Problem-solving in creative thinking process mathematics student’s based on their cognitive style

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Abstract. Problem solving plays an important role in mathematics that is to understand students' difficulties in math skills. This study aims to reveal students' mathematical problem solving profiles based on their cognitive style in their creative thinking process. As a result of this study, students who have Field Independent cognitive style are able to solve the mathematical problems given so as to belong to the process of creative thinking level 4. Students who have Field Dependent cognitive style are generally confined to math problems that can be solved to include creative thinking process level 0 (not creative). In this study, it is seen how the solution of mathematical problem-solving based on their cognitive style influences the creative thinking process.

1. Introduction

Somebody must be able to access education without limitation of age, time, or place in order to develop himself in a sustainable manner. Mathematics education can be developed through the process of thinking. Creative thinking ability is an ability that is important for everyone, not just when studying at school, but also when face with the world of work [1]. Students are given the opportunity to solve problems in order to know their creative thinking process. In the opinion of Siswono this research has 5 levels, 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 Creative Thinking Level 0 (Not Creative) [2]. Rochmad stated one kind of Mathematical logical in problem solving is creative thinking problem [3]. The variation of a problem could happen in the process of solving a problem, and it also could happen before or after solving a problem [4].

Problem solving is used as an approach to learning mathematics, so it is not only intended to learn mathematics but also to achieve learning goals [4]. Conceptual understanding and procedural knowledge are essential to skills in problem solving [5]. Mathematical problem solving skills and success of secondary school students differ according to class levels in this current study [6]. Problem solving plays an important role in mathematics that is to understand students' difficulties in math skills. Learning mathematics should avoid the use of traditional learning methods that leads to convergent thinking in which students only remember mathematical theorems and rules to solve problems [1]. Hobri stated the expected problem solving is problem solving which is involving and exercising creativity [7].

The process of solving problems taken is generally different from each other because the mindset in solving problems is also different [8]. The thought process needs to be considered to develop problem solving abilities, one of the dimensions that can be seen in mathematics is cognitive style [9].
Cognitive style is how one prepares, processes information, thinks, and resolves problems consistently that affect the academic field [10]. Cognitive style is divided into Field Independent and Field Dependent. Subject Field Independent is able to meet all indicators of problem solving even though sometimes errors still occur and in dealing with problems does not take long. Whereas the subject of Field Dependent is unable to fulfill all indicators of problem solving and in understanding the problem takes a lot of time [11].

Rahmawati stated the fundamental differences between individual FI and FD cognitive style can be observed to individual characteristics related to process information [12]. Field Independent easily concentrates in various environments so that it is not easily affected by noise or confusion and it is easier to understand each word that is read or heard. Whereas a calm environment is needed by Field Dependent to be able to concentrate, besides understanding problems, collaboration or feedback is needed from others [13]. FD children show performance that is not as good as FI children [14].

The problem in this case is that there is a significant difference between Field Independent and Field Dependent of undergraduate students of Mathematics Education Study Program. Therefore, the purpose of this study was to reveal the profile of students' creative thinking processes in solving students' mathematical problems based on cognitive style. Then find a solution so that the creative thinking process that occurs in students from Field Independent and Field Dependent didn’t much different and increases student creativity.

The model of Wallas is used to measure and determine student’s position in creative thinking stages [1]. The stages that the Walas theory has, namely preparation stage, incubation stage, illumination stage, and verify stage. This theory will be used to measure the position of Field Independent and Field Dependent students in the category of creative thinking processes.

2. Method
Qualitative descriptive research is a type of research used in this study. This research was conducted at Veteran Bantara Sukoharjo University by involves undergraduate students of mathematics education program. The subjects used in this study were 1 student for each category of cognitive style. The research subjects were selected based on the results of discussions with the lecturers.

Instruments used in this research are GEFT, Problem solving test, and interview guidelines. GEFT instruments were conducted to determine research subjects belonging to the Field Independent and Field Dependent groups. Students are categorized as Field Independent subjects if the correct answer is more than 9. While students are categorized as Field Dependent subjects if the correct answer is less than 9.

3. Result and Discussion
GEFT instruments are conducted on the odd semester of the lecture year 2016-2017, Mathematics Education Study Program, then subject is determined for the Field Independent and Field Dependent categories. The subject chosen to be observed from the Field Independent category is the subject of K1 while the Field Dependent category is the subject of K2. Subjects were asked to solve linear program problems. The solving test results are presented in Table 1.

| Table 1. Problem Solving Test Results |
|--------------------------------------|
| Subject | Score |
|---------|-------|
| K1      | 93    |
| K2      | 10    |

The process of solving problems through 4 stages, namely understanding problems (understanding of the elements contained in the problem to solve problems), planning the steps in solving problems (making a design to facilitate problem solving), implementing strategies to solve the problem (looking
for the right strategy to solve problems), and verification (make corrections and review the results of the work so that the correct problem is solved) [8]. In this case, the stages of the problem solving process are carried out to observe the creative thinking process of both Field Independent and Field Dependent subjects.

3.1. Subjek K1
The stage of understanding the problem that was passed in solving the problem is shown on the worksheet (Figure 1). On the problems given the subject can find and record what is known, what is available in the reading, the values associated, and the problems sought to resolve.

Subject plan for solving the problem is also shown in Figure 1. Troubleshooting is made easier by summarizing simple questions in the form of tables. The next step is shown in the form of a mathematical model that aims to implement the problem solving plan (Figure 2). Furthermore, the calculation process is done using a strategy (Figure 3).

The last stage is looking back. Things that must be considered when re-examining information that has been identified, checking the calculations previously performed, mathematical charts are made to obtain a solution from the problem (Figure 4) and do calculations as a solution to the results of problem solving (Figure 5).

So, the biggest sales were 40 purple sweet potatoes brownies and 220 purple sweet potatoes donuts from the total monet of Rp 410.000,00
3.2. Subjek K2
The stage of understanding the problem is done by the subject in solving the problem, shown through a worksheet (Figure 6). The subject can find and record what is known, the value related to the question, and what questions are sought. So that on the device phase a plan cannot be done properly because the subject does not understand the problem and does not know what to do.

![Figure 6. Stages understand the problem](image)

The next stage is also not appropriate because of an error in the previous stage. Problem solving cannot be done by K2 subjects correctly (Figure 7).

![Figure 7. Problem solving results](image)

The ability to think creatively is inseparable from the ability to solve problems in creative ways [1]. The creative thinking process of students in solving linear program problems is shown by the results of the work of both subjects. Interviews with Field Independent and Field Dependent students showed that each student had different types at each stage of Wallas Theory. This difference can be seen in table 2.

### Table 2. Creative Thinking Process in Mathematics Problem Solving on Wallas Model

| Wallas Stage | Creative Thinking Process level 4 | Creative Thinking Process level 0 |
|--------------|----------------------------------|----------------------------------|
| Preparation  | Students can understand the problem and communicate the problems given in their own language. | Students didn’t understand and communicate the problems given in their own language. |
| Inclubation  | Student tend to stop a moment to observe a given problems and remember the material that they learn previously. | Student tend to stop a bit longer and think about what to do. |
| Illumination| Students apply ideas to solve problems with confidence and have the right solutions. | Students didn’t solve problems and have wrong solutions. |
| Verification | The student checks the answer again. If they encounter errors they repeat to justify the answer until they get the right answer. | Student didn’t recheck the solution because they feel they did the correct solution. |
Based on the results of the analysis, students who have a FI cognitive style are able to solve a given mathematical problem so that it is classified in the level 4 creative thinking process (very creative). While students who have FD cognitive style are generally limited to mathematical problems that can be solved so that it includes the process of creative level 0 (not creative). Therefore, students in the FI and FD categories need a more creative and innovative learning model so that their creativity can be trained.

4. Conclusion
The conclusions obtained were the odd semester of the lecture year 2016-2017, Mathematics Education Study Program at Veteran Bangun Nusantara University which had different types of creative thinking processes based on their cognitive style groups.

The results of this study, students who have a FI cognitive style are able to solve mathematical problems that are given so that they belong to level 4 creative thinking process. While students who have FD cognitive style are generally limited to mathematical problems that can be solved so that it includes the process of creative thinking level 0 (not creative). Therefore, FD students still need extra training and mentoring when experiencing obstacles in the creative thinking process, while FI students need more practice.

Creativity is strengthened through indicators of learning plans so that the Creative Thinking Process can be analyzed in solving problems better. In addition, it is expected that there will be teaching aids and learning media that make it easier for students to have creative thinking processes in solving problems for FI types or FD.

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