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Capturing Students' Creative Thinking: An Analysis of Middle Schoolers' Processes in Solving Mathematical Reasoning Problems

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ABSTRACT

Schools play a critical role in enabling students to discover, develop, and express their creative potential. However, instructional practices that explicitly promote students' creative thinking skills in mathematics learning remain limited. Therefore, this study aims to examine and describe the creative thinking processes of junior high school students in solving mathematical reasoning problems. This study employed a qualitative case study design involving 35 eighth-grade students. A mathematical reasoning test was administered to identify students' levels of creative thinking. Based on the results, four students representing different categories of creative thinking (imitative, routine, creative, and very creative) were purposively selected as research subjects. Data were collected through students' written work, in-depth interviews, and document analysis.
The findings indicate that each category demonstrates distinctive characteristics in terms of problem-solving strategies, flexibility of ideas, and originality in constructing solutions. Students in the higher creative categories tended to generate multiple strategies and more original solution processes. These findings emphasize the importance of designing mathematics learning activities that encourage exploration of diverse strategies, idea generation, and reflective thinking.

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1. INTRODUCTION

The fundamental role of education is to equip students with the competencies they need to face the challenges of modern society. In mathematics learning, creative thinking is an important competency that supports students in exploring various problem-solving strategies and developing deeper conceptual understanding [1], [2]. In the context of rapid technological development and global competition, individuals are increasingly required to possess 21st-century skills, including the ability to think creatively, adapt to new situations, and generate innovative solutions to complex problems [3]. Students who develop strong creative thinking skills are better prepared to face future challenges because they can perform tasks that cannot easily be replaced by machines and address increasingly complex local and global problems [4], [5], [6], [7].

The importance of developing creative thinking in schools extends beyond preparing students for future careers. Schools play an essential role in helping students discover, develop, and express their creative potential [8], [9], [10], [11]. Schools also provide an environment where students can feel part of the society in which they live and use their creative abilities to contribute to its development. Encouraging students to think creatively during classroom learning activities can help them experience the relevance and benefits of learning, thereby increasing their interest and engagement in the learning process.

Creative thinking also plays an important role in the learning process itself. It enables students to interpret new experiences, connect prior knowledge with new ideas, and construct meaningful understanding [12], [13]. Students' curiosity and imagination can stimulate the learning process and encourage them to generate creative ideas when solving problems [14]. Therefore, learning environments that support creative exploration are necessary to increase students' motivation and interest in school. Such environments can help students who show little interest in school to express their ideas and achieve their potential.

In mathematics education, teachers play a critical role in fostering students' creative thinking. Teachers need to understand how creative thinking emerges, recognize students' creative potential, and create conditions that encourage creativity in the classroom [15]. A greater understanding of creative thinking can motivate teachers to encourage students to develop creative ideas in the learning process. This understanding also enables teachers to design learning environments, strategies, and tasks that actively stimulate students' creative potential. Moreover, integrating creative thinking into classroom practices helps students develop flexibility, originality, and problem-solving skills that are essential for lifelong learning [15], [16].

Creative thinking is also closely related to mathematical reasoning [17]. Mathematical reasoning requires students to analyze situations, identify relationships, and justify their solutions through logical arguments. In this process, creative thinking enables students to explore multiple solution strategies, consider alternative perspectives, and develop innovative approaches when solving non-routine problems. Therefore, integrating creative thinking into mathematical reasoning activities allows students to move beyond procedural problem-solving and to develop a deeper conceptual understanding.

In mathematics learning, reasoning tasks provide opportunities for students to demonstrate creative thinking. When students encounter reasoning problems, they are required to generate different solution strategies, evaluate the effectiveness of various approaches, and justify their conclusions. These activities involve important aspects of creative thinking, such as fluency in generating ideas, flexibility in applying different strategies, and originality in constructing unique solutions. Investigating students' creative thinking processes in mathematical reasoning tasks can therefore provide valuable insights into how students develop and apply creative ideas during problem solving.

Previous research has highlighted the critical role of creative thinking in mathematics education, demonstrating its positive impact on students' problem-solving abilities, reasoning skills, and conceptual understanding [18], [19], [20], [21], [22], [23], [24], [25], [26], [27]. Despite this, most studies have employed quantitative approaches, such as standardized tests or scoring rubrics, to measure students' creative thinking. As a result, there remains a paucity of research examining the actual processes through which middle school students engage in creative thinking when solving mathematical reasoning tasks. Investigating these processes is essential, as it provides insight into how students generate ideas, select and apply strategies, and construct meaningful solutions during problem solving.

Addressing this gap, the present study aims to capture and describe the creative thinking processes of eighth-grade students in the context of mathematical reasoning. Through the analysis of students' written responses and semi-structured interview explanations, this study seeks to identify patterns, characteristics, and levels of creative thinking exhibited by students. The findings are expected to inform instructional practices by guiding teachers in designing learning environments and tasks that actively foster students' creative thinking and enhance their mathematical reasoning skills.

To better understand the characteristics of students' creative thinking processes in mathematical reasoning, this study adopts a framework that categorizes creative thinking into four levels: imitative, routine, creative, and very creative. This framework illustrates the progression of students' thinking from reproducing known procedures toward generating flexible and original solution strategies. The conceptual framework used in this study is presented in Figure 1.

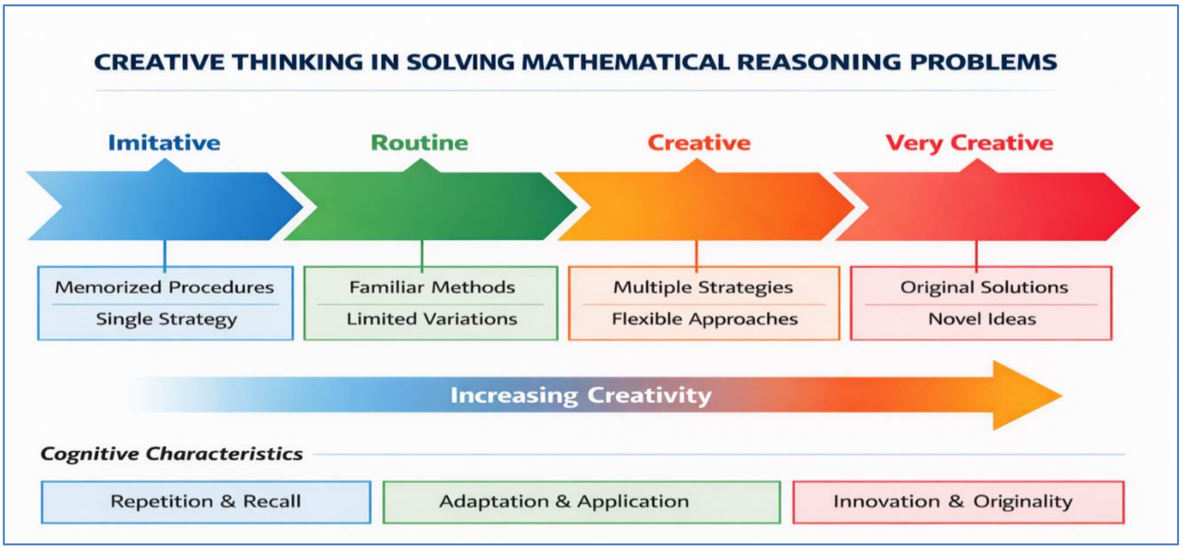


Figure 1. A Framework of Creative Thinking Processes in Mathematical Reasoning

2. METHOD

Research Design and Context

This study employed a qualitative, holistic case study design to explore students' creative thinking processes in solving mathematical reasoning problems. The research was conducted in a junior high school mathematics class in Muaro Jambi, Jambi Province, Indonesia, during the 2024/2025 academic year. The study focused on how students generate ideas, apply strategies, and construct solutions when working on mathematical reasoning tasks.

Participants

The participants consisted of 35 eighth-grade students (17 male and 18 female). All students completed a mathematical reasoning task designed to identify their levels of creative thinking. Based on the results of this task, four students were purposively selected as the main subjects of the case study. Each student represented one of four categories of creative thinking: imitative, routine, creative, or very creative.

The selection criteria included:

1. students' performance on the mathematical reasoning task,
2. representation of each creative thinking category, and
3. students' ability to clearly explain their reasoning processes during interviews.

Creative Thinking Indicators and Categorization

The categorization of students' creative thinking processes was based on three commonly used indicators in mathematics education research, namely fluency, flexibility, and originality. These indicators are widely used to describe mathematical creativity and students' ability to generate multiple ideas, apply different solution strategies, and produce novel solutions when solving mathematical problems [28]. Fluency refers to students' ability to generate several ideas or solution attempts when solving a mathematical problem. Flexibility indicates students' ability to apply different strategies or approaches to solve the same problem. Meanwhile, originality refers to the uniqueness or novelty of the solutions students generate.

Creative thinking in mathematics is also closely related to students' reasoning processes. When solving mathematical tasks, students may rely on previously learned procedures or construct new reasoning pathways to reach a solution. This distinction is reflected in the concepts of imitative and creative mathematical reasoning: imitative reasoning involves reproducing known procedures, while creative reasoning involves generating new arguments or strategies that are not directly derived from memorized algorithms [29]. In this study, students' reasoning processes were analyzed to identify how they generated ideas and strategies when solving mathematical reasoning problems.

Based on these indicators and reasoning characteristics, students' creative thinking processes were classified into four categories: imitative, routine, creative, and very creative. At the *imitative* level, students tend to replicate procedures previously demonstrated by the teacher. At the *routine* level, students can solve problems using familiar strategies, but their solutions remain limited to common procedures with little variation. At the *creative* level, students begin to demonstrate flexibility by applying alternative strategies or approaches when solving problems. Finally, at the *very creative* level, students generate diverse and original solution strategies that go beyond standard classroom procedures.

To ensure systematic classification, the criteria for categorizing students were operationalized through a rubric derived from indicators of fluency, flexibility, and originality. The use of rubrics allows researchers to systematically assess students' responses and clearly differentiate levels of performance based on observable characteristics [30]. In this study, the rubric served as a guideline for identifying the presence and intensity of the three indicators in students' written responses and interview explanations. The detailed rubric used to categorize students' creative thinking processes is presented in Table 1.

Tabel 1. Rubric for Categorizing Students' Creative Thinking in Mathematical Reasoning

Creative Thinking Category	Fluency	Flexibility	Originality	Characteristics of Students' Responses
Imitative	Low	Low	Low	Students tend to replicate procedures previously demonstrated by the teacher. Solutions rely on memorized formulas or examples and typically involve a single strategy.
outine	Moderate	Low	Low	Students can solve problems using familiar strategies learned in class, but their solutions show limited variation and rarely involve alternative approaches.
Creative	High	Moderate	Moderate	Students generate several solution ideas and apply different strategies when solving problems. Their responses show some variation beyond common procedures.
Very Creative	High	High	High	Students produce diverse and original solution strategies. Their approaches demonstrate novelty, flexibility, and the ability to construct unique solutions.

Data Collection

Data were collected using multiple techniques to obtain a comprehensive understanding of students' thinking processes. The data collection methods included mathematical reasoning tasks, classroom observations, semi-structured interviews, and documentation of students' written work. The mathematical reasoning tasks were designed to elicit indicators of creative thinking, particularly fluency, flexibility, and originality. In addition, semi-structured interviews were conducted to explore students' reasoning processes and clarify the strategies they used to solve the given problems. Classroom observations were also conducted to document students' behaviors and interactions during problem-solving activities. The instruments used in this study consisted of mathematical reasoning task sheets, interview guidelines, and observation sheets.

Research Procedure

The research was conducted through several stages. First, during the preparation stage, the researcher designed mathematical reasoning tasks and interview guidelines based on the indicators of creative thinking. Second, the mathematical reasoning task was administered to all 35 students to identify their levels of creative thinking. Third, based on the analysis of students' responses, four students representing each creative thinking category (imitative, routine, creative, and very creative) were purposively selected as the main subjects of the case study. Fourth, in-depth data were collected from these selected students through semi-structured interviews to explore their reasoning and solution strategies. Their written work and classroom behaviors were also documented. Finally, all collected data, including students' written responses, interview transcripts, and observation notes, were compiled and organized for further analysis.

Data Analysis

The collected data were analyzed using thematic analysis. The analysis process began with data familiarization, in which the researcher reviewed students' written work, interview transcripts, and observation records to gain a comprehensive understanding of the data. Next, open coding was conducted to identify meaningful units related to students' problem-solving strategies and creative thinking behaviors. Similar codes were then grouped into broader themes that represented patterns in students' creative thinking processes. A cross-case analysis was subsequently performed to compare the characteristics of the four selected students representing different creative thinking categories. Finally, the identified themes and categories were validated through triangulation of data sources and techniques by comparing students' written work, interview responses, and observation records. The interpretation of findings focused on identifying patterns, strategies, and characteristics of students' creative thinking processes when solving mathematical reasoning problems.

Trustworthiness

To ensure the credibility and trustworthiness of the findings, several strategies were employed. Data triangulation was conducted by comparing information obtained from students' written responses, interview data, and classroom observations. Triangulation was also used by combining multiple data collection techniques, including tests, interviews, and documentation. In addition, the researcher carefully reviewed and rechecked the coding and theme development process to ensure consistency and accuracy in interpreting the data.

3. RESULTS AND DISCUSSION

3.1 Results

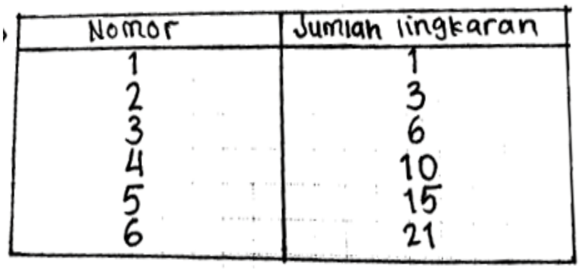
Overview of Students' Creative Thinking Levels

This study aimed to analyze students' creative thinking processes when solving mathematical reasoning problems related to number patterns. Based on the rubric derived from the indicators of fluency, flexibility, and originality, students' responses were categorized into four levels of creative thinking: imitative, routine, creative, and very creative.

From the 35 participating students, four students were purposively selected to represent each category of creative thinking. These students were coded as IS1, RS1, CS1, and CS2, representing the imitative, routine, creative, and very creative categories, respectively. The analysis focused on students' written responses to the mathematical reasoning tasks and their explanations during semi-structured interviews. To maintain clarity in the interview excerpts, R refers to the researcher. The following sections describe the characteristics of each creative thinking category based on students' solution strategies, written work, and interview responses.

Imitative Thinking (IS1)

Student IS1 demonstrated characteristics of imitative thinking when solving the mathematical reasoning tasks. At this level, students tend to reproduce procedures previously demonstrated by the teacher without exploring alternative strategies. In Question 1.a, IS1 was able to complete the table representing the number of circles forming triangular patterns. The student determined the missing values by observing the numerical pattern presented in the table.



Nomor	Jumlah lingkaran
1	1
2	3
3	6
4	10
5	15
6	21

Figure 2. IS1's Response to Question 1.a

However, difficulties appeared in Question 1.b when the student was asked to sketch the triangular arrangement representing the seventh figure. Instead of drawing the triangular configuration, IS1 associated the pattern with the Fibonacci sequence, resulting in an incorrect representation.

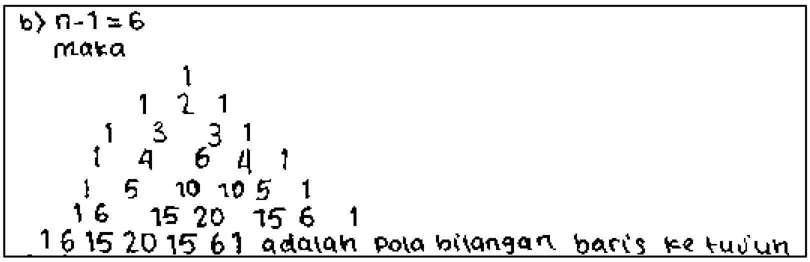


Figure 3. IS1's Response to Question 1.b

This response indicates that IS1 relied on recalling previously learned examples rather than analyzing the structure of the given pattern. The student's explanation during the interview further illustrates this reasoning.

R : *How did you determine the number of circles in the tenth triangle?*

IS1 : *I thought it was similar to a problem in the textbook, so I used the same pattern.*

This explanation suggests that IS1 relied on memorized procedures rather than constructing a reasoned argument based on the information presented in the problem.

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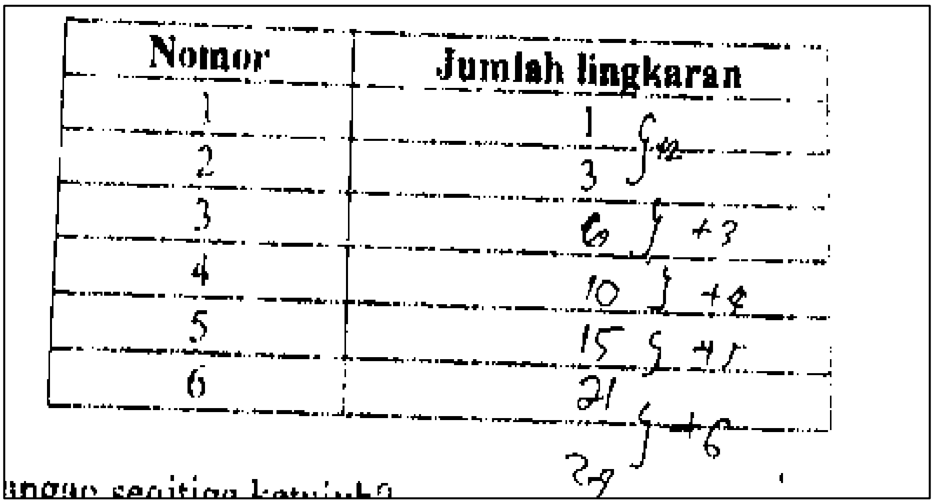
Therefore, the student demonstrated low fluency, limited flexibility, and minimal originality, which characterize imitative thinking.

Routine Thinking (RS1)

Student RS1 demonstrated characteristics of routine thinking, applying familiar strategies learned in class but rarely exploring alternative approaches. In Question 1.a, RS1 correctly completed the table of triangular numbers by identifying the increasing pattern between consecutive figures.



Nomor	Jumlah lingkaran
1	1
2	3
3	6
4	10
5	15
6	21

Figure 4. RS1's Response to Question 1.a

RS1 observed that the number of circles increased sequentially and extended the pattern to determine the missing values. During the interview, RS1 further explained the reasoning behind determining the next number in the pattern.

R : *How did you determine the next number in the pattern?*
RS1 : *I looked at the previous numbers and noticed that they kept increasing, so I continued the pattern.*

This explanation indicates that RS1 relied on identifying and extending the numerical pattern using a familiar strategy rather than exploring alternative approaches. The student focused on continuing the pattern based on previously observed values, which demonstrates moderate fluency but limited flexibility and originality in generating solution strategies. This reasoning reflects the characteristics of routine thinking, where students apply known procedures with limited variation.

Creative Thinking (CS1)

Student CS1 demonstrated characteristics of creative thinking when solving the mathematical reasoning problems. At this level, students begin to generate multiple solution ideas and apply different strategies in solving a problem. In the written response, CS1 not only identified the numerical pattern but also attempted to visually represent the triangular arrangement. The student used both numerical reasoning and visual representation to determine the number of circles in subsequent figures.

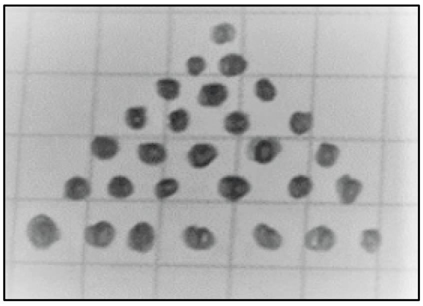


Figure 5. CS1's Written Response

The student explained that the number of circles could be determined by observing how each new row adds additional circles to the triangular structure. During the interview, CS1 further described the reasoning used to determine the number of circles in the tenth figure.

R : *How did you determine the number of circles in the tenth figure?*
CS1 : *I looked at how the triangle grows. Each row adds more circles, so I tried to see the pattern from the rows.*

This explanation indicates that CS1 analyzed the structural growth of the triangular pattern rather than simply extending the numerical sequence. By observing how each additional row contributed to the total number of circles, the student was able to interpret the pattern from both visual and structural perspectives. This approach demonstrates higher levels of fluency and flexibility, as the student generated and interpreted the solution using more than one representation of the pattern. Such reasoning reflects the characteristics of creative thinking, in which students begin to explore alternative strategies for solving mathematical problems.

Very Creative Thinking (CS2)

Student CS2 demonstrated characteristics of very creative thinking. At this level, students generate diverse solution strategies and show a high level of originality when solving problems. CS2 approached the problem by identifying a general rule for determining the number of circles in triangular patterns. Instead of counting circles individually or extending the table, the student attempted to formulate a mathematical relationship between the figure number and the number of circles.

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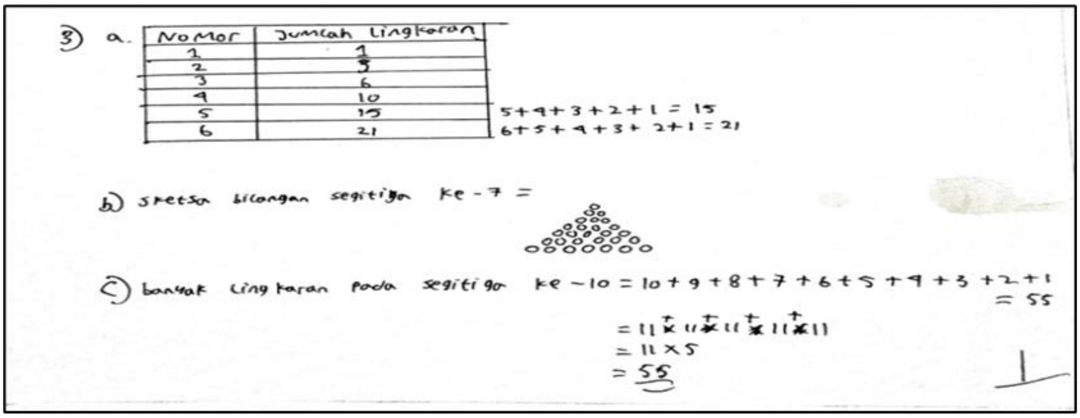

Figure 6. CS2's Written Response

The student recognized that the number of circles follows a specific pattern and attempted to express this relationship in a generalized form. During the interview, CS2 explained the reasoning process as shown in the following excerpt.

R : *How did you determine the number of circles in the tenth triangle?*
CS2 : *I tried to find a formula so I would not need to draw every triangle.*

This explanation indicates that CS2 attempted to construct a generalized mathematical rule rather than relying solely on extending the visual pattern. The ability to develop a general strategy and apply it to different figures reflects a higher level of abstraction and originality. Compared with the previous category, where students mainly extended patterns or applied familiar procedures, CS2 demonstrated a deeper level of reasoning by formulating a generalized approach. This ability demonstrates high fluency, flexibility, and originality, key characteristics of very creative thinking.

Cross-Case Analysis of Creative Thinking Processes

To better understand the differences in students' creative thinking processes, a cross-case analysis was conducted across the four selected students.

Table 2. Comparison of Students' Creative Thinking Characteristics

Student	Creative Thinking Category	Fluency	Flexibility	Originality	Main Characteristics
IS1	Imitative	Low	Low	Low	Reproduces memorized procedures
RS1	Routine	Moderate	Low	Low	Applies familiar strategies
CS1	Creative	High	Moderate	Moderate	Uses multiple representations
CS2	Very Creative	High	High	High	Develops generalized solutions

The comparison shows a clear progression in students' creative thinking processes. Students at the imitative level rely heavily on memorized procedures, while students at the routine level apply familiar strategies to solve problems. Students categorized as creative begin to generate alternative strategies and representations. Finally, students at the very creative level demonstrate the ability to generalize patterns and develop original solution

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strategies. These findings indicate that students' creative thinking processes in mathematical reasoning develop progressively as students become more capable of generating ideas, exploring alternative approaches, and constructing original solutions.

3.2. Discussion

One indicator of the cognitive aspect of students' mathematical reasoning is their ability to present mathematical statements orally and in writing through representations such as pictures, diagrams, tables, and graphs. In the context of number pattern problems, this ability reflects how students interpret and communicate mathematical relationships using various forms of representation. Students' reasoning ability can also be observed through their use of mathematical language, including symbols, diagrams, and graphs, as well as their ability to justify their answers when solving reasoning problems [31].

The categorization of students' creative thinking processes in this study was based on the indicators of fluency, flexibility, and originality, which are widely recognized components of mathematical creativity proposed by [28]. According to [28], creative mathematical thinking can be observed when students generate multiple ideas, apply different strategies, and develop original approaches to solving mathematical problems. In this study, these indicators were reflected in students' progression from imitative to very creative thinking.

The findings of this study reveal different levels of students' creative thinking when solving mathematical reasoning problems involving triangular number patterns. These differences can be observed in the strategies students used, the representations they produced, and the explanations they provided during interviews.

Students categorized as imitative thinkers (IS1) tended to rely on previously learned examples rather than analyzing the structure of the given problem. As shown in the results, IS1 completed the numerical table but struggled to visually represent the triangular pattern. Instead of analyzing the arrangement of circles in the triangular structure, the student associated the pattern with the Fibonacci sequence. This response indicates that the student relied on recalling familiar examples rather than constructing a reasoned argument based on the information provided in the problem. Such characteristics reflect limited fluency, flexibility, and originality in problem solving. This reasoning pattern is consistent with the concept of imitative reasoning described by [29], [32], [33], where students solve problems by reproducing memorized procedures rather than constructing new reasoning strategies. These findings are also consistent with previous studies [29], [34], [35], [36], [37], which show that students at lower levels of reasoning often depend on memorized procedures rather than developing their own representations. Furthermore, mathematical representations can take many forms, including diagrams, number lines, graphs, physical models, mathematical expressions, formulas, and equations, as well as symbolic displays that represent mathematical relationships [38].

Students categorized as routine thinkers (RS1) used the provided information and applied familiar strategies to solve the problem. RS1 correctly extended the numerical pattern of triangular numbers in the table but did not attempt to represent the pattern visually or explore alternative strategies. The student mainly relied on observing the increase in numbers and continuing the pattern accordingly. This indicates that the student demonstrated moderate fluency in recognizing patterns but still showed limited flexibility and originality in generating solution strategies. As observed in the findings, some students in this category were also unable to draw the triangular arrangement of circles. This difficulty may be related to students' limited ability to communicate mathematical ideas through representations. In line with [39], one important aspect of mathematical communication is the ability to construct representations, which involves transforming mathematical ideas into different forms, such as converting a table into a visual representation or vice versa.

Students categorized as creative thinkers (CS1) demonstrated more advanced reasoning processes. Unlike the previous categories, CS1 not only identified the numerical pattern but also attempted to analyze the structural growth of the triangular arrangement. The student observed that each new figure adds a row of circles, increasing the total number of circles in the triangular pattern. This reasoning shows that the student interpreted the pattern both numerically and visually. Such an approach indicates higher levels of fluency and flexibility, as the student was able to generate and interpret the solution using multiple representations. However, this reasoning was still partially supported by guidance during the learning process. Therefore, the role of the teacher remains important in facilitating students' ability to express mathematical ideas through diagrams, tables, and other representations. This is consistent with [40], which states that teachers should understand how to use diagrams, visual models, and manipulative tools to help students understand mathematical concepts and procedures.

Students categorized as very creative thinkers (CS2) demonstrated the highest level of creative thinking. The student attempted to construct a general rule for determining the number of circles in triangular patterns, rather than relying on repeated counting or extending the table. As shown in the results, CS2 tried to formulate a mathematical relationship between the figure number and the total number of circles. This reasoning indicates a higher level of abstraction and originality in solving the problem. The ability to generalize patterns and apply a rule to different figures reflects high fluency, flexibility, and originality. The classification of these creative thinking levels was operationalized using a rubric-based evaluation approach, which aligns with the perspective of [30], who emphasizes that rubrics can be used to systematically assess different levels of student performance based on clearly defined criteria. Such abilities are often developed through learning environments that encourage exploration and multiple solution strategies. Teachers can design learning activities that encourage students to present various solution strategies and representations in order to develop students' creative potential in mathematics learning [41].

Overall, the findings indicate a progressive development of students' creative thinking processes. Students at the imitative level rely heavily on memorized procedures, while students at the routine level apply familiar strategies to extend patterns. Students categorized as creative begin to interpret patterns using multiple representations, and students at the very creative level demonstrate the ability to construct generalized mathematical rules. This progression highlights the importance of providing learning experiences that encourage students to explore patterns, represent mathematical ideas in different forms, and develop original solution strategies in mathematics learning.

Theoretical Contribution of the Study

This study contributes to the literature on mathematics education by providing empirical evidence regarding the relationship between creative thinking and mathematical reasoning processes in solving number pattern problems. By integrating the indicators of creative thinking proposed by [28] with the mathematical reasoning framework, this study demonstrates how students' reasoning develops from imitative to more flexible and creative mathematical reasoning. Furthermore, rubric-based categorization within the framework of [30] provides a systematic way to interpret students' levels of creative thinking in qualitative research. The findings therefore enrich understanding of how students' creative thinking processes emerge in mathematical reasoning tasks and how these processes can be identified in students' written responses and verbal explanations.

Implications for Mathematics Teaching

The results of this study also provide important implications for mathematics teaching practices. Teachers need to design learning activities that encourage students to explore patterns, construct representations, and develop multiple solution strategies when solving mathematical problems. Learning environments that allow students to investigate patterns, visualize mathematical relationships, and discuss their reasoning processes can support the development of creative thinking skills. In addition, teachers can use open-ended problems, pattern exploration tasks, and collaborative discussions to stimulate students' ability to generate ideas, apply different strategies, and construct original solutions. Such instructional approaches can help students gradually move from imitative, routine thinking to more creative, flexible mathematical reasoning.

Limitations and Future Research

Despite the valuable insights this study provides, several limitations should be acknowledged. This research employed a qualitative case study approach with a single class of students, and the in-depth analysis focused on four students representing different levels of creative thinking. Therefore, the findings may not fully represent the diversity of students' creative thinking processes in broader educational contexts. In addition, the mathematical tasks used in this study were limited to number pattern problems involving triangular numbers, which may reveal only certain aspects of students' creative thinking and reasoning processes. Future research could involve larger samples, different mathematical topics, and various types of problem-solving tasks to obtain a more comprehensive understanding of students' creative thinking in mathematics learning. Further studies may also explore instructional strategies and learning environments that effectively foster students' fluency, flexibility, and originality when solving mathematical reasoning problems.

4. CONCLUSION

This study examined the creative thinking processes of junior high school students in solving mathematical reasoning problems related to number patterns. The findings indicate that students' creative thinking can be categorized into four levels, including imitative, routine, creative, and very creative. Students at the imitative level tend to rely on memorized procedures and previously learned examples when solving problems, while students at the routine level apply familiar strategies but rarely explore alternative approaches. Students categorized as creative demonstrate greater flexibility by using multiple representations and strategies in solve problems, although their reasoning may still require teacher guidance. Meanwhile, very creative students demonstrate the highest level of creative thinking by constructing generalized rules and developing original solution strategies based on the information provided in the problem. These findings indicate that students' creative thinking in mathematical reasoning develops progressively as students become more capable of generating ideas, exploring alternative strategies, and constructing generalized solutions. Therefore, mathematics learning should provide opportunities for students to explore patterns, use multiple representations, and develop their own solution strategies in order to support the development of creative thinking in mathematics.

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