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# Analysis of Students' Mathematical Creative Thinking Ability in Solving Multicultural-Based Open-Ended Problems

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**Abstract**

This research aims to analyze students' creative thinking abilities and identify factors that influence their ability to solve multicultural-based open-ended problems. This study uses a descriptive qualitative approach with purposive sampling, selecting three students who represent high, medium, and low levels of mathematical ability, based on teacher recommendations and previous academic grades. The research instruments used included three multicultural-based open-ended tests of mathematical creative thinking and semi-structured interview guidelines. Data were collected through written tests and in-depth interviews to explore students' problem-solving processes. The data analysis process was carried out through the stages of reduction, display, and drawing conclusions. The results showed that the mathematical creative thinking abilities of the first (S1) and third (S3) subjects were classified as creative, whereas those of the second (S2) subjects were categorized as less creative. Subjects S1 and S3 successfully met all indicators in the form of fluency, flexibility, originality, and detail. Meanwhile, Subject S2 met the indicators of fluency and detail but did not demonstrate flexibility or originality in problem-solving.

**Keywords**: creative thinking skills, *Open-Ended* questions, multicultural

## 1. Introduction

Mathematics is a branch of science that plays an important role in everyday life. Every student has different mathematical abilities (Asmana & Rohim, 2019). Mathematics is taught to help students develop critical reasoning, creativity, and problem-solving skills (Anita & Rohim, 2024). Therefore, mathematics must be well understood by all students when taught in schools (Rohim & Prayogi, 2023). To help students understand mathematics in schools, communicative, creative, and innovative learning is needed to optimize student achievement (Rohim & Asmana, 2023). The mathematics learning process should be as friendly and free of intimidation as possible, so that students understand the material presented (Rohmah et al., 2024). Teachers are required to create a pleasant learning atmosphere (Ilmiyah et al., 2024). This way, students' motivation to learn is high, resulting in better student learning outcomes (Rohim & Asmana, 2018).

Thinking skills are essential capacities in the 21st century that students must master,

especially in mathematics learning (Rohim et al., 2025). The government is pursuing the Asesmen Kompetensi Minimum (AKM) to equip students with a range of skills. These skills include critical thinking, creativity, problem-solving, and communication and collaboration. (Rohim & Rofiki, 2024). The thinking ability that needs to be developed is creative thinking. According to Munandar (2017), indicators that show creative thinking have 4 components. These indicators include fluency of thinking, namely, the ability to produce appropriate ideas; flexibility of thinking, namely, the ease of moving from one type of thought pattern to another; originality of thinking, namely, the ability to think in new and original ways; and elaboration of thinking, namely, the ability to add details to objects, ideas, or situations. Creative thinking skills can be developed by providing questions that require problem-solving. In general, students in Indonesia can solve factual and procedural problems well but struggle with non-routine problems (Mustofah et al., 2020).

Efforts to improve students' creative thinking skills by using open-ended questions. The open-ended questions used are on statistics. Statistics is essential material for students to learn because, in daily activities, they often encounter data that requires interpretation, thereby requiring a strong mastery (Chairunnissa et al., 2022). Open-ended questions are used to assess students' mathematical creative thinking skills, as the types of questions given allow more than one correct answer (Ayu et al., 2020). In addition to providing open-ended questions through multicultural-based learning education. Multicultural education is an educational system that provides equal opportunities to all children in the nation without discrimination based on ethnic, cultural, or religious differences. It teaches the importance of respecting and appreciating human dignity to the highest degree, regardless of cultural background (Anam & Marlina, 2022). A multicultural learning approach can be implemented across various disciplines, not limited to the fields of culture or the social sciences. The application of multicultural education in mathematics learning presents its own challenges, given the inherent characteristics of mathematics, which cannot be separated from its cultural context (Agho et al. 2022). All students, regardless of their backgrounds, are expected to have equal opportunities to maximize their potential and develop their creative mathematical thinking skills. Based on the explanation above, the researcher was motivated to study this topic through a study entitled "Analysis of Students' Mathematical Creative Thinking Ability in Solving

Multicultural-Based Open-Ended Problems".

## 2. Research Methods

The research design is qualitative descriptive, focused on exploring and understanding social phenomena in depth and the perspectives of individuals who experience them directly. The subjects of this study consisted of three grade X students from MA Sunan Santri, selected using the purposive sampling technique, who had relatively similar average odd-semester mathematics report card scores and experience in multicultural-based mathematics learning. This technique was used to address the research need for subjects able to provide in-depth data on mathematical creative thinking skills in solving multicultural open-ended problems. Selecting subjects with relatively similar average mathematics report card scores aims to minimize differences in general academic ability between subjects. With relatively similar basic mathematical abilities, differences in solving open-ended problems are more likely due to variations in mathematical creative thinking skills than to differences in the level of mastery of the material or basic cognitive abilities. The research instruments were first validated by the validator, including open-ended questions on data centralization statistics and interview sheets. Data collection was conducted through tests and interviews. A written test was administered to the research subjects to determine their mathematical creative thinking skills in solving multicultural-based open-ended problems. Furthermore, in-depth interviews were conducted to explore students' thought processes, reasons for choosing solution strategies, and factors that led to difficulty in achieving the creative thinking ability indicators. The results of this research analysis are based on the Miles and Huberman theory, which states that the data analysis process includes the stages of data reduction, data presentation, conclusions, and data validity.

## 3. Results and Discussion

Based on research data from open-ended test questions, interviews, and field-based learning, it was found that 3 subjects had almost identical average report card scores, but their mathematical creative thinking abilities differed. The three subjects were S1, S2, and S3. The summary results of the analysis of each subject's mathematical creative thinking abilities in solving the creative thinking ability test questions on data centralization

statistics material, according to the Munandar creative indicators, are 4 components. These indicators include fluency, flexibility, originality, and elaboration, which will be explained as follows:

**Creative thinking ability of the first subject (S1)**

Figure 1 below presents data on S1's creative thinking skills.

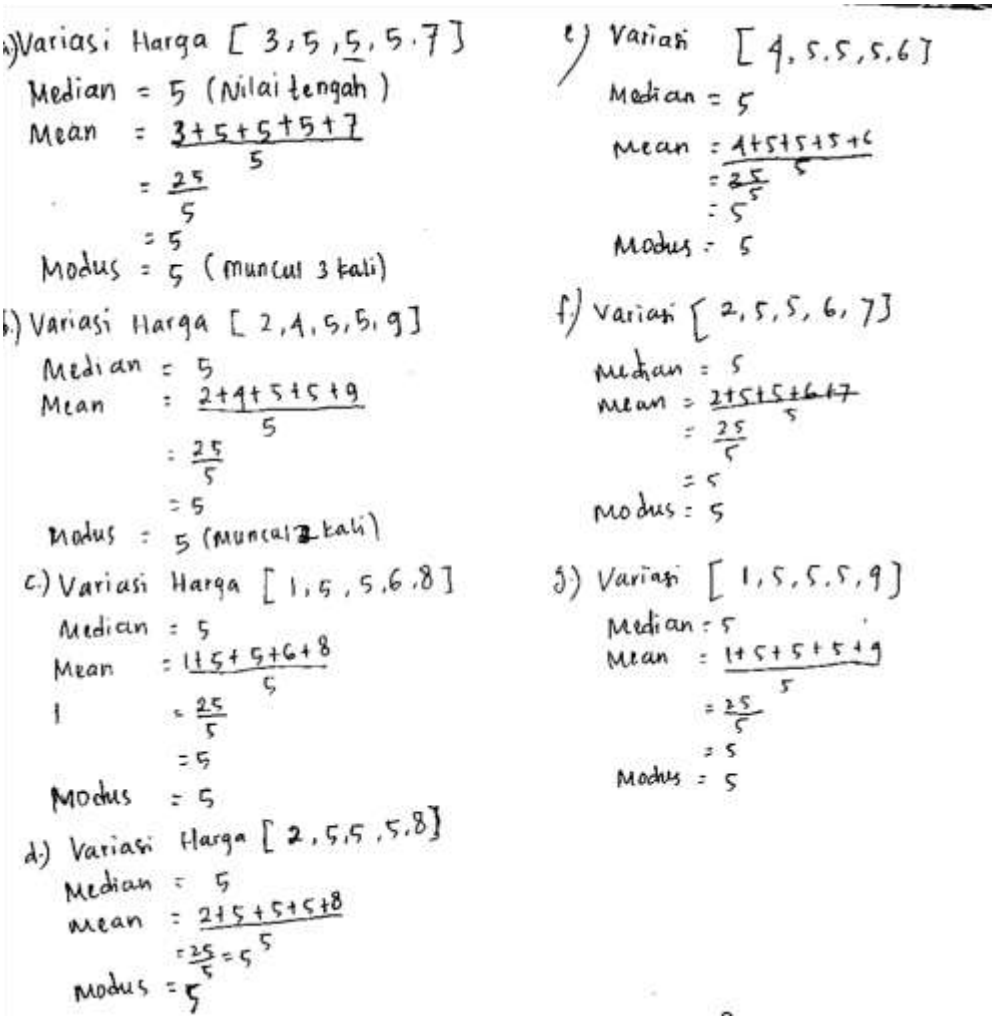


**Figure 1**. S1's Answer

R: Read the question carefully. If so, what do you know about this question?

S: In the question, the mean, median, and mode of the five data sets are 5. Create as many variations of the data set as possible, consisting of five data sets, that still produce a mean, median, and mode of 5, with numerical values ranging from 1 to 10.

R: How many possible answer variations are there to solve this question?

S: I was able to find 7 answer variations that meet the requirements of the question.

R: Is the answer you wrote your own discovery?

S: Yes, it is my own answer.

R: Please explain your answer in detail.

S: Yes, I will explain it in detail on the answer sheet I wrote, which you can see.

From the interview answers above, it shows that S1's fluency indicator is able to understand what is meant by question number 1 well, namely finding as many data variations as possible consisting of 5 data that still produce mean, median, and mode values of 5 with a number limit or numerical value of (1-10), originality is able to complete and write the answer to question number 1 with his own thoughts without asking his friends, namely: my own answer is correct, flexibility is able to understand and solve question number 1 with several correct answers, namely: finding 7 answer variations that meet the requirements of question number 1, namely the mode, mean, and median of 5 and elaboration with various answers in detail and all correct, namely: The first variation by appearing 3 times the number 5 $[3, 5, 5, 5, 7]$ the value of the mean resulting from the first variation of the mean $= \frac{3+5+5+5+7}{5} = \frac{25}{5} = 5$. The mode is 5 because the number 5 appears 3 times in the first variation. The median of the first variation is 5. In the second variation, the number 5 appears 2 times $[2, 4, 5, 5, 9]$ and the mean of the second variation is $\frac{2+4+5+5+9}{5} = \frac{25}{5} = 5$. The mode value in the third data variation Mode = 5, because it appears twice. For the median value produced in the third variation Median = 5, the third varition appears the number 5 twice, $[1, 5, 5, 6, 8]$ mean $= \frac{1+5+5+6+8}{5} = \frac{25}{5} = 5$, Mode = 5 appears 2 times Median = 5, The fourth variation is the number 5 appearing 3 times $[1, 5, 5, 5, 9]$ mean $= \frac{1+5+5+5+9}{5} = \frac{25}{5} = 5$, Mode = 5 appears 3 times Median = 5, The fifth variation is the number 5 appears 2 times $[2, 5, 5, 6, 7]$, mean $= \frac{2+5+5+6+7}{5} = \frac{25}{5} = 5$ Mode = 5 appears 2 times Median = 5, The sixth variation is the number 5 appears 3 times $[4, 5, 5, 5, 6]$ mean $= \frac{4+5+5+5+6}{5} = \frac{25}{5} = 5$ Mode = 5 appears 3 times Median = 5, The seventh variation with the number 5 appearing 3 times $[2, 5, 5, 5, 8]$ mean $= \frac{2+5+5+5+8}{5} = \frac{25}{5} = 5$ Mode = 5 appears 3 times Median = 5. The first subject (S1) is a good subject in terms of solving open-ended questions, because it can fulfill all the indicators of creative

thinking skills, including fluency, flexibility, originality, and elaboration.

**Creative thinking ability of the second subject (S2)**

Figure 2 below presents data on S2's creative thinking skills.

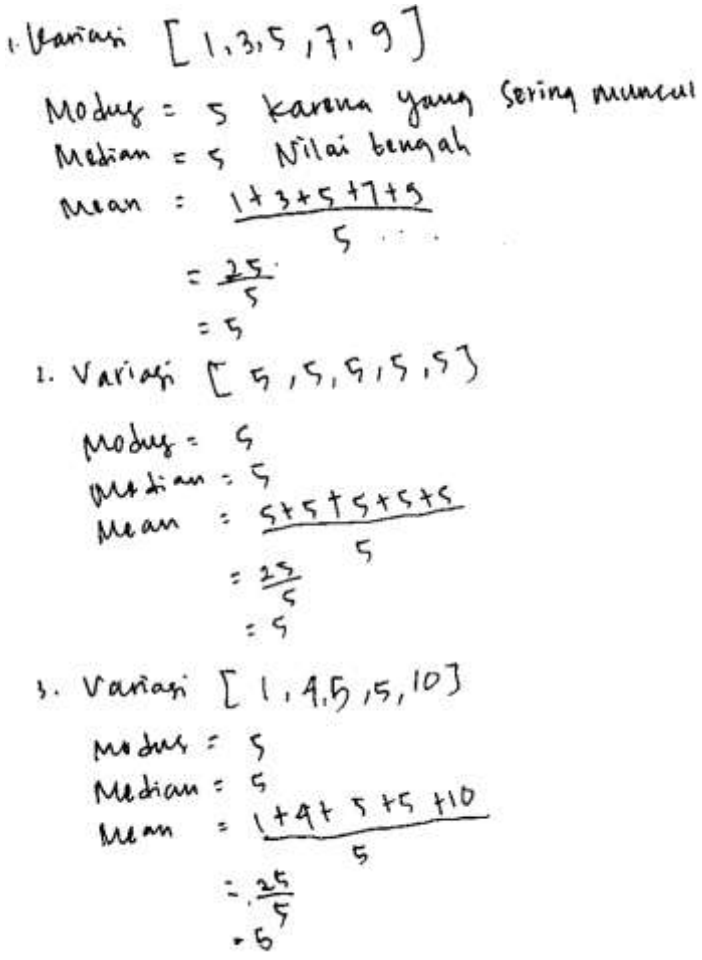


**Figure 2.** S2's Answer

R: Read the question carefully. If so, what do you know about it?

S: I was confused at first, but after reading it over and over, I understand what I know from question number 1: that all the resulting means, medians, and modes must be 5.

R: How many possible answer variations can be used to solve this question?

S: There are 3 variations, but I'm not sure if they're correct.

R: Is the answer you wrote your own invention?

S: No, I was confused earlier, so I looked at a bit of the answer from my friend next to me when you weren't looking.

R: Can you explain the answer you wrote in detail?

S: I'll explain in detail the variations $[1, 3, 5, 7, 9]$ [5,5,5,5,5] [1,4,5,5,10] as I saw my friend's.

From the interview answers above, it shows that the second subject (S2) showed a fluency indicator that he was able to understand what the question meant well, even though he was a little confused at first, namely "all the means, medians, and modes produced must be worth 5". The second subject was unable to achieve the flexibility indicator because the answers written were varied, but there were wrong answers because they did not meet the question requirements, namely, in the first price variation $[1, 3, 5, 7, 9]$ the price variation did not have a mode. This is in accordance with the results of research by Ayu et al. (2020), the majority of students stated that their views on the problem tended to be the same, so this condition resulted in the flexibility indicator being in the low category. In the originality indicator, subject S2 was also unable to complete and write the answer to the question with his own thoughts without asking his friend, namely: No, I was confused earlier, so I looked a little at the answer from my friend next to me. Elaboration indicator, the second subject (S2) was able to write a detailed answer even though the price variation in the first answer did not have a mode, the price variation $[1, 3, 5, 7, 9]$ the median or middle value is 5, the mean value is $\frac{1+3+5+7+9}{5} = 5$. Price variation $[5, 5,5, 5, 5]$ mode is 5, mean is $\frac{5+5+5+5+5}{5} = 5$ and median 5. The third price variation $[1, 4, 5, 5, 10]$ has a mode of 5, a median of 5, and the mean value is $\frac{1+4+5+5+10}{5} = 5$. The second subject (S2) was able to solve the open-ended questions given, but was only able to fulfill the fluency and elaboration indicators for creative thinking skills.

**Creative thinking ability of the third subject (S3)**

Figure 3 below presents data on S3's creative thinking skills.

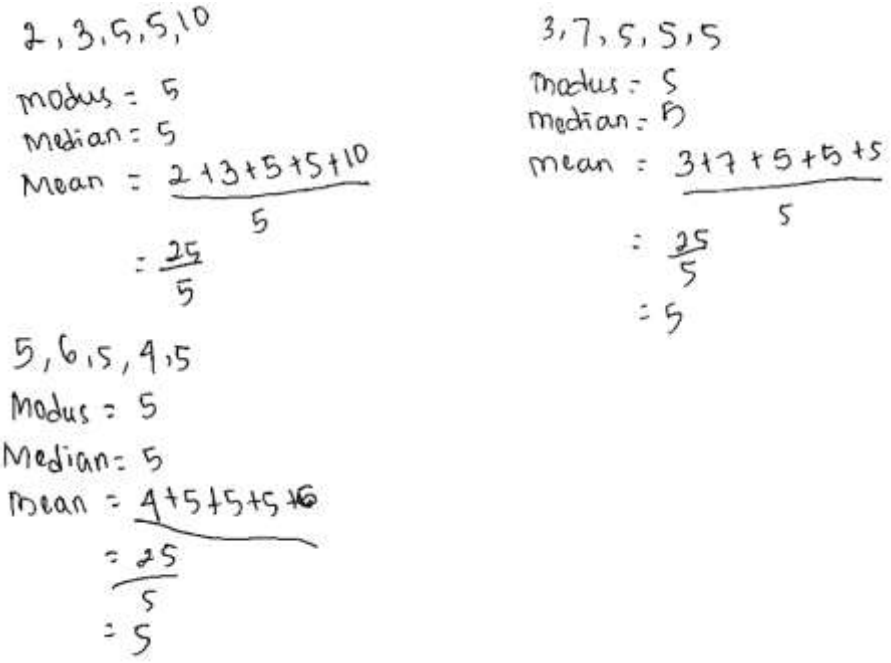


**Figure 3.** S3's Answer

R: Read the question carefully. If so, what do you know about it?

S: About the mean, median, and mode, all of which must be 5.

R: How many possible answer variations are there to solve this question?

S: I found 3 price variations.

R: Is the answer you wrote your own invention?

S: I tried to enter the numbers according to the question's requirement that the mean, mode, and median be 5.

R: Could you explain your written answer in detail?

S: I explained it in detail on the answer sheet, although my writing wasn't very clear.

The answers of subject S3, it shows that S3 fulfills all indicators. The third subject (S3) is good in terms of solving open-ended questions, with the fulfillment of all indicators of creative thinking ability, namely understanding fluency directly being able to understand the meaning of the information from the questions given, namely about the mean, median and mode, all of which must be 5, flexibility being able to provide different price answer variations "I found 3 price variations", originality providing answers to price variations by trying to enter the numbers according to the requirements in the question that the mean, mode and median must be 5 even though it takes quite a long time. and elaboration. The third subject can achieve the elaboration indicator, all the answers given are described in

detail, the first price variation is $2, 3, 5, 5, 10$, the median and mode are 5 and the mean is $\frac{2+3+5+5+10}{5} = \frac{25}{5} = 5$. The second price variation is $4, 5, 5, 5, 6$, the median and mode are 5 and the mean is $\frac{4+5+5+5+6}{5} = \frac{25}{5} = 5$. The third price variation is $3, 5, 5, 5, 7$, the median and mode are 5 and the mean is $\frac{3+5+5+5+7}{5} = \frac{25}{5} = 5$. This aligns with research conducted by Ayu et al. (2020). The elaboration indicator ranked second, indicating that students were able to develop ideas for a given problem by detailing the available information and solving it step by step.

**Creative thinking ability factors**

R : What do you think of the question I gave you earlier?

S : The question was a bit difficult because the answer wasn't immediately obvious, and there was more than one way to solve it.

R : Are you used to solving problems like this?

S : Not really. I'm more used to questions with a single correct answer and a single way to solve them, so questions like this are unfamiliar and leave me uncertain.

R : Why didn't you try a different method?

S : Because I was afraid of making mistakes, and I'd never tried a different method. Usually, if there's a formula, I just use that.

R : When studying statistics, how do you usually understand the material?

S : I usually memorize the formulas and example problems from the teacher, then follow the steps.

Based on the interview results, it was found that factors caused the subjects to have considerable difficulty in achieving the indicators of creative thinking skills. If viewed from the student factors, among others, 1) Students are not used to answering open-ended questions; 2) In answering questions, students are still less accustomed to using other methods or with a variety of correct answers, and 3) Students' tendency to memorize or imitate the material given by the teacher hinders the development of original thinking skills. This habit makes students less accustomed to generating new ideas or unique solutions when faced with problems, so their creativity is not optimal, leading to non-unique answers.

## 4. Conclusion

The discussion concluded that creative mathematical thinking skills in the first and third subjects encompassed achievement in four indicators: fluency, flexibility, originality, and elaboration. Meanwhile, the second subject achieved two indicators: fluency and elaboration.

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