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Creative Thinking Process on FI and FD Students in Mathematics Problem Solving

Ika Setyana[1, a)], Tri Atmojo Kusmayadi[2, b)], and Ikrar Pramudya[3, b)]

Mathematiccs Education Department of Graduate Program Sebelas Maret University
Jl. Ir. Sutami 36A Kentingan Jebres Surakarta 57126, Indonesia

[a)]ikasetyana1@gmail.com

Abstract. The purpose of this study is to describe the creative thinking process of Field Independent and Field Dependent students in solving linear programming problems. The subject of the study is selected by purposive sampling. The process of creative thinking is the ability to solve problems or create new ideas, plan and apply those ideas to produce a new product. The theory that used in creative thinking is "The Wallas Theory" which has four steps: 1) preparation, formulating a problem and making an initial effort to solve it, 2) incubation, a period in which no effort is made directly for solve problems and attention diverted briefly on other things, 3) illumination, gain insight from the problem, 4) verify, test the acquired understanding and make the solution. The GEFT test is applied for selecting of Field Independent and Field Dependent subjects. The results showed the creative thinking process subject Field Independent tends to solve the problem linear program with smooth and flexible so classified as very creative. While the subject of Field Dependent tend not to solve the problem linear program with flexible and smooth so classified as less creative or not creative.

Keywords: Process of Creative Thinking, FI and FD, and Problem Solving

INTRODUCTION

1945 constitution is too far as reason for math education, article 31, paragraph 1 which states that "every citizen shall have the right to education", each individual must be able to access education without age, time, or place. The purpose of mathematics education is to develop creative activities that involve imagination, intuition and discovery by developing divergent, oritional, curiosity, making predictions and guesswork and experimenting ideas[18]. According to [15], thinking is a fairly complex human cognitive activity. Then [16] reveals that thinking is a dynamic process that can be described by process and path. The process and the way of thinking is what is called the thought process. The process of thinking according to [8] consists of three phases, namely the initial phase to recognize and define the problem, the completion phase to perform the activities necessary to solve the problem, and the review phase to check whether the process of thinking in solving is correct. The type of thinking that emphasizes the variation of the way of settlement is often referred to as creative thinking [2].

[6] argues that creative thinking requires persistence, personal discipline and attention involving mental activities such as asking questions, considering new information and unusual ideas with an open mind, making connections, especially between something that is unlike, linking one another freely, applying imagination to every situation that evokes new and different ideas, and notices intuition. Creative thinking process according to [12] which become the guidance in this research there are 5 that are Creative Thinking Level 4 (Very Creative), Creative Thinking Level 3 (Creative), Creative Thinking Level 2 (Creative Enough), Creative Thinking Level 1 (Less Creative), and Level of Thinking 0 (Not Creative).

[9] says that creative thinking is seen as a process of synthesizing various concepts used to solve problems. Problem solving is a very important activity in learning for students of mathematics education courses. [17] argues that the lack of many mathematics skills caused difficulties in problem solving. Meanwhile, according to [4] conceptual understanding and procedural knowledge are essential to skills in problem solving. Then [5] weakness in understanding concepts and lacking of strategic knowledge result in difficulties in problem solving.

The subject of problem solving is exposed to the problem-solving step, their thought processes and they apply and evaluate the problem in a positive way [3]. Then according to [14] the abilities to give good concentration, to

make meaningfull preceptions, to think logically and to use memory skills are important factors in learning skill and solving problems. [21] argues that students have major difficulty in retrieving concepts, formulas, facts, and procedures during problem solving. If the learning process is not as effective for all students, the difficulty in acquiring mathematical skills by students may get worse. Understanding the students' difficulties in the mathematics skills needed in problem solving is one way to help this group of students [17].

Each individual has its own characteristics, so that each individual one with the other is different. The difference is caused by several factors and one of them is cognitive style. Cognitive style is an important variable that influences students' choices in the academic field, the contonuing development of academic, how students learn, and how students and teachers interact in the classroom [1]. Then [19] argues that it is revealed that one of the factors that affect individuals in filing and completing math problems is cognitive style.

Cognitive style is divided into two namely Field Dependent (FD) and Field Independent (FI) [10]. Field Independent hinges on the perceptual skill of seeing the forest for the trees. Then Field Dependence is conversely, the tendency to be 'dependent' on the total field so that the whole field is perceived as the whole unified [7].

[15] states that cognitive style is the characteristic of discrete particles and separated from its surroundings as well as analyzed in its analytic context. Cognitive style is an FD individual characteristics that tend to organize and process information globally so that its perception is easily affected by changes in the environment. The participants' cognitive styles were measured through the Embedded Figures Test Group (GEFT). The findings of the study indicate that field dependencies / independence cognitive styles have a significant correlation with vocabulary knowledge in the high, mid groups [11]. Students of Mathematics Education Study Program are well-educated students with the aim that the graduates will prepare the need of educator, be a teacher, lecturer and teacher in a course of study guidance. Students as prospective educators, the community asks professional educators, who are competent in their fields, and have the skills needed by a mathematics teacher to teach in the classroom. Therefore, students of Mathematics Education Program of FKIP as prospective educators are expected to have a variety of skills and one of them is problem solving skills. The grouping of mathematics education students is obtained based on the cognitive style of FD and FI based on GEFT test. From the results of the subject grouping analysis of each of the cognitive styles will be selected for a problem-solving test. The creative thinking process is described after a problem-solving and interviewing test.

METHOD

The type of this research is descriptive qualitative research. In this research will be described the creative thinking process of students based on their cognitive style in solving math problems. This research involves students of mathematics education program of Veteran Bangun Nusantara Sukoharjo University. Thetechnique of subject selection in the research using purposive sampling is a way of taking informant data source with certain considerations. Based on the results of discussions together with lecturers of subjects linier program obtained students who meet the criteria as a subject of research as much as 1 student in each category of cognitive style.

Instruments used in this research are GEFT test instruments, problem-solving test instruments, and interview instruments. To determine the cognitive styles of students used the GEFT [20]. The GEFT test instrument is used to determine the subject of research with the cognitive style of FI and FD, while the problem-solving test instrument is used to find out how the student steps in solving mathematical problems, and the interview test is used to comprehend, explore and clarify the creative thinking process delivered by the research subjects.

RESULTS AND DISCUSSION

Relevant research or in conformity with this is the research that has been done previously related to the process of creative thinking of students in solving mathematical problems with cognitive style. Journal [13] concluded that *"this research should be continued to explore deeply the differences of creative thinking process between male and female students, also a particular student's ability which is unclear. There by, revising a criteria, procedure, instrument, or level must be done in order to find the best conclusion".*

This research was conducted at Veteran Bangun Nusantara Sukoharjo University. The subjects of this research are 2 students of Mathematics Education Department consisting of 1 student with cognitive type style of Field Independent and 1 student with cognitive type style of Field Dependent. The data were obtained from GEFT test to all 5B semester students, which totally 23 people, held on Monday, 16 October 2017 from 10.00 to 10.50 WIB. The GEFT test takes 1 hour (50 minutes). The result of classification of student's cognitive style can be seen in Table 1 below.

Table 1. The result of cognitive type style of Field Independent

Cognitive Style	Student amount
FI	16
FD	7
Total	23

Finishing GEFT test, 16 students who have FI cognitive style and 7 students who have type of cognitive style FD. The technique of subject selection in the research using purposive sampling is a way of taking informant data source with certain considerations. Based on the results of discussions with lecturers of linear courses obtained students who meet the criteria as research subjects. Furthermore, observations were made to 2 students consisting of 1 student for each type of cognitive style as data source.

This study is a description of the process of creative thinking of students in solving linear program problems seen from the cognitive style categories that have been analyzed. The theory of the creative thinking process used in this study is "The Wallas Theory" which has four steps: 1) preparation, formulating a problem and making an initial effort to solve it, 2) incubation, a period in which no effort is made directly for solve problems and attention diverted momentarily on other things, 3) illumination, gain insight (deep understanding) of the problem, 4) verify, test the understanding that has been obtained and make solutions.

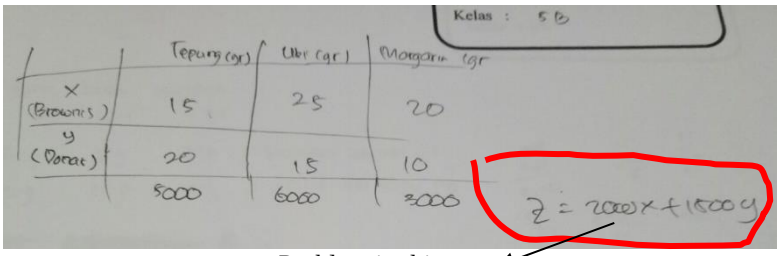
Based on the results analysis from each cognitive style category and the consideration of the lecturers, one student was selected to do the problem-solving test and interview to know the creative thinking process. The subject of PMS is one of the subjects selected by the researcher and lecturer from the cognitive style category of FD, while RDN is one of the subjects selected from the FI cognitive style category. The results of the linear program solving tests given to the chosen subject are presented in Table 2.

Table 2. Result of Linier Program Problem Solving

Cognitive Style	Student total
PMS	10
RDN	93

Subject of RDN

Subjects in problem solving firstly go through the steps of understanding the problem (understand the problem) that is by understanding the problem, in this case can be shown in the student work results shown in Figure 1. Subjects identify what is known, what is there, the amount and value -related values, and what's being searched for.



Problem in this case.

Figure 1. The step of Problem Understanding and subject planing RDH

The step of creating a plan (devise a plan) has also been shown the subject in Figure 1. The subject creates a table to simplify the problem so that the data is more sorted and easy to solve. The next step is to carry out the plan (carry out the plan) shown in the form of a mathematical model (Figure 2), then implemented a strategy in the calculation process takes place (Figure 3).

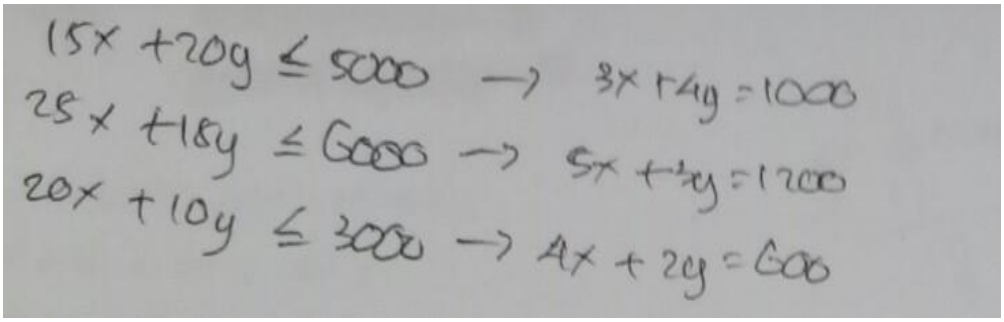


Figure 2. The step planning action in mathematic model subect RDH

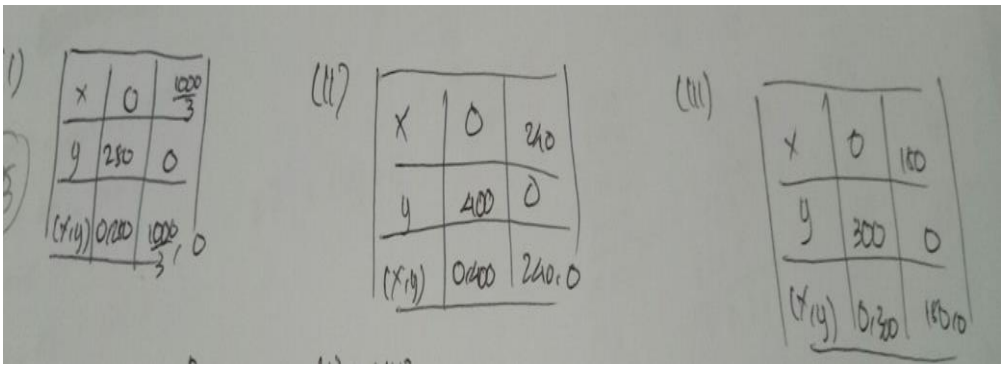


Figure 3. The step action planing of strategy in acount process subject RDH

The last step in problem solving is looking back (looking back). Aspects to keep in mind when checking back the steps that were previously involved in problem solving were to check the identified important information, to check the calculations involved, to create solutions in the form of mathematical graphs (Figure 4), and to work out solutions in the form of calculations until the results obtained split problem (Figure 5).

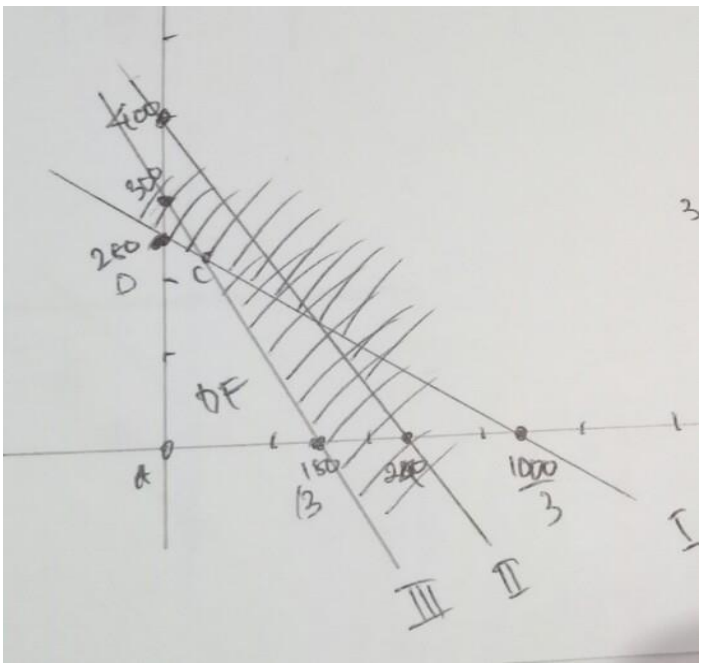


Figure 4. Solution in Grafic form to get result area

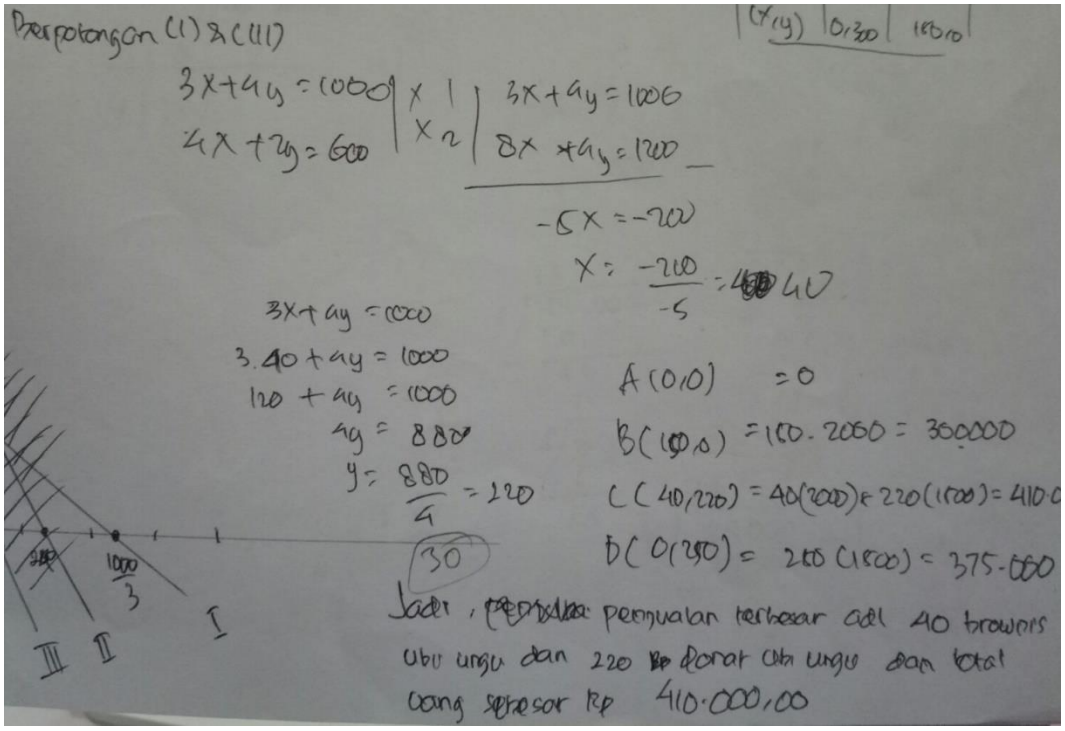


Figure 5. Solution in account

Subject PMS

Subjects in problem solving through the understanding of the problem (understand the problem) that is by understanding the problem, in this case can be shown in the student work results shown in Figure 6. Subjects identify what is known, what is there, the number and values related, and what is being searched for.

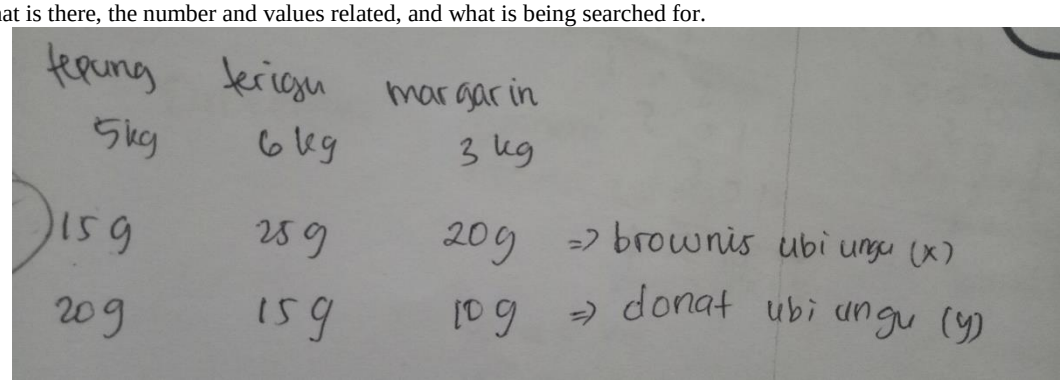


Figure 6. Step of comprehend Subject Problem of PMS

Steps of making a plan (device a plan) is not done clearly, in this case the subject does not understand the problem correctly so do not understand what to do. This can be seen in Figure 7.

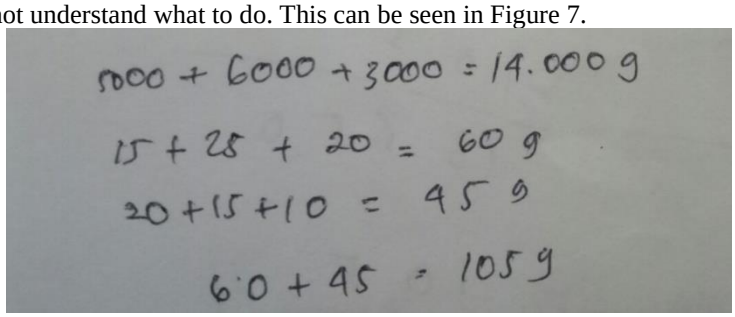


Figure 7. Step of comprehend Subect Proble PMS

The second step is not done subject properly so that for the next step also not done properly. The subject of the STD can not solve the given problem correctly. This can be seen from Figure 8.

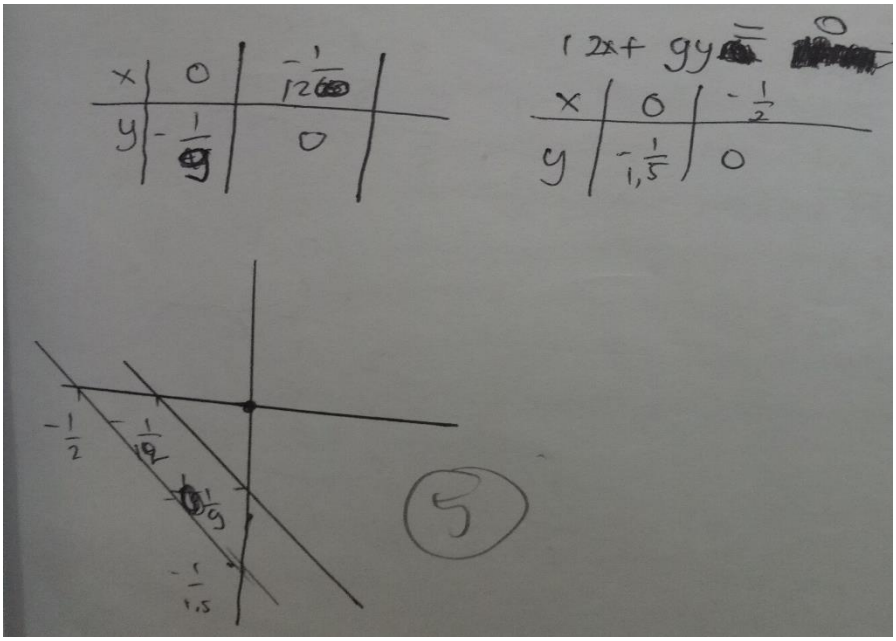


Figure 8. Result of Problem Solving Subject PMS

CONCLUSION

Based on the results of research and discussion, obtained the conclusion that students semester 5 mathematics education program of Veterans University Bangun Nusantara Sukoharjo who have cognitive style FD classified as not creative (creative thinking process level 0). While students who have FI cognitive style are very creative (creative thinking process level 4).

Creative thinking process level 0 (not creative) owned by FD cognitive style in preparation step, because its ability is less then settlement done wrong. At the incubation step, the subject experimilates in a known but less conceptually understood way. At the illumination step, subjects are unproductive and not fluent in solving problems because of the difficulty of recalling existing concepts. At the verification step, the result is not quite right and when done, the answer is not checked again.

Creative thinking process level 4 (very creative) owned FI cognitive style, in the preparation step, the subject is planning the implementation of ideas based on prior learning experience ever done. Then at the incubation step, the subject is able to recall and think about the idea of the most appropriate way to solve the problem. At the illumination step, because it already understands the information in the given problem, then the idea to solve problems appear more productively and smoothly by the subject, as well as difficulty can be overcome. At the Verification step, the subject is confident with the results of his work and when there are errors can be fixed quickly and accurately by the subject. Then the conclusion withdrawal is also obtained with caution.

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