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Mathematical Thinking Ability in Solving Mathematics Problems Consider Cognitive Styles of Field Independent and Field Dependent

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Abstract. This study aims to describe the students' mathematical thinking process through the Field Independent (FI) and Field Dependent (FD) cognitive style in solving mathematics problems. The process of mathematical thinking is an activity of learners in receiving, processing, concluding and reusing the information to solve problems related to mathematical concepts. While cognitive style is a characteristic of learners' activities in mental activities that are consistent in the field of cognitive (think, remember, process information, manage, solve problems, and make decisions). Cognitive style has a major role that can be utilized in an effort to improve the effectiveness of the learning process. Cognitive style is divided into Field Independent (FI) and Field Dependent (FD). This research is descriptive qualitative that describes the process of thinking students in solving mathematical problems on the concept of three-dimensional space. A method of collecting data in this study use GEFT and interviews, as a tool to determine the cognitive style of students on three-dimensional space's material and the process of students' thinking. Students are grouped based on their cognitive style into 2 groups namely FI and FD, then selected two students from FI and FD to be given the test of mathematical thinking ability and then interview. Data analysis techniques used are Miles and Huberman techniques, data reduction, display, and image or verification conclusions. The conclusion of this study is that students who have FI cognitive style tend to have a conceptual thinking process. Likewise, students who have FD cognitive style, these students also tend to have a conceptual thinking process. The conceptual thinking process is a thinking process that solves problems by using the concept that has been owned.

INTRODUCTION

The process of adding the first information is not known to know will be part of learning. The purpose of this learning is to cultivate the ability and self-potential to be optimal. Ability to be part of an important solution for the process of thinking is honed properly. This is in line with the graduate standards of the 2013 curriculum (Ngilawajan, 2013) with the aim of today's math learning. Through these students' thinking skills, they will understand the concepts conveyed. This thinking process is processed through the learning of mathematics, especially with students given the relevant problems.

Mathematics is one of the subjects that are able to develop the thinking process of learners. One of the characteristics possessed by mathematics is the thinking skill, either inductively or deductively. In addition, the vision of learning mathematics also emphasizes the process of thinking, attitude, curiosity and enjoy learning math. By having a good mathematical thinking pattern, then learners are expected to be able to understand the concept being studied.

Based on the results of a survey of junior high school students, there are still difficulties in the thinking process with regard to solving the math problems being studied. To overcome these problems required an analysis of how to improve the ability of students who can stimulate the ability to think. Aripin & Purwasih (2017) that the concept or formula if given directly will be memorized but if a learning in it aims to understand or find the concept it will hone students' critical and creative thinking skills. Thinking skills are needed to cope with the development of science, technology so fast and intense competition. Moreover, the ability to think well honed is expected to create

innovations for the good of themselves and the environment. Therefore, mathematics learning becomes one of the means to improve students' thinking ability.

Each person has a unique character with each other, so this difference that underlies the students to think diverse in providing an idea or solution to a particular response. The response in question is problem-solving in mathematical problems. Tayler (Susandi & Widyawati, 2017) states that basically every individual is different from each other, the dimensions of individual differences include intelligence, logical thinking, creativity, cognitive style, personality, values, attitudes, and interests. Based on Tayler's opinion, there are differences in cognitive factors attached to the individual to influence the mindset of students in acting, solving problems and thinking mathematics. This fact means that there is a cognitive style that affects the way students think in solving the problem. Messick defined cognitive styles as "characteristic self-consistencies in information processing that develops in congenial ways around the underlying personality trends"

When learners solve mathematical problems or mathematical problems, they will certainly come to an answer to the problem through the process of thinking. Stages of completion of the answers are different from each other. The process of thinking of students in learning mathematics needs to get the attention of teachers to know how the mindset of students in providing a solution to the given problem. Through this thinking process, the teacher knows how far the depth and understanding of the material received by the students. Sometimes the teacher only looks at the final outcome of the student's completion regardless of how the student actually gets to the answer. If the student's answer is different from the key, the teacher will blame the answer directly without exploring why the answer is different. Susandi & Widyawati (2017) revealed that one of the roles of educators in learning mathematics is to help learners in the process of thinking through understanding, solving and solving problems on math problems. Each student has a way of receiving lessons, processing information that has been given by the lecturer, then using the existing information to be used in the process. Based on the way students get, process and process the information they get that is called cognitive style.

Ausburn and Ausburn (Aripin, Rahman, & Asdar, 2015) define cognitive styles as psychological dimensions that represent consistency by way of individuals acquiring and processing information. Through this cognitive style affect the way one thinks in looking at the problem. This cognitive style gives students a way of thinking through collecting, analyzing, processing, interpreting data so that interpretation of data will vary from one to another. Based on psychological differences, cognitive styles are divided into two types: field-independent (FI) and field-dependent (FD) cognitive styles. Students with FI cognitive style tend to choose individual learning, respond well, and freely (not dependent on others). Whereas, students with cognitive style FD tend to choose to study in groups and as often as possible interact with other students or teachers, requiring extrinsic rewards/reinforcement. This is in line with Dillon & Gabbard (Shieh, Lioa, & Hu, 2013), A well-known of the individual cognitive differences is the construct of field dependence and independence (FD & I). Liu & Reed (Shieh, Lioa, & Hu, 2013), FDs & I describe learners along a continuum that FDs, and individuals at the other end field-independent (FI). Individuals who fall in the middle of the continuum are characterized as field-mixed (FM).

Students who have FI cognitive style are self-learning, intrinsic motivation, and unaffected by others and the environment. Able to overcome obstacles and disturbances well and can manage the time to reach what has been targeted before. While students who have FD cognitive style tend to be influenced by others, extrinsic motivation and require reinforcement to remain consistent with the tasks that have been targeted. The basic characteristics of these two cognitive styles are well suited for application in research involving thought processes in solving math problems. Ngilawajan (2013) argues that the FI individual is better at issuing all his abilities in solving a problem when he is given freedom. While the FD individual can use all his abilities as closely and effectively as possible in solving problems when he is given clear instructions or directions.

The above description becomes the basic theory to do research on the thinking process in solving Mathematical problems in terms of cognitive style of Field Independent and Field Dependent. The purpose of this study is to describe the students' thinking ability profile in problem-solving in terms of cognitive style of Field Independent and Field Dependent.

RESEARCH METHODS

This research is a descriptive research with the qualitative approach. Because in this study, researchers aimed to describe students' thinking ability in solving problems in General Algebra subject in terms of cognitive style of field dependent and cognitive field independent style. The subjects of this study were B2 class students who contracted General Algebra subjects consisting of 42 students in grouping into cognitive style field dependent and students with cognitive style field independent. Determination of subjects in this study was conducted by referring to the results of cognitive style tests by using Group Embedded Figures Test (GEFT) that has been valid and reliable. Messick (Hsieh & Wu, 2013), this division of cognitive styles uses The Embedded Figures Test (EFT) as the standard categorization tool used to distinguish the degree of field independence or field dependency of a given study's participants. Instruments in this study are grouped into main instruments and auxiliary instruments. The main instruments are self-researcher and auxiliary instruments consisting of Embedded Group Test Group (GEFT)

and Mathematical Problem Solving Problem (TPM). Data collection in this research is done by using is the test, interview, and documentation. The test instrument used is the Test Group Embedded Figure Test (GEFT). The GEFT instrument consists of 10 questions divided into three parts. In the first part consists of 2 questions to be done within 30 minutes as a form of exercise. In the second and third sections, each consisting of 4 questions within 60 minutes can be completed both stages of the test. Furthermore, interview techniques used are structured interviews by noting the key questions that will be given. In addition to tests and interviews, the next instrument is documentation. Documentation is a tool used To collect data in the form of documents such as photographs of activities and transcripts interviews In this study data analysis is done through data reduction, data presentation, and conclusions.

RESULTS AND DISCUSSION

In this section will be discussed the results of research. Research subjects were determined based on students' cognitive style through Group Embedded Test (GEFT) test. Students are then grouped into two groups: Fiel Independent (FI) and Field Dependent (FD) groups. Students who scored less than 50% of the GEFT maximum score were grouped into FD and scores over 50% of the maximal score including the FI group. The results of the GEFT test grouping are shown in Table 1 below:

Table 1. Cognitive Style Group

No	Group	The Number of Students
1	FI	18
2	FD	21

The first stage in solving a mathematical problem is understanding the problem. The subjects of FI and FD study together read the questions carefully and thoroughly. Through the sense of hearing and sight, the subject tries to observe seriously the matter is understood. Stimulus received through sensory processing is shown through reading activity. This is in line with the results of the study from Ngilawajan (2013) that the subject of FI and the subject of FD responds to the stimulus by using sensory records (sensory registers) and the subject uses his sense of sight to record the information he sees.

Students of the FI category are seen using a way of thinking in solving a problem sequentially and able to pour the idea into its own sentence form. Understand the problem then make the planning in such a way that the problem can be resolved step by step by step in detail and detailed well. Students of this FI category are in accordance with the characteristics of FI expressed by Eka, Sadia, & Suastra (2014) that learning, individual-style cognitive field independent have a tendency to achieve higher achievement than the tendency to avoid failure. When Individuals who have an independent field cognitive style are exposed to complex and analytical tasks, they tend to do well.

Students who have FD characters tend to use existing formulas and their motivations are affected by the surroundings. Characteristics of individual FDs are likely to accept existing structures due to lack of restructuring capabilities, have existing goals, work with external motivation. This will result in the low understanding of student concepts. Given the low level of restructuring capabilities, students will remain at the initial concept that individual FDs have possessed, hence students tend to accept existing structures, follow existing goals, and work with external motivations. This will result in the low understanding of students' mathematical concepts.

To identify students' thinking skills profiles, researchers looked at student activity in response to given stimuli. Students are observed regarding the way they go through the process of solving math problems. The process of thinking that students express in the form of writing that is the focus of this research, the subject solves the problem of solving the problem of mathematical students in the concept of building space. Responses and data are then collected, analyzed, and interpreted to obtain valid and consistent data. The examples of the results of the solution presented by students who are categorized FI and students who categorized FD as follows:

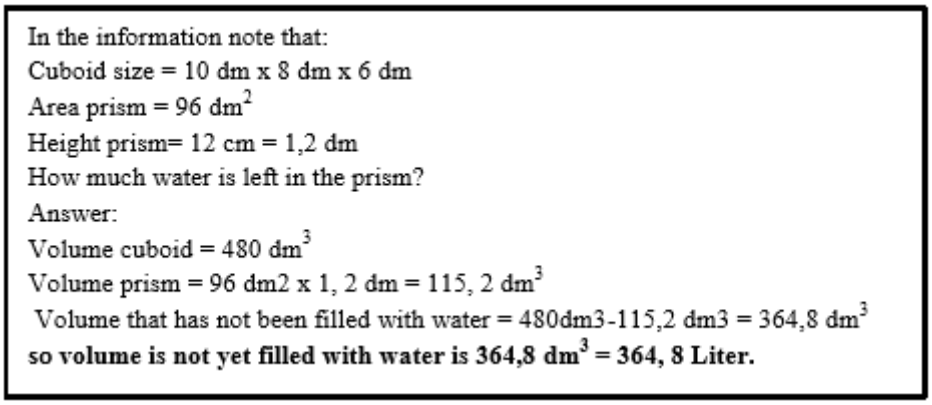
In the information note that:
Cuboid size = 10 dm x 8 dm x 6 dm
Area prism = 96 dm^2
Height prism= 12 cm = 1,2 dm
How much water is left in the prism?
Answer:
Volume cuboid = 480 dm^3
Volume prism = 96 dm2 x 1, 2 dm = 115, 2 dm^3
Volume that has not been filled with water = 480dm3-115,2 dm3 = 364,8 dm^3
so volume is not yet filled with water is 364,8 dm^3 = 364, 8 Liter.

Figure 1. One of the FI Student Completion Examples on Problem Solving Problems

In Figure 1 it appears that students already understand the problem. The answers given by the FI subject are more clear and write down the elements known in detail. In the problem-solving phase of the FI, consider the mathematical concept which begins to find solutions to the problem. This FI student is able to understand the problem, can interpret the problem in his understanding through writing, plotting the problem, it can obtain information so that it can analyze the information, solve the problem according to plan, can analyze a problem based on the information already obtained, check back answer, can check return the answer itself. Students try to express understanding of the problem through answers and training a settlement. Zembat & Yasa (2015), this convincing argument goes beyond a trial-error method. If this continues throughout, for example, a semester, the process of thinking that is done at the beginning of understanding the problem is the formula that will be used to solve the problem. Then the subject starts to try to apply the concept or formula that was thought out earlier to find ways to solve the problem. The thinking process that this FI subject has is conceptual. The conceptual thinking process is a thinking process that always solves problems by using the concept that has been owned based on the results of his lessons during this (Susandi & Widiyawati, 2017). Garger and Guild (Shieh et al., 2013), also found that FD learners prefer a learning environment in which they can interact and discuss with others and that FI learners prefer a teaching method that is purely a dissemination of the facts.

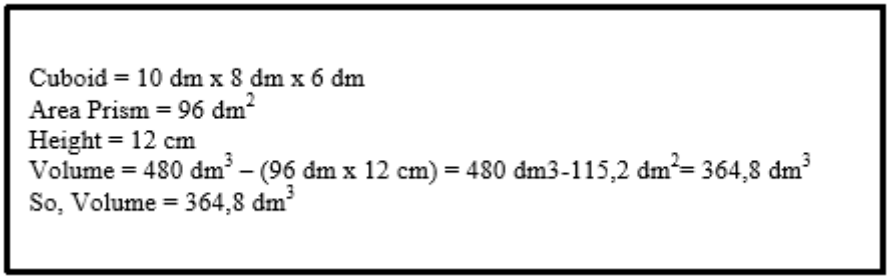

Figure 2. Example of FD student completion on Problem Solving Problem

In Figure 2, students are seen working on the problem directly and do not describe in detail the elements of the information contained in the problem. Students of this FD category understand the problem, can not interpret the problem in writing the form, plan the problem, can not analyze the information, solve the problem according to the plan, not yet can analyze a problem based on the information that has been got. The role of the teacher is to provide direction and guidance on the correct procedures according to the problem-solving steps. The tricot, 2003, Kazemi & Franke, 2004). The teacher will be able to explain the problem.

Another aspect that gives a significant influence that affective state (psychological aspects) of students such as interest, learning motivation, learning style, IQ and most important is to grow a great sense of confidence to students. The result of research of Hsieh & Wu (2015) that gender, age, cultural background, and IQ all impact the manner in which we learn. The result of this research shows that with high confidence, a student can overcome difficulties faced. they meet is an exciting challenge that must be faced, not as a barrier that is simply ignored. By growing confidence in students, students are not easily discouraged when faced with adversity and become smart people in determining the right strategies to solve the problems they face. This is the finding during the study that the subject of the FI category has a sense of self-confidence and a strong sense of self-ability. This subject has a sense of persistent struggle and never give up before the problem faced is solved. Like that of Dunn and Dunn (2011, Hsieh), also learns that the cognitive styles will be elevated and their attitude toward learning becomes more positive. Students must understand the concepts that are being learned when learning activities in the classroom because the concepts that exist in mathematics with each other are related. According to Harry & Purwasih (2015), students learn the material first without being asked by the teacher, they have prepared themselves to ask and argue before the learning process starts will be different understanding compared with the students without preparation. This activity will provide more preparation in understanding the problem so that students will be better prepared in terms of problem-solving. Each student has a cognitive style that affects the way to solve problems. This is in accordance with the opinion of Coop and Sigel (Agustan, Juniati, Yuli, & Siswono, 2016) that the cognitive styles correlate with intellectual and perceptual behavior. Intellectual associated with a person's ability to think, while perceptually associated with a person's ability to view or interpret anything.

Students who have the ability to think well is a strong person and has the attitude of Adversity Quitter is able to survive and struggle in the process of thinking to resolve the cognitive conflict that it faces. As per the cognitive style, students differ from each other in solving problems to find a solution. On the problem of mathematics problems undertaken by students, designed in such a way to be completed by students who have the ability of cognitive style FD and FI. Similar research, Meyer (2003) that successful learning within an Internet environment is highly related to learners' cognitive styles.

The research findings are in line with Utami & Wutsqa (2017), the students' ability to determine what is known and asked is the most common stage done by the students; however, some students still show that they have not been able to apply information on problem-solving problems, analyze the information on the problem given to solve the problem, especially many students who have not been able to determine the adequacy of information on the problem. This is commonly found in the field.

We found there are students who process thinking with novelty at the stage of solving the problem of mathematics. This is a finding of students' thinking processes during learning. Students express something different from other friends. Profile of students belonging to FD category, there are students who think lower than the average thinking ability of his classmates. The researchers' review, it is influenced by the background of the initial ability that they have students. Students realize the ability that they have away from their friends will emerge extrinsic motivation to better in learning achievement. In addition to cognitive style, student achievement is influenced by several factors including gender, motivation, character, IQ, and EQ. The opinion of Hsieh (2011) that in addition, many studies are explicitly in demonstrating the many factors that affect learning, such as IQ, gender, and personal characteristics.

The role of teachers is very influential on the student's thinking style. The important role of the teacher as a mediator and facilitator in the classroom in order to help students to understand the material and the mathematical concept is integral. On the basis of research, Bennett, and Carre (Beijaard, Verloop, & Vermunt, 2000) "... They found it important for teachers to possess this knowledge so that they can change programmes, develope! Active tasks, explain things at a high-quality level, and diagnose students' understandings and misconceptions adequately ". Herold (2014), teachers have to promote meaningful learning with different tools to respond to students' needs. Teachers have to help students to learn that ways truly effective. It is necessary to provide teachers, as clearly as possible, with the tools that they need in order to reflect upon and improve the way in which they do their instruction. Activity's analysis with a cognitive approach can be one of these elements.

CONCLUSION

The result of the research shows that the thinking profile in solving the mathematics problem for the FI students is when understanding the problem, the students interpret the problem in their understanding seen through the writing, the students can plan the problem, get the information so they can analyze the information, solve the problem according to plan, and can analyze a problem based on the information already obtained, re-examine the answer, to check back his own answer. While the thinking profile in solving mathematical problems for FD students is in understanding the problem, students are less able to interpret the problem seen from their understanding through writing; in planning the problem, students are less able to analyze the information provided; on completing the problem according to plan, students are less able to analyze a problem based on the information already obtained; on re-examining answers, students cannot check their own answers again.

The findings of the students' thinking process during the learning, the students found that the thinking process to solve the problem has a novelty in the stage of solving the problem of mathematics. In addition, the profile of students of FDter category also students who think much lower than the average thinking ability of his classmates. This is influenced by the background of their initial ability. By the time they realize that their ability far away from their friends comes extrinsic motivation for better learning achievement. This is the profile of the students of the FD category. In addition to cognitive style, student achievement is influenced by several factors including gender, motivation, character, IQ, and EQ.

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