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**Submission date:** 02-Dec-2021 09:52AM (UTC+0100)

**Submission ID:** 1718276572

**File name:** SIMANIS\_Mita\_Akbar\_Sukmarini\_2\_inggris\_cek\_plagiasi.docx (805.54K)

**Word count:** 2074

**Character count:** 9928

# Error Analysis in Answering SPLDV Questions Based on Newman Error Indicator

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## Article Info

### Article History:

Accepted:

Revised:

Published:

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### Keywords:

Error analysis  
Newman Stage  
SPLDV

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## ABSTRACT

This study focuses on the forms of errors made by students in solving math problems, especially on the material of a two-variable system of linear equations. The purpose of this research is describing detail the form of errors made by students based on error indicators according to the Newman Stages. The data collection technique used is observation. By collecting data in the form of written test results from students, the forms of errors made by students were obtained, including: at stage (1) the form of the error was wrong in writing down known information, incomplete in writing down the information contained in the question, and wrong in determining the information in question, at stage (2) it is not appropriate to write a mathematical model from known information, and does not use variable symbols to simplify calculations, at stage (3) does not operate similar variables, substitutes wrong values, does not apply rules of operation, miscalculations, and did not get the final result of the calculation process, at stage (4) did not change the variable symbol into the form that the question asked, did not provide information on the final answer, and wrote conclusions but did not match what the questions asked.

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## 1. PRELIMINARY

Mathematics is often needed in everyday life. Therefore, mathematics is an important to learn. Peraturan menteri No. 21 of 2016, it is stated that mathematics should be given to students since studying at the elementary school level. It is intended that students as early as possible have a logical, analytical, creative, critical and thorough attitude, and do not easily give up in solving problems [1]. These abilities are provided to students so that students can obtain, manage, and utilize information in order to survive in an ever-changing and competitive life. However, in reality, ability of student to master mathematics has not been satisfactory. This is indicated by the low student learning outcomes in mathematics. The results of academic research through PISA 2018, for the mathematics category, rank of Indonesia is 73 from 79 countries [2].

Mathematics is considered as the most difficult subject by most students. The number of materials and formulas that need to be memorized is the reason that is often put forward by students. Based on the results of an interview with one of the mathematics teachers at SMPN 1 Tegaldlimo, information was obtained that students often get low grades in mathematics, especially in math problems that are related to everyday life, for example in the Two Variable Linear Equation System (SPLDV) material.

SPLDV is one of the materials that must be mastered by students at SMP/MTs and the same level [3], but there are still many students who find it difficult or often make mistakes in solving SPLDV. Research that has discussed about difficulties of solving SPLDV, that are: in terms of the solo taxonomy, students still often make mistakes in solving on SPLDV questions, especially those with the most errors at the multistructural level [4], at the junior high school level there are still many students who make mistakes in solving problems of SPLDV [5], and students of SMPN 1 Sambu still have many difficulties in solving SPLDV questions [6]. Based on the findings

showing that there are still many students who have difficulty and also make mistakes in solving SPLDV questions, so this research was conducted to find out the forms of student errors, in order to get the right solution in the future.

## 2. RESEARCH METHODS

This research is a qualitative descriptive study that aims to describe the form of errors made by students in solving math problems on the SPLDV material based on Newman's Stages.

There are 4 types of errors based on the Newman Stages [7], which are used in this study, namely:

### 1. Misunderstanding

Misunderstanding occurs when students do not understand the meaning of the question. Misunderstanding can be seen when students write down what they know and are asked in the questions.

### 2. Transformation error

Students are said to make this type of error if students have understood the problem but cannot determine the procedure to be used to solve the problem.

### 3. Operation error

This type of error occurs if students have determined the right procedure to solve the problem but cannot carry out the procedure until they find the final answer.

### 4. Error making conclusions

Students are said to make this type of error if the student cannot write the answer from the calculation results into the desired form of the question.

The data used in this study is the test results of 8A grade students of SMPN 1 Tegaldlimo in solving SPLDV. The test questions used are shown in Figure 1.

#### SOAL TES

1. Dalam sebuah tempat parkir terdapat 90 kendaraan yang terdiri dari mobil beroda 4 dan sepeda motor beroda 2. Jika dihitung roda keseluruhan ada 248 buah. Biaya parkir sebuah mobil Rp5.000,00, sedangkan biaya parkir sebuah sepeda motor Rp2.000,00. Berapa pendapatan uang parkir dari kendaraan yang ada tersebut?
2. Diketahui harga 4 buah buku tulis dan 2 buah pensil Rp13.000,00 harga 3 buah buku tulis dan sebuah pensil Rp9.000,00. Harga 5 buah buku tulis dan 2 buah pensil adalah ....
3. Harga sepasang sepatu dua kali harga sandal. Ardi membeli 2 pasang sepatu dan 3 pasang sandal dengan harga Rp420.000,00. Jika Doni membeli 3 pasang sepatu dan 2 pasang sandal, Doni harus membayar sebesar ....

Figure 1. SPLDV material test questions

Data from the research results were collected and analyzed using the flow model technique developed by Miles and Huberman [8].

- 1) The first stage is to reduce the data, the data from the class 8A test results, totaling 32 students, on the SPLDV material is reduced to determine the research subject. In the subject determination test, the researcher reduced the data to find a research subject that was in accordance with the subject selection procedure in Figure 2.

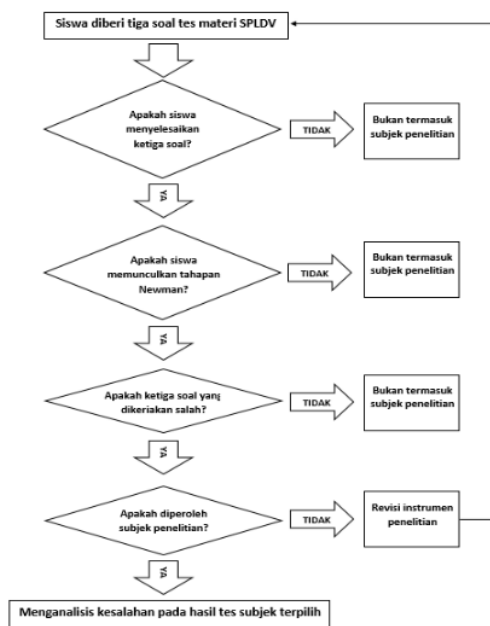


Figure 2. Flowchart of research subject selection

- 2) The second stage is presenting the data, in this study the presentation of the data is in the form of elaboration and depiction of the errors made by students in solving math problems on SPLDV material.
- 3) The third stage is drawing conclusions, at the final stage of this research conclusions will be drawn about the forms of errors made by students in working on math problems with SPLDV material.

### 3. RESULTS AND DISCUSSION

The results of the error analysis of grade 8A students in solving the SPLDV test questions are presented in Table 1 and the results of students' answers to each question are illustrated by the diagram in Figure 3.

Referring to the subject selection procedure, there were four students who were the research subjects. The four research subjects were students with absent numbers 11, 14, 23, and 32, with details as follows.

- S1 (subject 1) : student with absent number 11,
- S2 (subject 2) : student with absent number 14,
- S3 (subject 4) : student with absent number 23, and
- S4 (subject 4) : student with absent number 32.

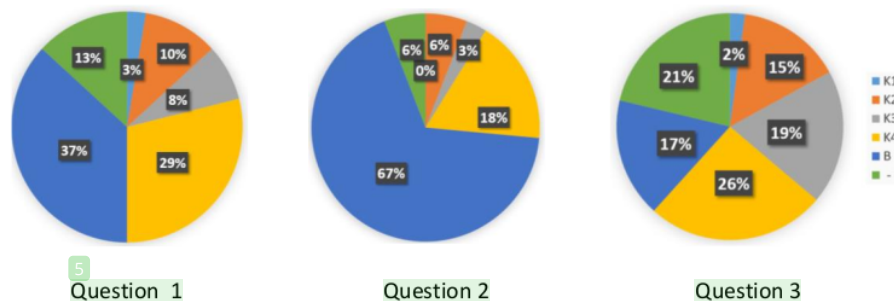


Figure 3. The results of the error analysis of students in solving SPLDV

Table 1 Results of the analysis of student answers

Roll number	Mistakes Made			Roll number	Mistakes Made		
	Problem 1	Problem 2	Problem 3		Problem 1	Problem 2	Problem 3
1	B	B	K2,K3	17	B	B	B
2	-	K2,K3	-	18	B	B	K2, K3, K4
3	B	B	B	19	B	B	K4
4	-	-	-	20	B	B	K3,K4
5	K2,K3	B	-	21	B	B	K4
6	K4	B	K4	22	K4	B	-
7	B	B	K2,K3	23	K2,K3,K4	K2, K4	K2,K3,K4
8	-	B	-	24	K4	B	K2,K3,K4
9	B	B	B	25	-	-	-
10	K4	B	K3,K4	26	K4	B	-
11	K1, K2, K3, K4	K4	K2,K3,K4	27	B	B	B
12	B	B	B	28	K4	K4	-
13	B	B	B	29	K4	B	-
14	K2,K4	K4	K1, K2, K3, K4	30	B	B	K4
15	-	K4	-	31	B	B	B
16	K4	B	B	32	K4	K4	K4

Information:

K1 : Misunderstanding

K2 : Transformation error

K3 : Operation error

K4 : making a mistake in making a conclusion

B : answer the question correctly

- : did not answer the question

Based on the results of the analysis on the answers to the four subjects, it was found a description of the forms of errors in each Newman Stages which are described in the discussion below:

(1) At the understanding stage, students should write down the information in the questions.

Of the four research subjects, S1 and S2 made mistakes at this stage on questions number 1 and 3.

Diket : Parkir = 90  
 Mobil berada 4  
 Sepeda berada 2  
 Parkir mobil = 8000  
 Parkir Sepeda = 2000

Figure 4. Form of error at the understanding stage (1)

3: misal sandal = a  
 sepatu = b

Figure 5. Forms of error at the understanding stage (2)

The form of errors found by the research subjects was inaccurate or incomplete in writing down the information that was known on the questions, and wrong in determining what was asked in the questions.

(2) The transformation stage is the stage where students develop ideas and choose the formula that will be used to solve the problem. At this stage, of the four subjects, there were three subjects who made mistakes, namely: S1 and S2 made a transformation error on questions number 1 and 3, while S3 on all questions.

$$a = 2 \times b$$

$$2b + 3a = 420.000$$

Figure 6. Form of error at the transformation stage (1)

mobil = 4    sepeda = 2  
 dalam tempat parkir ada 90 mobil dan sepeda  
 jadi mobil = 45  
 sepeda = 45

Figure 7. Forms of error in the transformation stage (2)

The form of errors found from the research subjects at the transformation stage was not being able to make mathematical models from known information, not using variable symbols to simplify calculations.

- (3) The operation stage is the stage where students carry out ideas using the formulas that they have set in the previous stage until they get the final result. At this stage, three subjects made the following mistakes: S1 and S3 on questions number 1 and 3, while S2 only on number 3.

$$2x + 3y = 920.000$$

$$2x + 3(60.000) = 920.000$$

$$2x + 180.000 = 920.000$$

$$2x = 920 - 180.000$$

$$2x = 290.000$$

$$x = 290 / 2$$

$$x = 120$$

Figure 8. Form of error at the arithmetic operation stage (1)

Total parkir =  $49 \times 5000 + 47 \times 2000$   
 $= 245.000 + 94.000$   
 $= 339.000$

Figure 9. Form of error in the arithmetic operation stage (2)

$$a = 2 \times b$$

$$2b + 3a = 420.000$$


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$$2b + 4a = 2 \times 420.000$$

$$b + 2a = 420.000$$

Figure 10. Form of error in the arithmetic operation stage (3)

The form of errors found by the research subjects at the operation stage was not being able to operate similar variables, not knowing the variables, resulting in substituting wrong values, miscalculations, and not getting the final result of the calculation process.

- (4) The stage of making conclusions is the last stage in the process of solving questions, where students write down the appropriate final answers. Of the four subjects, all of them made mistakes at this stage on questions number 1, 2, and 3.

A handwritten conclusion on lined paper. On the left side, there is a small square box. To the right of the box, the text "x = 120" is written in blue ink.

Figure 11. Forms of error at the stage of making conclusions (1)

A handwritten conclusion on lined paper. The text "Keseluruhan biaya parkir ada 339.000 ribu" is written in blue ink.

Figure 12. Forms of error at the stage of making conclusions (2)

A handwritten conclusion on lined paper. The text "harga sandal adalah 420.000" is written in blue ink.

Figure 13. Form of error at the stage of making conclusions (3)

The form of errors found from the research subjects was not changing the variable symbol into the form that the question asked about, not providing information on the final answer, and writing conclusions but not in accordance with what was asked for.

Based on the explanation above, when the subject solves a problem, there are errors related to one another. Mistakes made by the subject can affect the next stage. The most mistakes made by each subject are mistakes in making conclusions. Each step taken at the time of solving the problem is equally important. If the student has completed the problem well in the first three stages, but at the stage of writing the final answer the student makes a mistake, then the student has not been able to answer what was asked of the question he was working on.

#### 4. CONCLUSION

The forms of errors made by students in solving SPLDV questions based on Newman's stages are as follows.

1. At the stage of understanding, the forms of errors made by students are:
  - Wrong in writing information that is known in the problem.
  - Incomplete in writing the information contained in the question.
  - Wrong in determining the information asked.
2. In the transformation stage, the forms of errors made by students are:
  - Less precise in writing mathematical models from known information.
  - Do not use variable symbols to simplify calculations.
3. At the process skills stage, the forms of errors made by students are:
  - Does not operate on similar variables.
  - Substituting the wrong value.
  - Does not apply the rules of operations on numbers.
  - Miscalculated.
  - Did not get the final result of the calculation process.
4. At the stage of writing the final answer, the forms of errors made by students are:
  - Does not change the variable symbol into the form that the question asks for.
  - Does not provide information on the final answer.
  - Write a conclusion but it is not in accordance with the question asked.

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