Errors Identification In Solving Arithmetic Problems

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Abstract: The aim of this research is to identify students' errors in solving arithmetic problems. This qualitative research uses case study approach. The methods used to obtain the data are observation and semi-structured interview. The result of this research shows that the subject could solve arithmetic problems in reading, comprehension, transformation, and process skill stages. The subject made some errors in encoding stage. Encoding errors are often made by students. Moreover, encoding errors are not considered as errors when solving problems. This research contributes in the importance of encoding stage in solving problems.

1 INTRODUCTION

Errors in solving arithmetic problems are caused by students' inability to recall the lecturer's problem solving procedures. Arithmetic problem solving in class tends to be monotonous. Students solve problems by copying the lecturer's problem solving procedures. Students regard the lecturer's problem solving procedures as the most correct solution. It is the easiest way for the students to solve a new problem by copying the example of problem solving procedures given by the lecturer. Solving a new problem is easier to be done when the procedure refers to a successful problem solving (Wareham et al., 2011). Competitive and cooperative learning style as a learning strategy is very important to enhance the ability to solve mathematic problems (Özgen, 2012). Creativity is needed not only when learning in class, but also when solving problems.

The use of APOS theory as a framework revealed that several students' errors might be caused by over-generalisation of mathematical rules and properties (Siyepu, 2013). Difficulties in applying mathematical rules are caused by the inaccuracy of mental structure on the process, object, and scheme level (Maharaj, 2013). Students show low ability of solving problems in the stages of problem modeling process and applying mathematical procedure (Wijaya et al., 2014). Student who has creative idea in solving a problem is not necessarily correct in writing the problem solving systematics. The students' lack of creativity is affected by many factors, such as the mastery level of mathematic concept, the accuracy in using symbols, the confidence (Karwowski, 2009), and the openness towards an idea. Students who can solve routine problems show their level of ability only on one level, which means that although they can solve a problem correctly, they are still lacking in conceptual understanding (Brijlall and Ndlovu, 2013). Errors in solving mathematic problems are usually influenced by the previous learning habit that is by memorizing (Siyepu, 2015). According to the previous research, errors in solving mathematic problems happen in the mathematic problem modeling process stage (transformation) and in applying mathematic procedure (process skill). But, those researches ignore the errors in solving mathematic problem on the encoding stage. However, Newman in White (2009; 2010) defined five main abilities of literacy and numeracy, i.e. reading, comprehension, transformation, process skills, and encoding. Thus, this research aims to identify the errors in solving mathematic problems on the encoding stage. The focus of mathematic problem in this research is arithmetic problems. The data collecting in this research are done through observation and semi-structured interview. The five literacy abilities are the indicators of successful problem solving, one of which is the encoding stage.

2 RESEARCH METHODS

This qualitative research uses case study approach. The subject of this research is the students of

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Mathematics Education of Kanjuruhan University, the odd semester of academic year 2017/2018. The students were given contextual problems. These problems were related to daily life, so that the students were familiar with them. Solving contextual problems enable the mind to actively involve in searching and constructing new ideas (Lubart and Mouchiroud, 2003). The methods used to obtain the data are observation and semi-structured interview.

The research data are the observation result and interview result. Observation were conducted to the students solving the problems. Students wrote down the steps of problem solving. The data from this observation result was completed by the data from the interview. The researcher conducted an interview to explore the problem solving process. All of the data were then analyzed according to the problem solving stages.

The data analysis in this research were done simultaneously with the data collecting process, interpretation, and drawing conclusion. Every data obtained was directly analyzed, interpreted, and concluded. The process conducted in the data analyzing stage included data presentation, the whole data were thoroughly read, irrelevant data were ignored, and then conclusion were drawn from the reduced data.

Data presentation was started by preparing the data. The data were the transcript of observation result, interview, and field notes. The researcher read the whole data and marked the errors in the students' work. Next, the data from the solution writing, observation, interview, and field notes were segmented into categories of problem solving stages. The data reduction were done continuously during the research. The researcher then described the categories and theme to be analyzed. The theme which were going to be analyzed in this research is the students' errors in writing the solution. The analysis result was a description of students' errors in solving problems. The researcher interpreted the result of students' errors and drew a conclusion.

3 RESULTS AND DISCUSSION

The subject of this research was given a mathematic problem. The solving of arithmetic problem in this research met the rules of problem solving stages. Figure 1 shows the arithmetic problem solving.

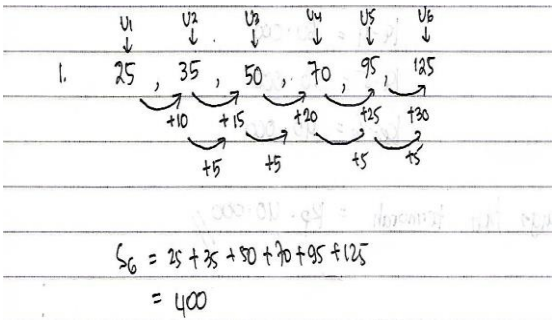

Figure 1: Arithmetic problem solving.

Subject wrote number sequence:

25, 35, 50, 70, 95, 125

Subject named each number in the number sequence:

Subject named 25 as
Subject named 35 as
Subject named 50 as
Subject named 70 as
Subject named 95 as
Subject named 125 as

Subject determined the numbers which had the following rule: "if the number is added with the number in the previous term, it will be the number in the next term". The numbers were:

10 and 10 + 25 = 35
15 and 15 + 35 = 50
20 and 20 + 50 = 70
25 and 25 + 70 = 95
30 and 30 + 95 = 125

He obtained numbers formed a new sequence:

10, 15, 20, 25, 30

Using the same step, subject determined the numbers with the following rule: "if the number is added with the number in the previous term, it will be the number in the next term". The numbers were:

5 and 5 + 10 = 15
5 and 5 + 15 = 20
5 and 5 + 20 = 25
5 and 5 + 25 = 30

The difference between the numbers in a term with the previous term showed constant numbers. Then subject added up the numbers in the sequence:

25 + 35 + 50 + 70 + 95 + 125 = 400

The result of the addition of the sequence was named. Expressing the sum of the first 6 terms. Subject made the following conclusion:

"Thus, there are 400 chairs in the building."

The arithmetic problem given to the students was in the form of number sequence. It only showed the amount of chair in the first row, that was 25; the amount of chair in the second row, that was 35; the amount of chair in the third row, that was 50; and the amount of chair in the fourth row that was 70. However, the amount of chair in the next rows was not determined. The amount of chair in the fifth and sixth row could be determined by the number sequence pattern.

In the reading stage, the students read the arithmetic problem sentence in detail. They were able to understand the situation. In the comprehension stage, they related the part of one sentence to the other part of the sentence. The correct understanding about the situation of the problem minimizes the errors in solving a problem (Jitendra et al., 2013). The understanding about the situation of the problem can help the students to develop their understanding, so that they can design the strategy to solve the problem (Capraro et al., 2012). In the transformation stage, the students wrote the arithmetic problem in numbers and mathematical rules. In the process skill stage, they applied the mathematic procedure. They could determine the number pattern. However, they did not go through the encoding stage. They did not write in detail the arithmetic problem solving. Therefore, the information in the arithmetic problem solving did not illustrate the full solution, although the end result was found.

The error identification in the encoding stage are: (1) students did not rewrite the new number sequence: 10, 15, 20, 25, 30; (2) students did not name the new number sequence; (3) students did not specify the term that was determined by the new number sequence; and (4) students did not specify that the term determined was the solution of the number sequence.

4 CONCLUSIONS

Five main abilities of literacy and numeracy are reading, comprehension, transformation, process skills, and encoding. Students were able to understand the problem situation by relating one part of the sentence with the others. The correct understanding towards the problem situation given can minimize the errors. This situation shows that students were able to do reading, comprehension, transformation, and process skill. However, they made errors in the encoding stage.

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