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Citation: AIP Conference Proceedings 1848, 040018 (2017); doi: 10.1063/1.4983956

View online: <https://doi.org/10.1063/1.4983956>

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Investigating and Analyzing Prospective Teacher's Reflective Thinking in Solving Mathematical Problem: A Case Study of Female-Field Dependent (FD) Prospective Teacher

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Abstract. In the last few years, reflective thinking becomes very popular term in the world of education, especially in professional education of teachers. One of goals of the educational personnel and teacher institutions create responsible prospective teachers and they are able reflective thinking. Reflective thinking is a future competence that should be taught to students to face the challenges and to respond of demands of the 21st century. Reflective thinking can be applied in mathematics because by reflective thinking, students can improve their curiosity to solve mathematical problem. In solving mathematical problem is assumed that cognitive style has an impact on prospective teacher's mental activity. As a consequence, reflective thinking and cognitive style are important things in solving mathematical problem. The subject, in this research paper, is a female-prospective teacher who has field-dependent cognitive style. The purpose of this research paper is to investigate the ability of prospective teachers' reflective thinking in solving mathematical problem. This research paper is a descriptive by using qualitative approach. To analyze the data related to prospective teacher's reflective thinking in solving contextual mathematical problem, the researchers focus on four main categories which describe prospective teacher's activities in using reflective thinking, namely: (a) formulation and synthesis of experience, (b) orderliness of experience, (c) evaluating the experience and (d) testing the selected solution based on the experience.

INTRODUCTION

In the National Council of Teachers of Mathematics (NCTM), it is stated that the competence in mathematical problems solving is one of the competencies which must be owned by a student in learning mathematics [1]. One of the thinking skills which can be applied in solving mathematical problem is reflective thinking [2] because it is a type of high-level thinking which can encourage student's curiosity [3]. This is in line with the demands of curriculum 2013 in Indonesia expressly found the key words on 13 competencies and basic competencies as behavioral of science includes curiosity, objective, fair, thorough, meticulous, diligent, careful, responsible, open, critical, creative, innovative and caring environment. Moreover the skills need to enter the 21st century are cognitive skills, intrapersonal skills, and interpersonal skills. It confirms that to face the challenges of globalization and the changes of the 21st century then reflective thinking skills should be taught to students as a future competence.

In addition, Goodell [4] and Ville [5] stated that one of the goals of the educational institutions and educational personnel (LPTK) creates a prospective teacher who is responsible and capable of reflective thinking. By reflective thinking, students can solve more complex problems because students' sense will be directed and solutions of the problem being solved tend to be correct and appropriate [6]. Reflective thinking also gives opportunities for students to justify misconceptions by helping students to think about what they did and why they did it [6-8]. This indicates

that the reflective thinking occurs after mathematical problem solving conducted with the aims namely checking the error of the concepts used and trying to justify these misconceptions, so that it can develop students' skills in using mathematical concepts [9].

Every student has a unique character and different ways to process information, learn a subject matter and solve problems [10]. One of students' character in processing information is by using cognitive style. These differences give affect on students' skills in reflective thinking and solving problems. This is in accordance with Coop's and Sigel's opinion [11] 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. Related to cognitive style, Witkin, et.al [12] developed it based on continuous global analytical. Based on this concept, cognitive styles are divided into field-independent (FI) and field-dependent (FD). Individuals who are FI is more analytical, they can choose the stimulus based on the situation, so that their perception is only a small part affected when there is a change in the situation. They prefer to separate the parts of a number of patterns and analyze patterns based on their components. Another hand, individuals who are FD tends to have difficulty in distinguishing stimulus through situations that owned in order that their perception is easy to be influenced by manipulation of the surroundings. They tend to see a pattern as a whole, not separate it into parts.

Based on the previous explanation, it can be indicated that cognitive styles correlate to intellectual which associate ability to think, in this study, reflective thinking. As a consequence, to investigate and analyze prospective teacher's reflective thinking in solving mathematical problem then it is used as a mathematical problem which can promote reflective thinking. In addition, we need to synchronize several components of reflective thinking that exist, namely the components of the process of reflective thinking by John Dewey [13] abbreviated PBRD; by Lee [14] abbreviated PBRL; by Rodgers [15] abbreviated PBRR, by Zehavi and Mann [16] abbreviated PBRZM. From the components of reflective thinking served by each figure who examined components of reflective thinking, there are similarities indicators on them. The results of the construction of reflective thinking obtained contained in the following table.

Table 1. Construction of Reflective Thinking

Dewey (1998) (PBRD)	Lee (2000) (PBRL)	Rodgers (2002) (PBRR)	Zehavi & Mann (2006) (PBRZM)	Reflective Thinking
5 experience Spontaneous interpretation of the experience Naming the 3 problem Generating possible explanations for the 5 problem Ramifying the explanations into full-blown Hypotheses Experimenting or testing the selected hypotheses	3 Problem context Problem definition/ Reframing Seeking possible solution Experimentation	Presence to experience Description of experience Analysis of experience Intelligent action/ Experimentation	Selection of techniques Monitoring of the solution process Conceptualization Insight or ingenuity	1 Formulation and synthesis of experience Orderliness of experience Evaluating the experience 1 Testing selected solution based on the experience

The Table 1 showed the construction of reflective thinking process with four stages, namely (1) Formulation and synthesis of the experience; (2) Orderliness of experience; (3) Evaluation of experience; and (4) Testing the selected solution based on the experience. By using the result of construction of reflective thinking process, it can be implemented to get the profile of prospective teacher's reflective thinking in solving mathematical problem by investigating and analyzing the result of prospective teacher's mathematical problem solving and it is associated to every indicator of reflective thinking which constructed before.

METHOD

Subject, in this study, is a female-prospective teacher who has Field Dependent (FD) cognitive style. The subject is also a student in Department of Mathematics Education, Muhammadiyah University of Makassar, Indonesia. To determine the subject, it will be used Group Embedded Figure Test (GEFT) and mathematical achievement. To get the data, the subject was given non-routine problem and it is used an unstructured interview which consists of questions to dig up reflective thinking aspects (see Table 1). This research paper aims to investigate and analyze student's reflective thinking in solving mathematical problem. As a result, the researchers used exploratory descriptive study by using qualitative method.

RESULTS AND DISCUSSION

Based on the result of construction on reflective thinking process, it is divided into four aspects. The subject had been interviewed deeply on matters concerning the four stages and link ages that may affect it. The results of interview toward the subject on data collection are presented by illustrating the description of reflective thinking in solving the contextual mathematical problem by Female-Field Dependent (FD) prospective teacher as follow.

1. Formulation and synthesis of the experience

The subject understood the problem by reading for about three times and imagined the description of it. As a consequence, the subject explained problem clearly related to the main point by using her owned word. The subject described the problem in out of order. The subject also can find the concepts which are related to the problem given. The subject stated that the mathematical problem is related to concept of algebra arithmetic operation (addition, subtraction, division and multiplication). The subject restated all the problem in another words. It indicates that the Female-Field Dependent tries to construct her understanding toward the problem by reading the problem in one more time. To make sure, she understood on the related to the mathematical problem, the subject restated the problem by using her owned word, yet the subject explained the information in out of order. Furthermore, when the subject identified concept or subject matter which is related to the problem, the subject mentioned not only the concept that ever the subject used in solving a problem before, but also the subject explained that the concept which will be used in solving contextual mathematical problem. For example; velocity, time and distance for concept related to the concept that ever the subject used in solving a problem before. For this problem, the subject investigates concept of algebra arithmetic operation (addition, subtraction, division and multiplication). Moreover, the subject describes the difficulties which are gotten when solving the contextual mathematical problem is the ability to look for the strategies.

2. Order lines of experience

The subject gave explanation in choosing operation and the difficulties in applying strategies. The subject investigated one concept and explained its impact development in solving other problems. For instance, algebra is related to algebra arithmetic operation (addition, subtraction, division and multiplication). The subject formulates information based on her experience by writing down the information known and information asked. The subject also focused on the structural relations which can be found in the problem so that it can give appropriate direction to get the correct solution. Moreover, the subject stated that she tends to use the same way to solve other problems. The subject also adapted her strategies in order to develop her solution to get the right answer. However, the subject also described that it was need a thoroughness to apply the strategies.

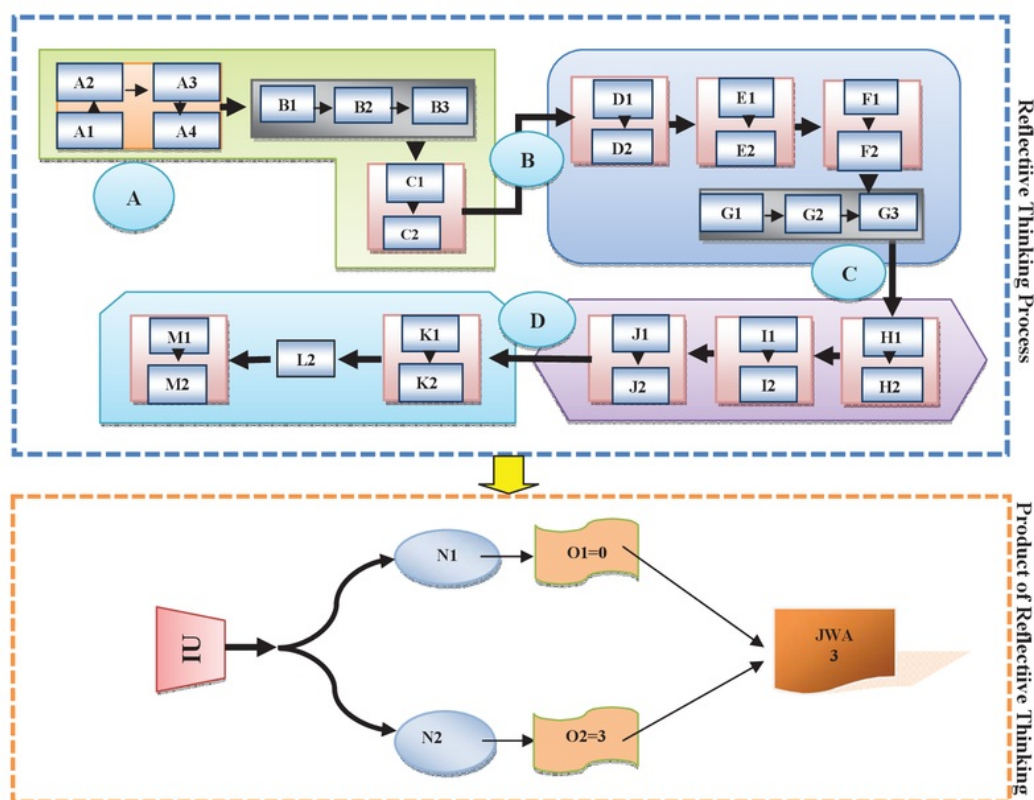
3. Evaluation of experience

The subject can explain how to determine criteria of good and proper solution. For the subject, there are two criterias which describes a good solution. Namely, (a) the ability to determine the known information and the asked information; (b) the ability to find the main point from the contextual mathematical problem. Moreover, the subject states that understanding related to main problem and to take the correct solution. It can be explained that in evaluating the subject's experience, the subject decides two categories related to a good solution. The first one is the ability to determine the known information and second one is the ability to find the main point from the contextual mathematical problem.

4. Testing the selected solution based on the experience

The subject explained how to choose operation to improve mistake in operation or procedure. It is done to help and find out the right answer. The procedure is used by subject because this is the easier way to

understand in applying her strategies. It is also the best solution which is understand by subject. Furthermore, to test the error in operation or in solution, the subject check back related procedures and operations and she tries to resolve the problem to make it sure herself. The result of reflective thinking in solving contextual mathematical problem which is done by the subject who has field dependent (FD) cognitive style can be shown by figure 1 as follow:



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FIGURE 1. Reflective Thinking and The Product of Reflective Thinking in Solving Contextual Mathematical Problem by Female-Field Dependent Mathematics Prospective Teacher

Based on Figure1, it can be illustrated that reflective thinking consists four stages namely (1) formulation and synthesis of the experience; (2) orderliness of experience; (3) evaluation of experience; (4) testing the selected solution based on the experience. The product of reflective thinking which is the result of solving contextual mathematical problem in two ways. The subject found two kinds of answers namely, 0 and 3 respectively the first method and the second method.

CONCLUSION

The result of prospective teacher's reflective thinking in solving mathematical problem can be described as follows. In the first stage, formulation and synthesis of the experience, subject explained that one of the ways to understand the problem read the problem in one more time and to make it sure her understanding, the subject restated the problem by using her owned word. The subject also identified conceptor subject matter related to the problem, and the subject described the difficulties when solving the contextual mathematical problem. It is the first way to look for the strategies in solving the problem. The second stage, orderliness of experience, subject

formulated information based on her experience, she also adapted her strategies previously in order to develop her solution to get the right answer. The third stage, evaluation of experience, the subject decided two categories related to a good solution. The first one is the ability to determine the known information and second one is the ability to find the main point from the contextual mathematical problem. The last stage, testing the selected solution based on the experience, the subject explained that to improve mistake in operation or procedure, the subject checked procedures and operations used. Moreover, the subject tried to resolve the problem to make it sure herself and exercise herself to solve other problem which can improve her ability in solving mathematical.

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