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# ANALYSIS OF MATHEMATICAL CREATIVE THINKING ABILITY OF HIGH SCHOOL STUDENTS IN WEST BANDUNG REGENCY

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**ABSTRACT**

The rapid development of technology requires creative human resources to solve various mathematical problems. The importance of thinking creatively is contained in the Graduate Competency Standards (SKL). This study aims to determine the mathematical creative thinking skills of high school students in West Bandung using sequence and series materials. The research method used is the descriptive qualitative research method. The study was conducted on 35 class XI students at a high school in West Bandung. The instrument used is four items about the ability to think creatively on the material sequences and series. The research was conducted in the odd semester of the 2022-2023 school year. The results showed that the percentage of flexibility indicator questions was 61.143%, which means most students can work on questions with the flexibility indicator. The rate of fluency indicator items was 52%, the percentage of originality indicator items was 43.169%, and the elaboration indicator was 40%. These results show that the elaboration indicator has the rate percentage compared to other indicators of creative thinking ability. The study's results concluded that the creative thinking skills of high school students in West Bandung Regency were still low, with a percentage of 49.19%. Researchers recommend using interactive learning media such as e-LKPD to improve mathematical creative thinking abilities.



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## INTRODUCTION

The development of science and technology is currently multiplying. Therefore, it is necessary to have high intellectual and creative human resources to solve problems in Indonesia. One way to improve these abilities is through education. The skill dimensions of

Graduate Competency Standards for SMA, according to Permendikbud Number 20 of 2016 (Kemendikbud, 2016), are having the skills of (1) creative, (2) productive, (3) critical, (4) independent, (5) collaborative, and (6) communicative using a scientific approach and other sources independently. Regarding skills for the Graduate Competency Criteria, students need creative thinking ability to solve math problems. Choosing and developing various alternative creative thinking strategies in mathematics certainly require creativity. This agrees with Ruggerio's opinion (Fisher et al., 2019), which states that creative thinking produces various concepts of problems accompanied by multiple ways to deal with them and possible solutions. Munandar said (Susanto, 2013) indicators in creative thinking, namely lancer skills; flexibility skills; original skills; detailing skills; and evaluation skills.

Although the ability to think creatively is one of the essential abilities for students, in reality, many still need students who still need to solve a mathematical problem related to the ability to think creatively. Mathematics is considered a complex subject for students. (Meika & Sujana, 2017) found that students' creative thinking abilities need to be improved or suboptimal. This statement is supported by data from students' creative thinking test results, where students had an average score of 12.88 (under 50) and a mode score of 0.00. From the study results (Wulansari & Astuti, 2022), the ability to think creatively in class XI Senior High School Bantul in the sum and difference of sines and cosines is still in the criteria of being quite creative. This is also supported by the achievements of Indonesian students on the 2018 PISA test (OECD, 2019), which shows that the average math score of Indonesian students is 379, with an average score of OECD countries 487. This means that Indonesian students' creative thinking ability still needs to improve. This is because the problem-solving process in solving PISA test questions is independent of standard formulas and requires creative thinking abilities to innovate to solve problems in different ways.

The ability to think creatively mathematically is the ability to solve mathematical problems with more than one solution, and students think fluently and flexibly, carry out elaborations, and prioritize answers (Marliani, 2015). (Lestari & Zanthy, 2019) stated that the ability to think creatively mathematically is the ability to build ideas and solve mathematical problems, including fluency, flexibility, originality, and elaboration. Munandar said (Susanto, 2013) indicators in creative thinking are fluency skills; flexibility skills; original skills; detailing skills; and evaluation skills. According to Filsaime (Artikasari & Saefudin, 2017), indicators of mathematical creative thinking ability consist of fluency, flexibility, and originality. Based on the description above, the researcher concluded that the ability to think creatively mathematically is the ability to generate ideas or new ways of solving mathematical problems. The indicators of creative thinking skills used by researchers in this study are fluency, flexibility, originality, and elaboration. This study aims to determine the mathematical creative thinking abilities of high school students in West Bandung using sequences and series material.

## METHOD

The research method used is the descriptive qualitative research method. The subjects in this study were 35 students of class XI who were taken randomly at a high school in West Bandung. The research was conducted in the odd semester of the 2022-2023 school year on sequences and series material. The instrument used is a matter of description of the ability to think creatively.

The researcher gives four questions about creative thinking instruments students. The results of student answers are given a score according to the rubric of student assessment on a predetermined grid. Each indicator's score results are added, and the percentage is calculated. Then the results of the proportion of students in each indicator are analyzed based on the table

that distinguishes creative thinking abilities. The next step is to describe the results of student work on the answer sheet.

The criteria for the ability to think creatively (Arikunto, 2007) are shown in the table below.:

**Table 1.** Criteria for Creative Thinking Ability

| Score | Criteria |
|---|---|
| 68%-100% | Creative |
| 33%-67% | Creative Enough |
| <33% | Less Creative |

## RESULTS AND DISCUSSION

### *Results*

Data from the outcomes of this study are in the form of student learning outcomes, and instrument test questions containing up to four question descriptions are used for data collection. The data is obtained by analyzing the answers using the scoring rubric for the ability to think creatively and mathematically. The indicators of creative thinking ability that researchers use are flexibility, Fluency, Originality, and elaboration.

**Table 2.** Data Analysis Results of Student Answers

| Code Student | No 1 Flexibility | No 2 Fluency | No 3 Originality | No 4 Elaboration |
|---|---|---|---|---|
| 1 | 10 | 4 | 8 | 6 |
| 2 | 2 | 4 | 8 | 4 |
| 3 | 6 | 4 | 15 | 2 |
| 4 | 10 | 4 | 8 | 6 |
| 5 | 6 | 8 | 15 | 2 |
| 6 | 6 | 4 | 10 | 2 |
| 7 | 6 | 4 | 10 | 6 |
| 8 | 6 | 10 | 10 | 2 |
| 9 | 4 | 8 | 8 | 2 |
| 10 | 4 | 4 | 0 | 2 |
| 11 | 10 | 0 | 8 | 2 |
| 12 | 10 | 0 | 8 | 2 |
| 13 | 6 | 4 | 10 | 2 |
| 14 | 4 | 4 | 0 | 2 |
| 15 | 2 | 4 | 8 | 6 |
| 16 | 4 | 8 | 10 | 2 |
| 17 | 0 | 0 | 15 | 10 |
| 18 | 2 | 10 | 0 | 6 |
| 19 | 0 | 4 | 8 | 2 |
| 20 | 2 | 4 | 8 | 6 |
| 21 | 8 | 0 | 0 | 2 |
| 22 | 4 | 4 | 0 | 6 |
| 23 | 10 | 4 | 5 | 6 |
| 24 | 10 | 4 | 8 | 6 |
| 25 | 8 | 4 | 5 | 6 |
| 26 | 6 | 8 | 0 | 6 |

| | | | | |
|---|---|---|---|---|
| 27 | 6 | 10 | 0 | 10 |
| 28 | 10 | 4 | 0 | 2 |
| 29 | 10 | 4 | 8 | 2 |
| 30 | 6 | 10 | 8 | 6 |
| 31 | 6 | 8 | 5 | 2 |
| 32 | 10 | 4 | 5 | 2 |
| 33 | 0 | 8 | 5 | 2 |
| 34 | 10 | 8 | 5 | 6 |
| 35 | 10 | 10 | 8 | 2 |
| Amount | 214 | 182 | 229 | 140 |
| Percentage | 61,143 | 52 | 43,619 | 40,000 |
| Average | | 49,190 | | |

Based on the table 2, the average percentage of students in question number 1 with indicator flexibility is 61.143%, question number 2 with indicators Fluency is 52%, question number 3 with indicators originality is 43.619%, and question number 4 with indicators Elaboration is 40%. Because the four indicators are below 70%, this shows that the creative thinking skills of high school students in the West Bandung district are still low.

***Problem No. 1 Flexibility***

*One hundred marbles will be placed in 10 different cups, each containing a different number of marbles so that the number of marbles in each cup forms an arithmetic series. How many marbles can be placed in one of the cups?*

a. *Identify known and asked elements!*
b. *Write two ways to count the most significant number of marbles that can be placed in one of the cups!*
c. *Please choose one of them, then complete it along with the concept or formula used in each step!*

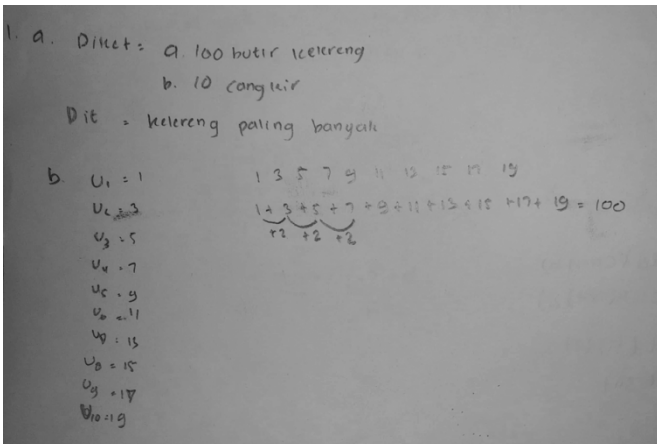


**Figure 1**. Example of Student's first answer No. 1

In figure 1, students assume that the difference in each cup is 2, but when 10 cups are added up, the result is 100. So students get $U_{10}$ which is 19. This shows that students can express their creative ideas to answer correctly. However, the student only wrote one way, while the questions were asked two ways. This follows research (Rasnawati et al., 2019) that there are students who answer with a calculation process, and the results are correct, but the answers do not vary.

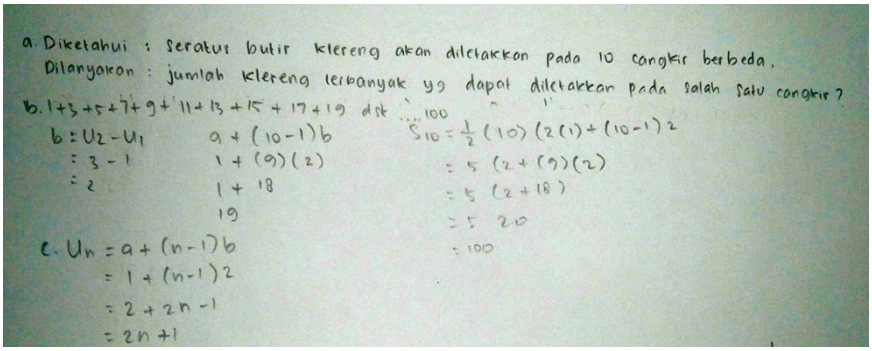


**Figure 2.** Example of the answers of the two students No. 1

Student answers in figure 2; students can write two ways to count the highest number of marbles placed in one of the cups with the correct calculation process and results. Even though students were asked to choose one of them, students were able to solve the question in two ways. On the Flexibility indicator, the average percentage of students is 61.143%. Most students can work on Question 1 with the flexibility indicator. However, this percentage is still below 68%. It is in the criteria of being immensely creative, which shows students' ability to answer indicator questions flexibility is still low and needs to be higher.

***Problem No 2 Fluency***

*Rina counted the natural numbers between 1 and 100, divisible by 6.*

a. *Make two questions based on the information above related to sequences and series!*
b. *Select a question, then check the completeness of the data. If the data is complete, complete the question accompanied by supporting reasons. If the data is incomplete, complete it first, then finish it!*

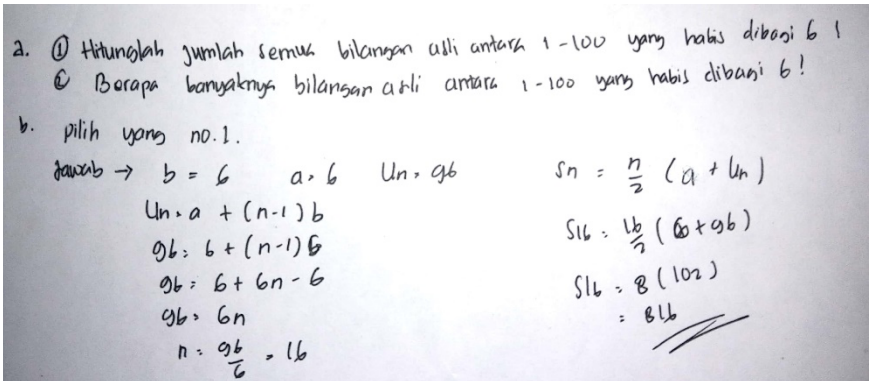


**Figure 3.** Example of Student Answers No. 2

In the answers in Figure 3, students can make two questions regarding the above information related to sequences and series. Then students choose the answer to the first question and answer it completely and correctly. This is by research (Santi et al., 2019) on indicators of student fluency having provided more than one relevant idea, and the completion is complete and precise. Students offer more than one relevant idea with a complete and straightforward solution. In question number 2, with the indicator of fluency, the average percentage of students is 52%, meaning that the rate in the criterion is quite creative, indicating that students' ability to work on questions on this indicator is still low.

***Problem No 3 Originality***

a. *Write a word problem regarding Sequences and Series in everyday life!*

b. *Identify known and asked elements and state them in the mathematical model of the problem!*
c. *Write down the mathematical concepts contained in the story problem.*

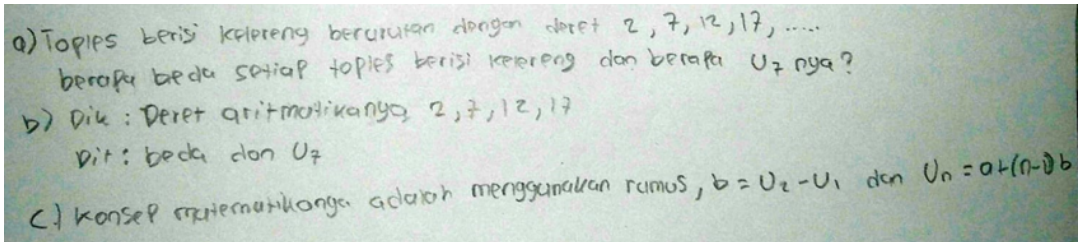


**Figure 4.** Example of Student Answers No. 3

In figure 4, students can make word problems regarding sequences and series in everyday life but are still confused about arranging words for these word problems. (Akbar, 2020) stated that questions must have good language skills starting from the sequence of words in sentences and mastery of EYD. Students write down elements that are known and asked in word problems and write mathematical concepts contained in story problems but still need to complete the story problems. In question number 3, with the indicator of Originality, the average percentage of students, namely 43.619%, means that the criterion is quite creative and shows that students' ability to work on questions on this indicator is still low.

***Problem No 4 Elaboration***

*Housing developers, to attract buyers, build a tower in the middle between the entrance and exit in the form of a pile of 5 equilateral triangular prisms that have different sizes with a height of 3 m each. The prisms are arranged regularly, and the position of the second prism is placed above the first prism, with every corner of the second prism placed right in the middle of each side of the first prism. The position of third prism is placed above the second prism, with every corner of the third prism placed right in the middle of each side of the second prism, and so on, until the fifth prism. The developer wants to paint all surfaces of the tower that are visible to passers-by; if the length of the first prism is 4 m and the cost of painting needed to paint the building is IDR 100,000.00 per $m^2$,*

a. *Identify known and asked elements!*
b. *Define a mathematical model to determine costs incurred by the developer to paint the tower, and write the concepts in the model!*
c. *Then complete the model accompanied by the concepts used in each step of completion!*

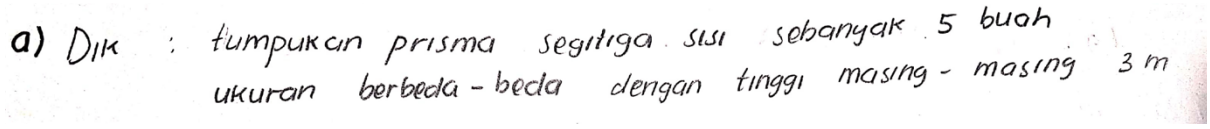


**Figure 5.** Example of Student Answers No. 4

In Figure 5, students can only write down what is known in the problem. This shows that students have not been able to understand what is being asked in the questions and are not familiar with questions in the form of stories (Fatahillah et al., 2017; Gunawan, 2017; Halim & Rasidah, 2019; Haryati et al., 2016; Indrawati et al., 2019; Saparwadi, 2022; Utami & Puspitasari, 2022). According to (Farida, 2015; Utari et al., 2019), the cause of students' lack of understanding of story problems is that students are unable to understand the intent of the questions, confusion when determining the operations used, and errors in the concept aspect.

After all, there has been a misconception among students. In question number 4, with the elaboration indicator, the average percentage of students is 40% with creative enough criteria; the results show that this question indicator has the lowest rate compared to other problem indicators. These results align with the study's results (Zanthy, 2019) that the indicator of elaboration questions has the lowest percentage, namely 80%.

***Discussions***

The average percentage of students from all indicators working on creative thinking ability questions on sequences and series material is 49.19%, which means that the average student is in the criteria of being quite creative. These results are by research (Putra et al., 2018) which shows that most of the student's creative thinking skills of junior high school students in Cimahi are quite creative criteria (moderate) in solving straight-line equation questions, with only six students obtaining a percentage of 18.18% on creative criteria , as many as 22 students got a percentage of 66.66% in the criteria of being quite creative, and two students with a percentage of 15.15% in the criteria of less creative.

The results of the research on the four indicators of the ability to think creatively, namely flexibility (61.143%), fluency (52%), originality (43.169%), and elaboration (40%) in the row and series material obtained a percentage of between 33% -67% which shows the four indicators on the criteria of being quite creative, while the research conducted by (Hanipah, 2018) regarding the ability to think creatively mathematically by 32 MTs students in solving Circle questions, namely that there were only two indicators that entered the high criteria, namely for the Flexibility indicator of 81%, Originality Thinking of 70% and 61%. The indicators that fall into the medium criteria are the Fluency indicators at 55%, and the indicators that fall into the low criteria are the Elaboration thinking indicators at 26%. This shows that the highest percentage is found in the flexibility indicator, and the lowest rate is in the elaboration indicator. These results indicate that students' creative thinking abilities in SMP/MTs and SMA still need to improve.

## CONCLUSION

Based on research at a high school in the West Bandung district on the material of sequences and series shows that students' creative thinking skills are still low, with an average percentage of all indicators, namely 49.19%. The average rate of students in question number 1 with indicator flexibility is 61.143%, question number 2 with indicators Fluency is 52%, question number 3 with indicators originality is 43.619%, and question number 4 with indicator Elaboration is 40%. The percentage of elaboration indicators is lower than other question indicators because students do not understand the meaning of the questions and are confused about the operations used.

To obtain the maximum results for mathematical creative thinking abilities, it is recommended that teachers and high school students in West Bandung use interactive teaching materials that can improve mathematical creative thinking skills. In addition, further research is needed regarding developing these interactive teaching materials to enhance mathematical thinking skills.

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