Characteristics of Differentiated Mathematical Creative Models in Problem-Solving Activities: Case of Middle School Students

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Abstract: Students have varying degrees of creativity and can develop their creative abilities in specific disciplines through various stimuli. Tracing the students' mathematical creativity is very important since creativity is not a gift for specific students; rather, all students have it. The participants of this study were 170 urban and rural middle school students in Greater Malang, Indonesia. This qualitative descriptive exploratory research revealed differences in middle school students' mathematical creative models in problem-solving activities which were then used empirically to classify differences in students' mathematical creative models and provide characteristics for each of their creative models. Data were collected from problem-solving activities and semi-structured interviews. Triangulation of sources and methods was used to obtain data validity. Data analysis was performed through fixed comparison analysis. This research created meaningful and reliable differences in students' mathematical creative models, including models of imitation, modification, combination, and creation. As a conclusion, this study revealed differences in students' creative models and recommended that further research develop other problem-solving activities to promote students' creative models traceable on an ongoing basis to more varied problem themes.

Keywords: creative model, mathematical creativity, mathematical creative model, problem-solving activities

INTRODUCTION

Creativity applies previously acquired information to solve problems and create new things (Calavia *et al*., 2021). It is a process that consists of several mental activities that people do when they create something, from identifying problems and acquiring knowledge to generating ideas and implementing them (Quiñones-Gómez, 2021). It is a sub-dimension of individual intelligence that can find unique ideas or modify existing ones (Deak *et al*., 2004). It is a relationship between talent, method, and environment in which people or groups create new things that are understood and helpful in a social context (Schoevers, 2019; Tubb *et al*., 2020; Hernández-Torrano & Ibraeva, 2020). One of the subcomponents of individual cognition has been recognized as general creativity that may change current ideas or generate new creative ideas (Bicer *et al*., 2020).

The interplay of three systems: a sociocultural system with symbolic norms, a personal system that provides symbolic uniqueness, and a field expert-configured system where the creative process is produced by identifying, assessing, and validating products might be understood as the source of creativity (Aguilera & Ortiz-Revilla, 2021). Parameters commonly used to assess creativity include the Torrance Test of Creative Thinking (Schoevers, 2019), which identifies the creative process and some forms of its assessment that are still used today for general creativity assessment (Said-Metwaly *et al*., 2018). The three most important indicators of creativity in the Torrance Test of Creative Thinking are fluency, flexibility, and originality. Fluency means the number of responses provided; flexibility means the variety of solution strategies; while originality means the uniqueness of student solutions (Torrance, 2008). According to Guilford, there are four essential sub-dimensions of creativity in the public domain: the number of ideas created, the diversity of ideas generated, the uniqueness of the ideas formed, and the number of detailed processes produced (Bicer *et al*., 2020).

Several researchers have investigated students' creativity in open-ended problem-solving through fluency, flexibility, and originality (Kattou & Kontoyianni, 2012). Fluency is measured using a variety of approaches for tackling a particular task. The ability to change concepts to develop different finishing approaches is connected with flexibility. The introduction of fresh ideas connected to issue solutions is referred to as originality. Supporting this concept, Bezerra *et al*. (2020) stated that fluency is indicated by the number of various ideas created and the relevant solutions for issue posing; flexibility refers to the number of different categories into which the resultant solutions for each problem may be divided; and creativity refers to the number of different ideas generated and the right solutions for problem posing. Originality is defined as the non-conventionality of the ideas developed; an acceptable solution that varies from the suggested answer is deemed original. According to Aguilera and Ortiz-Revilla (2021), creativity can be evaluated through some aspects: processes, by paying attention to creative processes or something similar; procedures developed by individuals; environmental factors that act as promoters of creativity evaluated; individual creativity capacity assessed using tests or questionnaires; and the characteristics of the results are obliquely evaluated.

Creativity indicates that pupils might have varying degrees of creativity in various professions. Students can hone their creative abilities by being exposed to a variety of educational, social, and environmental stimuli. Academics, for example, have distinguished between general creativity and mathematical creativity by identifying distinguishing characteristics of persons who are creative in mathematics (Leikin *et al*., 2013). The distinctions involving general creativity and mathematical creativity, on the other hand, may be complicated. Researchers, for example, have documented particular learning, which increases students' creative skills in mathematics, and general learning, which promotes creative abilities in any discipline (Bicer *et al*., 2020; Sheffield, 2009), showing that overall creativity-focused instruction can boost student creativity in specialized fields, such as mathematics.

Kattou and Kontoyianni (2012) investigated the structure of the link between mathematical skills and creativity. According to the findings of the study, there were three separate types of students depending on their mathematical ability: students with high, medium, and poor mathematical talents. Meanwhile, the three groups had different levels of mathematical creativity those getting the highest scores on the mathematics test were considered the most creative. Sriraman and Hadamard (2009) investigated five mathematicians to discover the characteristics of a creative process. The results demonstrated that their creative process followed the four steps of the Wallas model: preparation-incubation-illumination-verification. In this circumstance, the creative process might occur while they studied mathematics content.

Mathematical creativity is defined as a process that produces unexpected (new) and insightful solutions to specific or comparable issues or generates new questions and opportunities that allow current problems to be seen from fresh angles and need creativity. Understanding mathematics allows students to develop creativity in mathematical tasks (Leikin & Pitta-Pantazi, 2013; Schindler & Lilienthal, 2020) based on the concept that mathematics is concerned with the construction of structures, ideas, and relationships using logic. Truth in mathematics is discovered by logical and rigorous reasoning. Mathematical activities are predominantly concerned with logical and methodical thought processes, such as looking for similarities, generalizing, establishing and testing hypotheses, drawing connections, proving theorems, building representations, and eventually, solving problems. Bicer *et al*. (2020) constructed a comprehensive concept of mathematical creative capacity by combining key elements of current definitions. The capacity to develop new mathematical concepts is referred to as a mathematical creative ability to recognize and identify relevant mathematical structures and models that are novel to some individuals.

These three sub-dimensions of creativity are most commonly researched in mathematical problem-solving and problem-posing activities, which have been recognized as mediators of mathematical creativity. In the context of problem-solving, these sub-dimensions have been interpreted as follows: solutions generated for a given problem, different approaches discovered for solving a problem, and rare solutions produced by individuals as opposed to solutions produced by other individuals (Bicer *et al*., 2020).

According to Collard and Looney (2014), creativity is not a gift for particular students. Each student has a different degree of creativity. The learning environment plays a role in supporting student development, productivity, identification skills, and efficiency (Davies *et al*., 2013). Creativity involves new concepts or ideas (Leikin & Lev, 2013; Yaftian, 2015). Wallas' four stages of creative models that include preparation-incubation-illumination-verification to define creative professional mathematicians have been used in mathematics education (Schindler & Lilienthal, 2020). According to Schindler and Lilienthal (2020), school student creativity comprises phases similar to what the Wallas model has. Both still leave research gaps, thus requiring further research. In mathematics education, Pitta-Pantazi *et al*. (2018) described that a staged approach similar to Wallas' model had been recognized. However, Haavold and Birkeland (2017) assumed that distinct models are developed to accurately represent the creativity of professional mathematicians and students in order to identify creative students as a whole. The apparent differences in creative models may be investigated further based on the diverse perspectives of students analyzing the connection between general and mathematical creativity in the context of available inventions in everyday life.

To evaluate students' mathematical creativity, in general, research in mathematics education concentrated on students' creative outcomes, such as written responses (Levav-Waynberg & Leikin, 2012). The study provided uses a product-oriented approach, studying written reports with creative possibilities. All research, in this case, began with analyzing creative products, which are a general form of creativity and a tangible manifestation of the whole process. The primary goal of creative process research is to characterize the activities, and behaviors that occur during the processes of applying different ideas (Pitta-Pantazi *et al*., 2018). Based on this background, this study aimed to describe the characteristics of the differences in students' creative models in problem-solving activities.

METHOD

This research was an exploratory-descriptive qualitative study (Creswell, 2016). The researchers attempted to reveal the symptoms experienced by students participating in creative problem-solving activities to classify differences in students' creative models and provide characteristics for each of their creative models.

The participants of this study were 170 urban and rural middle school students in Greater Malang, Indonesia. The problems given to the students for this research were related to mathematical creativity to explore differences in students' creative models. The mathematical problems were adapted from previous research, consisting of open-start problems (approached in different ways), open-ended problems (with several possible outcomes), or a combination of them, which were considered as tasks that can promote creativity, which fulfilled the form of open-ended, connected, visualization, extendable, and communication problems (Levenson *et al*., 2018; Molad *et al*., 2020; Bicer, 2021 & Bicer *et al*., 2021; Levenson, E., 2022). These problems were then developed as mathematical problems in this study after going through content validation on problem construction and language construction (Purnomo *et al*., 2022).

Data validation in this study was obtained using the source and triangulation method (Moleong, 2017). The source triangulation was done by comparing and examining data (information) from different students (sources). The triangulation method was carried out by examining the data from the students with different methods, namely from written tests and interviews. A fixed comparison analysis was carried out to determine the theory's reliability by comparing specific data categories with other data categories to obtain categories with the same and consistent characteristics (Hayashi *et al*., 2019). The data analysis focused on the creativity-based problems given to students; their results or answers were then grouped based on the differences in the approaches they used. The characteristics of the creative model of at least two students were then compared to each other by looking at the similarities and differences (Belotto, 2018). Furthermore, from each group, a student who was considered to represent the group was observed. The results obtained were then used to identify characteristics based on the approach applied.

RESULTS AND DISCUSSION

According to the responses of 170 students who completed written tasks, only 74 students employed various creative models related to these problems, while 96 students did not. Of the 74 students with different mathematical creative models, 36 were in imitation, 19 were in modification, 12 were in combination, and seven were in creation. The classification of the 74 students' responses to the creative models are shown in Table 1 below.

Characteristics	Number of students	Selected student	Student code
Imitation	36	1	I2
Modification	19	1	M1
Combination	12	1	C1
Creation	7	1	C2

Table 1: Classification of student responses based on creative problems

Differences in students' mathematical creative models could be detected in the results of their works and through in-depth interviews. The students' solutions varied depending on the type of problem (Aguilar & Telese, 2018). They used different solution pathways in response to problem-solving activities. This indicated that each problem in problem-solving activities required a solution with special characteristics in its completion. Other processes such as communicating solving strategies or representing mathematical ideas acquired relevance in this context (Piñeiro et al., 2021). The following are the results of the interviews that show the characteristics of the students' different creative models.

Imitation

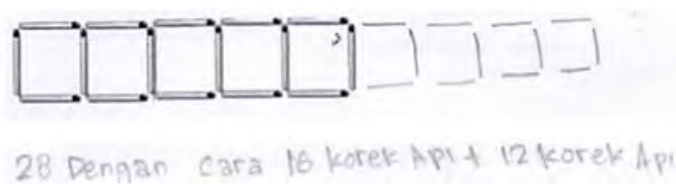
Mathematical creative models in the early phenomenon were traced from the students' answers to the following problems:

Look at the figure of the arrangement of matches below

To form 5 squares, 16 matchsticks are needed. Determine and explain how many matchsticks are needed to form 9 squares?

Figure 1: A creative problem adapted from Jonsson *et al*. (2016) & Norqvist (2018)

The following figure depicts a student's response to the aforementioned problem.



Translation: The answer is 28 by adding 16 by 12

Figure 2: An imitation-based written response

The student (I2) stated that the answer was 28 by adding 16 matches to 12 matches. The student (I2) described this by adding 4 squares to the 5 ones given, resulting in 9 squares. Based on this response, an in-depth interview was then conducted by the researcher (P) with the following results:

P: What steps did you take to solve this problem?

I2: There were five squares built from 16 matchsticks; the question was how many additional matchsticks we needed to build nine squares. So, I counted these (pointing to the question figure) and added these matches (pointing to the answer figure)!

P: You got the answer by adding these squares (pointing to the student's responses); Now, please explain how you came up with such idea!

I2: I counted the matchsticks in this figure (pointing to the question figure); there were 16 matchsticks, and I continued by adding these (pointing to the answer figure) to form a total of 9 squares.

P: Pay attention to the figure you made! Explain how your steps toward the question figure so you could made your answer.

I2: There were five squares available. I followed the pattern of the sticks to get 9 squares. I counted the additional matches (pointing to the figure of the connection made) and found there were 12. additional sticks.

The student determined a new form to solve the problem by imitating the squares on the problem. The student repeated the pattern of the squares to get a total of 9 squares. The student just repeated the stick pattern and then counted the squares and the matchsticks needed to make up them. Thirty-six students did the same to solve the problem.

In this creative model, the students tried to understand the problem information and recognize the images or strategies and then imitated them. Using this model, the students imitated the image's pattern and stategy to solve the problem. In the imitation model, students can solve problems smoothly and produce correct ideas/answers. According to Rohmah *et al*. (2020), students' fluency and flexibility can be seen when they demonstrate fluency in solving a problem and offer more than one solution to one problem. In this model, students imitate the figure as a whole, and some imitate it by repeating the pattern. The imitation model is used when someone wants to make a product by duplicating an existing item. It is a logical cognitive process based on prior knowledge.

According to Purnomo *et al*. (2023), students engage in a creative process during the imitation level by attempting to make solutions by observing the problem figure accurately. After paying attention to the figure, they select the solution technique. At this stage, the imitation process is complete. Imitation occurs when students use their memories and previous experiences to solve problems following existing algorithms (Lithner, 2017). Permatasari *et al*. (2020), in their research, concluded that students, in solving geometric problems, went through a process of imitation in their creative process. Moon & Acquaah (2020) explained that imitation is vital in the creative process. The imitation strategy means that the imitator does not simply copy the attributes or practices of the original product but creatively reconfigures it with his or her distinctive characteristics. According to Lestari *et al*. (2018), imitation plays a vital role in communicating solutions. Through imitation, students can use the same methods or steps as given by the example and can apply the example in new contexts. According to Mecca and Mumford (2014), imitation occurs when an object is imitated; It, therefore, depends on how individuals provide examples. Okada and Ishibashi (2017) defined imitation as the process of copying a product and the degree of deep cognitive processes.

Modification

The mathematical creative model for the following phenomenon may be traced back to the answers to the following problem:

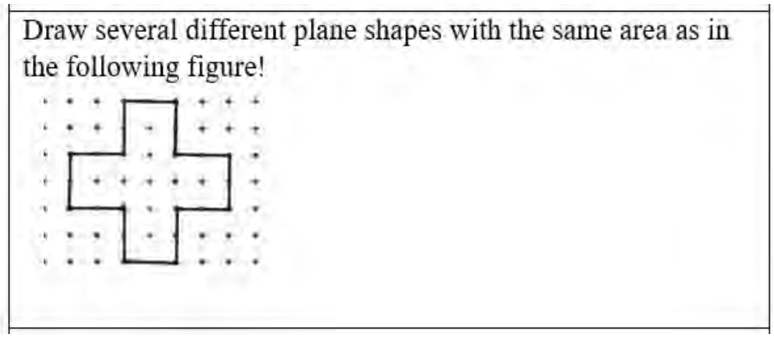


Figure 3: A creative problem adapted from Levenson et al. (2018) and Molad et al. (2020)

The following is a student's answer:

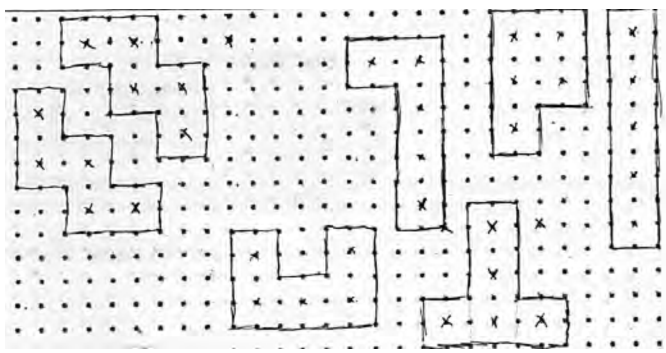


Figure 4: The modification-based written answer

Based on Fig. 4, the student solved the problem by changing the given shape into a new form. The student changed the shape by adjusting the existing area. The student calculated the area of the given shape to make the new shape. The researcher (P) then made an interview with the student (M1).

P: Explain what you know about the flat shape given in this problem, please.

M1: There were five squares (giving a cross for each square).

P: Please explain how could you make this one (pointing to the student's first answer)!

M1: I changed it to a U shape; First of all, I drew five squares, Sir, using these crosses
It then became a U shape!

P: Explain how you got this one (pointing to another figure).

M1: I changed it to a big square (pointing to 4 squares with crosses arranged into one square), then put one small square under it.

P: For this answer (pointing to another answer), please explain how you came up with such idea!

M1: For this one, I formed the letters M and W, made two squares and then made them like stairs, and then made one more to make five squares.

The student modified the plane shape while paying attention to the area. The student changed the strategy to produce a new shape by dividing the given shape into five equal squares, breaking down the existing shape with the help of small crosses to get new shapes. Based on the results above, this creative model is called the modification model.

In this model, students tried to understand the problem information and recognize the figure or strategy, then imitated them to solve the problem. They also imitated the strategy by making the same square repeatedly. Furthermore, in this model, they changed the plane shape by paying attention to its area. They also changed the strategy by dividing the existing plane shape.

Further, they also change the strategy by breaking down the existing plane shape to get new shapes. Modification means modifying the way used to solve a problem (Singer *et al*., 2017). According to Voica and Singer (2013), cognitive flexibility in the context of modification is an excellent predictor of mathematical creativity. Students carry out the process of modifying after recognizing that it is a more effective and efficient way to solve problems. The novelty of modification that is considered to be more effective for students is to change the completion steps and determine other strategies (Subanji *et al*., 2021; Purnomo *et al*., 2023). Therefore, students are challenged to develop new approaches. Yokochi & Okada (2020) explained that model modification is done by changing both the form of the strategy and the method of completion to make the product more in line with the previous idea. The main feature of the modification process is the expansion of ideas (Marhayati, 2019). The expansion of ideas causes variations in the solution form, marked by a change in the initial solution form. According to Eckert (2012), changing as little as possible is part of modification in the creative process. Creative students can modify and produce something original, meaningful, functional, and impactful. In line with the modification model, Leksmono *et al*. (2019) argued that students who can propose several solution strategies or offer a variety of solution strategies different from the commonly used ones already fulfill aspects of fluency and flexibility.

Combination

The solutions to the following question were used to trace mathematical creative models in early phenomena:

Draw as many different shapes as possible that have the same area as the following plane figure!

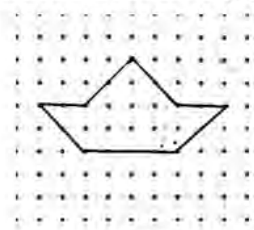


Figure 5: A creative problem adaptated from Hidajat et al. (2019) and Levenson et al. (2022)

A student responded to the problem, as illustrated in the following figure:

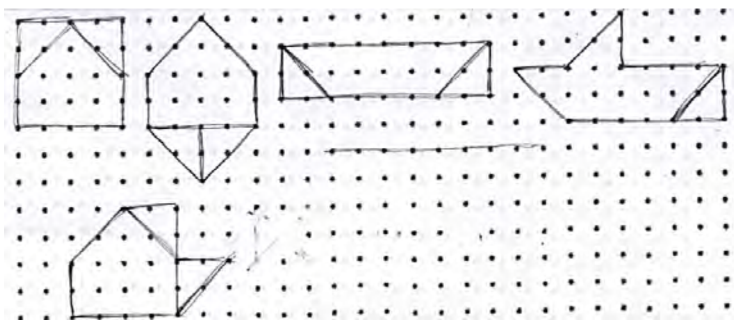


Figure 6: The combination-based written answer

The students tried to solve the problem by combining plane figures to create new figures. The students combined by distinguishing triangular and rectangular shapes. The student added a triangular plane to be placed in another position to produce a new shape. According to the answer of the student (C1), the researcher (P) performed the following in-depth interview:

P : Explain what you know about the plane figure in this problem!

C1: I was given a shape like this (showing the figure of the problem). Then, I was asked to draw another figure with the same area!

P: Explain how you got this plane figure (pointing to the first figure)!

C1: I joined the right-left side up next to the triangle above. There was a triangular plane in the boat-shaped plane.

P: What were your steps in determining these next plane figures?

C1: This one (pointing to the second figure) intersected the left and right triangles and was joined at the bottom of the rectangle. Furthermore, this one (third picture) intersected a triangle to be two equal triangles. Then put them on the right and left with another triangle.

P: How did you make this new figure (pointing to a unique figure)?

C1: I cut the right triangle on top, then added a triangle and joined it onto the right side.

The student combined some plane figures to create new ones. The student combined triangles with other triangles to produce new figures. The student also combined figures by differentiating triangles and rectangles that made up the original figure to produce a new one. The student also added triangles to the sides of other triangles to form a new figure. What the student did as described above can be classified as the creative combination model.

In this model, students understand problem information, recognize appropriate figures or strategies and use them in solving problems, and imitate the figures in solving problems. They can also imitate strategies by repeating the same squares to solve problems. Furthermore, in this model, students can change the figure by paying attention to the area. They can also change the strategy to obtain a new figure. In this model, students combine plane figures, combine strategies by differentiating plane figures, or combine strategies by adding plane figures to produce new ones.

In this model, students combine the same and different forms to produce new forms. The combination model is a creative stage through combining two or more concepts/forms into a new one. According to Edie and Krismonika (2021), combination is the process of integrating two works, both in form and function, into a work, which combines two products, or something entirely new. Creativity is generated by combining two or more concepts into a new concept and emerged various ideas (Chan & Shcunn, 2015; Rahmatina et al., 2022). Creativity results from a combination process (Yu, 2011; Kohn *et al*., 2011). The combination also occurs by combining strategies, methods, and functions from initial representations into new representations that can occur in various cognitive domains (Hinault *et al*., 2014). In line with the combination model, According to Rohmah *et al*. (2020), students who solve a problem smoothly produce more than one response and may supply varied and unique answers, thereby meeting fluency, flexibility, and novelty requirements.

Creation

The answers to the following problem can be used to deduce the mathematical creative model for the highest model phenomenon:

Look at the picture of the arrangement of matches below!

It takes 19 matchsticks to form 6 squares. Determine and explain how many matchsticks are needed to form 52 squares?

Figure 7: A creative problem adapted from Norqvist et al. (2019) & Jonsson et al. (2022) creative problem

The following the student's answer to the problem:

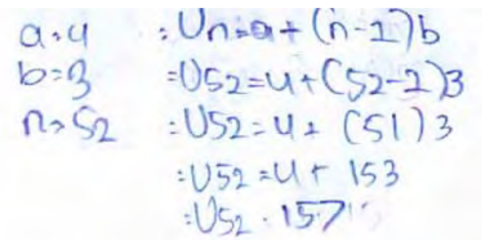


Figure 8: The creation-based written response

The student used the arithmetic sequence formula to find the number of matchsticks that make up 52 squares. The students generated the solution based on the pattern in the figure. The student created a strategy by determining the prefix a, difference b, and problem solutions. Depending on the outcomes of the student (C2), the researcher (P) performed an in-depth interview about the mathematical model utilized.

P: Please describe the steps you took to find these 52 squares!

C2: First of all, I used the arithmetic formula and looked for the prefix, the difference, and what was asked.

P: How did you get this answer (pointing to the student's answer having a pattern)?

C2: Initially, one square had four sticks. The difference is 3; Each additional box requires three matchsticks. So, we could apply an arithmetic formula.

P: How did you find this pattern (pointing to the mathematical model/pattern made by the students)?

C2: Let's see Un = a + (n – 1b; a is 4, b is 3, and n is the number of squares. Then solve like this (pointing to the answer).

P: Without that formula, can you solve it?

C2: You can also use this, Sir. 3...3...3 and then (pointing to the figure in the question) with the first side is 1; so, 1 plus 3 times 52 makes 157.

The student developed a formal mathematical model to determine the number of matchsticks required to build 52 squares. The student created the pattern of the problem based on the first square; there are four match sticks; each additional one needs three matchsticks. The student also created new strategies by determining the pattern of the figure: the first side consists of one stick; to make a square need 3. From this pattern, the student could create a new solution to the problem.

The last creative model in solving creative problems is the creation model. In this model, students create patterns on problems to produce solutions. Students create mathematical models to solve problems. Students also create new strategies for finding solutions to problems. In this model, students create formal mathematical models with formulas, while some create mathematical models by generalizing numerical patterns. Subanji *et al*. (2023) said that students can generalize by merging several problem-solving strategies processes. Students can use formulas in solving pattern-based problems. The use of these symbolic formulas is part of functional thinking. Students use formulas by connecting in solving pattern-based problems. In Rivera and Becker's (2016) study on pattern generalization in seventh and eighth graders, students were instructed to locate two distinct continuations of figural patterns. Riviera and Becker (2016) further revealed that creation in the creative process serves to stimulate conceptual meaning in the creation of solutions and problem-solving strategies. Wilkie (2021) looked on how potential instructors discover figural patterns based on quadratic functions. According to Wilkie (2021), the act of production promotes mental meaning for linear or quadratic functions.

Purnomo *et al*. (2023) also said that the creative process in solution difference begins with students being aware of patterns and determining the structure of the eventual mathematical model. Hidayanto and Rahmatina (2020) discovered that students with strong mathematical skills had a propensity to be able to answer all sorts of difficulties and attain the highest model of mathematical thinking abilities. This problem-solving method runs smoothly and is very flexible, as shown by the use of mathematical notation and the creation of equations. Creativity is the process of creating something relatively new or unique originality or using a new style/approach that involves a process or product generation effectively and innovatively (Henriksen *et al*., 2022). The creation process involves significant construction activities, which are categorized as a high level of creativity (Romero & Lambropoulos, 2015). The creation model is the final model of creative production that creates the final product (Jaarsveld *et al*., 2012). Chang *et al*. (2014) explained that knowledge creation is a holistic variable and influences product novelty and suitability. The creation model involves evaluating the quality and originality of the generated ideas and selecting the best idea from a set of alternatives accurately (Puente-Diaz & Cavazos-Arroyo, 2021). Students in the creation model are in the category of gifted students. Purnomo *et al*. (2021) & Sa'dijah *et al*. (2023) explained that gifted students in solving higher-order thinking problems are in the highest thinking model. In this term, Leksmono *et al*. (2019) and Rohmah *et al*. (2020) explained that students that fulfill the fluency, flexibility, and novelty requirements may produce various and unique answers and communicate their reasons in solving problems and drawing valid conclusions.

CONCLUSIONS

Students have various levels of creativity in problem-solving activities. In this study, there were four different mathematical creative models: imitation, modification, combination, and creation , with their respective characteristics. In the imitation model, students imitated the shape of the figure partially/completely or imitated the strategy by repeating. In the modification model, students modified the form partially/completely or modified the strategy by dividing or parsing. In the combination model, students combined the same/different shapes or combine strategies by differentiating and adding shapes. In the highest mathematical creative model, namely the creation model, students could create patterns for the problem given and develop mathematical models. In creating new strategies to find solutions to the problem, in this model, students created symbolic formal and numerical patterns.

Furthermore, by determining the different characteristics of students' mathematical creative models, teachers can encourage students to optimize their knowledge and experience to produce creative problem-solving. In addition, by knowing the characteristics of students' mathematical creative models, teachers are encouraged to use more creativity-based tasks in learning mathematics to increase students' mathematical creativity. This research was limited to problem-solving activities by adopting four problems aimed at exploring the differences in creative models. The creative problems in this study were limited to two main problem themes: geometry and arithmetic. F urther research needs to develop other problem-solving activities that promote students' creative models traceable on an ongoing basis to more varied problem themes.

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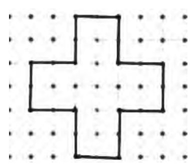
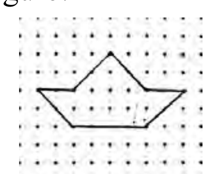
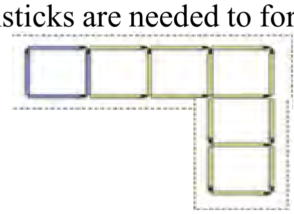
APPENDIX

Mathematical Creative Problem	Interview questions
Look at the figure of the arrangement of match  To form 5 squares, 16 matchsticks are needed. Determine and explain how many matchsticks are needed to form 9 squares?	• What steps did you take to solve this problem? • You wrote your answer by adding squares like this (pointing to the student's answers). Please, explain how you came up with this idea! • Look at the figure in your answer! Please explain the steps you took to produce your answer!
Draw several different plane shapes with the same area as in the following figure! 	• Explain what you know about the plane in this problem? • Explain how you produced this new figure based on the problem (point to the student's first answer)! • Please explain how you got this shape (pointing to another shape)! • You made this plane (pointing to another answer). Please explain how you came up with such idea!
Draw as many different shapes as possible that have the same area as the following plane figure! 	• Explain what you know about the plane in this problem! • Explain how you produced this new figure based on the problem (point to the student's first answer)! • What were your steps in making this next plane figure? • How did you determine the shape of this new plane (pointing the unique shape)?
Look at the picture of the arrangement of matches below! It takes 19 matchsticks to form 6 squares. Determine and explain how many matchsticks are needed to form 52 squares? 	• Describe the steps you took to find these 52 squares! • How did you come up with the idea to write like this (pointing to the patterned answer)? • How did you find the formula (pointing to the math model the student made?