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The Creativity of Reflective and Impulsive Selected Students in Solving Geometric Problems

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Abstract. This research purposed to describe the elementary students' creativity with reflective and impulsive cognitive style in solving geometric problems. This research used qualitative research methods. The data was collected by written tests and task-based interviews. The subjects consisted of two 5th grade students that were measured by MFFT (Matching Familiar Figures Test). The data were analyzed based on the three main components of creativity; that is fluency, flexibility, and novelty. This results showed that subject with reflective cognitive style in solving geometric problems met all components of creativity (fluency; subject generated more than three different right-ideas in solving problems, flexibility; subject generated more than two different ways to get problem solved, and novelty; subject generated new ideas and new ways that original and has never been used before). While subject with impulsive cognitive style in solving geometric problems met two components of creativity (fluency; subject generated more than three different right-ideas in solving problems, flexibility; subject generated two different ways to get problem solved). Thus, it could be concluded that reflective students are more creative in solving geometric problems. The results of this research can also be used as a guideline in the future assessment of creativity based on cognitive style.

1. Introduction

Creativity is one of the most important competencies that must be developed through education. Cropley argued that creativity is the key of success in economy-global era and absolutely necessary in the 21st century [5]. Akgul and Kahveci also stated that creativity is an invaluable skill for the new century [1]. Creativity is the ability to produce any composition, product, or idea that is essentially new and never been used before [7]. In mathematics subjects, creativity is needed in problem solving, because the processes of problem solving are required high thinking levels. Kru & Rudnick stated that the highest level of thinking is critical thinking and creative thinking [9]. Problem solving and creative thinking are closely related. Problem solving has creative aspects because creative thinking produces novel outcomes, and problem solving involves producing a new response to a new situation, which is a novel outcome [8]. Moreover, Silver suggested three components to assess the creativity of children and adults: fluency, flexibility and novelty [11]. Fluency in problem solving is the ability to find variety of correct solution. Flexibility in problem solving is the ability to use various methods to solve problems, while the novelty in problem solving is the ability to find new and different solutions or methods.

Everyone have different levels of creativity. Cognitive style is one of the factors that influence creativity. Sternberg stated that creativity is related to three psychological attributes; intelligence, cognitive style, and personality/motivation [12]. In addition, Al-Silami stated that creativity as an important element that supports the involvement of cognitive abilities, including problem-solving



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abilities [2]. The type of cognitive style that many students have is reflective and impulsive cognitive style. The results of Warli's research showed that the proportion of reflective-impulsive children is as many as 73.7% [9]. Rozenewajg & Corroyer's research show that the frequency of reflective-impulsive children is as many as 76% in one class [13].

This research describes the creativity of elementary students with reflective and impulsive cognitive style in solving geometric problems. The data was collected by written tests and task-based interviews. The geometric problem was solved in an open ended matter. Open-ended problem is very suitable for measuring student's creativity because it has many correct answers. Getzels and Jackson suggested one way to measure creativity about that is open ended problems [6]. The data collected would be analyzed and described based on three components of creativity: fluency, flexibility, and novelty. Fluency is used to check the diversity of problem solving ideas. Flexibility is used to check the diversity of problem solving methods. Novelty is used to check originality of problem solving ideas and methods. Students are considered creative if they met one of the three components.

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2. Method

This research is descriptive research with qualitative approach. Before conducting the research, research's instruments such as the geometry problem solving task sheets and interview guides were made and validated. The subjects consisted of two 5th grade students. Process to select research subjects started from the determination of research class, then applied MFFT (Matching Familiar Figures Test) to group students into four cognitive styles based on accuracy and speed (reflective, impulsive, fast accurate and slow inaccurate). Reflective and impulsive subjects are selected from the most reflective and most impulsive groups, the subject is also determined on the consideration that both of them have similar mathematical background and accomplishments, they are same in gender, and have good communication skills in order to succeed in the interviews to get a complete data of their creativity in geometric problem solving.

The data was collected by written tests and task-based interviews. Every subject was given two problem solving tasks and two task-based interviews. The type of written task was an open-ended problem solving with geometry material, those problem have more than one solution. The first problem-solving task asked the subject to make no less than three different garden design with two kind of flowers within an area of 24m², while the second problem-solving task asked the subject to make no less than three different pond designs with three kind of fish within an area of 18m².

Triangulation and member-check were used to check the credibility of the data. The data of students' creativity in geometric problem solving were assessed based on three components of creativity: fluency, flexibility, and novelty. Fluency in problem solving referred to the number of different right-ideas to get problem solved. Flexibility in problem solving referred to the different ways to get problem solved, while the novelty in problem solving referred to generate ideas or new ways that original and has never been used before.

3. Results

The results of this study describe creativity of reflective and impulsive student in solving geometric problems.

3.1 Reflective Student

Reflective student found five solutions at the first geometric problem solving task and six solutions at the second geometric problem solving task. Fluency component come to be fulfilled if student find no less than three solutions with different ideas. At the first geometric problem solving task, reflective student drew five garden designs with different size and shape. The first design (fs1) was combined by two rectangles with the sizes of 8m² and 16m², the second design (fs2) was combined by triangle and parallelogram with the sizes of 16m² and 8m², the third and fourth design (fs3) was combined by triangle and rectangle with the sizes of 16m² and 8m², the fifth design (fs4) was combined by kite and rectangle with the sizes of 16m² and 8m². The results of the first geometric problem solving task by reflective student showed on figure 1. At the second geometric problem solving task, reflective student drew six fish pond designs with different size and shape. The first design (fs5) was combined by three

rectangles with the sizes of 3m^2 , 6m^2 , and 9m^2 , the second design (fs6) was combined by two triangles and trapezoid with the sizes of 3m^2 , 6m^2 , and 9m^2 , the third and fourth design (fs7) was combined by triangle, parallelogram, and square with the sizes of 3m^2 , 6m^2 , and 9m^2 , the fifth design (fs8) was combined by three triangles with the sizes of 3m^2 , 6m^2 , and 9m^2 , and the sixth design (fs9) was combined by two triangles and rectangles with the sizes of 3m^2 , 6m^2 , and 9m^2 . The results of second geometric problem solving task by reflective student showed on figure 2. The fluency component of reflective subject is shown by making four designs with different ideas. Reflective subject makes several different designs and uses different ideas on each design. Although the subject made different ideas, all of designs are interconnected. New ideas are always based on previous ideas, starting from a simple idea to more complex idea. So, the relationship between ideas used is very visible.

Flexibility component come to be fulfilled if student find no less than three solutions with different ways. At the first geometric problem solving task, reflective student drew three garden designs with different ways to draw and different ways to determine sizes and shapes of design. At the second geometric problem solving task, reflective student drew four fish ponds design with different ways to draw and different ways to determine sizes and shapes of the design. Flexibility component of reflective subject is shown by using more than two different design methods. The first method gives contribution to the second method.

Novelty component come to be fulfilled if student create new solution that never been known before. Creativity in solving geometry problems in component novelty can be identified from the aspect of ideas and methods. Reflective subject only met novelty on the aspect of idea. The design idea was created by reflective subject that is novel and original. At the first geometric problem solving task, reflective student create four original and new designs (fs2, fs3, and fs4). At the second geometric problem solving task, reflective student create two modification designs (fs7, fs9) and two new designs (fs6, fs8).

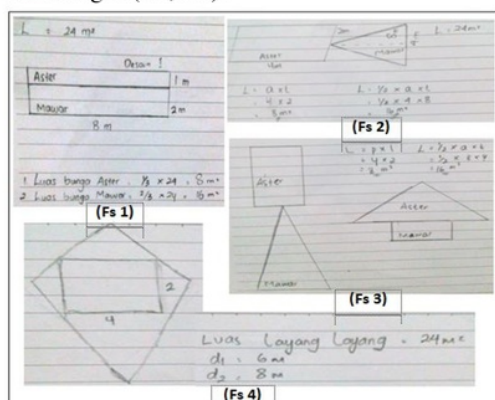


Figure 1. The Result of Cognitive Student Problem Solving Task I.

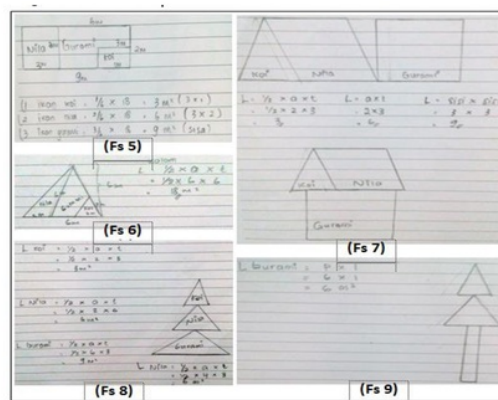


Figure 2. The Result of Cognitive Student Problem Solving Task II.

The summary of creativity of reflective subject in geometric problem solving can be seen in the Table 1.

Table 1. A Summary of Reflective Subject Creativity.

Component of Creativity	Geometric Problem Solving	Description
Fluency	✓	Reflective subject made no less than three solutions with different ideas.
Flexibility	✓	Reflective subject made no less than three solutions with different methods.
Novelty	✓	Reflective subject made different and original design.

Table 1 showed that reflective subject met all component of creativity, she has fluency criteria, flexibility criteria, and novelty criteria in solving geometric problem.

3.2 Impulsive Student

Impulsive student found four solutions at the first geometric problem solving task and four solutions at the second geometric problem solving task. Fluency component come to be fulfilled if student find no less than three solutions with different ideas. At the first geometric problem solving task, impulsive student drew five garden designs with different size and shape. The first and second design (fs1, fs2) was created by rectangle with the size of 24m^2 , the third design (fs3) was created by rhombus with the size of 24m^2 , and the fifth design (fs4) was created by parallelogram with the sizes of 24m^2 . The results of first geometric problem solving task by impulsive student showed in figure 3. At the second geometric problem solving task, impulsive student drew four fish pond designs with different size and shape. The first and second design (fs5, fs6) were created by rectangle with the size of 18m^2 , the third design (fs3) was created by rhombus with the size of 18m^2 , and the fifth design (fs4) was created by rhombus with the size of 18m^2 . The results of second geometric problem solving task by impulsive student showed in figure 4. Fluency component of impulsive subject is shown by making two designs with different ideas. Impulsive subject makes several different designs and uses different ideas on each design. Second ideas based on first ideas, the difference is only in the shape and size of the design.

Flexibility component come to be fulfilled if student find no less than three solutions with different ways. At the first geometric problem solving task, impulsive student drew three garden designs with different ways to draw and different ways to determine sizes and shapes of design. At the second geometric problem solving task, impulsive student drew three fish pond designs with different ways to draw and different ways to determine sizes and shapes of the design. Flexibility component of impulsive subject is shown by using more than two different design methods. The first methods contribute to the second method.

Novelty component come to be fulfilled if student create new solution that never been known before. Creativity in solving geometry problems in component novelty can be identified from the aspect of ideas and methods. Impulsive subject created usual design. The design that was made have been known before.

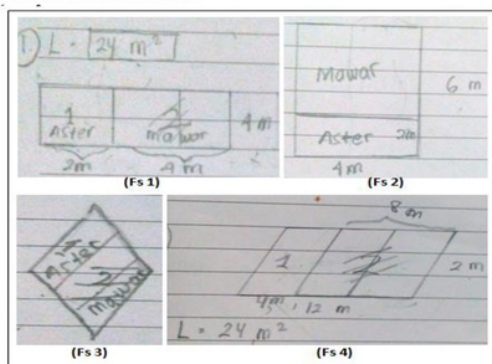


Figure 3. The Result of Cognitive Student Problem Solving Task I.

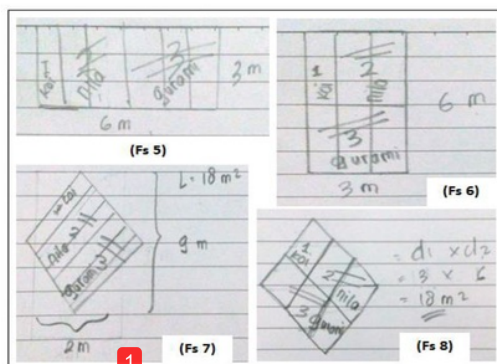


Figure 4. The Result of Cognitive Student Problem Solving Task II.

The summary of creativity of impulsive subject in geometric problem solving can be seen in the Table 2.

Table 2. A Summary of Impulsive Subject Creativity

Component of Creativity	Geometric Problem Solving	Description
Fluency	√	Reflective subject made no less than three solutions with different ideas.
Flexibility	√	Reflective subject made no less than three solutions with

Component of Creativity	Geometric Problem Solving	Description
Novelty	-	different methods. Reflective subject made different and original design.

Table 2 shows that impulsive subject met two component of creativity; she has the fluency criteria and flexibility criteria in solving geometric problem.

4. Discussion

The results of this research is in accordance to Al-Silami research which stated that reflective students are more creative than impulsive students, reflective students have a higher matter on the components of fluency, flexibility, originality, and elaboration [2]. The results of Warli research also showed that the students' creativity profile of reflective cognitive style in solving geometry problem tends to be high, while the students' creativity profile of impulsive cognitive style in solving geometry problem tends to be very low.

The results show that reflective students use their cognitive function better than impulsive students, in addition, reflective students are able to provide many different alternative answers and ways, even the solution provided met the criteria of novelty (original idea and has never been used before). Answers with diverse ideas and ways also indicate that reflective students are able to understand the meaning of the problem well. This is in accordance with the statement of Ancillotti which stated that based on cognitive processes, reflective individuals use analytic processing mode, whereas impulsive individuals use holistic processing modes [3]. Borkowski, Peck, Reid, and Kurtz also revealed that reflective individuals showed superior meta-memory compared with impulsive individuals. Reflective individuals student shows cognitive maturity and preference for analytic processing, unlike impulsive individuals student who exhibits no cognitive maturity and indicates preferences for holistic processing [4].

Differences in reflective and impulsive student creativity also indicate that cognitive style is one of the factors that influence creativity. Accordingly, creativity can be investigated from several perspectives: 1) personality differences, 2) differences in cognitive style or ability, and 3) social psychology [13]. Moreover, Sternberg explained that creativity is related to three psychological attributes; intelligence, cognitive style, and personality/motivation [12].

5. Conclusion

Based on the explanation above, it can be concluded that reflective student met all component of creativity in solving geometric problems. Reflective student met fluency component because she found no less than three solutions with different ideas, she also met flexibility component because she found no less than three solutions with different ways, and she met novelty component because she created different solution that is new for her. In other way, impulsive students met only two components of creativity in solving geometric problems. Impulsive student met fluency component because she found no less than three solutions with different ideas, she also met flexibility component because she found no less than three solutions with different ways, and she did not meet novelty because her finding solution never been known by her.

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