ISSN 2089-8703 (Print) Vol. 7, No. 2 (2018) 300-307
ISSN 2442-5419 (Online)

STUDENTS' THINKING PROCESS IN CREATING SCHEMATIC REPRESENTATION

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Received 23 July 2018; Received in revised form 17 September 2018; Accepted 26 September 2018

Abstract

The aim of this study is to describe students' thinking process in creating schematic representation. A describtive qualitative research is used in this paper along with case study approach. The examined case is students' thinking process in creating schematic representation in solving word problem. The subjects are Junior High School students at grade VIII. Data collection were done by *think aloud* technique and interview. The result show that students' thinking process in creating schematic representation is retrieved from processing theory started by taking the problem into account. Students read the problem based on its intonation with stress in each sentence. Then, students create a scheme and link all information they understand about. This scheme later is drawn into triangle form. By creating the scheme, students are able to comprehend the questions and problems proper. Students connect problems faced by theirself with the concept of Pythagoras stored in long-term memory. The students' understanding of the Pythagoras Theorem concept is well preserved so that students can solve the problem appropriately.

***Keywords*:** Information Processing System; Schematic Representation; Students' Thinking; Word Problem.

INTRODUCTION

Representation is one of the importan topics in Mathematics. Students are able to create more substantial mathematical ideas by using representation (NCTM, 2000). Moreover, various findings from different studies discover that representation is a vital part of mathematic activity (Cai, 2005; Cobb, 2003; Cobb, Stephan, McClain, & Gravemeijer, 2002; Gravemeijer, Lehrer, Oers, & Verschaffel, 2003; Kaput, Noss, & Hoyles, 2008; Meira, 2003; Nizarudin, 2014). Hence, representation is one of the aspects that must be mastered by students in term of Curriculum of mathematics learning in Indonesia (Pemendikbud No. 24, 2016).

Representation as general can be defined as a configuration that can describe one form into another form (Goldin, 1998). In field of mathematics, representation is viewed as internal abstraction of mathematics ideas or cognitif scheme which is developed by studetns through their learning experience (Pape & Tchoshanov, 2001). Scheme is one of the form of representations (Anwar, Yuwono, As'ari, Sisworo, & Rahmawati, 2017; Fagnant & Vlassis, 2013; Hegarty & Kozhevnikov, 1999; Zahner & Corter, 2010). Then, Amorapanth et al. (2011) propose that scheme is a non-verbal representation that describes spatial relation. Then, it is used to explain mental representation by providing codes at spatial relation (Talmy, 2000).

Students' ability in creating schematic representation as accurate as possible is the main key in overcoming word problem (Anwar et al., 2017; Boonen, van Wesel, Jolles, & van der

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Schoot, 2014; Fagnant & Vlassis, 2013; Hegarty & Kozhevnikov, 1999). Yet, a study conducted by (Boonen et al., 2014) find that there are number of students who can not accurately create schematic representation. The inaccuracies made by students in describing scheme will render difficult towards the problems (Surya, Sabandar, Kusumah, & Darhim, 2013). Meanwhile, the outcome of a study accomplished by Sari, Darhim, & Rosjanuardi (2018) discover that a lot of students face barriers in creating picture from visual representation to explain and facilitate problem-solving.

Some researchs in the field of schematic representation (Anwar et al., 2017; Boonen et al., 2014; Fagnant & Vlassis, 2013; Krawec, 2014) do not cover how schematic representation is formed. Therewith, it is important to be expossed as the process is needed when students face the problems. Henceforth, examining the process of schematic representation is important for the reason that it can be used to evaluate students' mathematical representation.

In order to present materials into scheme form, there is a needed skill that students must obtain. Goldin & Shteingold (2001) call it as internal representation system. Internal representation system takes place in students' mind that can be drawn into visual form so as to attain a problem-solving strategy. Moreover, Pape & Tchoshanov (2001) propose that students are able to create internal representation as an effort either to organize mathematics ideas or overcome word problem.

The process of internal representation is not able to be observed in plain view as it is a mental activity of human being that is related to his mind (Dahlan & Juandi, 2011). In order to identify mental activity of students in creating schematic representation, this study implements theory of information processing systems which is improved by (Slavin, 1997). Furthermore, (Slavin, 1997) also explains that information processing theory is a cognitif theory that describes the process, storage and recall ability. Informations owned by a student are processed and protected through three phases, namely sensory register, short-term memory and long-term memory. A good information system will affect high accuracy of someone's recall ability (Panjaitan, 2013). Therefore, the aim of this research is to describe students' thinking process in creating schematic representation which is retrieved from theory of information processing systems.

RESEARCH METHODS

A descriptive qualitative research is used in this paper along with case study approach. (Creswell, 2012) states that a qualitative research is a method to explore and comprehend the manings of a social problem. The examined case was about students' thinking process in creating schematic representation in term of word problem. The subjects were junior high school students at grade VIII. The subject selection was done by considering the uniquness of students' thinking process in overcoming word problem. Word problem that must be accomplished by students was in the form of complete sentences; " Faiz usually visited Farhan by foot. He walked 40 metres to the south, then he turned to the east for 30 metres. Today, Faiz wanted to take a shortcut by passing a plantation to arrive at Farhan's house as fast as he

ISSN 2089-8703 (Print) Vol. 7, No. 2 (2018) 300-307
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could. How long was the shortcut between Faiz's house and Farhan's?

The researcher asked subjects to finish word problem in order to discover the process. While finishing word problem, subjects were asked to to convey what they thought about (think aload). The entire activities during word problem completion were recorded by using two different cameras. Each camera was functioned to record students' writing activy and students' motion (facial expression). After completing word problem, every subject wasinterviewed to gain undiscovered information. Then, the data taken from the research consisted of written assignment, video (think aload) and interview video. These data were used to analyze students' thinking process in creating schematic represantation.

RESULTS AND DISCUSSION

The analysis of students' thinking process in creating schematic representation is provided into description below:

Students overcome the problem by understanding the problem proper. Polya (1973) states understanding the problem is the vital stage to overcome problem. Students read out loud the fist sentence in order to obtain information. Then, students identify problems by providing scheme. This scheme is later drawn into lines with arrow. The lines point to the south for 40 metres. The process done by students is in line with Stylianou (2010) who says that creating scheme can be done when reading the problem. Later, students continue reading first sentence until the end and continue creating scheme. Detailed information and length are tho componenets which assist students in creating scheme.

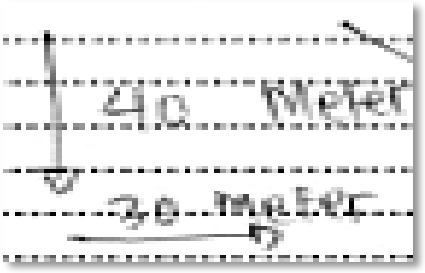

Figure 1. Written Answer in Understanding Problems

The drawing schematic formed by the students is a representation of the relationship between the information which contained in the problem. This scheme is also very accurate with the information, so it is very effective in helping the students in parsing and understanding the problem. Next, the students re-read the problem on the second sentence until the last sentence that contains the question of the problem. Moreover, the students' process in understanding the problem is shown in the written answer in Figure 1. It shows that the students are concerned with the problem at hand by understanding the problem in each sentence.

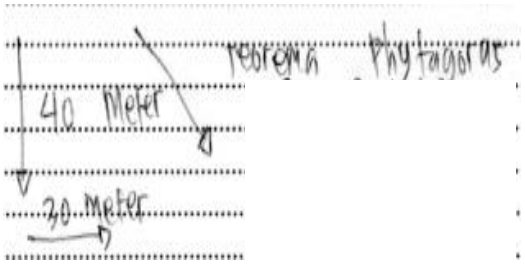

Figure 2. Written Answers in Developing a Plan

The next process is showing video *think aloud*, the students paused then made a statement that *"to find the length of a shortcut between Faiz's house and Farhan's house can be obtained by finding the length of the*

side of the slant." Then, the students arrange a plan to solve the problem by using the concept of Pythagoras Theorem. This is shown by the students making a slash in the schematic drawing presented in Figure 2. This process shows that when the students pay attention to the problems encountered in relation to the Pythagoras Theorem, there is a shift of information from sense-record to working memory or short-term memory. The result is in accordance with the statement by Panjaitan (2013) that the senses can receive some information by means of the senses (see) and store them in a very short time. The information perceived by students and getting attention then will be transferred to the next component of the short-term memory system. This result is also reinforced by the statement of Corter & Zahner (2007) that creating schematic drawings can help the students to find the basic ideas for constructing problem solving. In addition, by creating representations, it can help students in determining a strategy that is needed during solving verbal problems (Abdullah, Zakaria, & Halim, 2012).

In solving this problem, the students relate the problem encountered with their understanding stored in long-term working memory. The information indicating that the students can associate long-term working memory to solve obtained problems during the interview. Below are slice of the interview:

R : What do you understand of question?
S : The question on this issue is the length of the shortcut between Faiz's house and Farhan's house.
R : Okay, that's the question. You can immediately get information of a way that can be passed Faiz to go to home Farhan by looking for the side of the triangle. How can you have such thoughts?
S : Because if like this is farther (points to the image of the road that Faiz usually passes), if it passes the slant side, it will be closer.

The students then calculate the length of the way by using the Pythagoras Theorem. In this process of calculating the length of a way, the student successfully gets the right answer. This suggests that in solving of problems with short-term working memory, the students successfully connect with the existing knowledge of long-term working memory appropriately. This result is in line with the opinion of Slavin (1997) that the information stored in long-term memory is organized into a particular form of knowledge strata or called a scheme. The scheme groups of the information elements according to how the information will be used, so the scheme can facilitate access to information when it will be used. The results of this study are supported by the opinion of Diezmann & English (2001) and Novick, Hurley, & Francis (1999) that the process of understanding the problem by forming a scheme is one strategy that can be used in solving the problem, because by using the scheme can dismantle the structure problem, simplifying complex problems. Stylianou (2010) also supports this finding, that a scheme can be used as a tool for understanding information encountered in verbal form. The results of this study also supported by an opinion of Van Garderen & Montague (2003) that a successful student in problem solving generally builds a

ISSN 2089-8703 (Print) Vol. 7, No. 2 (2018) 300-307
ISSN 2442-5419 (Online)

representation to facilitate in understanding the problem.

Based on the data exposure above, the students' thinking process in forming schematic representation based on the information processing theory is presented in Figure 3.

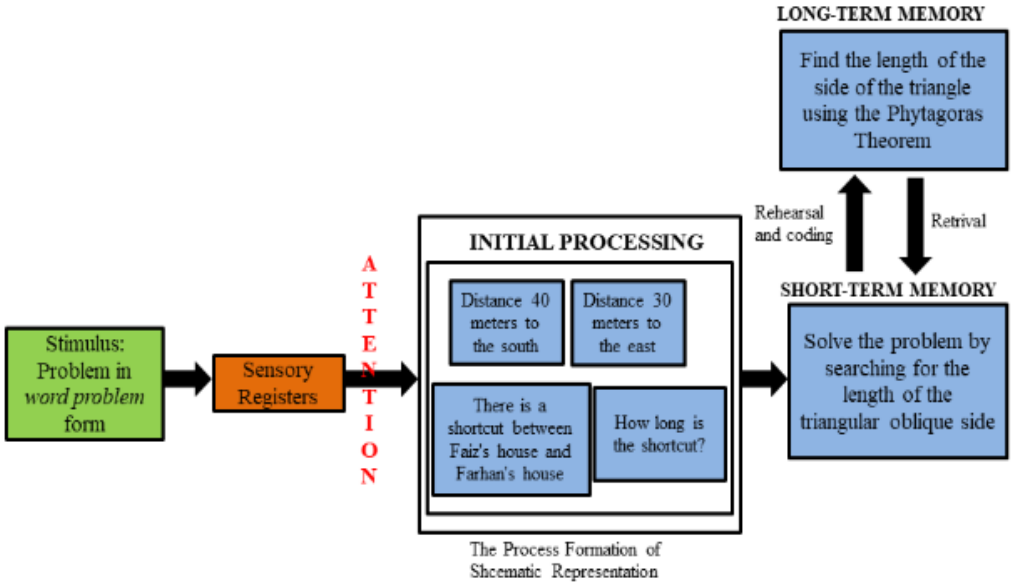

Figure 3. The Student's Thinking Process in Shaping Schematic Representation

CONCLUSIONS

The results of the research show that the students' thinking process in forming schematic representation in terms of information processing theory begins by paying attention to the problem. It is done by reading the problem students use intonation that is full of emphasis on every sentence. Furthermore, the students construct a scheme by connecting all the information understood. The scheme is manifested in the schematic drawing in the form of a triangular picture. By constructing a scheme, the students can understand the questions in the problem. By understanding the questions in the problem, the students relate the problem with understanding the concept of the Pythagoras Theorem stored in their long-term memory. The students' understanding of the Pythagoras Theorem concept is well preserved, so that the students can solve the problem appropriately.

During the data collection, the researchers found many students who could not construct a schematic representation accurately. So that, the student cannot finish it well. Moreover, based on the result above, the researcher suggests for subsequent research to be able to describe the students' difficulties or the students' failure in constructing the representation schematic in solving mathematical problem.

ACKNOWLEDGMENTS

The researcher thanked to the State Junior High School 4 Metro City and Junior High School Muhammadiyah Ahmad Dahlan Metro City which has facilitated in data collection.

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