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EXPLORING CREATIVE THINKING SKILL: HOW DO STUDENTS WITH LOGIC-MATHEMATIC AND VISUAL SPATIAL INTELLIGENCE SOLVE CONTEXTUAL MATHEMATICS PROBLEMS?

Hilaria Yesieka Ayu Wulandari[1*], Rooselyna Ekawati[2], Ali Shodikin[3]

[1,2,3] Mathematics Education Study Program, State University of Surabaya
Ketintang Wiyata Number 36, Surabaya City 60231, East Java, Indonesia

e-mail: [1] hilariayesieka.20026@mhs.unesa.ac.id

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*corresponding author**

Abstract

This study aims to describe students' abilities with visual-spatial and logical-mathematical intelligence in solving contextual mathematical problems. This qualitative research involved two eighth-grade students from a junior high school, each with a background in logical-mathematical and visual-spatial intelligence. The task consisted of two questions that asked students to create two park designs and two alternative payment methods for the "Suroboyo Bus." These findings show both subjects' complete fluency and flexibility indicators in creative thinking. Subjects exhibit the ability to generate diverse solution pathways and apply various problem-solving strategies. Furthermore, the creative thinking skills displayed by the subject contribute to their comprehensive understanding of mathematical concepts and foster deeper engagement with the subject. The analysis results show that students with logical-mathematical intelligence were able to solve the problems well and came up with various alternative answers that other students did not consider. Students with visual-spatial intelligence were able to solve the problems successfully but did not find ideas to search for alternative answers beyond what was already presented. These findings indicate that both students with visual-spatial and logical-mathematical intelligence were capable of solving the given contextual problems, although there is still room for improvement.

Keywords: creative thinking, visual-spatial, logic-mathematics

1. Introduction

One of the important educational aspects in the 21st century is creative thinking. Creative thinking has a role in the development of science, technologies, and social activities. Creative thinking has a very important role in explaining the conflicts that arise (Dwi et al., 2022). Creative thinking promotes the ability to see from multiple perspectives facilitate various parties and communicate with pleasure combining different interests in daily work (Qadri et al., 2019). Individuals with creativity can demonstrate a work ethic that is productive, innovative, flexible, and consistently optimistic, to confront the different challenges they encounter. Their creative thinking ability serves as a foundation for them to react to the outcomes they receive (Yayuk et al., 2020) Creative thinking in mathematics plays a significant role in enabling students to acquire a profound understanding of mathematical concepts and develop their mathematical abilities (Hadar & Tirosh, 2019). This involves encouraging students to approach mathematical problems in innovative ways, promoting their ability to think outside the box and make connections between different mathematical ideas. Developing these skills can help students become more confident problem-solvers, improve their overall mathematical ability, and ultimately contribute to their success in future academic and professional pursuits (Aizikovitsh-Udi, 2014)

Creative thinking refers to an individual's ability to generate ideas that are suitable for addressing problems, events, or situations. It is evaluated based on three key aspects: fluency, flexibility, and originality (Suherman & Vidákovich, 2022; Yazar Soyadı, 2015). Fluency involves producing numerous ideas, while flexibility entails exploring multiple perspectives on the subject matter. Originality refers to presenting new and innovative ideas that have not been previously proposed. Competence in all three areas is used to evaluate creativity. By excelling in these aspects, individuals can generate more effective and unique solutions to the challenges they face (Dilekçi & Karatay, 2023). Based on I. Casing & B. Roble (2021), the focus of the study is on how well students can demonstrate their ability to think creatively in mathematics. This ability has three components: fluency, flexibility, and originality. Fluency is the capability to provide prompt and effective answers to different questions. Flexibility refers to the ability to adapt one's thinking to overcome cognitive obstacles. Lastly, originality is the ability to come up with unique and uncommon solutions that stand out from those of others in the group

According to (Fitrianawati et al., 2020), an individual's creativity can be divided into four different models based on broader domains of creativity, namely mini creativity, small creativity, Pro creativity, and big creativity. (Siswono, 2018) suggests that an individual's level of creative thinking can be determined through creativity indicators such as fluency, flexibility, and originality. The levels of creative thinking are categorized into five levels of creative thinking ability (TKBK), which include TKBK 4 (very creative), TKBK 3 (creative), TKBK 2 (moderately creative), TKBK 1 (barely creative), and TKBK 0 (not creative). Students with TKBK 4 possess all indicators of fluency, flexibility, and originality, those with TKBK 3 have either indicator of flexibility and originality or fluency and originality, those with TKBK 2 have either indicator of originality or fluency and flexibility, those with TKBK 1 only have one indicator of fluency or flexibility, while those with TKBK 0 do not have any of the indicators.

According Azinar et al., (2020), intelligence consists of multiple components known as multiple intelligences. These include linguistic-verbal intelligence, logical-mathematical intelligence, spatial-visual intelligence, rhythmic-musical intelligence, kinesthetic intelligence, interpersonal intelligence, naturalist intelligence, and existential intelligence. Recognizing these different types of intelligence helps individuals understand their strengths and weaknesses, and educators can use this knowledge to develop better teaching and learning approaches. Regarding creative thinking, multiple intelligences are also relevant in measuring how an individual's creative thinking ability relates to specific intellectual abilities. In mathematics, two closely related multiple intelligences are logical-mathematical intelligence and visual-spatial intelligence (Azinar et al., 2020). Logical-mathematical intelligence involves reasoning, pattern recognition, and problem-solving using numbers, symbols, and logic. People with strong logical-mathematical intelligence excel in mathematical calculations, logic puzzles, and scientific reasoning. They are also adept at analyzing complex systems, making hypotheses and predictions, and applying deductive and inductive reasoning to solve problems. Visual-spatial intelligence refers to the ability to perceive and think about visual information in a three-dimensional manner and understand object and spatial relationships. Individuals with strong visual-spatial intelligence are skilled at visualizing objects and their connections. They often have a good sense of direction and orientation, and they excel at interpreting and creating visual representations such as maps, charts, diagrams, and drawings.

However, there were studies by Asriningsih et al., (2018) that show that students with moderate levels of logical-mathematical intelligence complete the indicator for fluency but have not yet demonstrated flexibility and originality. While students with logical-spatial intelligence can complete all the indicators of creative thinking (Yuliati et al., 2021). This may be due in part to the fact that the problems presented have not yet reflected issues that are close to the students themselves. Also, Ratnasari (2022) mentioned that with contextual problems, students become more understanding of the presented issues and more independent in problem-solving. Therefore, limited studies found that it would be better to present problems that are close to the students themselves in measuring their creative thinking abilities so that students can more easily construct and actively seek answers to the problems (Faturohman & Afriansyah, 2020)

Therefore, this present study aims to conduct an in-depth investigation of how students with logical-mathematic and visual-spatial intelligence use their creative thinking skills to solve numeracy problems based on contextual mathematics problems.

2. Method

This research engages as many as 27 seventh-grade students with various backgrounds in terms of gender, multiple intelligence, and also mathematical creative thinking ability from a state junior high school in Surabaya. Before selecting the students participating in the test, the students have to fill out the questionnaire to determine their multiple intelligence. They were asked to fill out the questionnaire which consists of 32 statements that represent the 8 multiple intelligences. The result from the questionnaire showed that the students have various multiple intelligences based on their scores. As many as 2 students were selected from each to represent the test. The selected students have Visual-Spatial and Logic Mathematics Intelligence, information from their mathematics teacher, and willingness to participate in the test of their mathematics creative thinking. Thus, we had one male student with the highest Visual Spatial Score (MVS) and one female student with the highest Logic Mathematics Score (FLM).

The instruments used in this research are a multiple intelligence questionnaire test, a mathematics creative thinking test, and an interview. Only selected samples are going to have creative thinking tests and walk-in interviews. First, all students have to fill out the questionnaire by giving a score on each statement. The purpose of this section is to choose subjects from visual-spatial intelligence and logic mathematic intelligence. This task was arranged by authors in a quantitative approach, while the second task was developed and arranged by authors in a qualitative approach in which the problem was a real-world problem situation. All instruments have been validated by the expert. The following instruments are below.

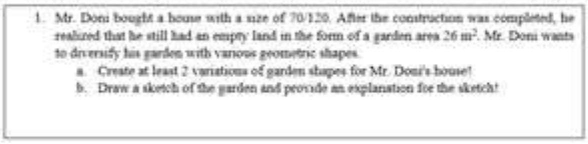
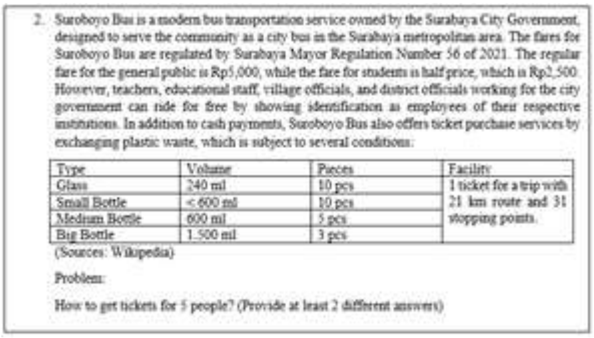

1. Mr. Doni bought a house with a size of 70/120. After the construction was completed, he realized that he still had an empty land in the form of a garden area 26 m^2. Mr. Doni wants to diversify his garden with various geometric shapes.
   a. Create at least 2 variations of garden shapes for Mr. Doni's house!
   b. Draw a sketch of the garden and provide an explanation for the sketch!

Figure 1. Mathematics Creative Thinking Test (1)


2. Suroboyo Bus is a modern bus transportation service owned by the Surabaya City Government, designed to serve the community as a city bus in the Surabaya metropolitan area. The fares for Suroboyo Bus are regulated by Surabaya Mayor Regulation Number 56 of 2021. The regular fare for the general public is Rp5,000, while the fare for students is half price, which is Rp2,500. However, teachers, educational staff, village officials, and district officials working for the city government can ride for free by showing identification as employees of their respective institutions. In addition to cash payments, Suroboyo Bus also offers ticket purchase services by exchanging plastic waste, which is subject to several conditions:

Type	Volume	Pieces	Facility
Glass	240 ml	10 pcs	1 ticket for a trip with 21 km route and 31 stopping points.
Small Bottle	< 600 ml	10 pcs	
Medium Bottle	600 ml	5 pcs	
Big Bottle	1.500 ml	3 pcs	

(Sources: Wikipedia)

Problem:

How to get tickets for 5 people? (Provide at least 2 different answers)

Figure 2. Mathematics Creative Thinking Test (2)

Table 1. Interview Instrument

No	Question	Indicators	Code
1	Do you understand the question commands? Try to explain the meaning of the question is?	Fluency	F1
2	How many ways are you getting? Try to explain every way you get it!		F2
3	What was the first step you took? What strategy did you use to answer this question?	Flexibility	F3
4	Is there another way to solve the problem other than the methods you have written?	Novelty	N1

Data from the interview were analyzed by firstly reducing data, displaying data, and finally drawing conclusions. The aim is to find how students with logic mathematics and visual-spatial intelligence solve the mathematics creative thinking problem related to a real-world problem situation. The first step is reducing data, 2 subjects that participated in the test of mathematics creative thinking automatically do the interview, to find the importance of the student's answers should be focused on the indicators of creative thinking: fluency, flexibility, and novelty. The second stage is displaying data. The result from the students' answers in the paper and from the interview section was then explained to display the student’s ability in creative thinking. Then, the last stage is concluding. From the first stage and second stages, Conclusions then can be drawn with an associated from the students' results. So, the subjects with logic mathematics, and visual-spatial intelligence can be categorized in TKBK. The final result is the students' creative thinking stages. Based on Siswono (2018), creative thinking is categorized stage in solving mathematics problems with creative thinking characteristics which are fluency, flexibility, and novelty shown in this table.

Table 2. Creative Thinking Stage Category

Creative Thinking Stage	Category	Characteristic
Stage 4	Most Creative	Students show fluency, flexibility, and novelty in solving mathematics problem
Stage 3	Creative	Students can give many mathematics models as a way to solve the problem even if the solution isn’t showing the original solution
Stage 2	Creative Enough	Students can give many ways and give more than one mathematics models to solve the problem and not show originality in solving the problem and also the given solution isn’t correct
Stage 1	Less Creative	Students can give many mathematics models in ways to solve the problem but the solution isn’t correct
Stage 0	Not Creative	Students can’t show fluency, flexibility, and novelty in solving mathematics problem

3. Results and Discussion

3.1. Results

3.1.1. Creative Thinking Ability of MVS (Male Visual Spatial)

On the first problem, MVS began his creativity to draw rectangles to give a symbol that it was the house. In the process of solving the problem, he read the information about the house types 70/120 and asked what the meaning of this information was. Subject FLM then helped him answer by saying that the house type has an area of $70m^2$ from a total area of 120 m^2.

Table 3. Interview of Fluency Indicators of MVS

R (Researcher)	*Can you understand the problem given? Please re-explain the problem and given information based on your understanding!*
MVS 1 *(F1)*	*Yes, I can. From the information, the point is that Mr. Doni has a house with a $120m^2$ area then he wants to modify his empty land in his house by making a garden in the $26m^2$ area*
R	*How many ways you get to solve the first problem?*
MVS 2 *(F2)*	*I can provide you with two different model solutions based on the given requirements.*
R	*Tell me your solution!*
MVS 3 *(F2)*	*The most reasonable shape to make a garden is a rectangle, but since the problem asked us to give 2 variations then I think a trapezoid is also good enough.*
R	*Then, what next steps you take to solve the problem?*
MVS 4	*Because the problem is to find area, we also need the formula of rectangle area and trapezoid area*

Subject MVS tries to guess the length of the height of the rectangle. Since the given area is $26m^2$, the subject guesses that the length is 13 m and the height is 2 m because when it’s multiplying, it gets $26m^2$ by the subject knowledge of the rectangle area formula. The subject was sure about the answer and then tried to find the side length of the trapezoid. He tries many times to find the exact value to determine the sides and length of the trapezoid. After several attempts to find the sides and the length area, the subject finally mentioned that he found that the value of parallel sides is 6 m and 7 m, and the length of the trapezoid is 4.

Table 4. Interview of Flexibility Indicators of MVS

R	*How can you get the size of a trapezoid?*
MVS 1 (F3)	*The area of the trapezoid is half multiplied by the sum of the sides and then multiplied by the height of the trapezoid. Since the given information is not given anything about the trapezoid sides, then I must guess any parts*
R	*Please tell me your steps so that you can find the size of the trapezoid!*
MVS 2 (F3)	*In the given area which is 26m² by 2, I had 52m², and from 52m² I tried to find the factors of 52, then I found 1,2,4,13,26, and 52. After I found the factors of 52, I chose 4 to be the length of the trapezoid. If the length is 4, we must find what value when multiplied by 4 is equal to 52. After calculating, I found that 13 is the value. Since the part that I did not know yet is the summary of the size of the up and down sides and I have 13 as the value, then I guess that the size of the upper side is 6 and the size of the lower side is 7. So here is my way to find the length and sides of the trapezoid*

Subject MVS received appreciation because he could explain his answer correctly and clearly. In these parts, the indicators of flexibility are completely successful. The subject can make these two shapes by observing and estimating the area of a flat shape and then trying to make the right size.

Table 5. Interview of Novelty Indicators of MVS

R	*Is there another way to solve the problem other than the methods you have written?*
MVS 1 (N1)	*No, I don't. I think my method and my solution are the final solution.*
R	*Are you don't want to try to find another method?*
MVS 2 (N2)	*No, I'm not interested.*

After guessing the size of the sides from any shapes and not interested in finding other ways to solve the problem, subject MVS continues his task to sketch the garden and gives explanations about his answer.

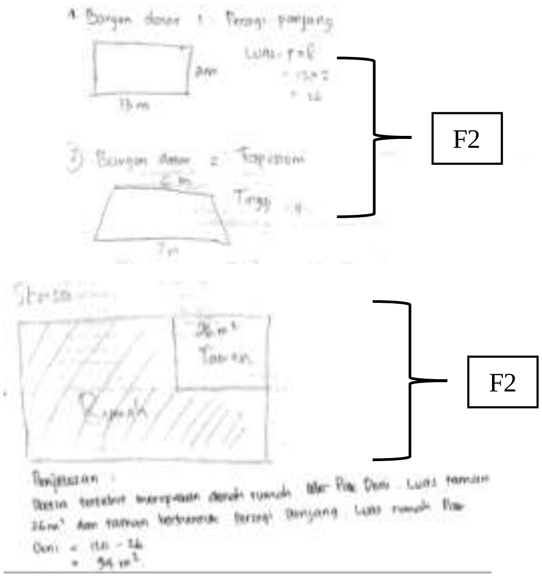


Figure 3. Subject MVS answers from the first problem

Subject MVS, in addition to his previous contributions, also provided the information that the area of Mr. Doni's house is 94 m2. MVS's fluent response to the question concerning the steps required to achieve the desired outcome showcased his problem-solving skills, despite the direct answer on the paper lacking a specific sequence. While MVS demonstrated impressive fluency, flexibility, and adaptability, it is important to acknowledge that he did not meet the criterion of originality since he could have proposed alternative solutions to the problem.

After finishing the first problem, the subject MVS is next to the second problem. The subject read the information and the problem given.

Table 6. Interview Session Problem 2 of MVS

R	*Can you understand the problem given? Please re-explain the problem and give information based on your understanding!*
MVS 1 (F1)	*The given information, is about the price of the Suroboyo bus. In the given information, we know that for the public the price is Rp5.000, then for students, the price is Rp2.500, and for the workers in Surabaya's government is free. From the information, besides e-money, to use Suroboyo bus also can by swapping the plastic bottle or plastic glass with the quantity as informed to get 1 ticket of Suroboyo Bus.*
R	*Then, what is the problem?*
MVS 2 (F2)	*I have to provide at least 2 ways to get a ticket if there are 5 people.*
R	*Tell me your solution!*
MVS 3 (F2)	*To get 5 tickets for 5 people is can buy e-money. We need Rp25.000 because, for 1 person, the price is Rp5.000. So, if we have 5 people, we need 5x Rp5000 and it's equal to Rp25.000. Because it's*

	need 2 ways, so for the second way is to collect medium plastic bottle
R	*Then, what next steps you take to solve the problem?*
MVS 4 (F3)	*From the information, if we get a ticket with a medium plastic bottle, each person has to collect 5 plastic bottles with 600ml size. So, if we have 5 people, we need a 5x5 plastic bottle with 600 ml size. In the end, we need 25 plastic bottles of 600 ml size to get 5 tickets for the Suroboyo Bus*
R	*Is there another way to solve the problem other than the methods you have written?*
MVS 4 (N1)	*We can combine from all ways that given in the given information. For example, when we have 5 people, we need 5 tickets, and from the given information there are also 5 ways to get a ticket, first is by paying with e-money, and for the public we need Rp5.000, then the second way is by collecting 10 plastic glass with 240ml to get 1 ticket, the third way is by collect 10 small plastic bottles with the size is smaller than 600 ml to get 1 ticket, the fourth way is by collecting 5 medium plastic bottles with 600ml to get 1 ticket, and the fifth way is to collect 3 big plastic bottles with 1500 ml to get 1 ticket. If we combine all the ways, we get 5 tickets for 5 people. So, there are other ways to get 5 tickets for 5 people*

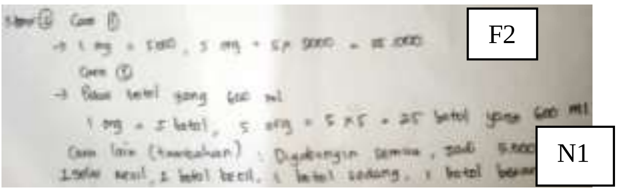


Figure 4. Subject MVS answers from the second problem

From MVS's answer, it can be seen that he is able to provide 2 solutions that can be done to obtain Suroboyo Bus tickets for 5 people. MVS suggested the idea of using e-money and exchanging 600 ml bottles. He was also able to provide an alternative solution by combining e-money with a 1,500 ml bottle. He said that the advantage of the first solution is the ease and speed of using e-money, while the second solution provides flexibility with the option of exchanging a larger bottle. This shows that MVS has the ability to think creatively and flexibly in finding effective and efficient solutions. With two solution options, MVS demonstrates his ability to provide alternatives that can be adjusted to individual situations and preferences.

3.1.2. Creative Thinking Ability of FLM (Female Logic Mathematics)

On the first problem task, to begin the finding problem solution, subject FLM read carefully any given information and the given problem. Almost the same with subject MVS, subject FLM starts with drawing a rectangle and explaining that it was the total area. After drawing the rectangle, then she divided the rectangle into 2 parts and gave information that the left side was the house and the right side was for the garden.

Table 7. Interview of Fluency Indicators of FLM

R	*Can you understand the problem given? Please re-explain the problem and give information based on your understanding!*
FLM 1 (F1)	*In number one, there are many given information, such as: first, there is an area of 120m^2 and there is a house with 70m^2. Second, after the construction, there is an empty area with a size is 26m^2. Then, the owner wants to make a garden with this empty area with the shape. So, the problem needs us to make 2 variations of the garden with different shapes, then sketch the variation that we make*
R	*How many ways do you get to solve the first problem?*
FLM 2 (F2)	*Actually, I think I can give more than 2 different shapes here. But, since the requirement is 2, then I will make 2 shapes*
R	*Tell me your solution!*
FLM 3 (F2)	*I think the best shape of the garden is squares and rectangles because sometimes people choose those shapes when they want to make a garden in their house.*
R	*Then, what next steps you take to solve the problem?*
FLM 4	*I think I have to find the value of each shape with the area's formula of shapes and rectangles.*

Subject FLM then tries to hook the information about the given area to determine the size of the sides in the square. Since the given area is 26m2 and 26 is not a square number, the subject FLM finds difficulties at the start of her work in finding the size of the side.

Table 8. Interview of Flexibility Indicators of FLM

R	*Do you find any difficult?*
FLM 1	*I forgot that the size of the square side is must same on each side. But, 26 is not a square number, and the nearest square number is 25 and the root of 25 is 5.*
R	*Then, can you find the solution to your difficulty?*

FLM 2 (F3)	*Since the given is 26 then I decided to make a square garden with the size of side 5 and the leftovers are the way to the garden or a border line near the garden.*
R	*What is your next step after this?*
FLM 3 (F3)	*The given information is about the area, so we also need the formula of rectangle areas to determine the size of the length and height of the rectangle.*
R	*What's your strategy to find the size of the length and height?*
FLM 4 (F3)	*Previously, I think the size is 13m and 2m from find the factors of 26. But it is not proportional. Since there's no regulation that has to whole number, I can use any number to determine the size length, and height of the rectangle*
R	*Then, what's the number?*
FLM 5 (F3)	*I find the best size for the length and height of the rectangle is 6 m and 4,3 m. I think with the length is 6 m and the height is 4,3 m it is the best size for the garden. Even if the result is not 26 m^2 but 25,8 m^2, I think it's not a problem since the difference is just 20 cm.*

These activities also represented that the indicators of flexibility are successful completely. Then, to know if the subject completes the last indicators with novelty, the subject FLM is asked to try to find another way to solve the problem.

Table 9. Interview of Novelty Indicators of FLM

R	*Is there another way to solve the problem other than the methods you have written?*
FLM 1 (N1)	*I'm trying to find another solution to solve the problem in part, but I don't know other ways to solve the problem*
R	*Are you don't want to try to find another method?*
2 (N2)	*I'm interested in making two kinds of sketches. So, I combined 2 shapes so the garden shape is like the letter L*
R	*Is there another way to solve the problem other than the methods you have written?*

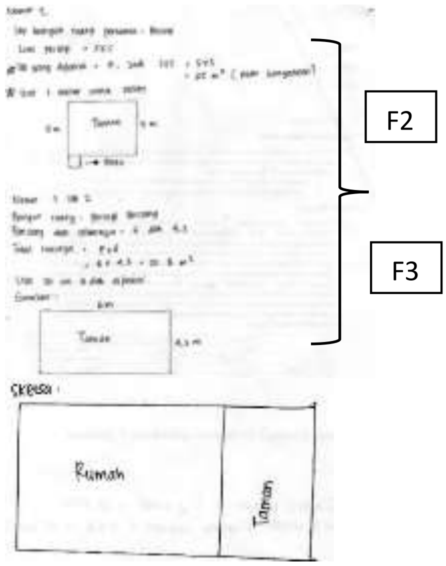


Figure 5. Subject FLM answers from the first problem

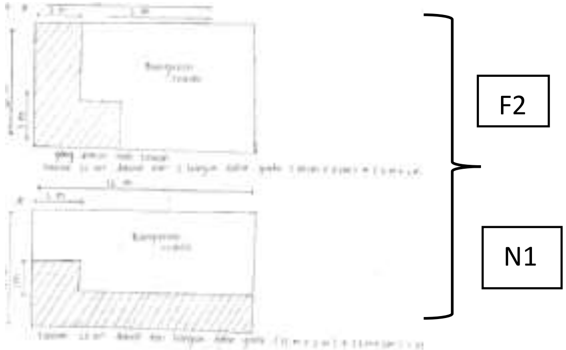


Figure 6. Subject FLM alternative solution

Subject FLM demonstrated exceptional ability in providing solutions that were never thought of by subject MVS. FLM successfully designed a square-shaped garden with an additional fence, presenting a highly innovative concept. Not only that, but FLM also showed remarkable creative thinking skills when given the opportunity to develop a garden sketch. In a short amount of time, FLM was able to produce two garden sketches in the shape of the letter L, demonstrating high intelligence and creativity. FLM's success in providing alternative answers that were never thought of by subject MVS is concrete evidence that FLM has a higher level of thinking and is capable of surpassing conventional thinking limits.

After finishing the first problem, the subject FLM is next to the second problem. She read the given information and was given the problem.

Table 10. Interview of Novelty Indicators of FLM

R	*What did you know about Suroboyo Bus?*
FLM 1	*When I swap the bottle, the operators will give me the card and, on the card, there are 10 places to collect the stamp and 1 stamp is valid just for 1 person. So, when swap 5 medium plastic bottles in the bus station, the operator gives me 1 stamp on*

	the card. Every time I need to use the Suroboyo Bus, I can give the card to the operators so operators can give the marks to the sample.
R	*Can you understand the problem given? Please re-explain the problem and give information based on your understanding!*
FLM 2 (F1)	*From the given information, is about the price of the Suroboyo bus and how to get a ticket for the Suroboyo Bus by swapping the plastic to get 1 ticket. In the given information, it is mentioned that for the public the price is Rp5.000, then for students, the price is Rp2.500, and for the workers in Surabaya's government is free by showing their identity.*
R	*Then, what is the problem?*
FLM 3 (F1)	*From the information, besides e-money, to use the Suroboyo bus also can by swapping the plastic bottle or plastic glass with the quantity as informed to get 1 ticket for the Suroboyo bus. Then, the given problem is I have to find at least 2 ways to get 5 tickets to Suroboyo Bus for 5 people*
R	*Tell me your solution!*
FLM 3 (F2)	*There's no information about who are 5 passengers. Based on that, I will choose that the first way is for 5 people to be public and the second way for 5 people for the combination of public and student.*
R	*Then, what steps did you take to solve the problem?*
FLM 4 (F3)	*To get 5 tickets for 5 people is can buy e-money. We need Rp25.000 because, for 1 person, the price is Rp5.000. So, if we have 5 people, we need 5 x Rp5000 and it's equal to Rp25.000*
R	*Then, what next?*
FLM 5 (F3)	*Then, the second way to get a ticket is by collecting three big plastic bottles and then swapping them. Because we just need 3 plastic bottles to get 1 ticket and it is less than the other. So, if we choose the biggest plastic bottle, we need a 5x3 plastic bottle with a 1500 ml size. In the end, we need 15 plastic bottles of 1500 ml size to get 5 tickets for the Suroboyo Bus*
R	*You also want to combine the passengers. What is the strategy?*
FLM 6 (F3)	*Yes, the combination is 3 public and 2 students. To get 5 tickets for 3 public and 2 students, the easiest way is also using e-money. Since, for the students it was free, so we just needed to pay for the 3 public. We just need Rp15.000 for 3 public and 2 students when we used e-money because, for 1 public person, the price is Rp5.000.*
R	*Can you provide other ways to solve the problem besides the 2 ways that you already mentioned?*
FLM 7 (N1)	*Yes, I think I can combine e-money and swapping the bottle. For example, if we need 5 tickets for 5 people, we can combine the plastic bottle with the size of 600 ml and 1500. We can collect 9 plastic bottles the size is 1500ml to get 3 tickets and collect 10 plastic bottles with the size 600 ml to get 2 tickets. The reason why I didn't choose to combine it with e-money is it just makes the way is not effective, because if we have e-money it's better when we use e-money for all tickets.*

By answering the last question, the subject FLM was completely the novelty indicator because she could mention another solution to solve the problem. In the end, all of the creative thinking indicators are completely by subject FLM.

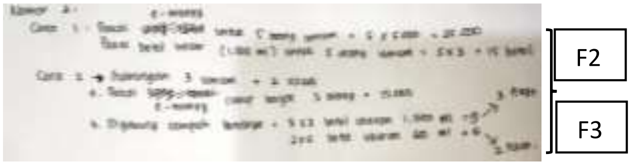


Figure 7. Subject FLM answers from the second problem

The answers provided by subject FLM reveal their remarkable ability to demonstrate both creative and critical thinking skills when considering the individuals who will be boarding as the 5 passengers. FLM ultimately decides that the group should consist of 3 regular passengers and 2 students, showcasing their thoughtful consideration. Additionally, FLM offers two alternative solutions for each of the two conditions created. The first condition involves 5 regular passengers, while the second condition involves a combination of 3 regular passengers and 2 students. FLM suggests solutions that involve the use of cash as well as utilizing bottles, displaying their resourcefulness and versatility in problem-solving.

3.2. Discussion

This study investigated mathematical creative thinking from two students with different kinds of multiple intelligence in solving mathematical contextual problems. Both subject MVS and FLM can understand problems, develop solutions, implement them, and can verify their answers. In addition, subject FLM solves problems according to a plan takes steps to re-check her solutions, and may always complete the verification process. Subject MVS shown indicates indicators of fluency and flexibility, but it cannot be said that they have fully achieved the indicator of originality because when answering the first problem, the subject did not demonstrate this indicator. MVS needs to read the meaning of the information and questions given several times as there are some unfamiliar words. Initially, subject MVS was still uncertain about the strategy to be used. The MVS subjects were able to use various methods to solve problems, but they did not show any innovative ideas. They were able to use their visual-spatial understanding to come up with diverse solutions by using different strategies, techniques, or approaches. However, the ideas they generated were not very new or unconventional. When it comes to creative thinking, generating original, innovative, or unconventional ideas is referred to as novelty of ideas. The MVS subjects may have used their visual-spatial understanding well, but they still need to improve their ability to generate newer or unexpected ideas. It is important to note that evaluating creativity is subjective and can vary depending on the analysis method used. Further analysis of specific evaluation tools can provide more detailed insights into the creative ability of MVS subjects.

However, the MVS subject is still able to solve all the given problems accurately. On the other hand, FLM does not need to read repeatedly, but she needs to validate whether her knowledge is right. In contrast to the MVS subject, the FLM subject shows signs of originality by discovering or presenting alternative strategies that were not taken into account by the MVS subject. The FLM subject is capable of articulating and implementing alternative strategies effectively in order to achieve the ultimate solution to the problem. The subject FLM, who has logical-mathematical intelligence, exhibits a high level of creative thinking based on the analysis of test results. Subject excels in generating a wide range of ideas or solutions, demonstrating proficiency in fluency. Subjects also exhibit flexibility in their thinking, allowing them to approach problems from different angles and consider alternative perspectives. Her fluency in generating ideas showcases their ability to think divergently and explore multiple possibilities. Her adaptability and openness to different perspectives and approaches demonstrate flexibility in her thinking, leading to innovative solutions. Lastly, she can generate novel and original ideas beyond conventional thinking patterns, pushing the boundaries of traditional approaches and introducing fresh perspectives. Despite that, both subject MVS and subject FLM are capable of answering and providing accurate solutions to the given problems. This result is in line with (Widiana & Jampel, 2016) and (Fitrianawati et al., 2020) who stated that students who have strong linguistic-verbal, logical-mathematical, and visual-spatial intelligence can demonstrate a good understanding of the problem, as indicated by their ability to fulfill markers of problem understanding (Yuniarti et al., 2021). They can devise a plan to solve the problem based on the concepts they have learned during the planning stage (Arsyad et al., 2020) During the completion stage, students follow through with their pre-planned solution to address the problem.

4. Conclusion

Based on the results of the research and discussion presented, it can be concluded that the creative thinking process of students with visual-spatial and logical-mathematical intelligence types in solving contextual mathematical problems is as follows:

Creative Thinking Ability of Students with Visual-Spatial Intelligence in Solving Contextual Problems. In the indicator of fluency, students with Visual Spatial Intelligence (MVS) understand the given problem, even if the subject still reads the information repeatedly, the subject can reexplain the given information. The subject carefully examines the problem and identifies the information provided in the question. He also creates a plan regarding the approach they will use to solve the problem. In the indicator of flexibility, the subject successfully comes up with an idea to solve the problem they haven't solved yet. Additionally, the subject is able to develop and expand on that idea. He also can explain why he used the strategy to solve the problem. But, in the indicator of novelty, the subject does not consider any other approach apart from the one they have already mentioned, as they believe that any new method would be more challenging than the solution that he has already presented. Based on the analysis conducted, the subject with MVS (visual-spatial intelligence) demonstrates a level of creative thinking in category 3. Although the subject is capable of using various methods to solve problems, there is no indication of novelty in the ideas presented.

Creative Thinking Ability of Students with Logic-Mathematics Intelligence in Solving Contextual Problems. In the indicator of fluency, a student with Logic Mathematic Intelligence (FLM) has understood the given problem and the subject verifies her knowledge about the given information. The subject shows her ability to carefully examine the question and identify the information provided. Then, she proceeds to create a plan for solving the given problem. In the indicator of flexibility, the subject also succeeds in finding an idea to solve the problem they haven't finished yet. Furthermore, the subject is able to develop and expand on that idea. The subject also clearly explains the strategy used to solve the problem. She can show and explain step by step what she used to solve the problem. Then, for the indicator of novelty, the s considers alternative methods besides the one initially provided and is able to apply those methods to solve the given problem as an alternative solution. Therefore, based on the analysis of the results of the creative thinking ability test, it can be determined that the subject FLM, with logical-mathematical intelligence, exhibits a level of creative thinking in category 4. The subject has demonstrated indicators of fluency, flexibility, and the ability to generate novel ideas and concepts.

Subject FML demonstrates higher creative thinking abilities compared to subject MVS because FML is able to meet all the indicators of creative thinking ability, particularly in the aspect of flexibility. FML shows the ability to think flexibly by proposing various approaches or different perspectives on a problem. For example, when faced with a challenge, FML can quickly change strategies or viewpoints to find a more effective solution, whereas MVS tends to stick to the same approach and has not yet been able to explore other strategies. This indicates that FML has a better ability to adapt to different situations and contexts, enabling the creation of more creative and innovative solutions.

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