

Analysis of Students' Errors in Solving Mathematics Story Problems on the System of Linear Equations with Two Variables

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Abstract

This research aims to describe the types of errors and the causes of students making mistakes in solving mathematics story problems. The research method used is qualitative descriptive research. The population of this research was students in Makassar with a total of 23 students and 2 students were determined as the research sample. The results of the research found that most students experienced errors due to a lack of understanding of the existing material and behavior that tended to be careless and hasty so they made mistakes in solving math story problems. There were 4 types of student errors, namely (1) errors in reading the questions occurred because the participant's students failed to understand the content or meaning of story problems and were not able to identify relevant information in mathematics story problems (2) Conceptual errors occur because students do not understand and master the concepts of the material being taught so they are confused when determining what method is appropriate for solving story problems mathematics, (3) errors in procedures/steps occur. After all, students are not careful in carrying out calculation operations. This can be seen in the ability test of students who make calculation errors in the stages of solving story problems. (4) Errors in concluding occur because students think that concluding is not important, they assume that if they have got the final score from the calculation then the solution to the story problem has been completed.

Keywords: error analysis, students, math story problems

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Introduction

Education has become an important need for humans. Education is a very important factor in improving the quality of human resources (Darling-Hammond et al., 2020); (Haleem et al., 2022); (Ratnasari & Haryanto, 2019); (Alharbi, 2023); (Atak & Erturgut, 2010). Therefore, education has become a mandatory part that humans must have from an early age. One of the crucial sciences in everyday life related to education is mathematics. Mathematics is a science that studies quantity, structure, space, and change. The concepts contained in mathematics are interconnected with each other (Yang et al., 2021). This means that the concepts that students have learned previously will become the basis for mastering the concepts of the next material. Mathematics story problems are a form of assignment that is usually used by teachers to determine students' understanding of solving mathematical problems (Era Setiyawati et al., 2022); (Nasrun et al., 2023); (Boonen et al., 2016); (Lee, 2024). Usually, mathematics story problems are real situations or problems in everyday life that require solutions to the problem (Ida et al., 2021). In solving mathematics story problems, students must be able to identify the correct information from real situations in the form of text and then translate it into mathematical concepts (Pongsakdi et al., 2020); (Soneira et al., 2023). Although mathematics story problems are often used by teachers in mathematics learning, the fact is that mathematics story problems tend to be difficult for students to solve. In this research, the type of error used as a reference is the error criterion according to Polya, there are several indicators, including the following.

Tahapan Penyelesaian Soal	Indikator Kesalahan	Aspek Kesalahan yang akan diteliti
Memahami Masalah	<p>Peserta didik tak mampu menuliskan apa yang diketahui dalam soal.</p> <p>Peserta didik tak mampu menuliskan apa yang ditanyakan dalam soal.</p> <p>Peserta didik tak mampu mengubah informasi dari soal menjadi model matematika.</p>	Kesalahan dalam membaca soal
Merencanakan Penyelesaian Soal	<p>Peserta didik tak mampu menentukan metode apa dan operasi hitung yang akan digunakan dalam menyelesaikan soal.</p>	Kesalahan Konsep
Melakukan Rencana penyelesaian soal.	<p>Peserta didik tak mampu mengoperasikan operasi hitung yang telah direncanakan sebelumnya dengan baik dan benar.</p> <p>Peserta didik tak mampu mengurutkan dengan prosedur yang sesuai pada penyelesaian soal yang ada.</p>	Kesalahan Prosedur/Langkah-langkah.
Membuktikan Kembali atau Penarikan kesimpulan	<p>Peserta didik tak mampu menarik kesimpulan dalam penyelesaian</p>	Kesalahan Penarikan Kesimpulan.

Figure 1. Error indicators

Based on observations made at the MA Al-Hidayah Makassar school, a story problem was given with the material System of Linear Equations in Two Variables, from the results obtained students had varying errors, some did not understand the content of the problem contained in the question, some did not understand regarding putting problems into mathematical form, some do not understand the concept of the material contained in the problems and some do not understand the

process of calculating operations so researchers are interested in studying more deeply the types of errors students make in solving mathematical story problems.

Methodology

This research is descriptive research with a qualitative approach. Descriptive qualitative research with detailed, complete, and in-depth sentences about the process of why and how something happened (Miles and Huberman, 1992:43). Thus, this research is a qualitative descriptive research. Qualitative research uses qualitative methods, namely observation, interviews, or document review. This method presents the essence of the relationship between researchers and respondents. What is described is the analysis of students' errors in solving mathematics story problems on Systems of Linear Equations in Two Variables in class XI MA Al-Hidayah Makassar.

The research subjects that will be used in this research are class XI MA Al-Hidayah Makassar with a total of 23 students. All subjects will be given an ability test containing 3 math story questions with difficulty levels of 1 each at easy, medium, and high levels. After the results of the ability test have been obtained, the subjects will be grouped into 2 groups, namely the group with low ability results and the group with high ability results. Then from each group, 1 representative student will be taken from the two groups and then an unstructured interview will be conducted as a verification of the causes of the subject making errors in solving mathematics story problems in the material System of Linear Equations in Two Variables.

The data that has previously been obtained will then be tested for the validity of the data. The technique used to test the validity of the data in the research is the Source Triangulation Technique. Source Triangulation Technique (Sugiyono, 2012) States that the data source triangulation technique explores the truth of certain information using various data sources such as documents, archives, interview results, observation results, or also by interviewing more than one subject who is considered to have a different point of view.

Results and Discussion

The data in this research was obtained by collecting test results given to students, which were then grouped by conducting interviews guided by the interview guide that had been prepared by the researcher before going into the field (Malmqvist et al., 2019); (Rashid et al., 2019); (Knott et al., 2022). The students' answers and responses will be analyzed using the aspects that will be observed, namely (Taber, 2018); (1) Aspects of Errors in Reading Questions, (2) Aspects of Conceptual Errors, (3) Aspects of Procedures/Steps, (4) Aspects of Errors in Drawing Conclusions. The 23 students will be divided into 2 groups, namely the High Ability Group (ST) and the Low Ability Group (SR).

These two subjects were interviewed in depth regarding what mistakes they made and to analyze the reasons why they made mistakes, (Dwivedi et al., 2023); including (1) not knowing if what was known and what was being asked was part of the procedure for solving mathematics story problems, (2) not understanding concepts of material that have been taught previously, (3) unable to solve problems using appropriate arithmetic operations, (4) not knowing correctly what the correct procedure is for solving mathematical story problems, and (5) assuming that concluding the answer is not a procedure in solving math story problems. The causes are (1) The subject is unable to change the question narrative which was originally in everyday language into a mathematical model, (2) Does not know the procedures for solving story problems well. (3) Lack of understanding of the material that has been taught, (4) Impressions of lack of accuracy, carelessness, and lack of focus in solving math story problems.

In this discussion, there are various types of errors made by students and the factors of their errors. There are 4 types of errors, namely:

1. Errors in Reading the Question (Understanding the Problem) This error occurs because students do not know the meaning of the question, and also at this stage, there are usually things that are known

and things that are asked. However, students think that if they write down what they know and what they ask, they don't need to write it down in the solution, this happens to Low Subjects (SR).

$$\begin{array}{l} 5x + 3y = 79.000 \\ 3x + 2y = 49.000 \end{array}$$

$$\begin{array}{r} 5x + 3y = 79.000 : 2 = 10x + 6y = 158.000 \\ 3x + 2y = 49.000 : 3 = 9x + 6y = 147.000 \quad - \\ \hline x = 11.000 \end{array}$$

Jadi, Harga 1 kg apel adalah Rp 11.000.

2. Conceptual Error (Planning to Solve the Problem) This error occurs because students are unable to plan or use what method to use and what operations to use in solving math story problems. The factor that causes this error to be made by students is because students do not understand the concept of the material that has been taught previously (Kaufmann et al., 2023); (Hakimi et al., 2024). This happened to SR

$$\begin{array}{r} 5x + 3y = 79.000 : 2 = 10x + 6y = 158.000 \\ 3x + 2y = 49.000 : 3 = 9x + 6y = 147.000 \quad - \\ \hline x = 11.000 \end{array}$$

3. In the picture above, SR incorrectly wrote the calculation operation which should have been multiplication, he wrote division. After conducting the interview, it turned out that the subject was unable to tell about the process of solving the story questions, the following is an excerpt from the researcher's interview with SR

P : Oke, setelah melihat hasil pengerjaanmu kemarin, saya ingin bertanya kenapa pada tahap eliminasi kamu tulis bagi disini?

SR : Anu itu kak.. saya tulis ka itu kak.

P : kenapa bisa salah tulis dek?.

SR : Terburu-buru ka kerjai kak, sehingga salah tulis ka kemarin kak.

P : oke kalau begitu berapa hasil dari operasi ini jika memang ini perkalian disini, coba ceritakan dengan bahasa mu sendiri, bagaimana penyelesaian ini?

SR : (Subjek menunduk diam, terlihat kurang merespon permintaan peneliti).

P : Kenapa dek, susah ya?

SR : Iya kak, agak susah kak.

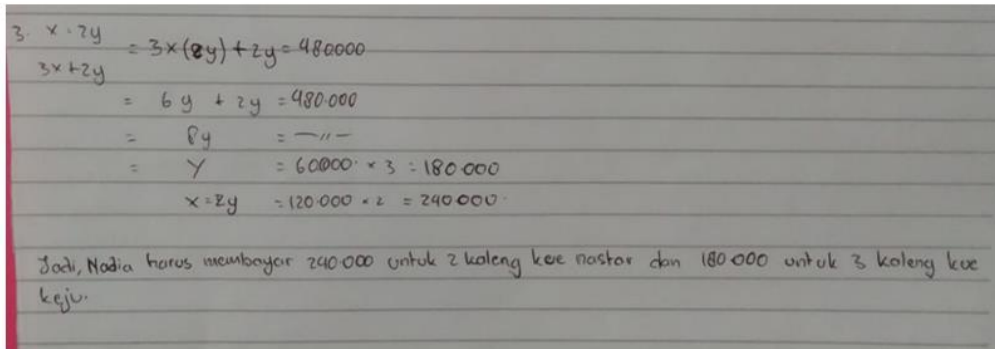
P : Oke, mari kita kerjakan sama-sama yah, sambil saya ajarin.

SR : Iya kak.

Based on the results of the ability test and interview excerpts, SR made a conceptual error, even though the subject's ability test results were correct, at the time of the interview he was unable to describe the completion process. Because SR does not yet understand the material that has been taught.

4. Errors in procedures/steps (carrying out a problem-solving plan)

Procedural errors include the subject's error in operating the calculation operation and the subject not knowing the correct completion procedure and not mastering the calculation operation being carried out.



$$\begin{aligned}
 3x + 2y &= 3x(2y) + 2y = 480000 \\
 3x + 2y &= 6y + 2y = 480000 \\
 &= 8y = \text{---} \\
 &= y = 60000 \cdot 3 = 180000 \\
 x + 2y &= 120000 \cdot 2 = 240000
 \end{aligned}$$

Jadi, Nadia harus membayar 240.000 untuk 2 kaleng kee nastar dan 180.000 untuk 3 kaleng kee keji.

As seen in the picture above, the subject wrote down the problem-solving carelessly, unordered, and irregularly. Based on the results of the interviews that were conducted, it turned out that the subject did not understand the actual contents of the questions and was unable to tell about the process of solving the questions that he had worked on. The following is an excerpt from the interview that was conducted with SR.

P.: Coba kamu ceritakan dengan bahasa mu sendiri, bagaimana cara kamu menyelesaikan soal nomor 3 ini?

SR.: (diam tertunduk, tidak merespon permintaan peneliti).

P.: Kenapa dek? Susah yah dek?

SR.: Iya kak, tidak paham ka ini kak.

P.: Oke, mari kita kerjakan sama-sama yah, sambil saya ajarin.

SR.: Iya kak.

P.: (Peneliti berusaha membimbing SR untuk menyelesaikan soal dengan step by step). Bagaimana dek, sudah dapat dipahami?

SR.: Hehe iye kak, insyaallah bisa mi sedikit kak.

5. Errors in Drawing Conclusions (Re-proving or Drawing Conclusions) This error occurs because students do not know or do not understand the procedure for solving mathematics story problems correctly, so students understand that after finding the answer, then the solution is complete and the conclusion is not correct (Liefgreen & Lagnado, 2023); (Abidin et al., 2023) important to do. The following is an excerpt from an interview conducted with ST.

Conclusion

Based on the results of the analysis of the two research subjects, the following conclusions were obtained; The types of errors made by students in solving mathematics story problems on Systems of Linear Equations in Two Variables are as follows: Errors in reading questions occur because students fail to understand the content or meaning of story questions and have not been able to identify relevant information in mathematics story questions. The types of errors found in reading errors include error indicators of not writing down what is known and what is asked in the question and less precise in changing the information in the problem into the form of a mathematical model. Conceptual errors occur because students do not understand and master the concepts of the material being taught so they are confused when determining what method is appropriate for solving mathematics story problems.

; Errors in procedures/steps occur because students are too hasty or rushed and are not careful in carrying out the calculation operations they are doing. This can be seen in the ability test of students who make calculation errors in the stages of solving story questions; Errors in concluding occur because students think that concluding is not important, they assume that if they have got the final score from the calculation then the solution to the story problem has been completed.

Conflicts of Interest

The authors declare no conflict of interest

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