Relational Thinking Process of Middle School Students with Gender

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Abstract- The ability to think relationally in solving problems is an important goal of school. This is the ultimate goal of teaching that students will be able to make connections between concepts and apply concepts or algorithms in a flexible, accurate, efficient, and appropriate way to solve problems. This research is based on students' difficulties in relational thinking in solving mathematical problems. The purpose of this study was to investigate the relational thinking of students from two eighth grade students in solving problems. They were selected from twenty students with mathematical ability tests and based on sex, the subjects obtained in this study were 2 students of different sexes and had the same mathematical abilities. Then they were interviewed based on their work from the assignment given. When solving problems, male subjects are able to draw problems, determine the core structure of the problem, analyze key elements of the problem. Meanwhile, the female subject knows about concepts that can be used to help the problem, but she does not look for key elements of the problem and she does not know how to determine the solution. These results can contribute to mathematics teachers by helping students use relational thinking in solving problems.

Index Terms- Relational Thinking, Relational Thinking Process, Gender

I. INTRODUCTION

Thinking and solving problems are two things that are difficult to separate. Thinking is a mental activity experienced by someone if they are faced with a problem or situation that must be resolved. Butterworth and Thwaites (2013) state that "when we talk of thinking as a skill we are referring to higher-order activities, such as analysis, evaluating and explaining; and challenges in problem solving and evaluating complex arguments (p. 6). Thinking includes the activity of analyzing, evaluating, and explaining, and for challenges such as problem solving and solving math problems.

Soedjadi (1999: 138) argues that "mathematics is one of the basic sciences, both its applied aspects and reasoning aspects have an important role in efforts to master science and technology". This means that to a certain extent, mathematics needs to be mastered by all Indonesian citizens, both the application and the mindset. That is an important reason why mathematics needs to be taught at every school level, besides that mathematics also plays a role in efforts to develop and train the sharpness of students' thinking in solving problems, especially problems in daily life. Based on the experience of the researcher while teaching at school, students often lack an understanding of the meaning of the story given. Students often cannot associate information that exists in the story matter or with the knowledge they have before. Because of the low relational understanding of students, this also affects students' relational thinking. This means that relational thinking has an important role in helping students understand mathematical problems.

Relational thinking is very important for students. Molina, Castro, & Ambrose (2005, p. 3) stated "This thinking of having a significant number of fundamental mathematical ideas includes relations between different representations of numbers and operations between them". Relational thinking is very important in mathematics because many basic mathematical ideas contain the relationship between the representation of different numbers and the operations between these numbers. Doumas and Hummel (2005, p.73) state "A fundamental aspect of human intelligence is the ability to acquire and manipulate relational consepts. Examples of relational thinking include our ability to appreciate analogies between seemingly different objets or events. This means that the fundamental aspect of human intelligence is the ability to acquire and manipulate relational concepts, one of which is relational thinking. Relational thinking is the ability to understand the analogy between seemingly different objects or events and apply abstract rules in new situations. Thus relational thinking is a mental process that is characterized by building linkages between the elements of information provided with prior knowledge and knowledge of the properties or structure of mathematics in solving mathematical problems.

Hejny, Jirotkova & Kratochviova (2006) states in relational thinking, students create a picture of the problem in their mind as a whole, analyze to find the core structure, and look for some important elements or relationships to build a resolution strategy, whereas those who do not think relationally, students activate several procedures in his mind after identifying the problem

In solving mathematical problems between male and female junior high school students is different. This is because the mindset between male and female students is not the same. This is consistent with what Branata said (in Asmaningtias, 2008, p. 3) which says that women are generally better in memory and men are good at logical thinking. In addition, it is seen that the mathematical abilities between male and female students are also different. As said Macooby and Jacklin (in Soenarjadi, 2011, p. 5) between men and women have the same mathematical abilities during elementary school (SD) until the beginning of adolescence. Starting at around the age of 12-13 years male mathematical skills increase faster than women. Krutetski (in Nafi'an, 2011, p. 574) also explained that differences in male reasoning abilities were superior to women and men had better mathematical and mechanical abilities than women. This difference is not evident at the primary school level but becomes more apparent at a higher level.

II. METHOD

Subjects

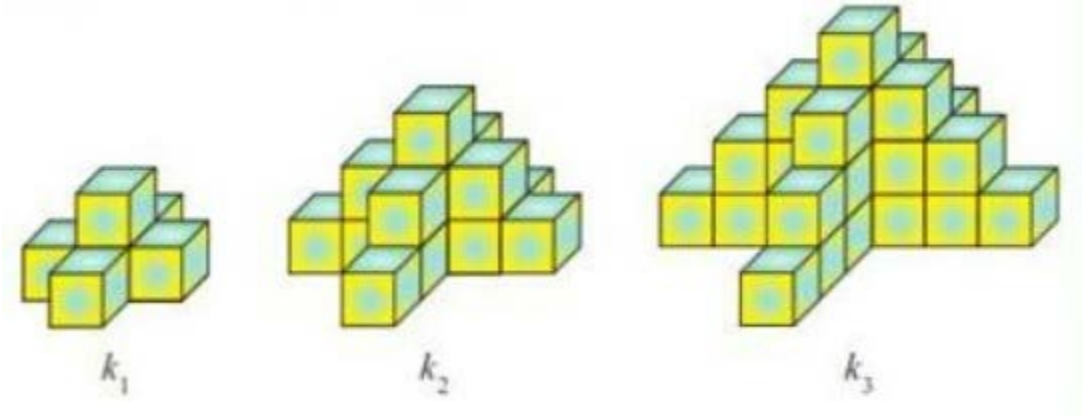
To determine the subject of the study, one class was given a test of mathematical ability to see the abilities of students who were equal, and grouped by sex. the next step is chosen by 2 students who have equivalent and different-sex math skills.

Instruments

The main instruments in this study are the researchers themselves and supporting instruments which include audiovisual recorders, mathematical ability tests, mathematical problem-solving assignments and interview guides.

1. Test of mathematical abilities
   This test was built by adopting National Final Examination items for elementary schools in Indonesia. Multiple choice forms have been changed to a description of the problem in accordance with the 2013 curriculum content standards for eighth-grade students. The test consists of 5 questions. The prepared examination sheet has been validated by elementary school math teachers (who have received certification) and 2 mathematics education lecturers. Based on the results of the validation, the test sheet is ready for use.
2. Test problem solving
   test questions made by the researchers themselves. The tests produced were then validated by certified mathematics teachers from elementary schools and 2 mathematics education lecturers. Validation is in terms of content and use of language. Based on the results of the validation, the test sheet is ready for use. the following problem-solving test questions.

   Follow the following cube arrangement!



   The number of cube arrangements in k1, k2, k3, and so on increases with the arrangement pattern as in the picture above.
   a. Specify many cube arrangements in the next pattern (k4)
   b. Specify many cube arrangements in k10.
   c. If the arrangement is painted, how many cubes are painted on two sides? (k4 & k10)
3. Interview Guide
   An interview guide was developed to help uncover the subject's relational thinking process when they face mathematical problems.

III. RESULT

Relational Thinking Process Students Male

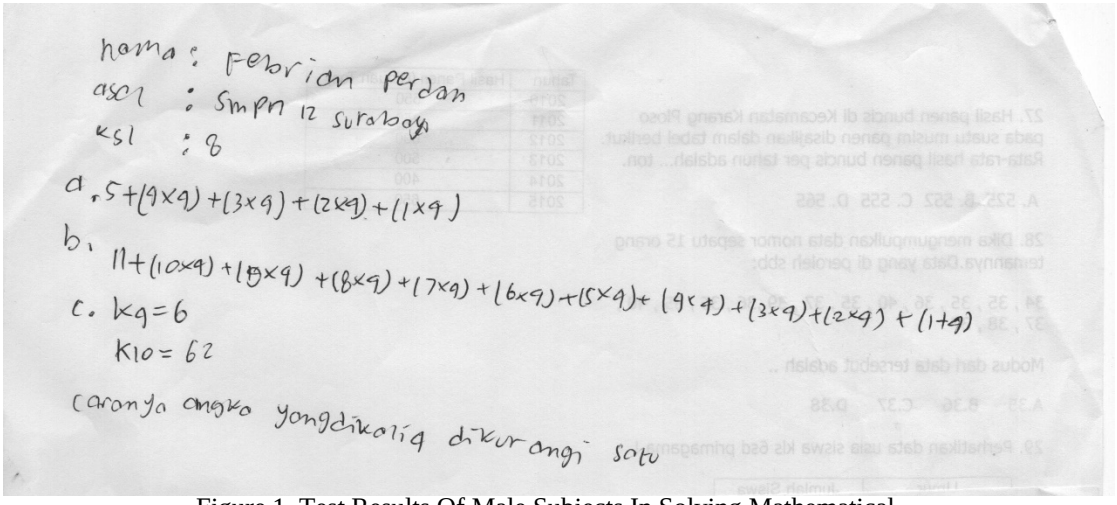


Figure 1. Test Results Of Male Subjects In Solving Mathematical

Based on test results and interview results, in the aspect of making a picture of the problem, the male subject identified the information in the problem. He ignores information that is considered as a supplement because the information has no connection with other information so it is not used in solving problems.

Then, the male subject connects information with the knowledge that is owned and related to the problem given. He connects previously possessed knowledge in interpreting the problems he receives. Furthermore, from the relationships obtained, he has a picture of the problem.

Furthermore, the male subject determines the core structure of the problem. The male subject find the relationship between different parts of the problem and the knowledge they have to solve the problem.

In the aspect of looking for the key elements of the problem, the male subject found a relationship between information obtained with the same sign as with the division operation. In solving problems, male subjects find and use relationships in problems rather than just doing all calculations. This is consistent with what Molina & Ambrose (2006, p.1) says that "when students employ relational thinking, the sentence by focusing on the relativity of numbers in the equation instead of performing all the computations". the male subject made a connection in the problem, he did not apply known procedures to solve the problem.

In the aspect of developing a problem-solving strategy, the male subject makes the steps that lead to solving the problem shown by the male subject by looking for new/additional information first and using that information to solve the problem. the male subject estimates the method to be used for the problem-solving step. In the aspect of implementing the problem-solving strategy, the male subject answers the question with the strategy that has been made.

Relational Thinking Process Students Female

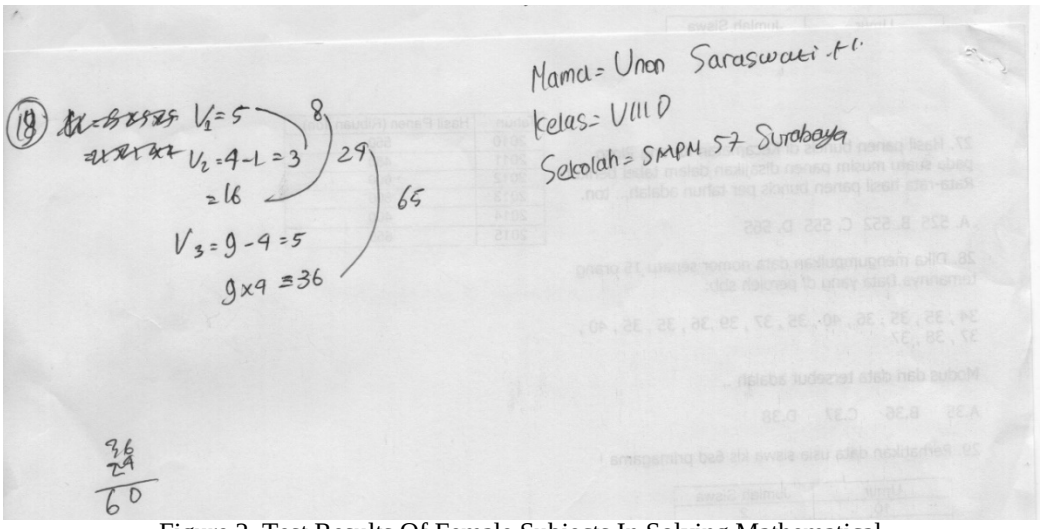


Figure 2. Test Results Of Female Subjects In Solving Mathematical

Based on test results and interview results, in the aspect of building a picture of the problem, the female subject identified information in the problem. the female subject knows all the information on the question either known or asked. the subject of women relates information to the knowledge that is owned and related to the problem given, indicated by linking information with his knowledge of the procedure of completion of comparable worth and reversing value.

In the aspect of determining the core structure of the problem, female subjects find a relationship between different parts of the problem or between information and knowledge they have to solve problems. the female subject connects some information to find new information.

In the aspect of looking for the key elements of the problem, the female subject used a procedure she knew to solve the problem without knowing the procedure was obtained. female subjects do not find the key elements or core relationships of mathematical problems. In the aspect of making a problem-solving strategy, female subjects use procedures that are known to be related to the problem to make a problem-solving strategy. Whereas in the aspect of implementing the problem-solving strategy, the female subject answered the strategy questions made by applying the sequential steps or procedures that have been determined.

IV. CONCLUSION

The male subject fulfils all aspects of relational thinking, namely making a picture of the problem, finding the core structure of the problem, finding key elements, developing strategies, and implementing strategies. while the female subject fulfils four of the five aspects of relational thinking, which the female subject does not do is the aspect of looking for key elements. the female subject does not look for core relationships or key relationships that exist in mathematical problems, she only applies some known procedures to solve problems.

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