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Profile of Male-Field Dependent (FD) Prospective Teacher's Reflective Thinking in Solving Contextual Mathematical Problem

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Abstract. Reflective thinking is an important component in the world of education, especially in professional education of teachers. In learning mathematics, reflective thinking is one way to solve mathematical problem because it can improve student's curiosity when student faces a mathematical problem. Reflective thinking is also a future competence that should be taught to students to face the challenges and to respond of demands of the 21st century. There are many factors which give impact toward the student's reflective thinking when student solves mathematical problem. One of them is cognitive style. For this reason, reflective thinking and cognitive style are important things in solving contextual mathematical problem. This research paper describes aspect of reflective thinking in solving contextual mathematical problem involved solution by using some mathematical concept, namely linear program, algebra arithmetic operation, and linear equations of two variables. The participant, in this research paper, is a male- prospective teacher who has Field Dependent. The purpose of this paper is to describe aspect of prospective teachers' reflective thinking in solving contextual mathematical problem. This research paper is a descriptive by using qualitative approach. To analyze the data, the researchers focus in four main categories which describe prospective teacher's activities 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 learning mathematics, every student must have the mathematical problem solving ability which is konwn as a competence in solving mathematical problems [1]. It is need a higher order thinking skill to solve a contextual mathematical problem, which it can stimulate student's curiosity so that there is a desire to solve mathematical problems faced. One of types of thinking skills which can be applied in solving contextual mathematical problem is reflective thinking [2] because reflective thinking 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 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 required to enter the 21st century, namely cognitive skills, intrapersonal skills, and interpersonal skills. It confirms that reflective thinking skills is a future competence that should be taught to students to meet the challenges of globalization and able to adapt to changes and respond to demands of the 21st century. 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's sense will be directed and solution of the problem being solved tend to be correct and appropriate [6]. In addition, Ambrose [7], Gelter [8] and Koszalka [6] stated that reflective thinking gives opportunities for students to justify misconceptions by helping students to think about what they did and why they did it. 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].

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Every student has a unique character so as to learn, master, process information, solve problems, and to teach the material well, in this case mathematics, someone will do it in also different way [10]. Every student has a cognitive style of ea. Differences in students' cognitive styles affect students' skills in reflective thinking and solving oblems. 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. Another concept of cognitive style developed by Witkin, et.al based on continuous global analytical. Based on this concept, cognitive styles are divided into field-indpendent (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.

LITERATURE REVIEW

Reflective Thinking

In the last few years reflective thinking be me a very popular term in the world of education, in particular on professional education of teachers [12], [13]. Reflective thinking is active, persistent, and careful consideration of any belief or suppose from of knowledge in the light of the grounds that support it and the conclusion to which tends [14]. Furthermore, Dewey [15] suggested that there are six phases in reflective thinking, namely: (a) an experience; (b) spontaneous interpretation of the experience; (c) naming the problem or question that arise out of the experience; (d) generating possible explanations for the problem or question posed; (e) ramifying the explanation full-blown hypotheses. Meanwhile, according to Lee [16], there are five phases reflective thinking, namely: (a) problem context; (b) Problem definition; (c) Seeking possible sol on; (d) experimentation; (e) evaluation; (f) acce ce/rejection. Rodgers [17] argues that there are four phases in the process of reflective thinking as follows: (a) presence to experience; (b) descripton of experienc (c) analysis of experience; (d) intelligent action/experimentation. Zehavi and Mann [18] stated that the reflective thinking for the level of meta-cognitive refered to four categories: electoral techniques, monitoring process of solutions, insight or ingenuity, and conceptualization which connects the concept and meaning.

From the definition reflective thinking described above, in this study it can be concluded that reflective thinking is a mental activity for empowering experience or knowledge by considering concepts, facts and insights as mathematical concepts, mathematical principles that are considered relevant or appropriate and confirms its trustworthiness to solve mathematical problems.

Construction of Reflective Thinking

To gain an overview of the process of reflective thinking in solving mathematical problems, previously it is need to be synchronized several components of reflective thinking processes that exist, namely the components of the process of reflective thinking by John Dewey [14] abbreviated PBRD; by Lee [16] abbreviated PBRL; by Rodgers [17] abbreviated PBRR, by Zehavi and Mann [18] abbreviated PBRZM. From the components of reflective thinking processes served by each figures who examineed reflective thinking process, there are similarities indicators on the component of reflective thinking, it is obtained results of the construction of reflective thinking process contained in the following table.

Table 1. Construction of Reflective Thinking Process

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

According to the table I above, it is obtained construction of reflective thinking process with four stages. These stages are: (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. The construction was made for the following reasons:

1. For the component: *an experience, spontaneous interpretation of the experience and naming the problem* **PBRD**; for the component: *problem context and problem definition* on **PBRL,** for the component: *presence to experience and description of experience* on **PBRR**; and for the component: *selection of techniques and monitoring of the solution process* on **PBRZM**; is part of the process of reflective thinking that it is only trying to interpret and formulate information on the problems faced based on recall and to describe information obtained before solving problem and connecting the information stated in the problem. Therefore, these components can be referred to as the process of formulating problem by using the experiences that have been owned and establishing or correlating information explicitly stated in the problem. It is called **formulation and synthesis of experience**.
2. For the component *generating possible explanations for the problem or question* on **PBRD**; for the components of *seeking possible solution* on **PBRL**; the component of *analysis of experience* on **PBRR**; and for the component; *conceptualization* in **PBRZM** is part of reflective thinking processes by trying to use the reasoning of the experience that has been obtained before in order to summarize ideas or experiences to construct problem-solving strategies. Therefore, these components can be referred to as the process of summarizing the ideas or experiences to construct problem-solving strategies toward problems faced. It is called **orderliness of experience**.
3. For the component of *ramifying the explanation into full-blown hypotheses* on **PBRD**; the component of *insight or ingenuity* on **PBRZ** is part of reflective thinking processes that are evaluating the experiences obtained to link the descriptions of analysis results with each other as well as to collect the various possibilities of the analysis as a hypothesis. Therefore, this component is the process of evaluating the experiences taking into account the relevance of experience with information regarding the completion or solving problems done. It is called **evaluating the experience**.
4. For the component of *experimenting or testing the selected hypotheses* on **PBRD**; for the component of *experimentation, evaluation* and *acceptance/rejection* on **PBRL**; for the component of *intelligent action/experimentation* on **PBRR**. It can be aligned with the testing of solution or the conclusions which have been made, because in this process, testing a solution or conclusions have been made in the previous stage to reach a conclusion which is believed to be true. It is called testing the selected solution based on the experience.

Cognitive Style

Students can solve more complex problems by using reflective thinking because thinking of students will be directed and students think reflectively toward solution or settlement of the problem being solved tend to be true and correct. This is according to research King and Kitchener [6] which states that the reflective thinking help somebody in solving complex problems, due to reflective thinking helps a person identify concepts, facts, formulas, and theories that are relevant to the solution of problems identified. In addition, reflective thinking also involves the process of analyzing, comparing, synthesize, clarifying, and choosing what someone is doing that shows the reflection itself [19], [20]. When someone does the activity of analyzing, comparing, synthesize, clarifying, and choosing, then he or she will do it in different ways based on their character. Everyone has a character different or unique [21], so as to learn, master, process information, solve problems, and to teach the material well, in this case the mathematics, someone will do it in a way that is different also [10].

Every student has a cognitive style. Differences in cognitive styles have affected the ability of students in reflective thinking and solving problems. This is in accordance with the opinion of Coop and Sigel 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. A number of cognitive styles have been identified in the literature, for example, Abdurrahman [22] states that one of the dimensions of cognitive style that is enough to attract attention in assessing children who have difficulty in learning is a cognitive style impulsive-reflective (to answer the problem quickly, but a lot of mistakes and addressing slow but less error prone).

Jerome Kagan introduced impulsive and reflective cognitive styles in 1965 [23]. Kagan classified the cognitive styles based on the amount of time which is used by a person in responding to a situation and the accuracy of the answers of the response given. People who have the characteristic use short time in addressing the problem, but no/less careful so that the answers tend to be wrong, called the person who had an impulsive cognitive style. Meanwhile, people who have the characteristic uses long time in answering the question, but carefully/meticulously so that the answers given tends to be true, called people who have cognitive style reflective.

Cognitive style developed by Tenant [24]and Witkin, et.al [25] is based on continuous global analytical. For this concept cognitive styles are divided into two parts namely field-independent (FI) and field-dependent (FD). Someones who have Field Independent cognitive style are 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 analysis patterns based on their components. Another hand, somebodies who have Field Dependent cognitive style tend to have difficulties in distinguishing stimulus through the 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. Above of all, it can be stated that because of the difference in cognitive styles, there is the possibility of students' solve problems done in different ways, according to the reflective thinking skills and his perceptions of a given problem. To find out if it really happens, it needs to be explored further.

To determine cognitive style which is owned by someone whether someone has field independent or field dependent cognitive style, it can be investigated by using instrument developed by Witkin et.al [25]. This instrument is called Group Embedded Figure Test (GEFT).

METHOD

Subject

Subject in this study is a male-prospective teacher who has capable to communicate and has Field Dependent (FD) cognitive style enrolled in Department of Mathematics Education, Universitas Muhammadiyah Makassar, Indonesia. To determine the participant, it will be used Group Embedded Figure Test (GEFT) and mathematical achievement test.

Instrument

Researcher is the main research instrument. This research also used the assistant instrument to get the subject, namely (a) mathematical competence test which is constructed from the SBMPTN or selection college entrance tests which have been converted into essay test; (b) the *Group Embedded Figures Test* (GEFT) to know subjects'

cognitive style; (c) to get the data, it is used an unstructured interview guidance which consists of questions to dig up reflective thinking aspects; (d) the task as a mathematical problem which is presented below:

> Mr. Sukri is a trader of mangoes in the city of Makassar. He peddles his mango in the shop where he rents in the terong central market complex. Distance between Mr. Sukri's home and his fruit shop is 20 km. There are 60 mangoes should be brought from Mr. Sukri's home to his fruit shop. Mr. Sukri is assisted by his son, Taufan, bringing mangoes by using bicycle equipped with a fruit basket and made of bamboo woven. The basket contains only a maximum of 20 mangoes. Because mangoes are sweet, tasty and crunchy, Taufan always eat his father's mangoes. When he brings it to his father's fruit shop, Taufan takes 1 mango every 1 kilometer which he had been through. Try to argue the strategy that you do to help reduce the losses suffered by Taufan's father by determining the largest number of mangoes delivered to in Mr Sukri's fruit shop.

Procedure

This research applies the qualitative approach. This research paper aims to explore and investigate student's reflective thinking in solving mathematical problem. As a consequence, the researchers adopted exploration approach to analyze the data [26]. By using non-routine problem, subject is interviewed to investigate the aspects of reflective thinking in solving the mathematical problem process (see table 1). The non-routine mathematical problem refers to the contextual mathematical task which have been never found and solved, and it applies more than one a different method and approach to solve it. Problem involves several mathematical concepts as settlement solution and it needs heuristic approach. The time triangulation is used to obtain credible data which is suitable for the fact. The data was analyzed, categorized, reduced and interpreted to make a conclusion.

RESULT AND DISCUSSION

Based on the result of construction of reflective thinking process which is divided into four aspects, the researchers investigated and found out what happened on every stage related to reflective thinking in solving algebra problem which had been done by the participant. The participant had been interviewed deeply on matters concerning the four stages and linkages that may affect it. The results of interview toward the participant on data collection are presented by illustrating the description of reflective thinking in solving the contextual mathematical problem by Male- Field Dependent (FD) prospective teacher as follow.

1. Formulation and synthesis of the experience

   The subject of research read the problem and then to understand the problem, subject read it repeatedly for about more than once. The subject of research explained the problem by imagining the situation of the problem and comunicated problem clearly by restating the main point of the problem by using his owned word. The subject also described the problem out of order by seeing the sheet of mathematical problem. The subject of research also can identify the concepts which are related to the problem given. They are linear program, concept of distance and velocity. The subject of research stated that the difficulties to solve the contextual mathematical problem is both the procedure which do not use routine solution or settlement and the ability to make formulation. Moreover, the subject of research got difficulties to apply good or right strategy because when subject read the problem, the subject directly thought that the answer is zero but when the subject connect to the main point of the problem, the subject identified that his answer is not logic because it is not relevant with solution ar settlement hoped. The participant restated all the problem in another words however participant's explanation still has the same idea from the problem.

   From the above explanation, it indicates that the Male-Field Dependent tries to construct his understanding toward the problem by reading the problem in more than once. To make it sure her undertanding related to the mathematical problem, the participant restated the problem by using her owned word, yet the participant explained the information in out of order. Furthermore, when the subject identified concept or subject matter which is related to the problem, the participant mentioned not only the concept that ever the participant used in solving a problem before, but also the participant explained that the concept which will be used in solving this contextual mathematical problem. For example; linear program, velocity, time and distance. Moreover, the participant describes the difficulties which are gotten when solving the contextual mathematical problem is the ability to look for the best strategies and the ability to use his logic to make the relevance between the answer and the main point of the problem.

2. Orderliness of experience
   In this step, the subject gave explanation based on his experience to construct his strategy in solving contextual mathematical problem. The subject of research stated that the principle of problem solving consisted of four main catogories namely the ability to understand the problem, planning to do problem solving, do the settlement and evalute the settlement to identify the right or wrong answer. The participant also explained that the use of formulation and the placement of notation gave impact related to the answer. The subject of research investigated three concepts which is used in solving this contextual mathematical problem namely linear programe, one variable linear equations, velocity, and distance. These concepts were collaborated to get right answer. The subject used concept of trial and error to solve the problem by stringing up the formulation and try to use the formulation to solve it and then try to compare many answers to choose the right answer. The difficulties which are gotten by the participant when he was applying his strategies are very difficult to determine right or wrong answer gotten because the way used to solve the problem is a trial way so that the answer gotten is disguised or doubt although evalution step has been done. When the subject see other problem but it still is the same context, the subject used the same method to solve the problem and developed his solution to improve knowledge to the new invention or new idea in solving the problem. The subject also explained that there are two impacts when the subject developed his solution namely (1) negative effect: constrained by the results obtained because it is very difficult to determine level of truth answers gotten; (2) positive effect: getting new idea or new way to solve problem
3. Evaluation of experience
   The process of evaluation which is done by subject is how to determine criteria of right solution. The participant mentioned that there are three criterias which describes a good solution. Namely, (a) the ability to understand the problem; (b) the ability to analyze problem by determining the known information and the asked information; (c) the ability to correlate between the ability of understanding the problem and analyzing the main point of cotextual mathematical problem. Moreover, the participant stated that aspects which must pay in solving mathematical problem are (a) use of approriate formula; (b) the ability to describe and establish or spell out the solution; (c) the ability to create many settlements to compare them; (d) using steps systematically and (e) the ability in using counting procedure. The subject of this research explained that to improve the weakness in solving mathematical problem, there are many ways to do it. Namely (a) sharing with his friends who is more master for this problem; (b) evaluating related to the solution gotten; (c) developing the solutions by practicing hisself in solving other contextual mathematical problem.
4. Testing the selected solution based on the experience
   The participant identified that to test the solution or resume which is made from the step before then the subject of research determined placement of right notation based on his description related to the contextual mathematical problem. The participant also explained how to choose right procedur by looking for the right operation to get the right answer. Furthermore, to test the error in operation or in solution, the participant discussed with someone who masters this problem and check back related procedures and operations which had been used. Moreover, the participant tries to resolve the problem to make it sure hisself by reformulating the solution.

Based on explanation above, 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 three ways. The participant found two kinds of answers namely, 0, 3 and 40 respectively the first, the second and the third way.

CONCLUSION

Based on the result, it can be concluded that reflective thinking can be investigated after someone did a mathematical problem solving. Reflective thinking provides opportunities the students to improve their weakness. When they get difficulties and find mistakes or misconceptions related to their answer, they will correct it and try to interpret it to obtain logical answer. Reflective thinking also can make grow accuracy and concentration when the students solve mathematical problem. Consequently, the students will get the right and logic answer by reflective thinking. Above all, this research paper provides insight into how promote reflective thinking that could be trained to prospective teacher that impact when prospective teacher become real teachers in society.

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