 1st level (less creative), while students with low abilities are at the 0th level of creative thinking (not creative). This research concludes that high-ability students can fulfill indicators of fluency, flexibility and originality, medium-skilled only indicators of fluency that can be met by students, and students who low ability has not shown indicators of fluency, flexibility, originality and elaboration.

Keywords: *creative thinking, mathematical problem solving, elementary school*

INTRODUCTION

Rapid development in the field of technology, information and communication can not be separated from the ability to think creatively human. The ability to think creatively from an early age needs to be developed. Efforts to maximize the ability to think creatively to deal with change and the development of times can be done with quality education. All fields of education, especially mathematics education must develop creative thinking.

In the 21st century, advances in technology and information have entered various fields of life, including education. One form of government efforts in facing the demands of the 21st century in the field of education is to formulate 21st-century learning that emphasizes competencies in critical thinking and problem solving, creativity and innovation, communication, and collaboration (Kemendikbud, 2017a). This competency is termed 4C (Creativity, Critical Thinking, Communicative, and Collaborative). Regulation of the Minister of National Education No. 103 concerning process standards, the existence of the 2013 curriculum is directed so that students have good creative thinking skills. The ability to think creatively is seen as the basis for giving birth to innovative students, who can find alternatives to problems or challenges in the future are increasingly complicated.

Creative thinking is an activity to see or think of unusual and extraordinary things, combining seemingly unrelated information and sparking new solutions or ideas that show fluency, flexibility, originality in thinking (originality) and elaboration (Irawan, 2015). Creative thinking is a thought process that produces various possible answers (Siswono, 2008). Problem-solving is an effort made by someone to solve a problem by using the knowledge, skills, and understanding they have (Siswono, 2008).

Haylock shows the criteria according to the type of Torrance Test in creativity, namely fluency (the number of responses received), flexibility (the number of different kinds of responses), and authenticity (the rarity of responses in relation to a pair of groups) (Siswono, 2008). The ability to think creatively can be demonstrated from fluency, flexibility, and authenticity. Indicators analyzing creativity in problem-solving are explained by Silver "Indicator of creative thinking: (1) fluency, is students are able to solve problems with various solutions and answers; (2) Flexibility, namely students are able to complete (declare) in one was later in another way and students discuss various methods of settlement; (3) novelty, namely students are able to solve problems with unusual answers made by students at the stage of their development or level of knowledge" (Siswono, 2008).

Siswono (2008) revealed that the level of creative thinking ability is, Level 4 (very creative): students can to demonstrate flexibility, fluency, and novelty or novelty and flexibility in solving problems, Level 3 (creative): students are able to demonstrate fluency and novelty or fluency and flexibility in solving problems, Level 2 (quite creative): students are able to show novelty or flexibility in solving problems, Level 1 (less creative): students are able to demonstrate fluency in solving problems, and Levels zero (not creative): students are not able to show the three aspects of indicators of think creatively. In solving problems when applying creative thinking, will produce many ideas that are useful in finding problem-solving. Mathematics is given in schools to develop students' creative thinking skills in the process of learning (Mann, 2006).

Krisiandi (2016) "The Trends survey in the International Mathematics and Science Study (TIMSS) in 2015 found that the mathematics achievement of Indonesian students was ranked 45th out of 50 countries with a score of 397" .Indriani (2016) "The survey was conducted by the Organization for Economic Cooperation and Development (OECD) in 2015 using the Program for International Student Assessment (PISA) test stated that Indonesia's mathematical achievements were ranked 64th out of 72 countries that participated in PISA". This has proven that mathematics learning achievement in Indonesia is still low.

The reality in the field shows that learning carried out by teachers, especially mathematics teachers still apply the old paradigm of the dimensions of cognitive processes. Besides that students also tend to be less able to solve reasoning problems because most practice questions given in the learning process are comprehension questions, this lack of reasoning skills can be caused by a lack of students' ability to think creatively. The mathematical creative thinking ability of students is considered still lacking because students are less able to give reasons for the answers given and conclude the material given by students during the learning process. Syamsuri (2011) also shows that Mathematics learning is dominated by lectures which then causes students to be passive. This condition makes students not creative because they only listen and solve problems just like the way teachers solve problems. Low creative thinking ability results from the learning process that most students only accept, less active in finding new information to solve mathematical problems.

The importance of students mathematical think creatively and low student abilities, innovative student learning needs to be developed to provide opportunities for students to improve their creative thinking skills, direct students to understand, apply and develop mathematics learning materials. It is necessary to have many ways of solving that are presented that are can to stimulate students high-level thinking skills towards creative thinking so that they can increase their ability to think mathematically creatively. Based on the background above then the purpose of writing this article is to describe the ability to think creatively about the fourth-grade students of SD Negeri 2 Mojosongo. The results of research can be used as

reference material about learning models that can be applied as an alternative to developing students' think creatively. Besides this research also can contribute to repair and developing a learning process in primary schools.

METHOD

Qualitative methods are used to explain the phenomena that occur by collecting data. Qualitative research is research whose produces descriptive data in written or oral form which can then be observed, the researcher aims to obtain in-depth and accurate data so that students can find mathematical creative thinking skills in solving problems.

The sampling technique in this study was carried out by a purposive sampling technique. The sample in this study was fourth-grade students of SD N 2 Mojosongo, Jebres Subdistrict. Subjects were chosen by taking representatives of 2 people who were ranked high, moderate, and lacking. For techniques in collecting data in the form of tests, interviews, and observations ,. Sugiyono (2016) suggests tests are ways or procedures taken in measurement and assessment, in the form of assignments in the form of questions that must be done by the test, so that the measurement results that produce values that symbolize behavior or test performance are obtained.

In this study, data analysis was carried out by flow model techniques with the stages of data reduction, data presentation, verification. Then the data is analyzed until the answers are found, then check the validity of the finding data. Re-check the validity of this data is done using triangulation techniques.

RESULTS AND DISCUSSION

Results the above research can be concluded that the level of ability to think creatively Mathematics elementary school students in solving problem-solving that is 26 students. There are seven students who are able to show fluency and authenticity or fluency and flexibility in solving problems so that they are categorized in level three (creative). Eleven students are at the level of creative thinking to one (less creative) students can show fluency in solving problems. Eight students have not shown indicators of fluency, flexibility, originality and so they enter the zero level (not creative).

After giving a test of the ability to think creatively in solving mathematical problems, interviews were then conducted to find out in-depth about the students' creative thinking skills in solving problems. The interview was conducted with a total of six subjects with details of two students with high ability levels, namely AA and HR, two students with moderate ability levels namely KA and MM, and two students with low ability levels namely AR and WA. A list of offline participants is presented in Table 1 below.

Table 1 List of Participants in the Interview Test Creative Thinking Ability

		Indicators Filled				
No.	Student Code	Fluency	Flexibility	Originality	Elaboration	Level of Creative Thinking Ability
1	AA	√	√	√	-	Creative
2	HR	√	√	-	-	Creative
3	KA	√	-	-	-	Less creative
4	MM	-	√	-	-	Creative enough
5	AR	-	-	-	-	Not creative
6	WA	-	-	-	-	Not creative

Based on Table 1, the results of interviews with students with AA code for fluency indicators obtained information that AA was able to solve the problem well, for indicators of AA flexibility able to solve questions in two ways to solve them well tooand can do the originalaty. Overall AA can answer questions with problem-solving steps and AA sure the answers given are correct. Interviews with students with HR code for fluency indicators obtained information that HR can resolve the questions well, for the flexibility of HR indicators able to resolve the problem in two ways settlement and the answer is correct. Overall HR answer questions with problem-solving steps and HR believes that the answers given are correct. According to Getz and Jackson (Ellys, et al, 2014) open questions provide more than one answer to knowing creativity in the field of mathematics. This must be an open problem as the core of creative thinking skills.

Yee (2002) open problems as structured problems because they involve missing data or assumptions and they do not have a fixed procedure that guarantees the right solution The results of interviews with students with the railway code for fluency indicators were obtained information that MM was can solve the problem well, for indicators of flexibility the train was able to solve the problem but only in one way of completion and the answer was correct . KA can answer questions with problem-solving steps and KA sure the answers are correct. Interview results for students with MM code for flexibility indicators can solve questions in two ways of solving and the answer is correct.

Interviews with students with AR codes for fluency indicators obtained information that AR can't solve the problem because of confusion with the process of processing the questions, for indicators of flexibility . AR can't solve the problem because e do not know how to solve it. answer the question. The results of interviews with students with SR codes for fluency indicators obtained information that WA can't solve the problem because of confusion with the question, for indicators of flexibility WA has not been able to solve the problem, for the novelty indicator can't solve the problem because he cannot answer the question how to solve it.

Based on interviews conducted can strengthen students 'answers and know students' creative thinking skills in solving problems, then obtain information, namely: (1) there are students who are confused in solving problems questions that contain fluency indicators; (2) there are students who cannot solve questions that contain indicators of flexibility; (3) there are students able to solve questions that contain indicators of novelty but the method used is still the usual way; (4) most students can answer with problem solving steps; (5) most students are sure of their answers. Chamberlain and Moon (2005) show that talented creative students have an extraordinary ability to produce something new and solutions that are useful for simulated or real problems, using mathematical models. Chiu (2009) “further connects students' mathematical creativity with the ability to solve routine and non-routine problems and even to approach structured problems”.

The assessment of the researcher used to find out the level of students' creative thinking is following the creative thinking criteria formulated by Siswono (2008) which provides indicators to assess students' creative thinking skills in problem-solving on three levels, namely fluency, flexibility, and novelty. From this study, researchers found several research findings, namely: (1) students' creative thinking abilities vary; (2) most students can answer questions with indicators smoothly (3) there are students who can solve problems in various ways, but are still homogeneous; (4) there are students who can solve problems in a variety of ways and are heterogeneous; (5) level of creative thinking at level 3 (creative); 6) not careful in checking the questions given is the weakness of students. So that following the table of creative thinking

levels, the findings that researchers have obtained can be cited into the 0th level, 1st level, 2nd, and 3rd level. Students with a high level of ability reach the level of 3rd creative thinking, while students with a level of ability are reaching the second and 1st level of creative thinking, and students with low ability levels are at the 0th level of creative thinking. According to Anderson and Krathwohl (2010) states that the creative in an educational context is defined as synthesizing information or materials to create entirely new. The purpose of creative thinking is not originality or distinctiveness, the ability of students to synthesize a whole.

From the results of data analysis, it is known that two students who have a high level of ability are both able to achieve the level of 3rd creative thinking (creative). They have met the indicators of fluency and flexibility. They can understand the problem and can predict the solution, then develop a plan, implement the plan and look back if there are obstacles in obtaining a solution. They can communicate their ideas both verbally and in writing clearly and coherently. They also have good abilities in combining the ideas they have. This is by the statement of Munandar (Siswono, 2008) which states that a person's ability to think creatively is higher if he can show many possible answers to a problem. So when viewed from the level of creativity, students with higher levels of creativity, the more complex the student is in uniting ideas. This is supported by Albert's (2013) opinion that providing open math problems will be more beneficial because it requires learning by collaborating knowledge rather than learning with application problems. In this study found students with the ability to achieve the same level of creative thinking as high-ability students. These students reach the third level of creative thinking (creative), that is, students have achieved indicators of fluency, flexibility and originality. Even to get creative thinking especially in mathematics, Vale & Barbosa (2015) requires high curiosity with the process of exploration and observation, and imagination and original thought. If someone does not like what is being learned, the thinking process will be hampered, they cannot be required to think creatively.

Students with ability levels are at the level of second creative thinking (quite creative) and 1st (less creative). These students reach the second level of creative thinking (quite creative), that is, students have achieved indicators of flexibility. Although the level of creative thinking achieved by students. For questions that contain indicators of oryginality, students with high levels of ability can solve questions well but are answered usual way taught by the teacher, while students with moderate ability levels cannot answer the question. Students with moderate levels of ability can understand problems and can predict solutions, plan and implement plans, but when they encounter obstacles in carrying out their plans they easily give up.

Students with low ability levels are at the level of the 0th creative thinking (not creative) because they are unable to show the three indicators of creative thinking, namely flexibility, fluency, originality and elaborasi. They are difficult to understand the problem and estimate the solution. When they make a settlement plan they don't know whether the method they gave is correct or not. The results of the research described above show that the level of creative thinking of each student is different. Besides, students who have the 1st creative level and 3rd creative level have differences in terms of results and understanding. In line with the opinion of Guilford (2007) which states that creative thinking has two assumptions, namely: first, everyone can be creative to a certain degree in a certain way. Second, the ability to think creatively is a skill that can be learned. So, each person has different degrees of creativity and has its way to realize his creativity. Gilakjani (2011) Creative thinking is thinking imaginatively in solving a problem. The question can be to sharpen the skills of students in creative thinking so that they can help students to better construct the concepts learned.

A similar study was conducted by Masruroh (2015) that the ability to think creatively on the smooth aspects of students with high and middle-skills was not much different, but still superior to students with high initial abilities. It can be seen in this study that students with moderate mathematical abilities can use their knowledge in solving problems. This research is also in line with Mursidik (2015) who claims that students in the medium category have achieved a good aspect of thinking because they can raise an idea in solving open mathematical problems. Inflexible thinking.aspects, students are also on good criteria. That means that he can determine one way to solve mathematical problems.

Furthermore, Anggraeny (2015) states that the originality aspect can only be achieved by some students. Among the three aspects of creative thinking ability, the originality aspect is the least achieved. In this study, it is quite difficult to get students who achieve the aspect of originality. Only students with high mathematical abilities can achieve this aspect even though they are not maximal. This is supported by Akgul (2016) which states that the relationship between aspects of originality and the ability to think creatively is very close. So, students who have been able to reach the originality aspect makes it possible to reach the level of creative thinking.

CONCLUSIONS

The results of the analysis of research data, can be concluded that there are seven students able to reach the third level (creative), eleven students are only able to reach the 1st level (less creative), and eight students are at the zero levels (not creative) Specifically based on the sub-problems formulated, the following conclusions are obtained: (1) High-capable students are able to reach the level of 3rd creative thinking. They can meet indicators of fluency, flexibility and originality. They solve problems in two or more ways ; (2) Medium-skilled students are able to meet indicators of fluency and flexibility. The students with a moderate ability with the first level of creative thinking are only can to fulfill fluency indicators. They solve the problem with two settlement ideas; (3) Low-ability students have not shown indicators of fluency, flexibility, originality and elaboration so that they enter the 0th level (not creative). They cannot solve the problem correctly.

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