NEWMAN'S ERROR ANALYSIS: SET MATERIAL IN 7TH-GRADE JUNIOR HIGH SCHOOL

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ABSTRACT

Set is one of the main materials contained in the mathematics subject for 7th-grade junior high school in odd semesters. In the set material, there's no formula used, but there are various kinds of notations, symbols, and also diagrams. Basically, some or even most students still face various difficulties in understanding and working on problems in set operations. This study aims to determine the types of errors and the percentage of errors in 7th-grade junior high school's responses to set material test questions using Newman's error analysis procedure. In this study, we used a qualitative descriptive method, while the data processing technique was done by analyzing student answers based on questions that were test instruments. The research subjects were taken from students in the VII-E class at SMP IT Fithrah Insani, which included as many as 22 students. Then the subjects were analyzed, and based on the results of the research, it turned out that there were still errors in solving set questions. The most frequent error made by students is an encoding error of 40.91%. In this error, the student did not write a complete final answer, or even the conclusion of the solution, so that he did not answer the question posed by the problem.

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INTRODUCTION

Mathematics is one of the sciences that is very important for our lives. Without realizing that mathematics is very closely related to our daily lives, for example, calculating the date in one year, time, and the technology that we use every day cannot be separated from mathematics. The above statement is in line with (Wulandari et al., 2018), who argue that mathematics is a subject that is closely related to counting, measuring, and applying formulas to real life. It is

undeniable that in our daily lives, mathematics is very relevant. For example, when we are taught to recognize the objects around us, sort numbers, and buy and sell transactions, there are many daily activities related to mathematics. One of the subjects in mathematics for 7th grade junior high school is sets, which are taught in odd-numbered semesters.

Sets are one of the materials that don't use formulas or even calculations, this material only uses a lot of notations, symbols, and diagrams. When students study set material, it is hoped that they can train critical and creative thinking skills, and other mathematical skills can develop (Hedriana in (Anggraeni & Kadarisma, 2020)). Based on this, the set material requires a very good interpretation of mathematical concepts so that there are no difficulties. This is in line with Nikmah's statement in (Komariyah et al., 2018) that the interpretation of concepts is one of the main things in learning, especially in learning mathematics. But in reality, it turns out that there are still various difficulties that are often faced by students with one set of materials (Dwidarti et al., 2019).

In the learning process, it is often found that some students still face difficulties with the set material because they do not understand the concept of the set itself. Based on the results of research that has been carried out by (J. Aulia & Kartini, 2021) students' conceptual errors in solving set material questions are in the high category. Students still experience difficulties understanding concepts and applying principles (Dwidarti et al., 2019). This is in line with the results of research that has been conducted (Aulia et al., 2022), which state that the difficulties faced by students are that they do not understand the lessons that have been delivered, they have difficulty answering questions, and they lack confidence in explaining set material. Students' learning difficulties in set material can also be caused by external factors (Pranajaya et al., 2020). These difficulties cause various errors in learning mathematics. Errors faced by students in various set materials include frequent student errors such as not being able to read symbols or notation on sets, errors in making Venn diagrams, and operations on sets. Therefore, this error can be analyzed using the Newman analysis procedure.

Newman's procedure analysis is one way to check for mistakes made by students. Newman provides five procedures to make it easier to analyze the mistakes made by students in working on math problems on set material, which can be seen at each stage of solving the problem. When students are unable to read the words and symbols contained in a problem, they are in the reading error stage; when students are able to read questions and symbols but do not understand the problem to be solved, they are in the comprehension error stage; the transformation error stage occurs when students are able to read and understand the problem but are not able to choose the approach or formula that should be used to answer questions; the process skill error stage occurs when students are able to choose the mathematical operations to be used but are unable to calculate correctly when answering questions; and the encoding error stage is when they write the wrong final answer to the question (Rahmawati & Permata, 2018). If there is an error at the beginning of the process, it will cause an error in the next process.

Based on the background that has been described, the author conducted research in VII-E class of SMP IT Fitrah Insani that aims to analyze type errors and percentage errors made by 7th grade students of SMP IT Fitrah Insani regarding set material using the Newman procedure. Error analysis with the Newman procedure can be used as evaluation material to find out the location of student errors in the set material, so that later it can be used as a guide for making improvements in providing learning by teachers.

METHOD

The method used in this study is a qualitative research method whose results are described descriptively. (Heriyanto, 2018) defines qualitative research as "a study that aims to tell and

explore one's experiences in an incident." The things that are described in this study are the types of errors and the percentage of students' errors in solving set questions based on the Newman error analysis procedure. The population in this study was SMP IT Fithrah Insani students, and the sample included up to 22 students from the VII-E class. The research location is SMP IT Fithrah Insani, which is located in Tanimulya, Ngamprah, Bandung Barat.

This study uses the test method to collect data with instruments in the form of five questions describing the set material. In this study, data were obtained in the form of student answer sheets, which would later be used to analyze and determine the types of errors and the percentage of student errors in set questions. To find out the percentage of each type of student error in each question, use the formula:

$$P = \frac{n}{N} \times 100\%$$

Description:

P : Percentage of types of student errors

n : Number of errors for each type of error

N : Number of possible errors

Data analysis was carried out by analyzing student test results for each question, which focused on reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors according to Newman's error analysis procedure. Therefore, in this study, coding was used to identify the types of errors made by students, which were presented with error indicators in Table 1 below.

Table 1. Student Error Indicators

Error Type	Code	Indicator
Reading Errors	R	• Students misread terms, symbols, word, or important information in the problem.
Comprehension Errors	C	• Students don't know what is actually being asked in the questions. • Error in capturing information in the problem, preventing it from being completed for the next process.
Transformation Errors	T	• Students fail to change to the correct mathematical model. • Students make the mistake of using set operation signs to solve problems.
Process Skill Errors	P	• Students make mistakes in calculations or computations. • Students do not continue the completion procedure. • Students make conceptual errors.
Encoding Errors	E	• Students cannot write down the final answer requested from the questions. • Students cannot conclude answers according to mathematical sentences. • Negligence-related errors.

Not doing questions	N	• Students do not work on the questions given.

RESULTS AND DISCUSSION
Result
Based on the results of the analysis of the answers on the student test sheets, it was found that students made mistakes in solving set questions, which were divided into five categories based on Newman's error analysis, namely (1) reading errors, (2) comprehension errors, (3) transformation errors, (4) process skill errors, and (5) encoding errors. The data from the analysis results can be seen in Table 2 below.

Table 2. Recapitulation of Types of Students Errors

Subject	Error-Type Each Question				
	1	**2**	**3**	**4**	**5**
1	N	N	R, E	R, E	-
2	-	C	-	-	-
3	C, E	E	-	-	T
4	-	-	-	-	-
5	E	C	R, T, E	T, E	T, E
6	-	E	-	-	-
7	E	C	E	E	T
8	-	-	E	E	-
9	-	-	T, E	R, E	P
10	-	P	E	E	E
11	T, P, E	T	T, E	R, P, E	E
12	-	-	C, E	C, E	-
13	-	T	T, E	E	E
14	-	R, E	T, E	T, E	-
15	-	-	-	E	-
16	-	-	-	R	-
17	C, E	C, E	T, E	T, E	R, E
18	E	-	T, E	-	-
19	-	-	T, E	-	-
20	-	-	E	E	-
21	-	-	-	N	N
22	-	R	T, E	E	E

Total	1N, 2C, 1T, 1P, 6E	1N, 2R, 4C, 2T, 1P, 4E	2R, 1C, 9T, 15E	1N, 4R, 1C, 3T, 1P, 14E	1N, 1R, 3T, 1P, 6E

Based on the data analysis in Table 2, it can be seen that there are still many students who make mistakes in solving set questions. The mistakes made by students varied according to the type of error in the Newman procedure. To find out the types of errors most students make, the following presents a summary of the percentage of student errors based on the type of error in Table 3.

Table 3. Recapitulation of The Percentage of Student Errors

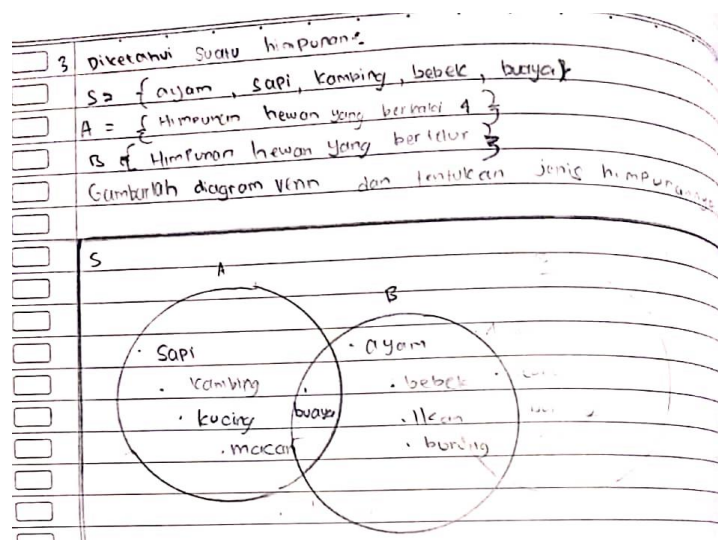| Error Type	The Number of Students Who Incorrectly Answered the Question					Total	Percentage
	1	**2**	**3**	**4**	**5**		
Reading	0	2	2	4	1	9	8,18%
Comprehension	2	4	1	1	0	8	7,27%
Transformation	1	3	9	3	2	18	18,36%
Process Skill	1	0	0	1	2	4	3,63%
Encoding	6	4	15	14	6	45	40,91%

By looking at the data in Table 3, it appears that the most errors made by students were coding errors, which accounted for 40.91%. Based on an analysis of the test answer sheets that students had worked on, the error in writing the final answer occurred because many students did not write the final answer in full according to the instructions on the given set of questions.

Discussion

Based on the data collected, there are various types of student errors discovered when solving set problems. Each type of error based on the Newman error analysis procedure will be discussed in more detail as follows:

Reading Errors

In Table 3, the percentage of reading errors is obtained, which indicates students' errors in reading are relatively low. In reading errors, students still experience errors in reading complete information or mathematical symbols, errors in interpreting sentences correctly, and errors in finding keywords in questions (Rahmawati & Permata, 2018). An example of a reading error is a mistake made by subject 1 when working on question number 3. An example of this error can be seen in Figure 1.
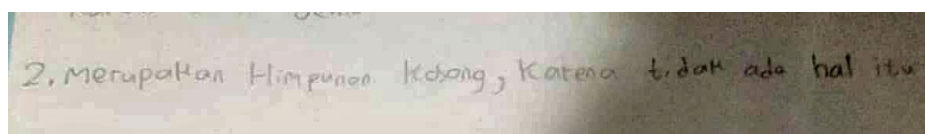
Figure 1. Example of Reading Errors

In Figure 1, it can be seen that students made reading errors. In the questions given, students are asked to make a Venn diagram with the members of the universe, namely chickens, cows, goats, ducks, and crocodiles. However, because subject 1 did not read the information completely, he made the mistake of making the requested Venn diagram by adding another member outside the given universe. Meanwhile, the definition of a universal set is a set that contains members named and written with the letter "S" (Rismawati et al., 2022).

Comprehension Errors

Comprehension errors occur when students are able to read all the words in the question, but they do not understand the meaning of the word as a whole, so they cannot continue their work further (Nurdiawan & Zanthy, 2019). The results of the analysis show that the error in understanding the problem is low. In misunderstanding this problem, students misunderstood information and did not know what was actually being asked in the question, so they could not complete it and not move on to the next process. An example of a mistake in understanding the problem is a mistake made by subject 2 when working on number 2. An example of this error can be seen in Figure 2 below.
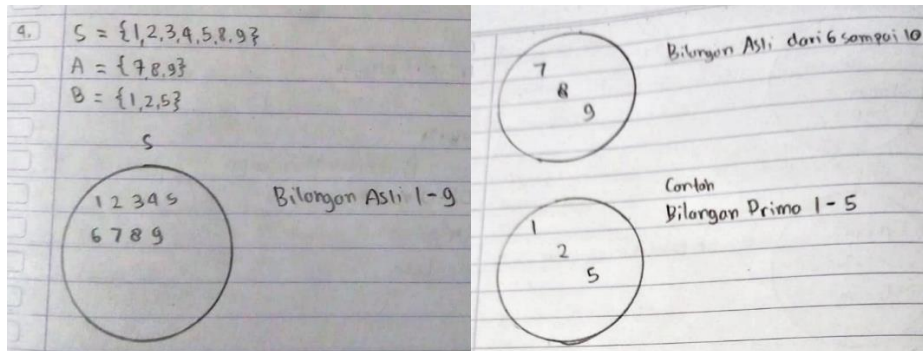

Figure 2. Example of Comprehension Errors

Figure 2 shows students making mistakes in understanding the questions. In question number 2, several sets are presented, and students are asked to determine the empty set and not the empty set along with the reasons. Based on the results of the answers above, students did not know what was actually being asked in the questions and misunderstood the information in the questions, so they immediately wrote down the answers. The reasons given by students are not relevant because the empty set itself is a set that has no members (Mauleto, 2019).

Transformation Errors

According to Jha in (Trisnasari et al., 2022), transformation errors occur when students are able to understand the problem in the questions presented but are unable to choose an approach to solve the problem. The percentage of transformation errors in Table 3 shows that the errors are quite high. In the transformation error, students incorrectly transform the

information they know into a Venn diagram. Transformation errors will also affect other errors, namely processing skill errors and answer writing errors. An example of a student transformation error was made by subject 5 when working on question number 4. An example of this error can be seen in Figure 3 below.
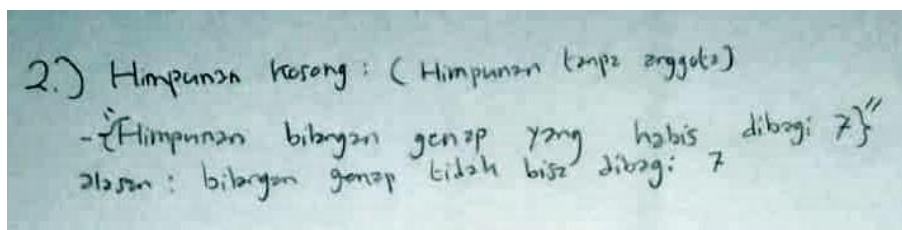

Figure 3. Example of Transformation Errors

Students make the transformation error in Figure 3. In this error, students already understand the information in the problem but are unable to determine how the correct Venn diagram's shape. This makes students fail to change to the correct set form so that they draw sets separately, different from what is desired in the problem. In this case, students cannot represent the problem in the form of a Venn diagram (Ngedo et al., 2020).

Process Skill Errors

Errors in processing skills made by students take the form of conceptual errors, computational errors, and errors in determining arithmetic operations and the steps for solving them. In Table 3, it is obtained that the percentage of student errors in processing is classified as very low, and at least it is done by students. An example of a processing skill error can be seen in Figure 4. This error was taken from subject 10 when working on question number 2.
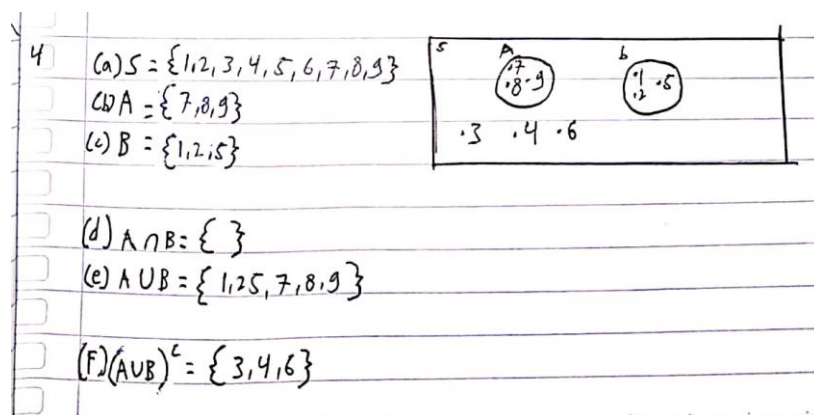

Figure 4. Example of Process Skill Errors

In Figure 4, students make processing skill errors. Based on the results of the analysis of the answers, students are able to capture information correctly and know the solution to the problem. However, in solving it, students made a conceptual error by assuming that there was no even number that was divisible by 7, giving rise to an erroneous final answer. This concept is wrong because an even number is a number that is divisible by 2 equally (Safitri & Rahmawati, 2018). Thus the set has members, for example, 14, 28, 42, etc.

Encoding Errors

The percentage of errors in writing the final answer shown in Table 2 is classified as very high and is mostly done by students. In the mistake of writing the final answer, many students did not write down the answer or conclusion asked in the question. An example of an error in writing the final answer was made by subject 15 when working on question number 4, which can be seen in Figure 5 below.

Figure 5. Example of Encoding Errors

It can be seen that subject 15 made encoding errors in Figure 5. In question number 4, students were asked to draw a Venn diagram and determine the type of set according to the data that has been presented. On the answer sheet, students are able to make a Venn diagram correctly but are unable to show the type of set correctly according to the instructions in the question. This shows that students made an encoding error by not writing down the final answer requested from the set questions (Sundari et al., 2019).

CONCLUSION

Based on the results of research on a total of 22 students in 7th-grade junior high school, it can be concluded that students made 5 types of errors in solving the set material test questions according to the Newman error analysis procedure, reading errors, comprehension errors, and process skill errors are among the lowest errors, while transformation errors are in the moderately high category as well as encoding errors very high. As a result, the majority of errors made by students occur when writing the final answer (encoding errors). This is in line with the results of the analysis of student answer sheets, which show that there are still many students who do not write down the complete final answer in accordance with the instructions on the set questions given.

The suggestions in this study are to minimize the mistakes made by students in working on set questions, namely, emphasizing to students the importance of completing complete questions by reading the questions repeatedly, trying to translate the meaning of the questions, and re-checking the answers. Furthermore, for other researchers to develop student error analysis research on other mathematics material based on the Newman error analysis procedure, add research subjects in order to obtain more detailed and in-depth types of errors and factors that cause errors, and conduct research in an effort to find alternative strategies to minimize student mistakes.

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