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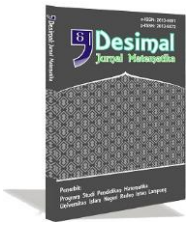

Student's errors in solving set problems for junior high school students based on newman's procedure

Noviana Puspita Sari*, Sukoriyanto, I Made Sulandra

Universitas Negeri Malang, Indonesia

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*Correspondence: E-mail:
novianapuspita01.math@gmail.com

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ABSTRACT

Errors in solving mathematical problems, especially in the material of sets, are still widely found in junior high schools. This study aims to describe the types of student errors and the factors causing them in solving problems about sets based on the Newman Procedure. The study was conducted on 31 eighth-grade students at one of the state junior high schools in Malang City, with three students (S-1 to S-3) selected as subjects by purposive sampling. The main instrument was the researcher, with supporting instruments in the form of tests and interviews. Data analysis was carried out using the Miles & Huberman model. The results of the study showed that subjects S-1 to S-2 misunderstood the problem (misunderstood what was actually known and asked in the problem incompletely), while S-3 did not. All subjects experienced transformation errors (wrong writing of mathematical models/formulas), process skills (miscalculations/not continuing the procedure), and final answers (wrong conclusions). The main causal factors include lack of reading accuracy, weak conceptual understanding, and errors in calculations and procedures. The implications of this study indicate the need for learning strategies that emphasize conceptual understanding, accuracy, and more systematic procedural solutions.

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INTRODUCTION

Some students feel afraid or have difficulty learning mathematics because of the abstract nature of the object, which often causes difficulties in understanding and solving problems (Alifa, Hasbi, & Usman, 2023; Debi, Kadir, Masi, & Salim, 2021). In fact, in the field, mistakes made by students when solving math problems are caused by various factors, both internal and external (Puspitaningati, Pramesthi, & Antonius, 2024). According to Parwati, Suryawan, & Apsari (2018), student errors that come from internal factors are insufficient conceptual understanding, difficulty understanding questions, inaccuracy, bad study habits, and conditions such as health or low self-

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confidence. In this case, an error is defined as an action that deviates from the applicable rules or provisions, which is carried out by someone in completing a task. One of the important topics that needs to be mastered in learning mathematics is sets.

Sets are one of the important materials to be learned in 8th grade junior high school mathematics. Learning sets is learning concepts, a few formulas, and using various symbols, notations, and diagrams (Sholikhah & Masriyah, 2022). In the classroom learning process, students who have struggled with set theory due to insufficient understanding of its fundamental concept are often found (Zulfayanto, Lestari, Ilmiah, & Mustangin, 2021). The basic characteristics of set material in the context of solving problems include the existence of questions that require conceptual understanding so that students can recognize and solve problems related to sets (Dwidarti, Mampouw, & Setyadi, 2019). Therefore, a deep understanding of the concept of sets will help students overcome difficulties in solving mathematical problems involving the use of symbols, notations, and set diagrams.

Based on a preliminary study at SMP Negeri Kota Malang, it showed that 31 students of class VIII-F made mistakes in understanding and transforming set questions. In the question, information was presented about a community consisting of 60 people. It was recorded that 25 people liked comedy films, 30 people liked drama, and 20 people liked action. A total of 15 people liked comedy and drama, 10 people liked comedy and action, 8 people liked drama and action, and 5 people liked all three. Then, students are instructed to create a Venn diagram based on the data. The results of the students' work are displayed in Figure 1.

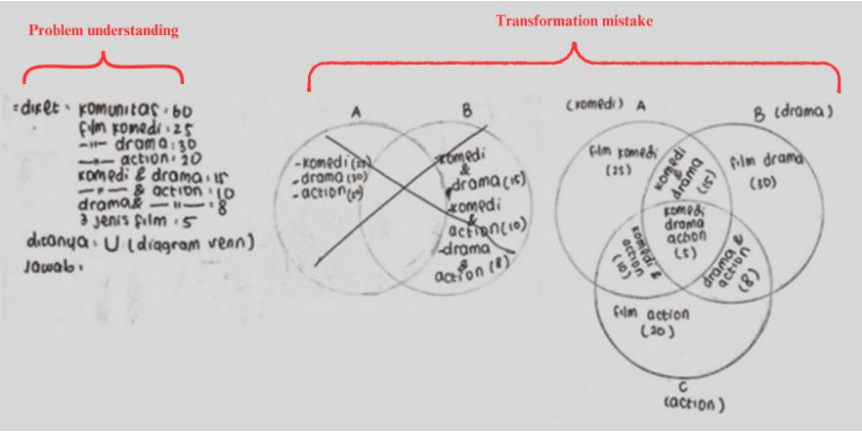

Figure 1. Errors in Student Work Results

The picture above shows that students have actually tried to write down the information that is known and asked in the question. However, the writing is known to be started with the word "many" in each point because it is to indicate the set. Meanwhile, the error in writing the information asked should be written "Draw a Venn Diagram!". Then, when the transformation process is seen, the error made was that initially the student made a Venn diagram of 2 sets, while the information in the question suggests that the Venn diagram consists of 3 sets. After realizing the error, the student changed the image to a Venn diagram of 3 sets. However, the answer written was still wrong because the numbers in the Venn diagram were not processed according to the information in the question. Apart from these errors, it is possible that students still make other errors when solving the problem.

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Student errors can be analyzed, one of which is using Newman's Error Analysis Theory (NEA). NEA is a process for analyzing and understanding students' problem-solving processes based on their responses to given questions (Newman, 1977; Rahmawati & Permata, 2018). According to Newman (1977), there are 5 error analyses when solving questions, namely when reading, when understanding the problem, when transforming, when using operational skills, and when writing the final answer. The success of students in solving mathematics problems reflects the achievement of learning objectives. Therefore, analyzing and solving student errors is important to support the achievement of these goals.

Research related to student errors in solving set problems has been widely studied by experts who show that these errors include not understanding symbols, difficulty converting problems into mathematical language, lack of accuracy, confusion in using formulas, and not being used to writing conclusions (Asih, 2018; Mursalina, Sujatmiko, & Kurniawati, 2019; Nufus, Roza, & Maimunah, 2022). Research by Hidayat & Pujiastuti (2019), using the Polya procedure, showed that errors occurred because students are not precise in mathematical calculations and are also less precise in concluding the given problems. Then, research by Sulistio, Muhsetyo, & Qohar (2019), using the KIAT procedure, revealed that student errors were caused by a lack of understanding of the concept, inability to choose the right formula, and being less careful and hasty in answering questions. The main difference with previous studies lies in the procedure used; the focus of this study uses the Newman procedure. In addition, most previous studies focus on analyzing student answers according to the Newman procedure (Nufus et al., 2022). Meanwhile, this study focuses on students' errors in solving problems using the Newman procedure. In relation to the descriptions above, it is important to analyze the errors made by junior high school students in solving problems about sets using the Newman procedure approach.

METHOD

This study applies a descriptive qualitative methodology to examine students' mistakes in solving set problems according to the Newman procedure. The research location was at one of the junior high schools in Malang City, involving class VIII-F students (31 students). Subjects were selected by purposive sampling based on test results that showed errors according to the Newman procedure. After the answers were corrected, 3 students with the most prominent errors were selected as research subjects and given codes S-1 to S-3. The error categories based on the Newman procedure adapted from Nurdiawan & Zanthy (2019) and Sunardiningsih, Hariyani, & Fayeldi (2019), which are the main references in the analysis, are shown in Table 1.

In this study, the researcher acted as the main instrument responsible for determining objectives, selecting informants, collecting, evaluating, analyzing, and interpreting data. To ensure the objectivity and accuracy of categorizing student mistakes, the researcher was assisted by two experts in mathematics education to validate the results of student work analysis. Test sheets and interview guidelines are the supporting instruments. The test sheet used contains 2 descriptive questions on the set material, as shown in Figure 2.

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Table 1. Categories of Mistakes According to Newman's Procedure

No.	Categories of Mistakes According to Newman's Procedure	Indicator
1.	Reading mistake	a. Misunderstands terms, symbols, words, or important information in the question.
2.	Problem understanding	a. Misunderstands the information that is known and asked in the question. b. Misunderstands information so that it cannot proceed to the next stage of the solution.
3.	Transformation mistake	a. Miswrites the mathematical model that is appropriate for the question. b. Misuses the correct operation signs or formulas to solve the question.
4.	Operational skills mistake	a. Errors in calculation or computation. b. Does not continue the solution procedure until the final answer is obtained.
5.	Final answer's writing mistake	a. Miswrites the final answer requested in the question. b. Miswrites the conclusion of the answer according to the correct mathematical sentence.

1. Dalam sebuah penelitian terhadap 135 siswa di SMPN 1 Jakarta, ditemukan kesukaan terhadap dua jenis makanan di kantin, yaitu mie dan soto. Hasil penelitian menunjukkan bahwa 80 siswa suka mie, 40 siswa suka soto, dan 30 siswa tidak suka mie maupun soto. Berapa banyak siswa yang hanya suka makan keduanya?
2. Suatu klub ekstrakurikuler di sekolah memiliki 50 siswa yang bergabung di klub teater, 40 siswa yang bergabung di klub paduan suara, dan 25 siswa yang bergabung di kedua klub tersebut. Selain itu, 10 siswa tidak tertarik untuk bergabung di kedua klub tersebut. Berapa banyak siswa yang terdaftar dalam klub ekstrakurikuler sekolah tersebut?

Figure 2. Test Sheet Instrument

The data collection process is conducted by performing tests to identify student errors when solving set problems according to Newman's procedure. Then, interviews are used to explore students' written answers in order to clarify errors in students' answers. Furthermore, Figure 3 illustrates the data analysis is conducted using the interactive model of Miles & Huberman (1984), including data collection, data reduction, data presentation, and verification/withdrawal.

RESULTS AND DISCUSSION

Based on the research that has been conducted, data on student errors was obtained based on Newman's procedure, which is presented in Table 2.

Table 2. Student Error Data based on Newman's Procedure

Question No.	Categories of Mistakes According to Newman's Procedure				
	Reading mistake (M1)	Problem understanding (M2)	Transformation mistake (M3)	Operational skills mistake (M4)	Final answer's writing mistake (M5)
	Number of students				
1	0	20	8	9	6
2	0	5	27	30	30

Of the 31 students, 3 were selected as research subjects because their answers highlighted errors according to Newman's Procedure, namely at the

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stages of problem understanding, transformation, operational skills, and final answer writing. The student's answer errors' recapitulation can be seen in Table 3.

Table 3. Recapitulation of Research Subject Errors

Subject	Types of Errors based on Newman Procedure										Number of Errors
	Question No. 1					Question No. 2					
	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5	
S-1	-	✓	✓	✓	✓	-	✓	✓	✓	✓	8
S-2	-	✓	✓	✓	✓	-	✓	✓	✓	✓	8
S-3	-	-	✓	✓	✓	-	-	✓	✓	✓	6

The errors of each subject based on Newman's procedure when solving set problems will be explained in detail along with evidence of written test results and the following interview excerpts.

Subject 1 (S-1)

When solving problem No. 1, S-1 made mistakes in problem understanding, transformation, operational skills, and final answer writing. The student's work result can be seen in Figure 3.

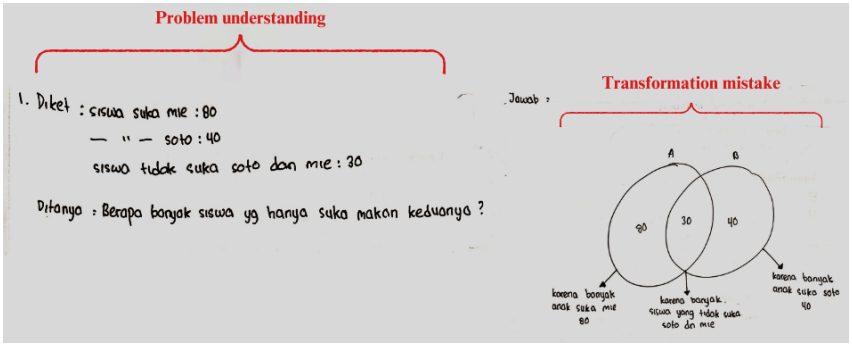

Figure 3. Results of S-1 Work on Question 1

Based on Figure 3, it can be identified that S-1 makes a mistake in understanding the problem, namely making a mistake in understanding what is actually known and asking incompletely. Where students ignore one piece of information in the question so that they write what is known incompletely, this is because they are not focused when solving the question. Question 1 contains information that the number of students studied was 135 students, but S-1 made a mistake by not writing that part so that it affected the next answer. Through investigation during the interview, it was proven that the subject actually made the mistake.

P : "Why write down the information and problems in a question like this?"

S-1 : "From the question, I wrote down everything that is known so that it is easier to answer."

P : "What are they? Please mention them."

S-1 : "Students who like noodles are 80, like soto 40, and students who do not like soto and noodles are 30."

S-1 made a mistake when transforming where the student was wrong in changing/processing it into the right mathematical model. In the answer, S-1 made a mistake by writing those who do not like soto and noodles in the middle of the Venn diagram, even though that part

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should be to show the number of students who like soto and noodles. When explored in the interview, it was proven that the subject had made the mistake.

P : "Why change it without following the rules in the Venn diagram?"

S-1 : "Not focused and forgot the concept, Ma'am. If you don't like both of them, it should be outside the Venn diagram."

According to the work of S-1, it also shows that mistakes occurred in the operational skills stage because the completion procedure was not implemented by them because, at the transformation stage, students forgot the concept used in solving the problem. Mistakes in the final answer's writing because they do not write the answer and final conclusion correctly. This is because S-1 does not continue the completion stage, so they make mistakes when writing the answer and conclusion at the end of the solution.

For question No. 2, S-1 again made mistakes, starting from understanding the problem to mistakes during final answer writing. The student's work result is presented in Figure 4.

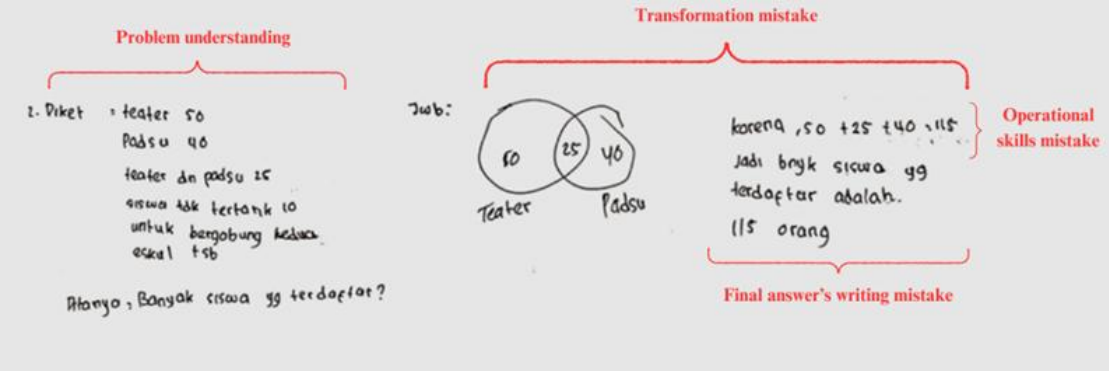

Figure 4. Results of S-1 Work on Question 2

Based on Figure 4, it can be seen that S-1 made a mistake when understanding the problem, namely a mistake when understanding what is actually known and asked in the question incompletely. Where the information should be written is known in the question at each point starting with the words "Students who join in ... = ..." because it is to show the set. Inaccurate understanding of the information known and the questions asked causes errors in the problem-solving.

S-1 made a mistake when transforming, namely the student made a mistake in changing it to the correct mathematical model form. In the answer, S-1 made a mistake in filling in the numbers in the Venn diagram by directly entering the numbers from the known information without processing it first. In addition, there was also a mistake when using the calculation operation sign or formula to solve the problem. S-1 immediately added "$50 + 25 + 40 = 115$"; it should be "$50 + 40 - 25 + 10 = 75$".

The results of the work also showed that S-1 experienced errors in the operational skills stage due to errors when running calculations, because at the transformation stage, students forgot the concept to solve the problem. Errors when writing the final answer because S-1 had made errors starting from the transformation stage resulted in the answer's writing error and final conclusion.

According to the analysis and interview of questions No. 1 and No. 2, S-1 made a mistake in understanding the problem because important information

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was read incompletely, not carefully, and not focused. Conversion mistakes are caused by a lack of focus and forgetting the concept of sets, as well as errors in drawing Venn diagrams. Operational mistakes occurred because they did not continue the solution procedure due to forgetting the concept. In writing the final answer, the student was not careful and could not complete the work properly, so the final answer was less than accurate.

Subject 2 (S-2)

When solving problem No. 1, S-2 made mistakes when understanding the problem, mistakes when transforming, mistakes when processing skills, and mistakes during the final answer writing. Figure 5 shows the students' work results.

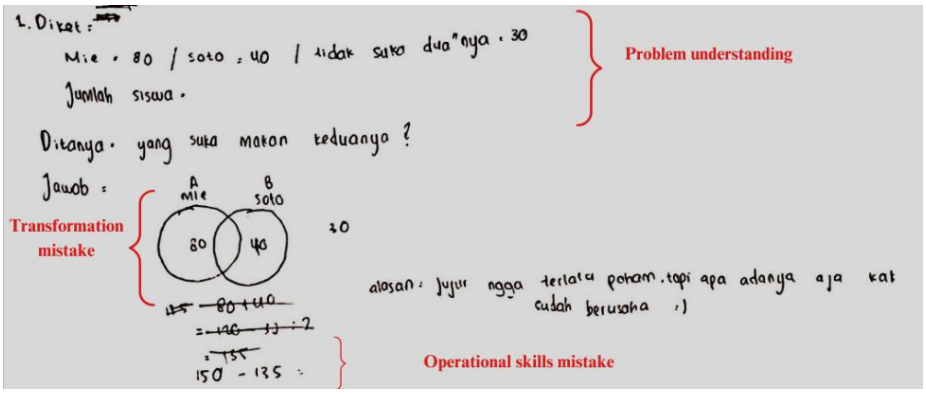

Figure 5. Results of S-2 Work on Question 1

Based on Figure 5, it is recognized that S-2 experienced a mistake in understanding the problem, namely that the student made a mistake when understanding what is actually known and asked in the question incompletely. The student should have written the number of students studied according to the information in the question, but the student only wrote "Number of students = ", meaning that the student had not finished writing the existing information. When explored in the interview, it was proven that the subject had made the mistake.

P : "Why did you write the information and problems in the question incompletely, especially in the section on writing the number of students? Why is it empty?"

S-2 : "At that time, I was still confused about how to explain it."

P : "When solving a question, do you write known, asked, and answered?"

S-2 : "I usually always write it down, but I'm still confused."

S-2 made a conversion mistake by changing the information into a mathematical model, but made a mistake in filling in the numbers in the Venn diagram without processing it first. This was due to insufficient understanding of the question's objective, so that the set rule was not applied correctly. S-2 also made a mistake in determining the formula; he should have used an example (for example, 'x') to find the number of students who liked both, namely "$(80 - x) + x + (40 - x) + 30 = 135$", but instead wrote "$135 = 80 + 40$". In the interview, S-2 admitted his confusion and only did what he could. This error reflects an insufficient understanding of the concept of sets, which was evident in the interview.

P : "Why is the middle part of the Venn diagram empty?"

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S-2 : "Because yesterday 30 should have been in the middle, but I forgot to write it outside."

P : "If you don't like both of them, is it really in the middle?"

S-2 : "As far as I remember, it's in the middle, Ma'am. But I wrote it outside."

P : "Why did you use that formula to solve the problem?"

S-2 : "That was random; I just added it straight away."

The results of the work also showed that S-2 experienced errors in the process skills stage due to errors when running calculations because at the transformation stage, students do not understand the set to properly solve the problem. It can be seen on the student's worksheet that several times they crossed out or revised the writing, but errors still occurred because they do not understand the set's concept. When explored in the interview, it was proven that the subject had made the error.

P : "Why did you run the calculation procedure like that?"

S-2 : "I was confused about how to write it, and then I got it wrong, so I crossed it out."

P : "How did I get it wrong?"

S-2 : "I was confused; 135 was the number of students, so I wrote 80 + 40. I wanted to continue, but I got even more confused, so I crossed it out."

P : "Why didn't you continue the calculation procedure in your answer?"

S-2 : "Because I was confused, I seemed to have forgotten how to do this concept even though I used to be able to do it."

The error in the final answer writing is because S-2 made an error starting from the transformation stage so that the student has difficulty in writing the answer and final conclusion according to the question. In addition, because the subject was not sure about the results of his work, he decided not to write the conclusion of the final answer even though he usually always does it when solving the question. When explored in the interview, it was proven that the subject had made the error.

P : "Why don't you write the conclusion of the final answer in your answer?"

S-2 : "Usually I write it, ma'am. But this time I don't because I'm not sure about my answer, it's not completely finished, if I want to write it, I'm confused."

For question No. 2, S-2 also makes mistakes in understanding the problem until the final answer writing. Figure 6 shows the results of the student's work.

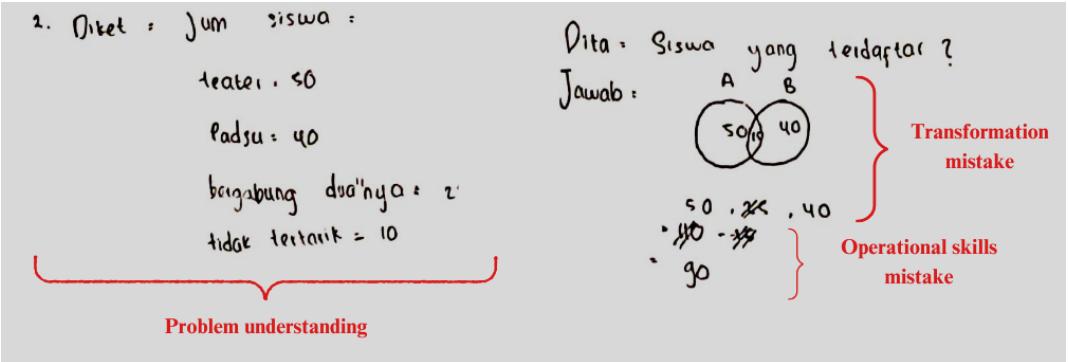

Figure 6. Results of S-2 Work on Question 2

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Figure 6 presents that S-2 also makes a mistake in understanding the problem, namely not fully listing the known and asked information. Ideally, each information point should begin with "Students who join ... = ..." to indicate a set, while writing "Number of students = " is not necessary because this information is not in the question, unlike question No. 1, which lists the total number of students. The interview results also confirmed that the subject made this mistake for the same reason as in question No. 1.

P : "Why did you write the number of students when it is not in the question, and why was it left blank?"

S-2 : "Because I am still confused about how to explain it, plus I was in a hurry when I did it."

S-2 also made a mistake at the transformation stage, namely a mistake in changing or processing information into the correct mathematical model. In his answer, S-2 immediately entered the numbers into the Venn diagram without processing them first. In addition, there was an error in the use of operation signs or formulas, where S-2 wrote "50, 25, 40", then "$= 110 - 15$", and finally "$= 90$", when in fact the correct formula should be "$50 + 40 - 25 + 10 = 75$". This error shows that S-2 does not fully understand the concept of sets, so he again made a mistake in determining the solution formula. The interview results showed that the subject did make an error for the same reason as in question No. 1.

P : "Why do you use that formula to solve the problem?"

S-2 : "That's confusing, so when it comes to determining the formula, it's confusing and complicated."

S-2 made another mistake at the process skills stage due to incorrect calculations, which resulted from insufficient conceptual understanding of sets at the transformation stage. The interview results showed that the cause of this error was the same as question No. 1, proving that S-2 did not understand the concept of sets well. This error also affected the writing of the final answer, where S-2 felt hesitant and chose not to write a conclusion, even though he usually always did.

Based on the analysis of questions 1 and 2, S-2 makes errors in problem understanding, transformation, and operational skills. Mistakes in understanding the problem were caused by incomplete writing of known and asked information. At the transformation stage, S-2 made mistakes in determining the rules and formulas because the student did not understand the question's objective and made mistakes in drawing Venn diagrams. Operational mistakes occurred because the student continued the procedure with the wrong formula due to an insufficient conceptual understanding of sets. As a result, the final answer's writing given is less than accurate, including in writing the conclusion requested by the question.

Subject 3 (S-3)

When completing question No. 1, S-3 students made errors during transformation, errors during operational skills, and errors in the final answer's writing. Figure 7 is the result of S-3 students' work.

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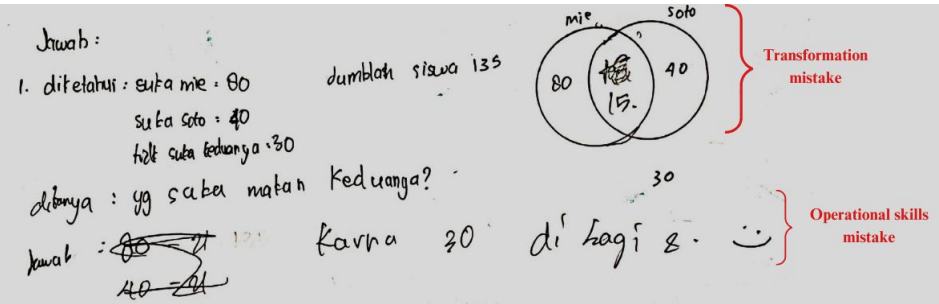

Figure 7. Results of S-3 Work on Question 1

Based on Figure 7, S-3 made a mistake at the transformation stage. Although he could process the information correctly, the error occurred when filling in the numbers in the Venn diagram by directly using the numbers from the question without processing them first. This reflects a lack of understanding of the question and a non-conformity with the rules of the set. S-3 also made a mistake in determining the formula; he should have used an example (for example, 'x') to find the number of students who liked both, which resulted in the equation "$(80 - x) + x + (40 - x) + 30 = 135$". The interview proved this error.

P : "Where did you get 15 from? Why did you divide it by 2?"

S-3 : "Because you don't like both of them, 30 is divided by 2."

P : "In the Venn diagram, it's in the middle if you don't like both?"

S-3 : "No, it should be outside. I panicked when I did it, so it was wrong."

The S-3 work also shows that there is an error in the process skills stage because it continues the solution procedure, but uses the wrong formula because at the transformation stage the student forgets the concept for solving the problem. Errors in the final answer's writing because the student does not provide the answer and final conclusion according to the problem. When explored in the interview, it did prove that the subject had made the error.

P : "Why did you run the calculation procedure like this? Where did 15 come from?"

S-3 : "I asked a friend, he said, 30 was divided by 2."

P : "Aren't you suspicious why it was divided by 2?"

S-3 : "At first I was suspicious, but because time was running out, I immediately wrote it in the middle."

P : "Did you recheck your answer?"

S-3 : "No, because I was afraid the time was running out, so I did it quickly."

In question No. 2, S-3 again made mistakes during transformation, errors during operational skills, and mistakes in the final answer writing. Figure 8 shows the results of S-3's work.

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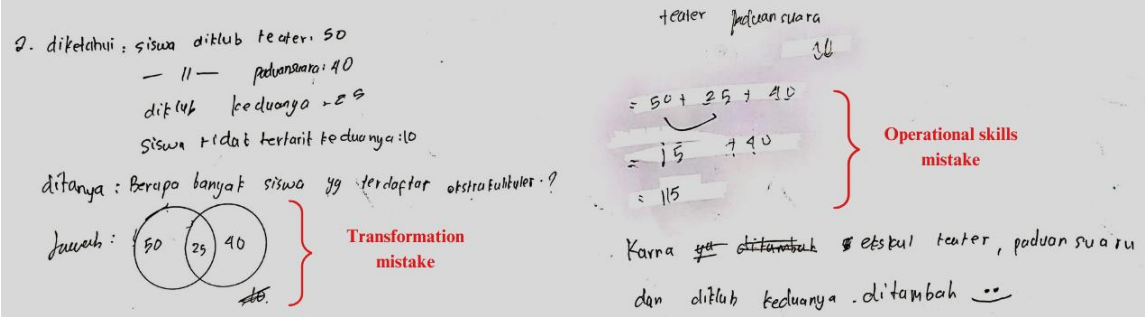

Figure 8. Results of S-3 Work on Question 2

Based on Figure 8, it can be seen that S-3 made a mistake at the transformation stage by directly entering the numbers into the Venn diagram without processing them first. In addition, S-3 made a mistake in using the formula, adding "$50 + 25 + 40 = 115$", when it should be "$50 + 40 - 25 + 10 = 75$". This error shows an insufficient concept understanding of sets.

The work of S-3 also shows errors in the operational skills stage due to errors in calculations caused by forgetting the concept at the transformation stage to solve the problem. Errors in the final answer writing occurred because S-3 made mistakes starting from the transformation stage, so that the writing of the answer and the final conclusion were wrong.

Based on job analysis and interviews on questions 1 and 2, S-3 made a Conversion mistake because he did not understand the purpose of the question, so he did not use the correct set rule. Errors also occurred when drawing Venn diagrams for both questions. In operational skills, S-3 used the wrong formula because he forgot the concept of solving it. In addition, errors in the final answer's writing occurred because he was not careful and did not complete the work properly. The hasty attitude exacerbated these errors, and S-3 did not check before collecting the answers.

Errors based on Newman's procedure that occur when solving a problem consist of five types, including errors when reading, errors when understanding the problem, errors during transforming, errors in operational skills, and errors when writing the final answer. A detailed explanation of each type of error will be presented below.

Reading mistakes are errors that occur when students misread symbols, terms, words, or important information in a question. Based on the results of the work of the S-1 to S-3 subjects, no students experienced reading mistakes. This finding is supported by Delfita, Roza, & Maimunah (2019) and Prakitipong & Nakamura (2006), who state that students' ability to understand problems while reading indicates a sufficient level of reading comprehension. Furthermore, Mursalina et al. (2019) also found that students generally can read the questions correctly, but difficulties arise in the next stages.

S-3 subjects did not experience errors in understanding the problem, while S-1 and S-2 subjects experienced errors in understanding the information they knew and were asked questions incompletely. This error is the result of insufficient accuracy, focus, and understanding of the problem, as well as difficulty in explaining the information. Research by Dewi & Kartini (2021) and Halim & Rasidah (2019) states that students tend to be less trained in clearly presenting the known and requested information in the questions, so that errors often occur in recording important information. Apart from that, students' lack of attention when reading questions

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is also a common cause of errors in understanding problems, according to findings from Darmawan, Kharismawati, Hendriana, & Purwasih (2018). Retnawati & Wulandari (2019) also emphasized that poor reading strategies and limited mathematical literacy contribute to comprehension failures.

All subjects (S-1 to S-3) experienced Conversion mistakes, such as errors in converting information into the correct mathematical model, as well as errors in using or not including operation signs or formulas. The causes include forgetting, being careless, rushing, lack of practice, and not understanding the concept of sets. Research conducted by Sudiono (2017) shows that these errors occur because students collapse in recording or using appropriate methods. In addition, students often make mistakes when drawing Venn diagrams, such as determining inaccurate members of the set (Sundari, Andhany, & Dur, 2019). Similarly, a study by Siskawati, Zaenuri, & Wardono (2021) highlighted that transformation errors often stem from students' tendency to rely on memorization rather than conceptual understanding, especially when using set notation or drawing Venn diagrams.

All subjects (S-1 to S-3) experienced Operational mistakes, such as errors in calculations or computations, and the inability to complete the solution procedure. These errors occur because students fail to understand the problem correctly from the start, are not careful in calculating, and do not master the calculations used. Nurdiawan & Zanthy (2019) stated that these errors are caused by students' inability to carry out transformations correctly. This includes errors in changing mathematical forms or determining the necessary calculation steps, which cause errors in solving problems (Sunardiningsih et al., 2019). According to Triliana & Asih (2019), calculation errors and incomplete procedures usually occur when students are unsure about the previous transformation step, which creates a domino effect in the problem-solving sequence.

Errors in writing final answers occurred in all subjects (S-1 to S-3) and included writing answers and final conclusions that did not match the question requests and did not include the requested final answer. This error was caused by students' insufficient initial understanding of the question, rushing to answer, and not rechecking. This finding is consistent with research by Puspaningrum, Rohaeti, & Maya (2020), stating that students often fail to record final answers according to the question requests and make conclusions without the necessary calculation process. Interviews showed that students rarely rechecked due to time constraints or being in a hurry to complete the question perfectly (Haryati, Suyitno, & Junaedi, 2016). This aligns with the findings of Hadi, Herman, & Hasanah (2018), who reported that many students failed to provide final answers because they either lacked confidence in their process or ran out of time without reviewing their work.

CONCLUSIONS AND SUGGESTIONS

Based on the results and analysis of the study, it indicates that students make mistakes in solving set problems based on the Newman procedure, except at the reading stage. Errors include understanding the problem, transformation, process skills, and writing the final answer, with the most frequent errors occurring from the transformation stage to the final answer. Errors in understanding the problem occur because students misinterpret information that is known and asked incompletely, caused by a lack of accuracy, lack of concentration, and difficulty in analyzing information. At the transformation stage, students write or change information incorrectly into the

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correct mathematical model and make mistakes or forget to use the appropriate operation signs or formulas due to an insufficient concept and practice understanding. Operational mistakes involve incorrect calculations or procedures that are not continued, often due to a lack of understanding from the start and inaccuracy in calculations. Errors in the final answer's writing occur when students do not present the answer according to the question's request, often due to being in a hurry and not rechecking. The main factor causing errors is an insufficient understanding of the concept of sets.

In relation to the findings that students often experience errors in understanding problems, transformations, operational skills, and writing final answers when solving problems, teachers can improve students' understanding and performance with several practical steps. Teachers can train students to read problems carefully, provide sufficient practice for transformation, strengthen students' understanding of process skills, and practice writing final answers. In addition, teachers can apply a differentiation approach, individual assistance according to student needs, and group discussions or online learning forums to help students overcome errors more effectively and deeply. With this approach, it is hoped that students can be better prepared to face various types of problems and improve the quality of their learning. This study has limitations, namely the researcher acts as the main instrument in analyzing students' answers. It is better if, in further research, the researcher involves another expert to analyze the student's result, for example, 1 researcher + 2 experts in mathematics education. This step will make the study more objective in terms of categorizing the students' mistakes.

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