

Relational Thinking Process of Junior High School Students with Low Self-Efficacy in Understanding Mathematics Contextual Problems

Didik Hermanto¹, I Ketut Budayasa², Agung Lukito³

¹Mathematics Education Postgraduate Program, State University of Surabaya, Indonesia

²Department of Mathematics, State University of Surabaya, Indonesia

³Department of Mathematics, State University of Surabaya, Indonesia

Abstract: *The students' relational thinking process has a very important role in solving mathematics contextual problems. Relational thinking always exists in human cognition, which underlies the process of thinking about everything from the ordinary (simple) to something higher/complex (Dumas and Hummel, 2004). Students' thinking process can be influenced by students' attitudes, self-efficacy as a person's belief in his ability to perform actions in various situations (Bandura, 1997), will greatly affect his thinking process. This study aims to describe the relational thinking process of junior high school students with low self-efficacy in understanding mathematical contexts problems. The conclusions of this study are as follows. In building relationships based on elements of information in context or prior knowledge, subjects mention the elements of information that exist in matters related to mathematics, which are summations, numbers, and "equals" signs that they perceive as "results". Male subjects are more concerned with the relationship between information obtained that is believed to be used to find answers. While the subject of women tends to bring problems to routine procedures, namely the way of elimination is called the "two-variable equation".*

Keywords: relational thinking, mathematics contextual problem, self-efficacy

1. Introduction

Mathematics is a part of science that underlies other fields. The existence of mathematics is always related to the problems of everyday life. In fact, many problems of daily life which solution are directly or indirectly depend on the science of mathematics. Therefore, the skill of relating the real situation with the knowledge that the students have has to be the main target in mathematics education. Oktiningrum, et al. (2016) states that, most of students' failure at PISA are mostly caused by students' inability to relate mathematical problems with problems that occur in daily life. PISA is a study conducted by the OECD (Organization for Economic Co-operation and Development) on mathematics, reading, and science skills in 15-year-old students in many countries around the world. Assessment is focused on real-life issues, outside of situations or problems that are often discussed in the classroom. Some of the above conditions provide an illustration that the contextual problem is a basic requirement in learning mathematics. The results of research conducted by Surya et al. (2017: 91) showed that, improvement of problem solving ability of mathematics of students who were given contextual learning is higher than with students who were given expository learning.

In solving problems related to human life, students must be able to determine what knowledge is relevant, what processes must be gone through to be able to deliver it to possible solutions of the problem, and how to describe the truth and usefulness of the answers or solutions obtained. To fulfil these demands, the student must understand the context of the problem well. By understanding the context of a problem, the student can determine the next step toward the final solution. According to Polya the problem-solving stages

are understanding the problem, devising a plan, carrying out the plan and re-examining the results obtained. Some of these conditions can illustrate that understanding the problem is a foundation in problem solving.

With regard to problem solving, the students' thinking process has a very important role when they encounter a problem, either a problem that focuses on mathematical theory or mathematical problems related to the problems occur in the real life. Thinking is the formation of a new mental representation through the transformation of information (Solso, 1995). The students' tendency to do thinking activity can be caused by a problem and efforts to solve it. To be able to solve the problem especially the contextual problem, the student must be able to think to build relationship between real situation with mathematical knowledge which is owned by mathematical modeling and interpretation of relevant solution with building relationships among mathematical structures itself so that the problems encountered can be solved. This thought process is called the relational thinking process.

Besides influenced by the context of the problem, students' thinking process are also influenced by the attitude such as anxiety and self-efficacy. Excessive anxiety will have an impact on one's performance. Mathematical anxiety has a significant correlation to student math performance (Luo et al. 2009). Self-efficacy as a person's belief in his ability to perform actions in various situations (Bandura, 1997), will greatly affect his thinking process. A person who has high confidence in his ability will think confidently, so that will affect the thinking process that occurs. Jensen (2008: 372) says that in anxious and unconfident conditions, the brain loses the ability to correctly interpret cues from the

environment and some ability to index, store and access information. Bandura (1993) states that the effects of self-efficacy on cognitive processes take roles in various forms. Most of human behavior, which in fact, is governed by a thought, embodies the established goals. From these opinions, the question arises how the relational thinking skills of students with low self-efficacy level in understanding contextual problems, and how it is when viewed from gender differences? Jensen (2008: 147 - 153) conveys that there are physical differences between men and women, which can lead to differences in cognitive processing between men and women.

2. Literature Survey

Thinking is an activity that often occurs inside an individual, consciously or not by him/her. According to cognitive psychological view, thinking is a mental activity that is affected by the existence of the brain as the center of all body activities. DE Bono (1990: 3). "Thinking is a process by which a new mental representation is formed through the transformation of information by complex interaction of mental attributes of judging, abstracting, reasoning, imaging and problem solving" (Solso, 1995: 408).

Relational thinking is always present in human cognition, which underlies the process of thinking about everything from the simple to something complex (Doumas and Hummel, 2004). When students use relational thinking, they can complete the sentence of numbers by focusing on the relationship between numbers in the equation instead of doing all the calculations. For example, in equation $8 + 4 = \dots + 5$, can be solved only if the student has a broad understanding of the "equals" sign. Students can solve this problem using relational thinking by noting that 5 is 1 more than 4, so the value of the unknown number must be 1 less than 8. (Molina & Ambrose, 2006).

Relational thinking is a thinking activity, in which a relationship is constructed from various objects to form a new object. Objects can be objects of real situations and formal situations, Thus the process of relational thinking in understanding the problem of contextual mathematics is a series of mental activities of a person in building relationships based on elements of information in the context or knowledge previously owned, building relationships to find information important and interpreted into various contexts through mathematical reasoning or the use of concepts and facts, and building relationships to create a picture of a problem as a whole.

Studies on relational thinking that have been done previously include: Naik & Banarjee (2004) studied grade 6 elementary school students using the problem in a short form by filling the dots with symbols (<, = and>); Carpenter et al (2005) studied grade 3 elementary school students by designing a brief questionnaire focused on exposing students' understanding of the "=" sign as a symbol of a relationship; Molina et al (2005 and 2008) studied elementary students in obtaining relational thinking information using an objective problem of right / false flick; Stephens and Wang (2008)

studied elementary students using numbered sentences focusing on how students performed on sentences involving two unknown numbers; Baiduri (2014) examines the relational thinking process of elementary students in problem-solving activities seen from a high level of mathematical ability.

In this research, student's relational thinking in understanding contextual problems identified by student's way in: 1) establishing relationships based on elements of information in the context or prior knowledge, 2) building relationships to find important information and interpreting into various contexts through mathematical reasoning or the use of concepts and facts, and 3) building relationships to create a picture of a problem as a whole.

Self-efficacy is one's belief regarding his/her ability in organizing and solving a required task in order to achieve certain result (Bandura, 1997). Self-efficacy is one of qualities possessed by each individual. According to Robbins (2003: 27), self-efficacy includes factor that influences one's performance in fulfilling certain goal. In terms of academic, academic-efficacy refers to an individual's belief that he/she is able to do specific action (Sehunk, 1991). Furthermore, Sehunk stated that self-efficacy is not the only influence on behavior. Behavior or action is a function of many variables.

Dimensions of self-efficacy used as base for measuring self-efficacy was stated by Bandura (1997) as follows: 1) Magnitude, related to task difficulty that should be done from simple, moderate, to complicated demands. 2) Generality, related to the breadth of the task that is done. 3) Strength, related to the individual's level of strength towards his/her belief. An individual with high self-efficacy tends to be unstoppable and tenacious in improving his/her effort even though encountering many obstacles.

3. Method

This study aims to describe the relational thinking process of students. The data collected in the form of qualitative data obtained through interview with the subject. Thus, this research is the kind of explorative research with qualitative approach. The subjects were taken from 8th grade of junior high school, consisting of a male and a female student, each with low self-efficacy level. Subjects were selected from the same group of mathematical skills, i.e., moderate mathematical skills.

The main instrument of this study is the researchers themselves, because at the time of data collection in the field researcher role as data collector during the process of research. Auxiliary instruments in this study include Self-Efficacy Tests, Problem Solving Tasks (TPM), and Interview Guidelines. The self-efficacy instrument uses the General Self-Efficacy Scale (GSES) instrument, developed by Schwarzer Ralf & Jerusalem Matthias (1995 & 2010). The implanted TPM is a contextual problem which adapted from examples of contextual problems by Zulkardi & Ilma (2006). Interview guidelines used in this study prepared by researchers based on the goal to be achieved, namely the process of relational thinking in understanding the contextual

problems of mathematics. Instrument validation is performed by expert validators to enable the instrument to function optimally.

After the selected research subjects, to collect the necessary data, the researcher collected data on subject activity at the time of understanding the mathematical contextual problem in accordance with the relational thinking indicator of students in understanding the mathematical contextual problem. The process of collecting data begins with the giving of TPM to the subject. Subsequently the subject was asked to understand the problem on the task and continued with in-depth interviews. To obtain credible and valid data, triangulation of time. Data analysis techniques in this study using Miles & Huberman (1992) model consisting of three activities: data reduction, data presentation, and conclusion.

4. Result and Discussion

From the results of given assignment about problem solving tasks 1 and 2 to each subject, the data interview was obtained based on the task. The problem-solving task given to the subject is as follows.

TPM 1

A stationery puts up promotional prices as the following picture:

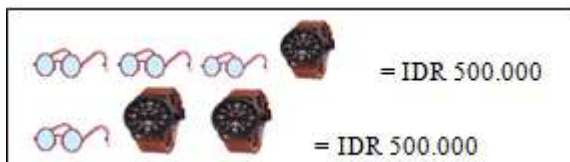


From the picture above,

- Without knowing the price for each item, which one is more expensive? Glasses or calculator?
- Without knowing the price of each item, how many calculators can be purchased for IDR 100,000?
- What is the price of one calculator and one glasses?

TPM 2

A stationery puts up promotional prices as the following picture:



From the picture above,

- Without knowing the price for each item, which one is more expensive? Glasses or Watch?
- Without knowing the price of each item, how many watch can be purchased for IDR 500,000?
- What is the price of one watch and one glasses?

From the result of triangulation by comparing the interview data on TPM 1 and TPM 2, there appears to be consistency between the answers of subjects on TPM 1 and TPM 2. It can be interpreted that the data of the interview with the subject is credible. The results of the data analysis are described as follows. 1) In establishing relationships based

on elements of information in the context or prior knowledge, the male subject mentions the elements of information contained in matters related to mathematics, which are summations, numbers, and "equals" signs that it understands as "Outcomes" and have encountered similar problems in class lessons, but cannot elaborate on what they mean by such questions. While the subject of women mentions the elements of information that exist on the problems associated with mathematics, the sign "same as" which he understands as "results" and the number and have encountered similar problems in class lessons, namely "two-variable equation" which he called as a way to search for x and y (variables). 2). In building relationships to find important information and interpreting into various contexts through mathematical reasoning or the use of concepts and facts, the male subject finds what is known by building relationships between views on the first picture, a pair of glasses and three calculators as well as the "equal to" sign and the one hundred thousand rupiah referred to as "Price 1 glasses equal to 3 hundred calculators". The word "similar" is defined as "plus" and the second picture, two glasses and a calculator and the "equal to" sign and the one hundred thousand rupiah denoted as "two glasses and one calculator cost a hundred thousand." The words "and" are referred to as "plus". The subject also finds out what is asked by building a relation between what is seen in the question as the characteristic of the question, the word "how" and the "?" Sign behind the sentence. The subject of the woman discovers what is known by establishing the relation between what is seen in the matter of the first picture referred to as 1 glasses plus 3 calculators equal to one hundred thousand, the second picture referred to as two glasses plus one calculator equal to one hundred thousand. It can be understood because it is written clearly on the matter, that is the price for some pictures. The subject finds what is being asked, by establishing a relation between what is seen in the question as the feature of the question, the "how" and the "?" Behind the sentence. 3) In building relationships to create a picture of a problem as a whole, the male subject mentions what is known and what is asked, then mentions that to answer each question can be used information from what is known and mentions that with the same money, when choosing the pair of images with 1 glasses then obtained 4 items (1 glasses and 3 calculators), and when selecting the image pair with 1 calculator then obtained only 3 items (1 calculator and 2 glasses). While the subject of women mentions what is known and what is asked, then mentions that to answer each question can be used information from what is known and understand that the problem can only be solved by means of elimination, namely the so-called "equality of two variables" or by way of making sample from the price of goods.

5. Conclusion

Based on the results of the data analysis described above, it is concluded that the description of the relational thinking process of junior high school students with low self-efficacy level in understanding the mathematical contextual problem is as follows.

In building relationships based on elements of information in a context or prior knowledge, the two subjects mention the elements of information that exist on mathematics-related

issues, which are summations, numbers, and "equals" signs that they understand as "results". The male subject once encountered a similar problem in the classroom lesson, but could not elaborate on the meaning of the similar problem, whereas the female subject once encountered a similar problem in the class lesson, namely "two-variable equations".

In building relationships to find important information and interpreting into various contexts through mathematical reasoning or the use of concepts and facts, the two subjects discover what is known by building relationships between views on the question i.e., the first image is referred to as 1 glasses plus 3 calculators equal to one hundred thousand, the second picture referred to as two glasses plus one calculator equal to one hundred thousand. The subject of women can rationalize what is found. Both subjects find what they are asking, by establishing a relation between what is seen as a feature of what is asked, the word "how" and the "?" sign behind the sentence.

In building relationship to create a picture of a problem as a whole, both subjects mention what is known and what is asked, and to answer each question can be used information from what is known. The male subject mentions that with the same money, when choosing the pair of images with 1 glasses then obtained 4 items and when choosing the image pair with 1 calculator then obtained only 3 items. While the subject of women understands that the problem can only be solved by means of elimination, namely the so-called "equality of two variables".

6. Future Scope

This research resulted in description of student's relational thinking process with low self-efficacy who is only able to understand mathematics contextual problems. It is possible to broaden this research to study about student's relational thinking process in problem solving. This research carried expectation for other researchers to continue carrying out a follow-up study from another side that could strengthen the results of this study.

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Author Profile



Didik Hermanto a mathematics education's lecturer who works at STKIP PGRI Bangkalan, Indonesia. Currently finishing doctoral degree at Mathematics Education Postgraduate Program State University of Surabaya, Indonesia. His research interest includes mathematics education, cognitive psychology, and learning process in mathematics classroom.