

A Creative Thinking Process of Junior High School Students in Solving Story Problems Viewed from Field Dependent - Field Independent Cognitive Style

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Abstract: Giving math lessons is very important in life. This is in line with content standards in Permendiknas No. 22 of 2006 that mathematics subjects need to be given to train and teach thinking skills, one of which is creative thinking. The purpose of this study was to describe the creative thinking processes of junior high school students with field-dependent and field-independent cognitive styles in solving problems on the surface area of geometric shapes. The subjects in this study were two students, one student each with field dependent and field independent cognitive styles who had high and equal mathematical abilities and were male. The research instruments used were GEFT sheets, Mathematical Ability Test (MAT) sheets, Problem Solving Task (PST) sheets and interview guidelines to find out in detail the students' creative thinking processes. The data analysis technique in this study refers to the process of creative thinking according to Wallas. Based on the results of the study, at the preparatory stage field dependent students read more questions than field independent students. In the incubation stage, field dependent students need 15 minutes, while field independent students need 5-10 minutes to get out of this stage. At the illumination stage, field dependent students are not yet fluent in solving problems and only get one answer idea, while field independent students are fluent in solving problems and have several ideas for solutions. At the verification stage, field dependent students are not sure about the results of their answers while field independent students are very confident about the results of their answers.

INTRODUCTION

According to Permendiknas No. 22 of 2006, mathematics is mandatory for all students to train and teach rational, analytical, methodical, critical and creative thinking. Because the availability of mathematics is very important for life, more emphasis needs to be placed on the development and training of students' thinking skills, one of which is creative thinking.

Supardi (2015) defines creative thinking as the ability to understand and solve problems using various problem-solving strategies. Meanwhile, Sari (2016) defines creative thinking as a mental activity that involves the ability to generate fresh and diverse ideas to solve a problem. Darwanto (2019) defines creative thinking as a mental activity related to understanding a problem, evaluating new and unusual facts and ideas, and being able to build connections when overcoming difficulties. According to the description above, creative thinking is an ability related to activities that involve mental problem solving with the ability to create new and various problem solving ideas. Indicators of creative thinking

used in research are indicators according to Guilford (1977), namely fluency, namely the ability to generate ideas in solving problems, flexibility, namely the ability to produce solutions according to certain conditions, originality, namely the ability to generate problem-solving ideas. different, elaboration (elaboration) namely the ability to develop problem solving coherently.

According to Siswono (2016), the process of creative thinking is a stage of creative thinking which includes synthesizing ideas, generating ideas, and implementing problem-solving ideas. Meanwhile, Oktaviani et al. (2018) explained the process of creative thinking as an illustration of how student creativity occurs. The creative thinking process is a development that can direct students to find new ideas (Novitasari, 2021). Based on this explanation, the process of creative thinking is a stage of student creativity in solving problems by finding and implementing new ideas. The stages of students' creative thinking processes in this study used the stages proposed by Wallas (2014) because these stages of the creative thinking process are very commonly used. The stages of the creative thinking process according to Wallas are, 1) Preparation is the preparatory stage in solving problems by studying a problem from all angles to solve it (Sari, 2017); 2) Incubation is the stage when students stop not thinking about the problems they face but thinking about them in the student's subconscious (Sari, 2017); 3) Illumination is the stage when problem solving ideas begin to appear (Sari, 2017); 4) Verification is a testing and assessment step of a problem solving process (Sari, 2017).

In solving the problem requires creative thinking. This is in line with the opinion expressed by Siswono (2007), that creative thinking is needed in solving problems in order to obtain varied ideas. Problem solving is defined as the process of overcoming difficulties to solve problem-based questions (Sumartini, 2016). Siahaan (2018) also defines problem solving as the process of finding strategies to overcome a problem. From this explanation it can be concluded that problem solving is the process of finding strategies that can be applied in overcoming when solving problem-based questions. The problem-solving steps in this study use problem-solving steps according to Polya (1973) because they are more structured and make it easier for students to solve problems (Siahaan, 2018). Problem solving steps according to Polya (1973), 1) Understanding a problem; 2) Develop a problem solving plan; 3) Solve problems according to the plan that has been made; 4) Looking back

Solving problems in learning mathematics is generally in the form of word problems (Yus, 2019). Word problems are questions in the form of sentences that contain questions that are solved with numeracy skills (Budiyono, 2008). Story problems are also interpreted as problems by presenting everyday life problems in the form of stories (Nurjanatin, et al., 2017). From this explanation it can be concluded that word problems are mathematical problems in the form of sentences containing questions related to everyday life and are solved with numeracy skills. In this study using the steps of solving story problems according to Rosyidi (2005). The steps for solving story problems are as follows: 1) Read questions; 2) Separating and determining what is known and what is asked and the

operations used; 3) Create a math model; 4) Model finishing; 5) Returns the solution obtained in the problem

In solving problems, each student has a different way of thinking (Wulan, 2019). This difference in way of thinking is called cognitive style (Alifah, 2018). According to Liu & Ginther (1999) cognitive style refers to the consistency and characteristics of a person in perceiving, remembering, organizing, processing data, thinking, and solving problems. In line with this opinion, Usodo (2011) explains cognitive style as a person's characteristic in remembering, thinking, making decisions, solving problems, obtaining and organizing information consistently and for a long time. Based on this description it can be concluded that cognitive style is a person's characteristics in thinking, organizing information, and solving problems consistently.

Witkin (1977) classifies cognitive styles into field dependent (FD) and field independent (FI) based on the global analytic continuum. According to Witkin (1977) these two cognitive styles are able to distinguish disturbing and confusing information. FD students remember and learn material better than FI students, FD students need clear additional instructions and motivation depends on the environment, while FI students can solve problems with strategies that they develop themselves and motivation depends on themselves (Witkin, 1977). The different characteristics of FI and FD were also explained by Usodo (2011), that is, students with the FD cognitive style receive information as a whole and cannot analyze its components, while students with the FI cognitive style can analyze the components of the information as a whole.

Santia (2015) also explained that FD students can receive a wider range of information, are more influenced by their environment and will work better if given directions, while FI students can distinguish objects from the information obtained and work better if given freedom. From the description of the differences between FI students and FD students, it can be concluded that FI students prefer to work independently, are self-motivated, able to explore new things, and do not need guidance in solving problems. Whereas FD students prefer to work in groups, need clear instructions, reinforcement, and information to solve problems, and motivation depends on the environment.

In a study conducted by Hidayat et al., (2015) in junior high school students, it was found that there was a difference between FD and FI cognitive styles at the stages of students' geometric thinking, where students with the FI cognitive style had a level of ability above students with the FD cognitive style because FI students could understand problems and construct new information accurately and quickly, while FD only relied on the information they already had. In research conducted by Quintasari (2019) on junior high school students it was also seen that there was a difference between students with a field dependent cognitive style (FD) and students with a field independent cognitive style (FI) in solving geometry material problems. students with the FI cognitive style are superior and more fluent in every stage of the creative thinking process than students with the FD cognitive style. From the two previous studies, it can be concluded that there are differences

in the creative thinking processes of students with FI and FD cognitive styles in solving geometric material problems.

Geometry material is material that is considered difficult by students (Maisyarah, et al., 2020). One of the geometry materials that has a high level of difficulty is geometry material, because in this material students are required to imagine geometric shapes that are physically invisible (Nurhikmayati, 2017). The results of the 2013 national exam in Mulyadi's research (2015) reflect the low ability of students to solve questions related to the surface area of geometric shapes. In line with this opinion, Prabowo (2018) in his research also found that geometric surface area material is material that has a high level of difficulty, this can be seen from the percentage of material difficulty based on the results of the 2013 to 2016 national exams. In the results of observations conducted by Arifin (2017) in his research, it was found that 23 students out of 32 in class one of the Pontianak State Middle School did not complete the daily tests on the material surface area of the geometric shape. This incompleteness is because students are not able to apply the formula for the surface area of a geometric shape to solving a given problem regarding the surface area of a geometric shape. The low level of mastery of the geometric surface area material was also found in observations made by Astuti (2019), there were as many as 62% of students who did not complete the test given regarding the geometric surface area material. This incompleteness occurs because students are unable to solve contextual problems related to the surface area of geometric shapes. From these problems it can be concluded that the material surface area of geometric shapes is a material that is relatively difficult and requires a high level of understanding, so in this study the material surface area of geometric shapes was used in class VII SMP.

Based on this description, this study aims to determine the creative thinking processes of junior high school students in solving word problems about flat shapes in terms of field independent – field dependent cognitive styles.

METHOD

This research is a qualitative research with a descriptive approach. The main data from this study are the results of the Problem Solving Task (PST) and interview results. Data collection will be carried out through tests with Problem Solving Task tests to find out students' creative thinking processes in solving problems in the form of word problems with geometric surface area material as well as by interviews to find out in detail students' creative thinking processes which are not obtained from PST.

The subjects in this study consisted of one student with a field dependent cognitive style (FD) and one student with a field independent cognitive style (FI). The criteria for selecting subjects in this study were having high and equivalent mathematical abilities (the difference in obtaining a maximum 10 point Mathematical Ability Test (MAT) score), male gender.

The instruments used were GEFT sheets to group students with field dependent (FD) and field independent (FI) cognitive styles, Mathematical Ability Test (MAT) to determine

the highest mathematical abilities and subject equivalents, Problem Solving Tasks (PST) and Interview Guidelines.

The GEFT sheet will be examined according to the scoring rules, namely if the correct answer gets a score of 1 and if the wrong answer gets a score of 0. Then grouping cognitive styles is carried out based on the score obtained. Students with field dependent cognitive style (FD) get scores in the range 0-9, while students with field independent cognitive style (FI) get scores in the range 10-18. The Mathematical Ability Test will be examined according to the scoring guidelines, then the scores will be grouped and students who have high and equivalent mathematical abilities will be selected (maximum difference in MAT scores is 10 points). Data analysis of PST subjects' work refers to creative thinking processes according to Wallas (2014), steps to solving word problems according to Rosyidi (2005), as well as indicators of creative thinking according to Guilford (1977).

Table 1. Indicators of Creative Thinking Process in Solving Story Problems

Creative Thinking Process According to Wallas	Problem Solving	Steps to Solving Problems in the Form of Story Questions	Creative Thinking Indicator	Code
Understanding a problem		Read questions (R-01)	Able to spark various kinds of ideas, answers, and problem solving (<i>fluency</i>)	PM1-01
		Separating and determining what is known and what is asked (R-02)	Able to write down what is known and what is asked in the problem smoothly (<i>fluency</i>)	PM2-01
Preparation	Develop a problem solving plan	Determine the operation needed to work on the problem (R-02)	Able to generate various kinds of problem solving ideas (<i>fluency</i>)	PR2-01
			Looking at the problem from a different point of view (<i>flexibility</i>)	PR2-02
			Able to find alternative solutions to different problems (<i>flexibility</i>)	PR2-03
			Able to change the approach according to the problem at hand (<i>flexibility</i>)	PR2-04
		Creating a mathematical model (R-03)	Able to generate various kinds of problem solving ideas (<i>fluency</i>)	PR3-01

Creative Thinking Process According to Wallas	Problem Solving	Steps to Solving Problems in the Form of Story Questions	Creative Thinking Indicator	Code
			Looking at the problem from a different point of view (<i>flexibility</i>)	PR3-02
			Able to find alternative solutions to different problems (<i>flexibility</i>)	PR3-03
			Able to change the approach according to the problem at hand (<i>flexibility</i>)	PR3-04
Incubation	Solving problems according to the plan that has been made	Complete the mathematical model that has been made (R-04)	Able to generate various kinds of problem solving ideas (<i>fluency</i>)	IS4-01
			Able to find alternative solutions to different problems (<i>flexibility</i>)	IS4-02
Illumination (<i>Illumination</i>)	Solving problems according to the plan that has been made	Complete the mathematical model that has been made (R-04)	Able to think of various kinds of ideas, answers, and ways of solving (<i>fluency</i>)	LS4-01
			Able to generate various kinds of answers and solutions; able to see problems from different perspectives; able to find alternative solutions that are different and change the approach according to the problem (<i>flexibility</i>)	LS4-02
			Able to generate new and different answers and solutions (<i>originality</i>)	LS4-03
			Able to develop ways of solving and solving problems in detail (<i>elaboration</i>)	LS4-04
Verification (<i>Verification</i>)	Looking back	Returns the solution obtained from solving the mathematical model to the	Recheck the correctness of the answer (<i>elaboration</i>)	VK5-01
			Summarize and communicate answers in a coherent and detailed manner (<i>elaboration</i>)	VK5-02

Creative Thinking Process According to Wallas	Problem Solving	Steps to Solving Problems in the Form of Story Questions	Creative Thinking Indicator	Code
		solution in the problem (R-05)		

RESULT AND DISCUSSION

The Creative Thinking Process of Field Dependent (SFD) Students in Solving Story Problems

In the preparation stage, to understand the questions, SFD read the questions 4 times and asked the researchers the meaning of the questions. In accordance with the characteristics put forward by Witkin (1977) and Darmono (2012) that students with a field dependent cognitive style (FD) need additional instructions and guidance to solve problems. SFD's initial strategy was to draw a net of cubes on other paper to make it easier to draw the pattern on the answer sheet (PM1-01).

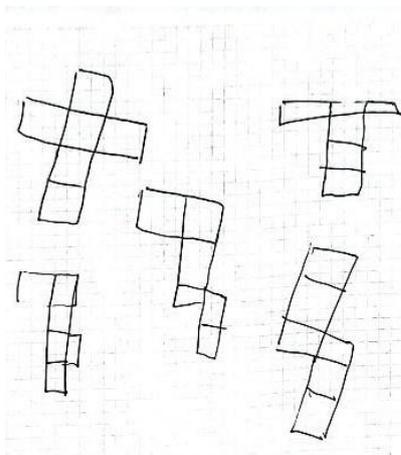


Figure 1. SFD scribble results

SFD does not write down information (what is known and what is asked) in the questions but can mention it during the interview. SFD stated that what was known in this problem was the size of the cube, the number of cubes that had to be made in one group, the price of the paper, while what was being asked was how many groups Arif could invite and the maximum remaining paper (PM2-01). After drawing the SFD net, they seemed confused about continuing to draw the net on the answer sheet. So that SFD stopped working and doing other activities. At this time of confusion, SFD was in the incubation stage. SFD looked around and talked to his friends and researchers. When asked during the interview, SFD kept thinking about how to solve these two questions when SFD conducted the activity. It took SFD 15 minutes each to exit this stage.

The following shows the results of SFD's answers:

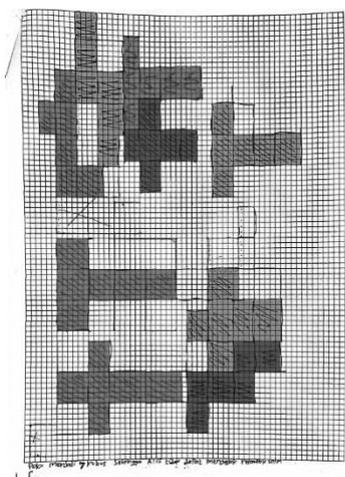


Figure 2. Alternative 1 SFD Answer Results

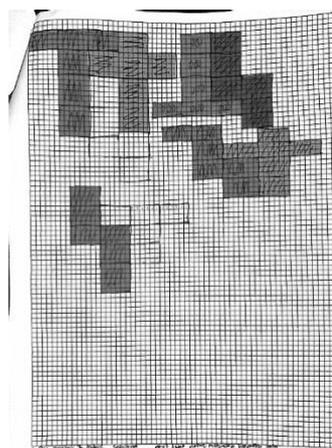


Figure 3. Alternative 2 SFD Answer Results

In the illumination stage, SFD begins to work by drawing and arranging patterns on the answer sheet. The solution idea that SFD found was with 2 alternative answers (LS4-01), but from several alternative answers there was no correct alternative answer in the first question. It can be seen from the results of the work, SFD draws patterns on both questions without the right strategy. SFD didn't think of a pattern drawing strategy to get the maximum amount of paper left. SFD only draws random patterns and draws 6 cube nets without considering the positions between the patterns so that the remaining paper is maximized. This is consistent with the characteristics of SFD stated by Usodo (2011) and Santia (2015) that students who have a field dependent cognitive style receive information as a whole and cannot analyze and distinguish its components.

At the verification stage, SFD checks the results of the answers (VK5-01). However, SFD was not sure about the results of the answer because it found an error and could not fix it. SFD has no other solution ideas to solve the PST problem. This is in line with the opinion put forward by Yousefi (2011) that students who have a field dependent cognitive style can see a problem as a whole but are less critical.

The Creative Thinking Process of Field Independent Students (SFI) in Solving Story Problems

In the preparation stage, to understand the questions, SFI read the questions 2 times without asking the researcher. In accordance with the characteristics put forward by Witkin (1977) and Darmono (2012) that students with a field independent cognitive style (FD) can process information and have the ability to solve problems independently. SFI's initial strategy was to draw nets of cubes and tubes on other paper to make it easier to draw the pattern arrangement on the answer sheet (PM1-01).

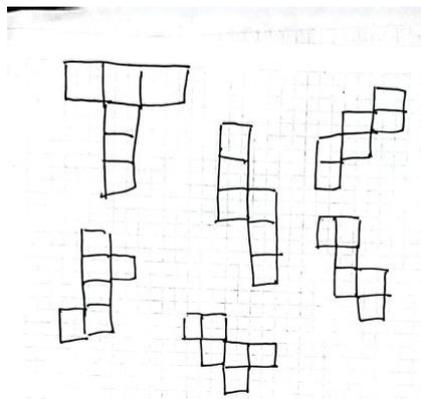


Figure 4. SFI scribbled results

SFI did not write down information (what was known and what was asked) in the questions but could mention it during the interview (PM2-01). SFI's initial strategy in finding paper scraps was to subtract the area of cardboard from the surface area of the cube (PR2-01; PR3-01; PR3-03)

After drawing the nets, SFI seemed confused about continuing to draw the nets on the answer sheet. So SFI stops working and doing other activities. At this time of confusion, SFI was in the incubation stage. SFI looks around, holds and claws head, bites pencil and scribbles on paper. Sfi will take 5-10 minutes to exit this stage. SFI only takes a short time to go through the incubation stage, because SFI has characteristics and is competitive in solving problems (Witkin, 1977).

The following will present the results of SFI's answers:

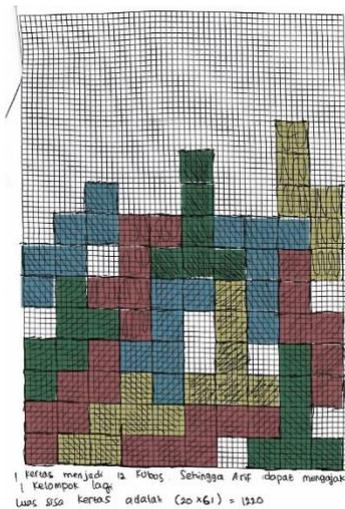


Figure 5. Alternative SFI Answer Results 1

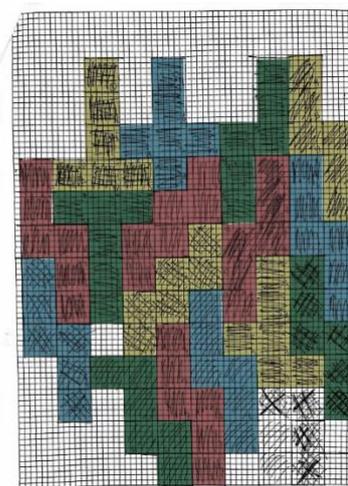


Figure 6. Alternative SFI Answer Results 2

In the illumination stage, SFI begins to work by drawing and arranging patterns on the answer sheet. The solution idea found by SFI is with 2 alternatives (LS4-02; LS4-03). All the solution ideas that come from SFI are correct. SFI can also find remaining papers on both questions. In the first question, SFI was able to make a pattern on the answer sheet by paying attention to the distance between the cube nets (LS4-01; LS4-02). It can be seen from the results of the answers, that the distance between the cube nets is very close together and SFI

also combines nets with one another so that they can utilize paper and get as much remaining paper as possible. This is because SFI has analytical characteristics, can distinguish the components of information obtained and is critical (Witkin, 1977; Yousefi, 2011; Santia, 2015), SFI is able to solve both questions properly and correctly.

At the verification stage, SFI checks the results of the answers (VK5-01). SFI is very confident with the answer because it feels the answer has answered the question. SFI concluded the answer, namely the first pattern is the pattern that produces the maximum remaining paper (VK5-02). SFI has another solution idea to solve those two PST problems. Yousefi (2011) suggests that students who have a field independent cognitive style are critical.

CONCLUSION AND SUGGESTIONS

Based on the results of research and interviews conducted by researchers, it can be concluded that the creative thinking processes of junior high school students in solving problems in word problems in terms of field dependent - field independent cognitive styles are as follows:

The Creative Thinking Process of Cognitive Field Dependent (FD) Middle School Students in Solving Problems in Story Problems

In the preparatory stage, FD students read the questions four times to be able to understand the problems in the Problem Solving Task (PST). FD students also need direction to be able to understand the problem by asking the researcher while working on PST. FD students experienced confusion when drawing patterns on the answer sheet so they stopped working and did other activities. At this time, FD students are in the incubation stage. At this stage FD students carry out other activities that have nothing to do with PST questions. The solution idea emerged when FD students did the activity for 15 minutes.

When the solution ideas began to appear, the FD students began to continue the process of working on the PST questions. At this time FD students are in the illumination stage. At the beginning of this stage, FD students have not found the right strategy to complete. FD students draw patterns arbitrarily without thinking about strategies in order to get the maximum amount of paper left. This is because, the characteristics of the FD cognitive style are receiving information without being able to distinguish its components.

At the verification stage, FD students check the results of their answers. However, FD students did not feel confident with the results of their answers. Because when checking the results of their answers, the FD student found an error but could not solve the error. When examined by the researcher, not all of the FD students' answers were correct, there was an error when drawing the pattern on the second question. The FD student when interviewed said that he had no other ideas to solve these two questions.

The Creative Thinking Process of Field Independent (FI) Cognitive Style Middle School Students in Solving Problems in Story Problems

In the preparation stage, FI students read the questions twice to be able to understand the questions in the Problem Solving Task (PST). FI students do not need directions to be

able to understand the questions. However, when drawing the pattern on the answer sheet, FI students were confused, so they stopped working and did other activities.

When FI students start to feel confused and stop working, FI students are in the incubation stage. At this stage FI students carry out other activities that have nothing to do with PST questions. The solution idea emerged when FD students did the activity for 5-10 minutes.

When the solution ideas began to appear, FI students began to continue the process of working on the PST questions. Currently, FI students are in the illumination stage. At the beginning of this stage, FI students immediately found the right strategy to solve these two questions. FI students pay attention to the distance and position between the nets in order to get as much paper as possible. This is consistent with the characteristics of the FI cognitive style, namely students with the FI cognitive style are able to distinguish the components of the information obtained.

At the verification stage, FI students check the results of their answers and are very confident about the results of their answers. After being checked by the researcher, the answers from the students were correct. This is consistent with the characteristics of students with the FI cognitive style, namely students with this cognitive style are very critical so that every step in solving the problem has been evaluated beforehand. In the interview, FI students also said that they had other solutions for working on PST questions. In order to get better research results, it is hoped that further research will eliminate the weaknesses in this study which were mentioned in the previous chapter.

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