



Math Creativity Survey For Class 4 Elementary School

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ABSTRAK

Masalah dalam matematika semakin rumit, terutama terkait dengan kreativitas siswa. Masalah mendasar dari pembelajaran matematika adalah pembelajaran yang sulit dan membosankan serta berdampak pada hasil belajar matematika siswa. Hal tersebut perlu perhatian khusus agar kemampuan kreatif siswa dalam matematika harus dikembangkan dengan berbagai cara. Tujuan dari penelitian ini adalah untuk menganalisis kreativitas siswa sekolah dasar dalam pembelajaran Matematika. Penelitian ini menggunakan pendekatan deskriptif berupa survei. Penelitian ini melibatkan 200 siswa dari 11 SD. Instrumen penelitian berupa angket berdasarkan 4 aspek yaitu kelancaran, keluwesan, orisinalitas dan elaborasi. Pendekatan deskriptif statistik digunakan untuk menganalisis data penelitian. Temuan menunjukkan bahwa kreativitas matematika siswa berbeda dalam empat aspek. Aspek Kelancaran mendapat skor 3,07 dengan kategori sedang. Aspek keluwesan mendapat skor 3,098 dengan kategori sedang. Aspek orisinalitas mendapat skor 2,37 dengan kategori sedang. Aspek elaborasi mendapat skor 2,47 dengan kategori sedang. Berdasarkan hasil penelitian, dapat disimpulkan bahwa dari keempat aspek kreativitas matematika siswa dalam kategori sedang. Temuan tersebut menyatakan bahwa subindikator dalam tiap aspek kreativitas matematika perlu dikembangkan dan ditingkatkan.

ABSTRACT

Problems in mathematics are increasingly complicated, especially related to students' creativity. The fundamental problem of learning mathematics is that learning is difficult and tedious and impacts students' learning outcomes. It needs special attention so that students' creative abilities in mathematics must be developed in various ways. The purpose of this study is to analyze the creativity of elementary school students in learning Mathematics. This research uses a descriptive approach in the form of a survey. This study involved 200 students from 11 elementary schools. The research instrument is a questionnaire based on four aspects: flexibility, originality, and elaboration. A descriptive approach was used to analyze the research data. The findings show that students' creativity differs in four aspects. The Fluency Aspect got a score of 3.07 in the medium category. The flexibility aspect got a score of 3,098 in the medium category. The originality aspect got a score of 2.37 in the medium category. The aspect elaboration got a score of 2.47 in the medium category. Based on the study results, it can be found that from the four aspects of student creativity in the medium category. The findings state that sub-indicators in every aspect of creativity need to be developed and improved.

1. INTRODUCTION

The importance of academic skills, especially in the fields of mathematics, science, and reading, has been in the spotlight of the global economy and workforce readiness in various countries (X. Huang, Chin-Hsi, Mingyao, & Peng, 2021; Soh, 2017; Wulandari, Dantes, & Antara, 2020). Assessment results such as PISA and Trends in Mathematics and Science Study (TIMSS) are closely monitored and the results are very influential in making national education policies (Guo, Marsh, Parker, & Dicke, 2018; Lee & Stankov, 2018). As a scientific discipline, mathematics has an important role in technological and scientific development (Ayvaz & Durmuş, 2021; Wulandari et al., 2020). The topic related to developing creativity among school

students has received attention and has become a topic of discussion in education policy (Ginns, Freebody, Anderson, & O'Connor, 2021; Pulgar, 2021; Sebastian & Huang, 2016). The results of the study also state that creativity is an important component that must be considered (Gita Cemara & Sudana, 2019; Thuneberg, Salmi, & Bogner, 2018). Creativity can be developed more optimally when integrated into lessons rather than being trained as a separate skill. Student creativity can be maximized if the educational environment supports creativity. So that it is necessary to develop a curriculum that is oriented towards creativity to improve creative abilities to generate ideas (Bicer et al., 2021; Kim, Roh, & Cho, 2016; Leikin & Elgrably, 2020).

There are five principles that must be considered in the ability of mathematical creativity in student learning, namely: 1) The Gestalt principle, 2) The aesthetic principle, 3) The free-market principle, 4) The scholarly principle, 5) The uncertainty principle (Moore-Russo & Demler, 2018; Regier & Savic, 2020). By paying attention to these principles, it is hoped that they can monitor the development of students' creativity and be able to study students' attitudes and behavior in the experience of creativity. Creative thinking is also not only useful in the context of learning mathematics outcomes in the school environment, but also as a provision of knowledge that can be useful in the community (Rahmani & Widayarsi, 2017). In addition, the level of students' mathematical creativity needs to be known by the teacher to create learning according to students' abilities (Agustika, Kartika, & Wiarta, 2019; Tubb, Cropley, Marrone, Patston, & Kaufman, 2020). Problems in mathematics are increasingly complicated, especially related to students' creativity (P. S. Huang, Peng, Chen, Tseng, & Hsu, 2017; Wulandari et al., 2020). So, it needs special attention that students' creative skills in mathematics must be developed in various ways (Regier & Savic, 2020; Utari, Wardana, & Damayani, 2019). The basic problem of learning mathematics is that learning is difficult and boring and has an impact on students' mathematics learning outcomes. Based on the results of observations made in 11 elementary schools in Malang City, it was found that teachers tend to provide conventional learning. The questions given are closed and the problem solving is the same as the teacher exemplifies. Lack of giving space for thinking/exploration for students in solving problems. Interviews were also conducted to determine the level of creativity of students. The results show that teachers are less aware and less optimal in developing students' creativity. Because of that, the ability to think creatively is not embedded in learning mathematics.

Previous research that is relevant to this study. Such as research on the level of survey analysis of the relationship between creativity and student achievement. The results show that mathematical creativity is positively related to student achievement (Sebastian & Huang, 2016). Further research related to exploration fosters mathematical creativity which can have an impact on students' self-efficacy. Develop new methods that will be used by instructors and implementation of teaching (Regier & Savic, 2020). Related research compares the impact of applying technology and conventional teaching methods on students' creativity in mathematics classes. The results showed that there was a positive effect of using technology on students' creativity (Baciu, 2021; Berezcki & Kárpáti, 2021). Research on the link between creativity and equity in classroom teaching (Kozłowski & Si, 2019). The learning strategy so that elementary students can express mathematical creativity with open mathematics learning. Students can express ideas, generate many answers in open mathematics learning (Schoevers et al., 2019). Based on a review of previous research, there has been no survey of the creativity of elementary school students in learning Mathematics in terms of fluency, flexibility, originality and elaboration aspects. The level of student creativity needs to be known by the teacher, so that the learning strategies provided can develop student creativity. Through creativity, students can have many ideas to solve problems in everyday life. The purpose of this study was to analyze the creativity of elementary school students in learning Mathematics based on aspects of fluency, flexibility, originality, and elaboration.

2. METHOD

This research uses a descriptive quantitative approach in the form of a survey. This study uses a descriptive qualitative approach in the form of a survey. The survey was conducted by providing questions that could facilitate students to think creatively in learning mathematics. Questions are presented in the form of a google form. Google Form contains ten questions that are used to determine the level of creativity of students. The research subjects were 200 elementary school students in grade 4 at 12 elementary schools in Malang, Indonesia. The sampling used is random sampling. Most of the respondents are female. The average age of respondents is 9-10 years. Respondents came from 9 public schools and 3 private schools from Malang City. All respondents are Indonesian citizens. The research instrument used was a questionnaire based on a review of several studies with a Likert scale. The questionnaire developed consisted of 4 criteria, namely fluency, flexibility, originality, elaboration. Details of the Mathematical Creativity criteria and sub-criteria used for the survey can be seen in Table 1.

Table 1. Criteria for Mathematical Creativity

Criteria	Sub-Criteria
Fluency (Kirisci, Sak, & Karabacak, 2020; Mukhlis & Tohir, 2019)	Generating many ideas in answering questions. Answer with a number of answers. Work faster than other friends. See the weakness of the object being observed.
Flexibility (Al Fatta, Maksom, & Zakaria, 2018)	Interpret a problem. Implementation of the concept in another way. Discuss something different from the others. Have different ideas in solving problems.
Originality (Bahar & Ozturk, 2018; Novak-Leonard, Skaggs, & Robinson, 2021)	Found a new problem. Ask the difference between old and new problems. Give a new idea on a problem. Identify and immediately work on existing problems.
Elaboration (Fernández-Fontecha, 2021; Hidajat, Sa'dijah, Susiswo, Sudirman, & Asari, 2018; Kandemir & Gür, 2009; Nadjafikhah & Yaftian, 2013)	Elaboration Look for the meaning of the answer in detail. Explore ideas. Has a broad answer. Connect between concepts

Data analysis methods include manual calculations. The data analysis technique used descriptive quantitative based on the average value of each criterion and sub-criteria. The results of the interpretation of the average value of the variables obtained ranged from 1.0 to 4.0. Qualification criteria are listed in Table 2 (Demirtaş & Batdal Karaduman, 2021; Fajriah & Asiskawati, 2015; Fernández-Fontecha, 2021)

Table 2. Skala Penilaian Kreativitas Matematika

No	Score Range	Category
1	1.0-1.75	Very low
2	1.76-2.50	Low
3	2.51-3.25	Medium
4	3.26-4.00	High

3. RESULT AND DISCUSSION

Result

In this study, the sample used was 4th grade elementary school students. Respondents came from 11 schools in Malang City. The number of students is 200 students, with 115 male students and 85 female students. Gender of 4th grade students who dominate is male students. The results of the analysis of the mathematical creativity of grade 4 students based on four criteria are shown in Figure 1. Figure 2 shows the results of the survey of students' mathematical creativity for each sub-criteria.

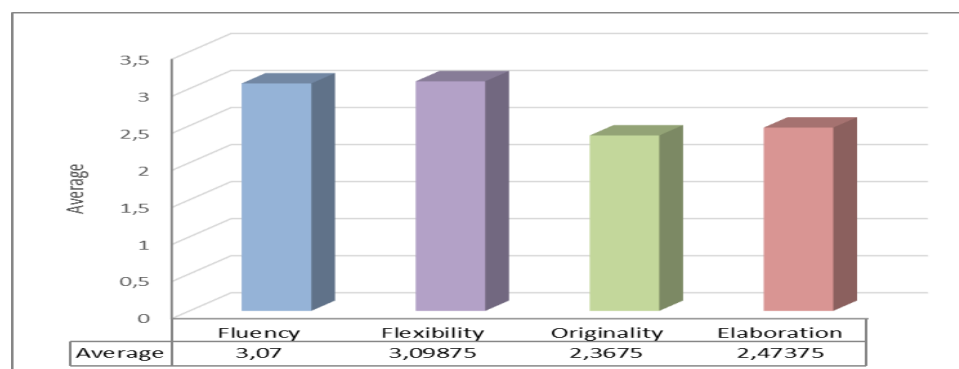


Figure 1. The Results of the 4th Grade Students' Mathematical Creativity Scores

Based on Figure 1, the fluency aspect gets a score of 3.07 in the medium category. Through this aspect, students can generate many ideas in answering questions, answer with a number of answers, work faster than other friends, see the weaknesses of the object being observed (Maharani, 2014). The flexibility aspect got a score of 3,098 in the medium category. Through this aspect, students can interpret a problem, implement concepts in other ways, discuss something different from others, have different ideas in solving problems. The originality aspect got a score of 2.37 in the medium category. Through this aspect, students can find new problems, ask the difference between old and new problems, give new ideas on a problem, identify and immediately work on existing problems. The elaboration aspect got a score of 2.47 in the medium category. Through this aspect, students can look for the meaning of answers in detail, explore ideas, have broad answers, link between concepts. From the results of the analysis that has been carried out, the highest students' creative abilities are aspects of fluency and flexibility. For the lowest score is originality. It also appears that students with poor math skills, they don't have enough math skills to imagine an idea, flexible or creative solution in solving a math problem (Ayvaz & Durmuş, 2021; Stolte, Kroesbergen, & Van Luit, 2019).

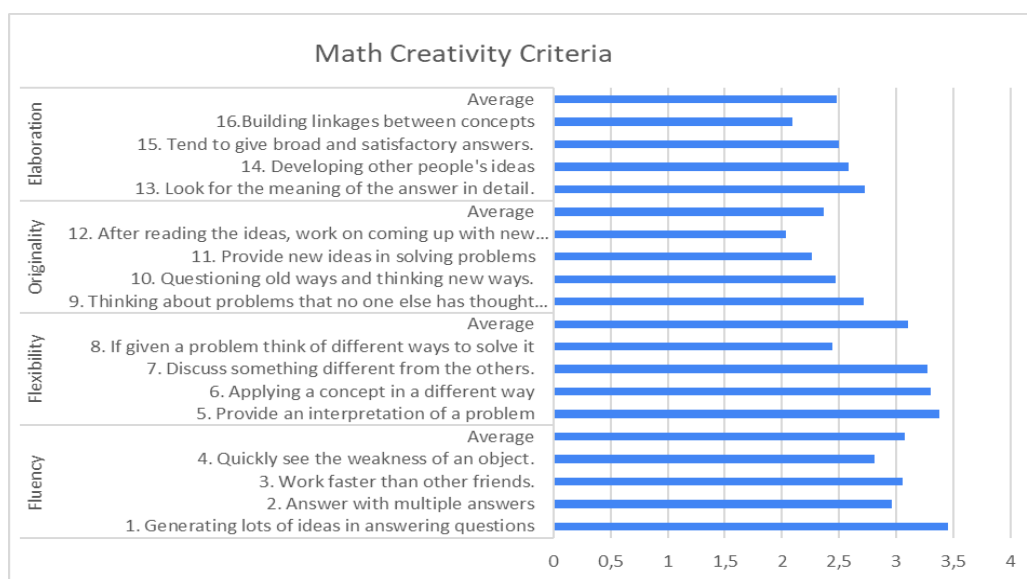


Figure 2. The Results of the 4th Grade Students' Mathematical Creativity Criteria

Figure 2 shows the results of the survey of students' mathematical creativity for each sub-criteria. The results of the survey describe the competence of mathematical creativity for the fluency aspect which is highest in the sub-sparking many ideas in answering questions. A high level of student knowledge will affect the formation of ideas (Montag-Smit & Maertz, 2017).

Discussion

In the aspect of Flexibility, the highest sub-indicator is providing an interpretation of a problem. Aspects of Originality, the highest sub-indicator thinks about problems that have not been thought of by others. Judging from the data, the level of originality in finding new ideas has little difference with usability, novelty in elaboration. Especially in solving math problems. Finally, on the elaboration aspect, the highest sub-indicator is seeking detailed answers. At this stage students will share interpretations related to mathematics, students' views regarding mathematical concepts that are sought in more detail and detail (Aqda, Hamidi, & Rahimi, 2011; Kozłowski & Si, 2019; Mukhlis & Tohir, 2019). Based on this, the ability of students' mathematical creativity is very important to be developed especially related to the aspect of originality. It is important for teachers to develop activities for students to continue to exceed various sub-indicators in mathematical creativity abilities (Ayalon & Wilkie, 2020; Gralewski & Karwowski, 2019; Kasirer & Shnitzer-Meirovich, 2021). From the survey results, it was found that there were different levels of students' mathematical creativity. Data or information related to mathematical problems has its own achievements, from each sub-aspect there is a component of mathematical creativity.

There are many ways to improve students' mathematical creativity, one of which is to provide problems in the form of open answers (Kirisici et al., 2020; Nadjafikhah & Yaftian, 2013). Extracting information from math problem-based questions given by the teacher produces a lot of data that develops students' creative abilities (Dietrich, 2019; Ulrich & Nielsen, 2020). The learning environment and forms

of student collaboration activities also affect mathematical creativity (Corazza, 2016; Lasky & Yoon, 2020; Pulgar, 2021). Through collaboration, it will encourage students to find their own ideas and find new ideas in solving problems (Bruce, Flynn, & Bennett, 2016; Ulrich & Nielsen, 2020). Through the application of the PBL learning model, it can increase students' mathematical creativity (Katz-Buonincontro, Perignat, & Hass, 2020; Zhou, 2021). Because students are trained to think critically to solve mathematical problems so that students can find new ideas (critical thinking).

4. CONCLUSION

The mathematical creativity ability of students in 11 elementary schools in Malang was analyzed based on 4 aspects, namely fluency, flexibility, originality and elaboration. It was found that the students' most prominent creative abilities were fluency and flexibility. The lowest calculation is originality. Based on the results of this study, students' abilities related to originality in solving mathematical problems need to be considered and improved. Teachers need to develop open-ended questions and story questions so that students abilities related to originality in solving problems increase.

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