

Profile of Students' Thinking with High Achievement in Solving Mathematical Problem Based on Reasoning in Gender

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Abstract—Curriculum 2013 appointed by the government since 2015 uses a scientific approach to the mathematics learning in the classroom. The scientific approach is used to introduce students to the variety of mathematical problem to be solved. It makes students to be familiar in reasoning to solve mathematical problem. Based on this consideration, the aim of this study is to find out students' who have high learning achievement thinking profile in solving mathematical problem based on reasoning in terms of gender. This study was conducted by using explorative qualitative method. The sample of the study were students of SMPN 13 Banjarmasin. The result of this study indicated that (1) the male subject can understand the problem, devise and implement a plan to solve a problem poorly, not look back and has a give up spirit; (2) the female subject can understand the problem, devise and implement a plan to solve a problem very well, looking back, and structure thinking perfectly.

Keywords— *High Achievement, Mathematical Problem, Profile, Thinking, Gender*

I. INTRODUCTION

Mathematics is one of the basic sciences that can be applied to other fields of science. For example, in the health field, mathematics is used to find a mathematical model of a disease, while in the engineering field, mathematics is used to design a building that is strong and stable. In order to create it, a person requires special ability that is problem solving. Problem solving is one of the important skills [1], [2], [3]. Therefore, the problem-solving ability needs to be instilled as early as possible through learning in school.

The concept of mathematical abilities is not something that is frequently discussed [4]. In language, ability can be defined as potency to do something [5]. It means, mathematical ability is the potency to do math. Mathematical ability is a human construct which can be defined as cognitive or pragmatic, depending on the purpose of the definition [6]. Mathematical ability contains some standards such as problem solving, reasoning, communication, connections and representation [7]. Therefore, the mathematical ability highlighted is potency to solve problem involving reasoning.

The problem usually contains a situation that encourages a person to solve it, but he/she does not know directly what should be done to it [8]. [9] argues that not every problem can

be called as a problem. The characteristics a question referred to the problem contains at least two things: question challenging the mind and question is not automatically known way to resolve it. Mathematical problem by [10] is divided into two kinds that is the problem to find and the problem to prove. In the problem to find, the students are expected to find a solution to the problem. The problem to prove, the students are expected to show the truth of a theorem or statement. Mathematical problem that is truly problematic and involve significant mathematics have the potential to provide the intellectual context for students' mathematical development. In addition, one kind of mathematical problem is word or story problem. The story problem is not problematic enough for students and hence should only be considered as exercises for students to perform [3].

Furthermore, mathematical problems have benefits with criteria: (1) the problem is important, useful mathematics embedded in it, (2) the problem requires higher-level thinking and problem solving, (3) the problem contributes to the conceptual development of students, (4) the problem creates an opportunity for the teacher to assess what his or her students are learning and where they are experiencing difficulty, (5) the problem can be approached by students in multiple ways using different solution strategies, (6) the problem has various solutions or allow different decisions or positions to be taken and defended, (7) the problem encourages students engagement and discourse, (8) the problem connects to other important mathematical ideas, (9) the problem promotes the skillful use of mathematics [3].

Students have their own way to solve mathematical problem. Problem solving is an effort to find a way out of a difficulty for reaching a goal which is not so easy to immediately achievable [10]. The problem solving refers to mathematical tasks that have potential to provide intellectual challenges that can enhance students' mathematical development [3]. Problem solving is a complex cognitive activity, as a process to fix a problem which encountered and required a number of strategies to solve them. Training students to solve the problem in mathematics learning does not solely expect students to complete a given question or problem. However, it is expected to become a habit in problem solving process and make it able to live a life of the complexity of the problem [11]. Based on these definitions, we can conclude that

problem solving is an attempt to find a solution that involves complex cognitive activity to determine the result.

A complex cognitive activity in solving problem needs to describe the process. Thinking process is a step of students thinking to determine the intended results. A student's thinking needs to be visible for a teacher to identify misconceptions or to decide how to move the student's thinking forward [12]. Therefore, student's thinking processes in solving mathematical problem need to be described through thinking profile.

All this time, student's thinking processes described for solving mathematical problem through problem-posing [13], using the strategy of working backwards which in terms of achievement [14], based on the step Polya terms of adversity quotient [15], based on linguistic, logical-mathematical, visual and spatial [16]. Based on the studies that have been done about the thinking process, the researcher is interested in investigating profile of students' thinking that have high achievement in solving mathematical problem based on reasoning in gender.

Gender difference has become a hot issue being discussed in several research topics. The performance of male students are better than female students in solving problems a graph at the age of 9-12 years in Australia [17]. There was no significant difference in the ability of students mathematics in terms of gender in the field of geometry [18]. There was no significant difference in the student's ability to solve mathematical problems in terms of the overall gender differences in TIMSS 2011.

However, there are 20 of 42 countries that participated in TIMSS 2011 showing that there was significant differences in the ability to solve mathematical problems in terms of gender. One of them was Indonesia. Results of the research conducted by TIMSS 2011 showed that students of Indonesian women are better than male students in solving mathematical problems. It can also be seen from the acquisition of the average score of female students at 392 points and the male students at 379 points [19].

SMPN 13 Banjarmasin is one of schools that implements the 2013 curriculum as appointed by the government. Curriculum 2013 uses a scientific approach to the mathematics learning in the classroom. The scientific approach introduces students to the variety of mathematical problems to be solved. It makes students to be familiar in reasoning to solve mathematical problems. Based on these condition, this article describe profile of students' thinking that have high achievement in solving mathematical problem based on reasoning in gender.

II. METHOD

This research is a qualitative descriptive with explorative approach. The subjects were students that have high achievement which consists of 1 male (S1) and 1 female (S2). The subjects selection was based on the results of the middle test.

The instruments of this study were the researchers themselves, problem solving ability test, and interview

guidelines. The problem solving ability test was adopted from TIMSS. Guidelines for the interview consisted of questions that were used to clarify data from the results of problem-solving ability test. Guidelines reference to Polya steps is understand the problem, devise a plan, carry out the plan, and look back in details can be described as follow:

TABLE I. INDICATORS OF PROBLEM SOLVING

Polya Steps	Indicator
Understand the problem	Students can specify the available information given to questions.
Devise a plan	Students have a problem-solving plan which he/she used and reason for it.
Carry out the plan	Students can solve the problem with the steps that he/she uses.
Look back	Students check his/her written work

Data analysis was done by reducing the data, presenting the data, and drawing conclusions. The validity of the data was done by triangulation between the data from the students' written work and interview.

III. RESULT AND DISCUSSION

Student 1 (S1) could mention things that are known and asked the problem. The following are some excerpts of the interview:

Researcher : *Try to explain what do you know on this problem, S1?*

S1 : *Teachers and doctors each has 45 books. 4/5 of the books belongs to the teacher and 2/3 books that belongs to the doctor is novel.*

Researcher : *Asked the problem?*

S1 : *Which novels at most, teacher or doctor? How much difference does the novel that belong to teacher and doctor?*

S1 devised a plan by looking at equivalent fractions from the known book. Following is some excerpts of the interview:

Researcher : *How do you solve this problem?*

S1 : *Equalizing the denominator 4/5 and 2/3.*

S1 could carry out the plan, but it was still not perfect. S1 felt difficult to determine the final result. Following are some excerpts of the interview:

S1 : *4/5 is equal to 2/3.*

Researcher : *Then?*

S1 : *(be quiet)*

Researcher : *How?*

S1 : *It is this way.*

S1 did not look back to his works because he constrained to solve this problem. Following the structure of S1 thinking:

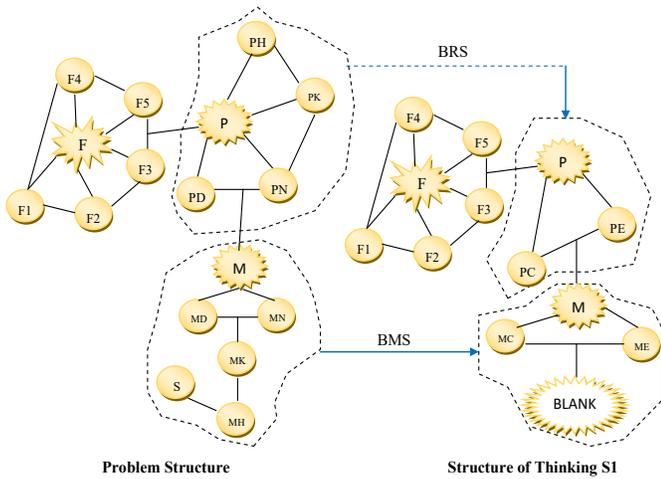


Fig.1 The Structure of S1 Thinking

TABLE II. INFORMATION FOR STRUCTURE OF THINKING S1 DAN S2

Code	Information
F	problem
F1	knowing that teachers and doctors each have 45 books
F2	knowing that 4/5 of teacher books is novel
F3	knowing that 2/3 of teacher books is novel
F4	asking about the book which is more novel.
F5	knowing about the difference between novels that belong to teacher and doctor
P	making a devise plan
PD	making a plan to create multiplication operation between part of teacher books and all of books.
PN	making a plan to create multiplication operation between part of doctor books and all of books.
PK	making a plan to compare teachers and doctors books
PH	making a plan to determine the difference between teacher and doctor books
MD	carrying out the plan 'PD'
MN	carrying out the plan 'PN'
MK	carrying out the plan 'PK'
MH	carrying out the plan 'PH'
S	completing and true
PC	making a plan to looking equivalent fractions from teacher books
PE	making a plan to looking equivalent fractions from doctor books
MC	carrying out the plan 'PC'
ME	carrying out the plan 'PE'

Furthermore, Student 2 (S2) could mention things that were known and asked of the problem too. Following are some excerpts of the interview:

- Researcher : Try to explain that is known on this problem, S2?
 S2 : Teacher and doctor each have 45 book. If 4/5 of teacher book and 2/3 doctor book is novels.
 Researcher : Asked the problem?
 S2 : Which most novels, teacher or doctor? How much difference novels have teacher and doctor?

S2 can make a perfect plan indirectly. She can explain the steps to resolve in accordance with problem structure. Following are some quotes of the interview:

- S2 : 4/5 multiplied by all of books. 4/5 multiplied by 45. 45 divided by 5 is equal to 9. Then, multiplied by 4 is equal to 36.
 Researcher : Then?
 S2 : 2/3 multiplied by 45. 45 divided by 3 is equal to 15. 15 multiplied by 2 is equal to 30. So the teacher has 36 books and The doctor has 30 books
 Researcher : Then?
 S2 : Teacher's books are more than the doctor's books. The difference of teacher and doctor book is 36 minus 30. The result is 6.

S2 looked back to see her works to confirm the result. Following are some excerpts of the interview:

- Researcher : Did you check it?
 S2 : Yes.
 Then, the following is the structure of S2 thinking:

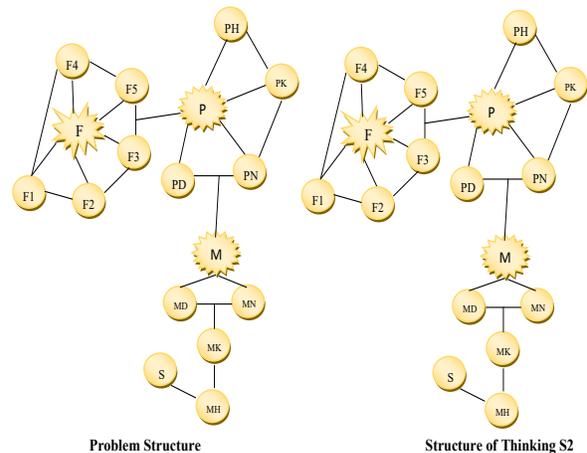


Fig.2 The structure of S2 Thinking

Based on the research results, S1 and S2 could understand the problem well, because he/she could mention what was known and asked on the problem. S1 and S2 could devise a plan, but S1 devised a plan that leads to the wrong answer. S1 and S2 could carry out the plan, but S1 constrained that has an impact on blank thinking. S2 looked back to his work. S1 did not look back because he felt unsuccessful in solving the problem. In fact, problem solving requires a never gave up spirit to complete [20].

Teaching problem solving in the classroom has a positive effect in developing students' mathematical thinking skills [21]. They will be familiar reasoning to solve problems. Students do not often solve similar problems, make the students a bit of experience and meaningful to the students themselves. Finally, the structure of the students' thinking becomes difficult to form in accordance with the structure of the problem they have encountered previously.

IV. CONCLUSION

The conclusions of this research are (1) the male subject can understand the problem, devise and implement a plan to solve a problem poorly, not look back and has a weak sprit; (2) the female subject can understand the problem, devise and implement a plan to solve a problem very well, look back, and has perfect stucture of thinking.

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