Analysis of student’s misconception in solving system of linear equation in two variables

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Abstract. Mathematics is a logical means of thinking. Reasoning is one part of thinking that we must understanding about mathematics learning. But in fact, there still were students made errors. The aim of study is to describe the causes of students making errors in working on the matter of System of Linear Equation in Two Variables. The research was a qualitative descriptive study. Subjects in this study were four eighth grade students. Data collection was done by tests, interviews and documentation. The types of errors used in this study were the types of errors according to Newman, namely: (1) reading errors, (2) comprehension errors, (3) transformation errors, (4) process skills errors, and (5) errors in writing answers (encoding errors). The results of data analysis showed that students made errors in solving the problem form of System of Linear Equation in Two Variables. Moreover, the errors made by the students lied in the concept, interpretation of language, procedures, and calculations. While the cause factor the students were less thorough, did not understand the meaning of the problem, less know the concept of the formula, and students who did not check again the answers that have been made. In addition, we found that students were still having difficulties when understanding the meaning of the problem and wrong in process to answer the problem.

1. Introduction

Understanding Concept is one of the mathematical abilities that students must possess. Mathematics is usually regarded as a subject of great precision in which concept can be defined accurately to provide a firm foundation for the mathematical theory [1]. So that students should have a correct understanding of the concept in a material they learn. In fact, there are still students who make mistakes in solving the given problem. Students’ errors analysis is one of the important tools to diagnose the difficulties experienced by students who require direct handling [2]. By knowing the mistakes made by students, scaffolding can be given to overcome the same mistakes.

In carrying out the problem solving process, there are two obstacles encountered by students in finding the right answer. The first obstacle is the problem in linguistic fluency and the conceptual understanding that related to the level of simple reading and understanding meaning of problems. The second obstacle is problems in mathematical processing that consists of transformation, process skills, and encoding answers [3]. As for one of the ways in analysing student errors in this study using the Newman error procedure. Newman’s error analysis is, (1) reading level (simple recognition of words and symbol), (2) comprehension level (understanding linguistic problems), (3) transformation level
Not all students are able to solve the problems given by the teacher because they have difficulties. According to several studies, student’s errors in solving the word problem in linear equation are largely due to their inability to understand and interpret sentences before facing the process and skills coding [4]. It causes students making other mistakes as they have experienced difficulties in understanding the meaning of the question. In addition, primary students in the fourth grade have difficulties in facing content knowledge compared to language difficulties when mathematical tasks in English [5]. The problem in English makes students feel confused in understanding. Thus, it leads students wrong in dealing with the problem. Another research found that most of the students are capable of performing the first stage of New Man's Model (Read and Recode), however they face difficulties in performing the second until the five stage of Newman's Model (Comprehension, Transformation, Process Skills and Encoding) [6]. Therefore, the teacher can ask students about what problems they encounter when solving problems, observe student’s reactions and analyses errors committed by student [7].

Based on the aforementioned explanation, this study aims to analysed errors made by students using Newman level. By doing so, we will find what causes of student’s mistake which useful to avoid the mistakes occur again in the system of linear equations in two-variable.

2. Experimental method
The research used a qualitative method with type of research to be used was case study. The superiority is to provide broader access or opportunities for the researcher to examine in depth, detail, intensive, and thorough analysis of the social unit under study [8]. Purpose of case study in this research was to find out directly the cause of errors made by students in solving. Subjects used in this study were four eighth grade students (ages 13 – 14 years old) at one of the schools in Bandung, as many as 4 students randomly selected. Students were given a problem in Figure 1 below, after that students were interview. The test using the procedures for Newman’s Error analysis required that the researcher ask the subjects to provide responses to questions and to determine learners’ causes of errors.

Instruments in this study consist of main instruments and auxiliary instruments. First, the main instrument was the researcher her selves, because researcher was directly related to the subject of research and not represented to others. Second, instrument aids, Instruments used in this study was a matter of tests on System of Linear Equations in Two Variables material that in grade VIII which amounted to one problem. The results of this study were analyzed used the error indicators according to Newman. Based on the study of the theory that has been done, researcher formulate used indicators of error according to Newman

In order to avoid misinterpretation, the researchers also conducted interviews with the subject of research. The interview is a meeting of two people to exchange information and ideas through question and answer, so it can be constructed meaning in a particular topic. Interviews were conducted to further track student answers that can’t be traced through test results [9].

**Figure 1.** The given problem.

3. Result and discussion
The results of the research have been done by using the Newman error analysis on students' answers and then interviewing. It was found that students carried out two levels of errors according to Newman, namely the errors of comprehension problem and process skills described below:
3.1. Misconception in understanding the problem
The error of understanding this problem occurred because the student was wrong in interpreted the intent of the question asked, or misinterpreted what was known in the problem. Error understanding the problem done by the student is as in Figure 2 below.

![Figure 2. Example of misconception in understanding the problem.]

From Figure 2 above shows that student was wrong in understanding the meaning of the problem. Students writing inquired not in accordance with the request questions. On the problem known if Bu Gita bought 3 kg of Apples and 4 kg of Orange with the price of Rp. 208,000.00. But students equated the variables used for apples and also oranges that was by forming 4x+3x = 161.800 and 2y +5y = 182.600. Students experience errors in forming problems into their mathematical models. So that in answer this student also made error in problem form into the form of mathematical model (indicator of transformation). So in the process of doing from the beginning to the end was wrong. Students also made error on the concept and also the process of calculation where seen 6x -20y = 14xy, where the two different variables that can’t be performed its operation. If the operation can be done also student still made an error that was 6x -20y = 14xy, the value should be negative.

In addition, student also wrote that asked not in accordance with the request questions, and also did not write question in the problem. Students made error in interpreted question. Based on the answers written by the student, assume that the question was the price of oranges and apples, but what was asked the price per kilogram apples and oranges. When interviewed students known if the question, but did not understand the concept so made an error when solving the problem.

3.2. Error in process skills
The process error in the settlement occurred because the student was less precise in the calculation process, in applying the concept, and not writing the calculation phase. Error completion process which done by student is as in Figure 3 below.

![Figure 3. Figure show that students made error in the process skills.]

From Figure 3 it was seen that the student made wrong when substituted the value that has been obtained. Student didn’t write the variables used so made an error in determining the answered. But the student was correct for the formation of the mathematical model of the matter. From the student's answer the wrong part beginner with an error in the substitution process that was the student has found the value of y in answer it was apple. Next the student substitutes the value of y to x on the equation 3x + 5y = 162.600 which should be substituted to its y value. So to proceed to the next will be wrong too.

When interviewed about how students process students working on the given questions, students have understood the questions, used the correct operation during work and also mentioned the correct work steps. But in the process there is an error in substituting the value of x.

3.3. Misconception in process skills
The process error in this settlement occurs because the student was able to read the question but fail to understand the problem, and in implemented the concept. Error completion understanding done by student is as in Figure 4 below.

![Figure 4. Students made error in process skills.](image)

From Figure 4 it can be seen that the student misconstrued the concept. In the formation of the problem into a mathematical model there was still wrong of writing 4x + 6y = 161.800, but at the value of 6y students do not multiply by 3 fixed 6y only. In the process there was still wrong, where the student was multiplied the variable with each selected number but did not multiplied the price as well. So it was because student didn’t know the concept if we want to multiply an equation then all the parts must be multiplied as well.

Student also did not understand the purpose of the given problem because he did not continue the process of calculation. He did not know how to continue solving problem. When the interview was conducted, student though he was only able to finish it until finding the value of y. This is because he only understood the method of elimination. When asked about the form of question, he knew that the problem was a problem System of Linear Equation in Two Variables.

3.4. Error in understanding the problem
The process error in this settlement occurred because the student was less precise in the calculation process, and did not continue the settlement procedure (loss). Error completion process done by students is as in Figure 5 below.

From Figure 5 show that student has been correct in forming questions into the form of mathematical model. By using the elimination method student solve the problem. But when doing the process of calculation students made errors, 6y - 20y = 14 should be 6y - 20y = -14. Students didn’t understand the reduction rules. In addition, students made error when reducing 485,400 - 730,400 = 245,000. Furthermore, students only answered to found the value of y, but the problem to find the value of apples and oranges or x and y. When the interview was done the student said if he did not know the next step with the reason was forgotten. So students cannot proceed to the next step.
Based on the above analysis it was known that students made errors in understanding the purpose of the given problem. Cannot made a problem into the form of a mathematical model, the errors in used the concept of funds to continue the concept used, the errors did not make known and asked of the problem, the errors in the calculation process caused by the students were less thorough and did not understand the System of Linear Equations in Two Variables. Based on the results of the interview, students have been able to read the problem but failed to understand the purpose of the problem. Student was also confused in solving the problem because they do not know the stages in solving it. Based on the results of the interview study it is known that students still make mistakes in solving the given problems. The mistakes made by students are errors in understanding problems and errors in the process of solving problem. In accordance with the research that has been done, factors errors students’ is not to absorb information well, not understanding the problem of transformation, not following the material thoroughly, and mathematical of weak concepts [10]. Therefore, it clearly shows that students need to understand the meaning of the questions before going through the mathematical processing in order to produce the correct answers [11].

4. Conclusion
Based on the results of test analysis and interviews conducted on the samples, conclusions of this study were students made errors when solved the problem. Students have been able to read the questions but still fail to understand the purpose of the problem so that students make errors in working on the given questions. This is because students have not understood well about the material System of linear equations in two variables.

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