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Analysis of Students' Errors in Solving Algebraic Story Problems Based on Newman's Procedure: A Case Study in Junior High School

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Abstract: This study aims to obtain a description of student errors in solving algebraic form story problems based on Newman's procedure in junior high school. This type of research is descriptive using a qualitative approach. This research uses Newman's error analysis. The subjects of this study were three students, each of whom had high mathematical ability (ST), medium mathematical ability (SS), and low mathematical ability (SR) selected from class VIII W.R Supratman based on the report card value of mathematics class VII odd semester 2023/2024. The results of this study are as follows: Students with high mathematical ability (ST) tend to make mistakes at the reading stage by not reading the problem completely, especially the symbol "Rupiah," and at the writing/notation (encoding) stage by not writing the conclusion and the symbol "Rupiah". Students with moderate mathematics ability (SS) made mistakes at the comprehension stage by not writing and mentioning the question information completely, the transformation stage by making an incorrect mathematical model, and the writing/notation (encoding) stage by not writing the "Rupiah" symbol. Students with low mathematics ability (SR) made mistakes at almost all stages: reading by not mentioning the Rupiah symbol and not reading the complete problem, comprehension by not writing and mentioning the problem information completely, transformation by making an incorrect mathematical model, process skills with calculation errors, and writing/notation (encoding) by not writing the Rupiah symbol and the correct conclusion. This research shows the importance of understanding the problem thoroughly, making the right mathematical model, and writing complete notations and conclusions in solving mathematical problems, the results of this study are expected to contribute to the improvement of the mathematics learning process, both from the teacher and student side, so as to improve students' mathematical problem solving skills, especially in the material of algebraic form story problems.

Keywords: problem solving errors, math skills, algebraic story problems, newman procedure.

▪ INTRODUCTION

Education is very important in life. Education occurs since a person is born and continues to develop along with the times (Sari, et al., 2019) . Mathematics is one of the subjects in elementary school, junior high school and senior high school education (Nabila, 2021). Mathematics helps develop logical thinking, problem solving, and analysis skills. In addition, mathematics is also the basis for many other disciplines. One of the mathematical materials studied in Junior High School (SMP) is algebraic material. Algebraic operations are mathematical materials that can be applied in everyday life (Mauliandri & Kartini, 2020). Therefore, it is important for students to master and understand the concept of algebraic operations so that they have no difficulty in applying algebraic material in math lessons and in everyday life. Algebra itself is actually one of the difficult materials to understand and teach (Marisa, et al., 2020). Moreover, if the form of the problem given is in the form of a story problem. This is in accordance with the opinion of Asmaliyah, et al., (2023) students' ability to master math lessons, especially story problems, is a problem that often occurs. The low mathematical ability of students

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can be seen from students' mastery of the material taught. Mastery of the material can be seen or measured by giving questions. According to Gerhani, et al. (2019) , there are individuals who are classified as having high math ability, moderate math ability and low math ability. Thus, the mistakes made by each individual in solving math problems also vary.

According to Kamarullah in Sudjanta, et al., (2024) error is a form of deviation or misalignment from the actual thing, so if there is a misalignment of student answers in solving math problems, it means that the student has made a mistake. According to Tsaqifah (2020) , students' understanding of mathematics can be known through the results obtained by students in working on problems or solving math problems. This is in accordance with the error procedure compiled by Newman, namely (1) reading errors; (2) comprehension errors; (3) transformation errors; (4) process skill errors; and (5) encoding errors (Fitriatien, 2019) .

Based on observations made by researchers at the Madani Integrated Model State Junior High School, some information was obtained from one of the mathematics teachers who taught in class VII Hasan Bahasuan that many students had difficulty when working on algebraic form story problems. Some of the difficulties encountered include changing or different variables between the example and the problem given, unknown quantities with variables and modeling the story problem into algebraic form. This research makes a significant contribution in the effort to improve students' understanding of algebra and their ability to solve math story problems. By understanding student errors and their causes, teachers can design more effective learning and ultimately improve student learning outcomes.

Several previous studies have examined the analysis of errors with the Newman procedure. Some of them are Analysis of Student Errors in Solving Class V Mathematics Story Problems at SDN Ronggo 03 Jaken District by Fitry, et al., (2022), Errors in Solving Story Problems Based on Newman's Theory in View of Computational Thinking by Fatmawati & Nasution, (2024), Analysis of Student Errors According to Newman's Theory in Solving Story Problems on Pythagorean Theorem Material in Class VIII by Rian, et al., (2024). The above studies show that error analysis with Newman's procedure is still very relevant in the context of education because it can help identify the types of errors made by students in solving problems, understand the causes of errors based on students' cognitive styles, design more effective learning to overcome student errors.

Class VII Hasan Bahasuan consisting of 32 students still have difficulty determining a quantity from the variables given, when students are given examples using the variables x and y , they can answer, but when given the same problem but the variables are changed to a and b, some students have difficulty and are confused to answer the question. For example, "The letter x is used as a variable that expresses the number of cubes in a paper bag. If the Algebraic form 4x+5 is made in the form of the most appropriate picture is?". In this example there are students who answer incorrectly because they are confused by the value or quantity represented by the variable x in the problem. With some difficulties experienced by these students, of course, they could have made several types of errors in solving the algebraic form story problems. Errors can be identified by analyzing the results of problem solving from students (Tsaqifah, 2020). Story problems tend to be more difficult to solve because they have to model problems in story problems into mathematical models. This is supported by the opinion of Pellokila,

et al. (2020) student difficulties in solving story problems are students' difficulties in understanding the story, determining the existing quantities and their relationships so that a mathematical model is obtained and solving the mathematical model mathematically. This research explicitly describes how high, medium, and low ability students' errors in class VIII of Madani Integrated State Junior High School in solving algebraic story problems. This needs to be reviewed more deeply so that teachers can design more appropriate learning strategies, so that the mistakes made by students can be reduced in solving math problems, especially in solving algebraic form story problems.

▪ METHOD

Research Design and Procedures

This research uses a type of qualitative research with a descriptive approach. This research uses qualitative research methods because it will explore naturally and more deeply about student errors in solving algebraic form story problems. The research used a descriptive approach to describe the analysis of errors in understanding the problem, errors in developing plans, errors in completing plans, and errors in checking back made by class VIII students of SMP Negeri Madani Integrated Model in solving algebraic form story problems. This study aims to describe the errors of high, medium, and low ability students in class VIII of Madani Integrated State Junior High School in solving algebraic form story problems.

This research was conducted for one month starting with the observation stage, namely the selection of research subjects based on mathematics ability obtained from the calculation of ability with standard deviation, after obtaining the research subject, then giving a test of algebraic form story problems, after completing the test, entering the interview stage, the research subjects were interviewed one by one about what they did, after conducting the interview, the researcher analyzed the research data.

Participants

This research was conducted in class VIII WR Supratman of SMP Negeri Terpadu Madani Palu. Class VIII at Madani Integrated State Junior High School consists of 5 classes, namely class VIII WR Supratman, class VIII Suratin, class VIII Ki Hajar Dewantara, class VIII Gajah Mada, and class VIII Raden Saleh. One of these classes was chosen as the class to be used for the research subject, namely class VIII WR Supratman which consisted of 32 students. The researcher chose the class because the class has students who get lower report card scores than students in other classes and have received algebraic form story problem material.

The subjects of this study were 3 students of class VIII WR Supratman Madani Integrated State Junior High School who were categorized as high, medium and low mathematics ability respectively. The categories of high, medium and low mathematics ability will be seen from the results of the calculation of students' report cards in the odd semester of the 2023/2024 school year. Based on the results of the calculation of ability with standard deviation according to Arikunto, (2012) then the subjects of high, medium and low math ability can be seen in Table 1 below.

Table 1. Grouping of students based on report card grades of mathematics subjects class VII odd semester

Math Skills	Number of Students	Score Range
High	3	83.06 – 100
Medium	28	76.94 – 83.05
Low	1	0 – 76.93

The selection of subjects with different mathematical abilities aims to illustrate the completion of algebraic story problems obtained from all categories of students with high, medium, and low mathematical abilities. Based on Table 4.1 above, from 3 high ability students, researchers chose 1 person with the highest score. Then for medium ability students, the researcher asked for advice and recommendations from the mathematics teacher to choose 1 of the 27 medium ability students with the consideration that the student could communicate well, had learned the subject matter of algebraic forms, and was willing to be a research subject. There was only one low ability student, so the researcher automatically chose that person as the research subject.

The following is a list of high, medium, and low ability subjects and coding in this study presented in Table 4.2.

Table 2. Research subjects

Student Initials	Code	Math Skills
HCS	ST	High
ACP	SS	Medium
MR	SR	Low

Instrument

The instruments used in this study consisted of main instruments and supporting instruments. The main instrument in this research is the researcher himself. The supporting instrument used in this research is a validated test sheet containing algebraic form story problems. The algebraic form story problem used consists of one number with 4 parts of the problem (a, b, c, and d) taken from the seventh grade semester exam question in the 2023/2024 school year. Interviews in this study did not use interview guidelines (unstructured interviews). The interview process was carried out in the odd semester of 2024/2025 after students completed the algebraic form story problems at Madani Integrated State Junior High School. Checking the quality of the research results using data credibility. Testing the credibility of data or trust in the data from this research is the extension of observation and involvement with the subject, discussion with peers, and membercheck with the subject. The following Figure 1. is a written test in the form of algebraic form story problems adapted from the final semester exam questions that researchers get from the VII grade mathematics teacher at Madani Integrated State Junior High School. Then the question was changed by the researcher to make it even more difficult and had been validated by the validator lecturer.

Sandy and his family went on vacation to the night market in Tondo. They consisted of 4 children and 3 adults. Everyone has to buy a ticket to enter the night market. Tickets are divided into 2 types, namely children's tickets and tickets for adults. The unit price of the children's ticket is Rp10,000, while the unit price of the adult ticket is Rp15,000. In addition to the entrance tickets, Sandy and his family also wanted to buy some food and try some rides. The price of food is Rp15,000.00 per serving and each person buys 3 servings. Each game requires an additional ticket of Rp10,000.00 per person. Each person tries 3 types of games, so calculate:
a. What is the total price of admission that Sandy and his family need to pay?
b. How much food did Sandy and his family buy in total?
c. How much was the total ticket price for the games that Sandy and his family tried?
d. How much money did Sandy and his family spend in total?

Figure 1. Story problem of algebraic form

Data Analysis

The data analysis technique used in this research is a qualitative data analysis technique as stated by Miles, et al. (2014), namely data condensation, presenting data (data display) and drawing conclusions and verification. Data condensation refers to the process of summarizing, selecting, focusing, simplifying, abstracting, and or transforming data that approaches the entire section of written field notes, interview transcripts, documents, and other empirical materials. In this study, data condensation was carried out to summarize all data obtained from interviews, documentation results, and work on student answer buckets and focus on the main things according to the data under study. Data presentation is an organization, a collection of information that allows conclusions and actions to be drawn. Presentation of data helps in understanding what is happening and to do something, the intention of deeper data analysis or taking action based on understanding. Conclusions are drawn after data condensation and data presentation. Conclusions can be drawn if the data about solving story problems in algebraic form based on the mathematical abilities presented are credible. In this study, the data presented are data about solving algebraic story problems in the form of test results and interviews that have been condensed. In the data display section, the written test data and interview results of each subject are presented based on Newman's indicators. The following are Newman's error indicators in Table 3.

Table 3. Newman's error indicators

Stages in Newman's Error Analysis	Error Indicator
Reading	1. Students are unable to read the symbols in the problem 2. Students are unable to interpret the meaning of each word, term or symbol in the problem 3. Less thorough
Comprehention	1. Students are not able to understand what is known completely 2. Students are not able to understand what is asked completely
Transformation	1. Students are unable to create mathematical models from the information presented 2. Students transform the information contained in the problem into a mathematical model but inaccurately

Process Skill	1. Error in computation 2. Students are unable to perform procedures or steps that will be used to solve the problem 3. Careless in the calculation process
Encoding	1. Writing notation (negative sign, symbol, equal sign, etc.) incorrectly 2. Did not write variables/units 3. Incorrect use of units 4. Students do not write the conclusion

Source: (Adapted from Dewi & Kartini, 2021)

▪ RESULT AND DISSCUSSION

The findings show a description of high mathematics ability students, medium mathematics ability students, and low mathematics ability students in solving algebraic story problems based on Newman's error procedure (Newman's Error Analysis), namely reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors.

Reading

At the reading stage, the ST subject did not read the problem completely, namely not reading the symbol "Rupiah" in the problem. The following is an interview excerpt related to this.

Table 4. Interview with subject ST regarding reading errors

	Dialog
P-03	Can you read the questions?
ST-03	(read the questions)
P-04	There is a Rupiah symbol in this question, why didn't you mention it when reading the question earlier?
ST-04	Sorry sis, I read it in a hurry so I didn't mention the word Rupiah again
P-05	Oh yes deck, usually when you read problems that have the symbol Rp (Rupiah), do you rarely mention it?
ST-05	Yes, rarely, because I don't think it's important, the important thing is that we know the price.

Based on the interview above, subject ST did not mention the word "Rupiah" (ST-03) when reading the problem because according to subject ST it was not important (ST-05) and also in a hurry when reading the problem (ST-04). At the reading stage, subject SS did not experience any reading errors. Subject SS was able to read the symbols in the problem and was careful in reading the problem. The following are interview excerpts related to this.

Table 5

	Dialog
P-03	Can you read the questions first?
SS-03	(read the questions)

P-04	Okay, now try to briefly retell what you think about this problem
SS-04	So, a family went to the night market in Tondo. They had to buy entrance tickets, food, and tickets to play

Based on the interview above, subject SS could read the problem well and correctly (SS-03), read the symbol "Rupiah", and even able to briefly retell the problem (SS-04). At the reading stage, the SR subject made a reading error, namely not mentioning the Rupiah currency symbol when reading the unit price. The following are interview excerpts related to this.

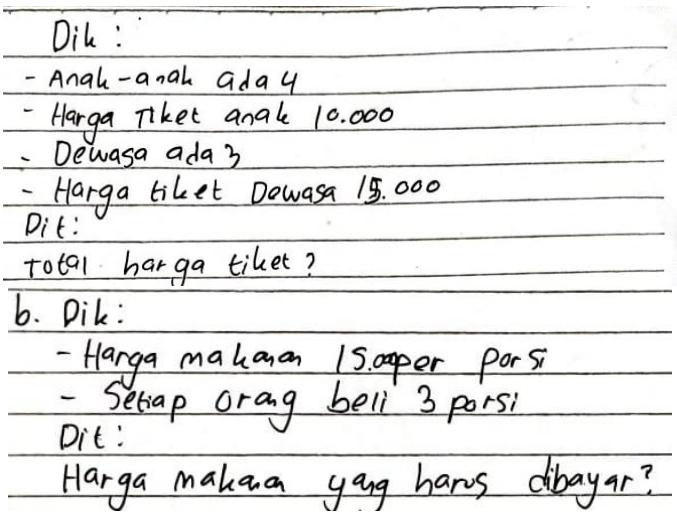
Table 6. SR subject interview related to reading errors

	Dialog
P-03	Oke, can you read the questions first?
SR-03	(read the questions)
P-04	Okay, why don't you read the word "Rupiah"?
SR-04	I don't know, i only see the numbers

Based on the interview above, SR subject did not read the problem completely, namely not reading the symbol "Rupiah" because he only saw the number or price when reading the problem (SR-04). Not reading the problem completely is a reading error because students do not read the problem as a whole. This can cause missing information needed to solve the problem. In addition, not reading the problem completely can cause misunderstandings in working on the problem. This is in accordance with the opinion of Annisa & Kartini, (2021) that in reading errors students still experience errors in interpreting sentences correctly, errors in finding keywords in problems and errors in reading information and mathematical symbols in problems completely.

Comprehention

At the comprehention stage, ST subject wrote down what was known and asked from each part of the problem to solve the problem. Figure 2. below shows the answer of ST subject at the comprehension stage.



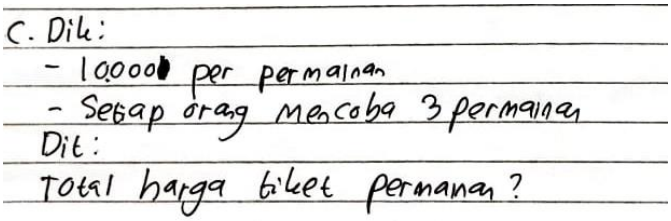


Figure 2. Subject ST's answer at the comprehention stage

Based on the answers of ST subject above, at the comprehention stage, ST subject is able to understand the test given well, ST subject can mention and write what is known and asked completely. The following is an interview excerpt related to this.

Table 7. ST Subject Interview related to comprehention error

	Dialog
P-10	Okay, after you read the problem, what do you think is known from the problem?
ST-10	So, what is known from the question is that there are 4 children, the ticket price for children is 10,000, there are 3 adults, the ticket price for adults is 15,000, then the price of food is 15,000 / portion, then each person buys 3 portions, then 10,000 / game, each person tries three games
P-11	Is there anything else that needs to be considered?
ST-11	There are kak, there are 7 people in total kak, it is important to pay attention to counting food and games.
P-12	Okay, after you know what is known from the problem, then what are all the questions?
ST-12	It asks about the total price of admission that Sandy and her family need to pay, then the total price of food that Sandy and her family buy, then the total price of game tickets that Sandy and her family try, then the total money that Sandy and her family use from the total price of admission, total price of food, and total game tickets.

Based on the interview above, the ST subject can mention all the known information (ST-10, ST-11) and the information asked (ST-12) from the problem. Figure 3. below displays the SS subject's answer at the comprehention stage.

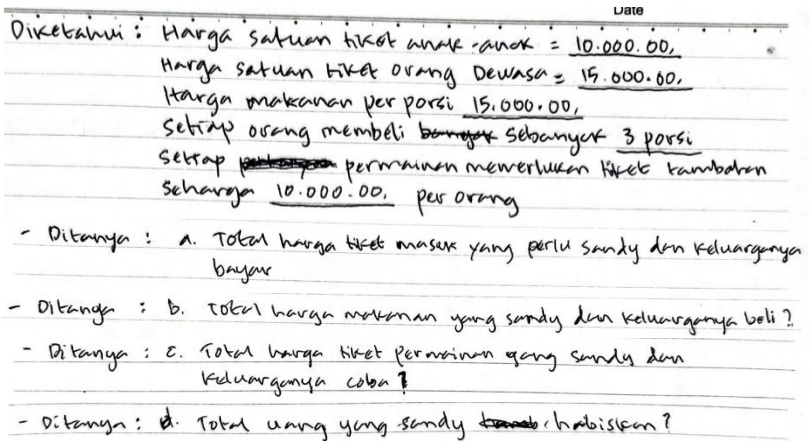


Figure 3. Subject SS's answers at the comprehention stage

Based on the answer of subject SS above, at the comprehention stage, subject SS did not mention all the information known in the problem completely, namely not mentioning the number of adults and the number of children and not mentioning the number of rides each person tried. The following are excerpts of interviews related to this.

Table 8. Interview of subject SS related to comprehention error

	Dialog
P-05	Oh yes, what do you think is known from the question?
SS-05	The unit price of children's tickets is 10,000, if the unit price of adult tickets is 15,000, the price of food per serving is 15,000, each person buys as many as 3 servings, each game requires an additional ticket for 10,000 per person.
P-06	Is that all you know?
SS-06	Yes, sis
P-07	There is still a deck, why don't you also mention the number of children and the number of adults, then the number of rides that each person tries is also not mentioned.
SS-07	Gosh yes sis, I think the important thing is just the prices, so I don't mention everything else.

Based on the interview above, the SS subject did not mention all the known information from the question, namely not mentioning the number of children and adults as well as the number of rides that each person tried because he felt it was not important to mention (SS-07). Figure 4. below displays the SR subject's answer at the comprehention stage.

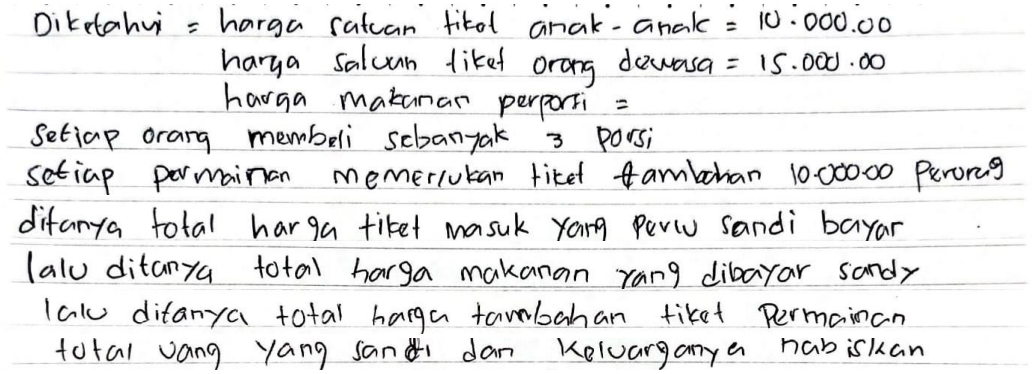


Figure 4. Subject SR's answers at the comprehention stage

Based on the SR subject's answer above, at the comprehension stage, the SR subject did not mention all the information known in the problem completely, namely not mentioning the number of adults and the number of children, not writing the price of food per serving, and not mentioning the number of rides that each person tried. The following are excerpts of interviews related to this.

Table 9. SR Subject interview related to understanding error

	Dialog
P-05	From the question you read, what do you think is known from the question?
SR-05	So what is known is that the unit price of children's tickets is 10,000, the unit price of adult tickets is 15,000, the price of food per portion is 15,000, each person buys 3 servings, each game requires an additional ticket of 10,000 per person.
P-06	Is that all?
SR-06	Yes, sis
P-07	There is still a deck, why don't you mention the number of people and the number of rides each person tried?
SR-07	Uh yes sis there is, I forgot sis
P-08	So why did you not write the price per serving in your answer?
SR-08	Gosh yes, i forgot

Based on the interview above, SR subject did not mention and write down everything known from the problem (SR-05) because he forgot (SR-07, SR-08). Comprehension errors occur when students are unable to understand what is known and asked completely. This is in accordance with the opinion of Dewi & Kartini, (2021) that one of the causes of comprehention errors is because students cannot mention what is known completely from the problem.

Tranformation

At the transformation stage, ST subject could not change the information contained in the problem into an algebraic mathematical model. Figure 5. below displays the answer of ST subject at the transformation stage.

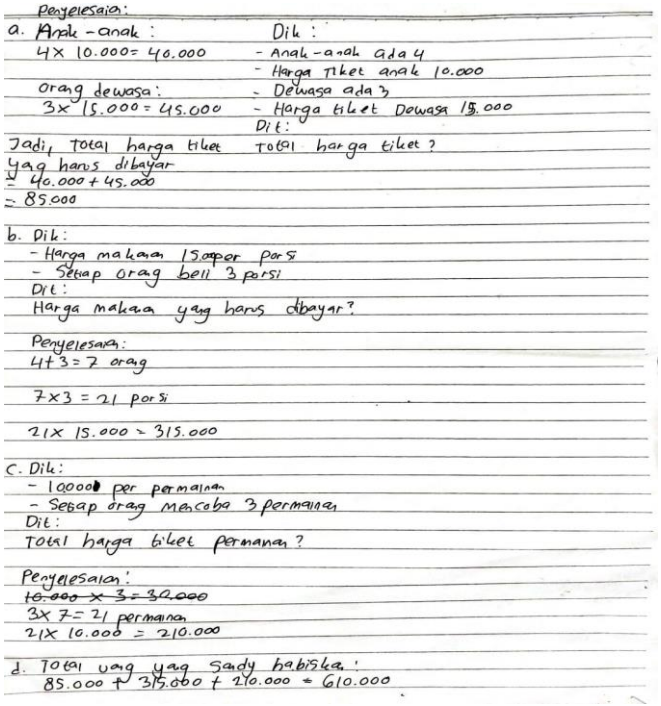


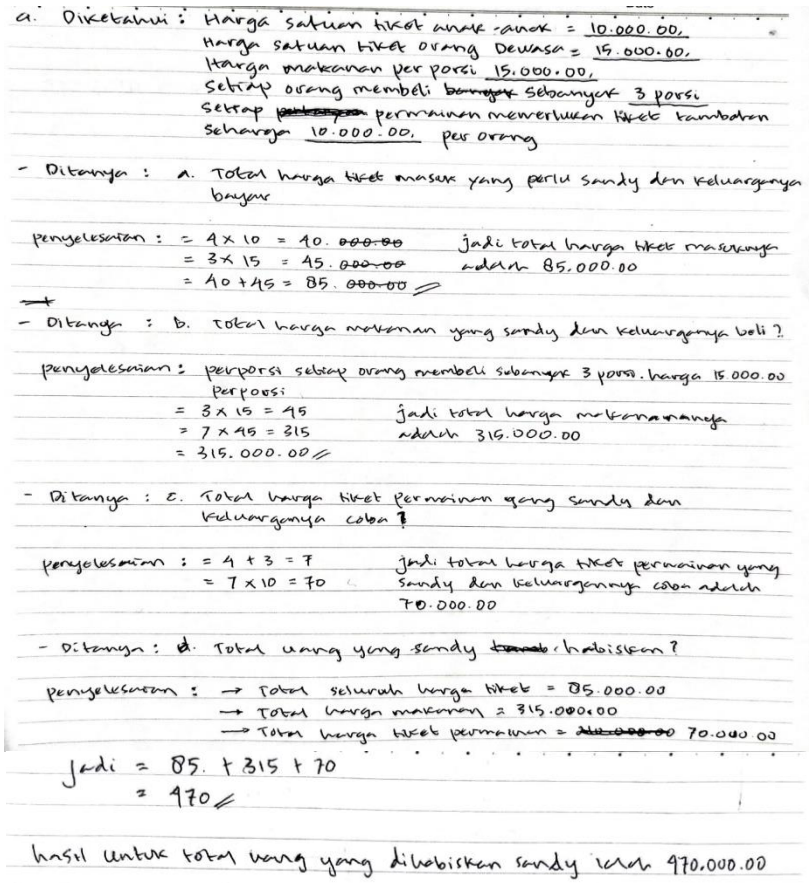
Figure 5. Subject ST's answer at the transformation stage

Based on the ST subject's answer above, it can be seen that the ST subject did not change the story problem into an algebraic mathematical model. Subject ST only modeled it in ordinary mathematical models without algebraic elements such as$x$, y, z and so on. The following is an interview excerpt related to this.

Table 10. ST subject interview related to transformation error

	Dialog
P-36	From problem parts (a) to (d), do you think you can use algebraic variables like$a$, b, c, x, y , why?
ST-36	Hmm I don't know how to generalize kak, it's faster to do it directly like this

Based on the interview above, it is known that the ST subject cannot transform the information in the problem into a mathematical model, namely the algebraic form from the answer to part (a) to the answer to part (d) because he does not know how to generalize (ST-36). Figure 6. below displays the answer of the SS subject at the transformation stage.


a. Diketahui : Harga satuan tiket anak-anak = 10.000.00,
Harga satuan tiket orang Dewasa = 15.000.00,
Harga makanan per porsi 15.000.00,
Setiap orang membeli ~~berapa~~ sebanyak 3 porsi
Setiap ~~[illegible]~~ permainan memerlukan tiket tambahan
seharga 10.000.00, per orang

- Ditanya : a. Total harga tiket masuk yang perlu sandy dan keluarganya bayar

penyelesaian : = 4 x 10 = 40.000.00 jadi total harga tiket masuknya
= 3 x 15 = 45.000.00 adalah 85.000.00
= 40 + 45 = 85.000.00

- Ditanya : b. Total harga makanan yang sandy dan keluarganya beli ?

penyelesaian : perporsi setiap orang membeli sebanyak 3 porsi. harga 15.000.00 perporsi
= 3 x 15 = 45 jadi total harga makanannya
= 7 x 45 = 315 adalah 315.000.00
= 315.000.00

- Ditanya : c. Total harga tiket permainan yang sandy dan keluarganya coba ?

penyelesaian : = 4 + 3 = 7 jadi total harga tiket permainan yang
= 7 x 10 = 70 sandy dan keluarganya coba adalah
70.000.00

- Ditanya : d. Total uang yang sandy ~~[illegible]~~ habiskan ?

penyelesaian : → Total seluruh harga tiket = 85.000.00
→ Total harga makanan = 315.000.00
→ Total harga tiket permainan = ~~[illegible]~~ 70.000.00

Jadi = 85 + 315 + 70
= 470

hasil untuk total uang yang dihabiskan sandy ialah 470.000.00

Figure 6. Subject SS's answer at the *transformation* stage

Based on the answer of subject SS above, at the transformation stage, subject SS can make a mathematical model but it is not correct because it does not include all the necessary information. In addition, the SS subject also did not make a mathematical model by including algebraic elements such as$x$, y, z, a, b, and so on.

Table 11. SS Subject Interview related to transformation error

	Dialog
P-41	Why don't you use variables in the solution, for examplex, y, z, a, b , etc.?
ST-41	I don't know sis, I usually do it in the usual way.
P-42	But have you ever not generalized before? When learning algebra material before
SS-42	I have but I have forgotten

Based transform the information in the problem into a mathematical model, namely the algebraic form from the answer to part (a) to the answer to part (d) because he forgot how to generalize (SS-42). Figure 7. below displays the answer of the SR subject at the transformation stage.

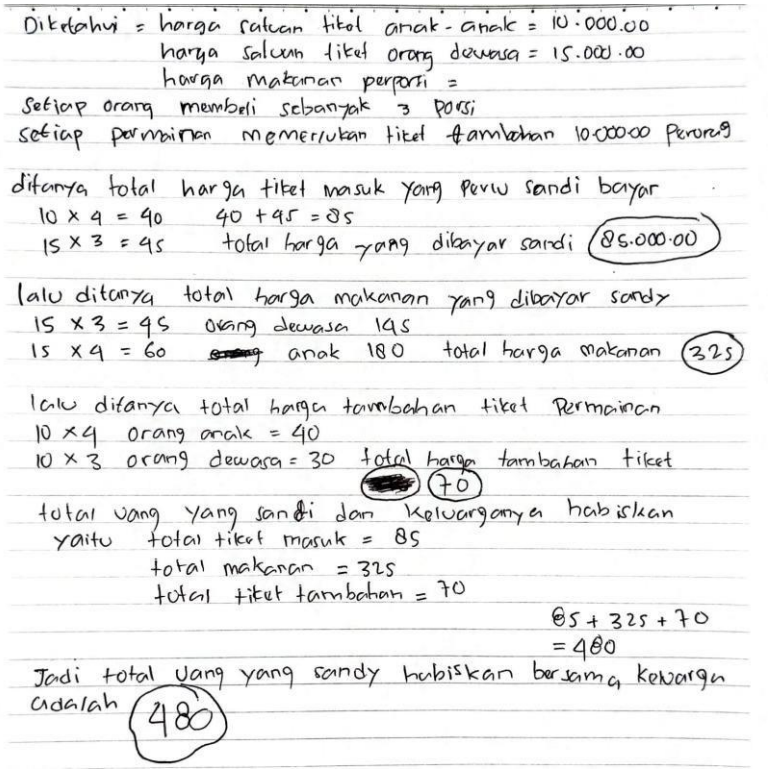


Figure 7. Subject SS's answer in the *transformation* stage

Based on the SR subject's answer above, at the transformation stage, the SR subject made a mistake in making a mathematical model of the information given in the problem. SR subject did not model the story problem by including algebraic elements such as$x$, y, z, a, b, and so on. The following are interview excerpts related to this.

Table 12. SR subject interview related to transformation error

	Dialog
P-36	Why don't you use variable memorization when doing problems, for example$x$, y, z, a, b, etc?
SR-36	I don't know how to use those letters, I'm confused.

Based on the interview above, it is known that the SR subject could not transform the information in the problem into a mathematical model, namely the algebraic form from the answer to part (a) to the answer to part (d) because he did not know and was confused about how to generalize (SS-36). Transformation errors occur when students are unable to make mathematical models from the information presented and students change the information contained in the problem into a mathematical model but inaccurately. This is in accordance with the opinion of Rofi'ah, et al. (2024)) that transformation errors that students often make are including incorrectly converting the information received into a mathematical model, incorrectly determining the equation, and student failure in determining the steps to be followed in the correct solution operation.

Process Skills

At the process skill stage, ST subject did not make mistakes in computation, was not careless in the calculation process, but did not perform the procedures or steps that would be used to solve the problem. Figure 8. below displays subject ST's answer at the process skill stage.

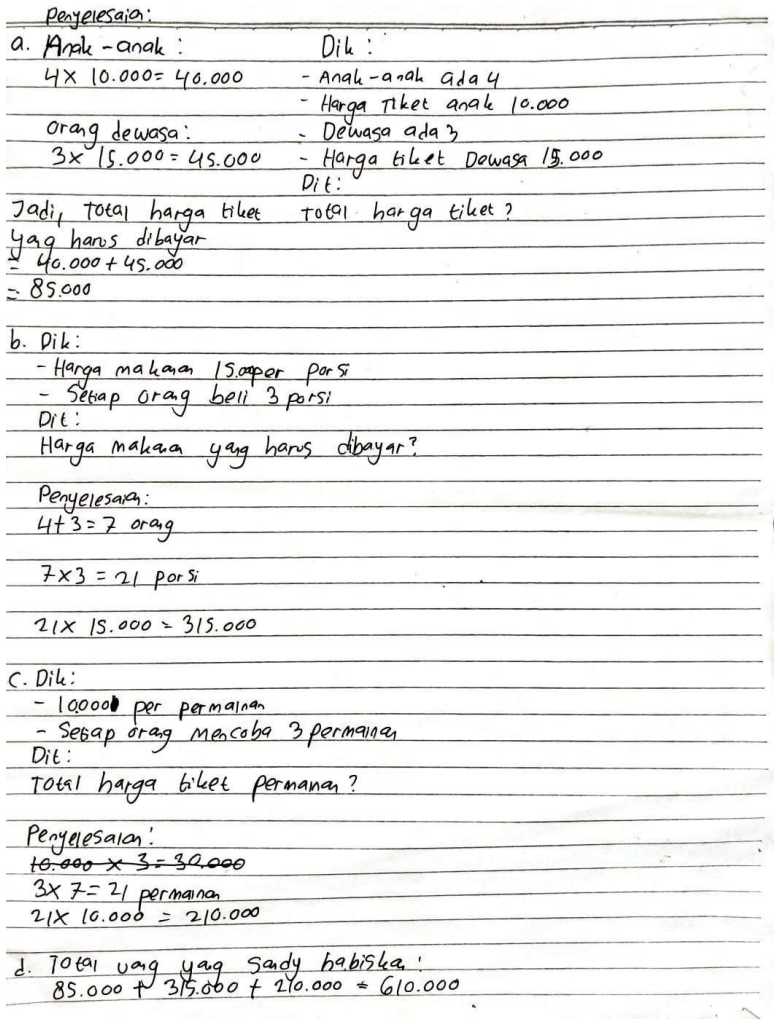

Penyelesaian:
a. Anak-anak : 4x 10.000 = 40.000
Orang dewasa: 3x 15.000 = 45.000
Jadi, Total harga tiket yag harus dibayar = 40.000 + 45.000 = 85.000
Dik : - Anak-anak ada 4 - Harga Tiket anak 10.000 - Dewasa ada 3 - Harga tiket Dewasa 15.000
Dit: Total harga tiket ?
b. Dik: - Harga makanan 15.000 per porsi - Setiap orag beli 3 porsi
Dit: Harga makana yang harus dibayar?
Penyelesaian: 4+3=7 orag
7x3 = 21 porsi
21x 15.000 = 315.000
c. Dik: - 10.000 per permainan - Setiap orag mencoba 3 permainan
Dit: Total harga tiket permanan?
Penyelesaian: ~~10.000 x 3 = 30.000~~ 3x 7 = 21 permainan
21x 10.000 = 210.000
d. Total uang yang Sandy habiskan: 85.000 + 315.000 + 210.000 = 610.000

Figure 8. Subject ST's answer on the *process skill* stage

Based on the written test results above, subject ST can perform the calculation correctly according to the formula that subject ST used. But from the answer to part (a) to the answer to part (d), subject ST did not perform the procedures or steps that subject ST would use in solving the problem because subject ST did not model the story problem into algebraic form. Subject ST only used the procedures or steps to solve the problem according to the formula that subject ST made, which is a formula without algebraic elements in it. Figure 9. below displays the answer of subject SS at the process skill stage.

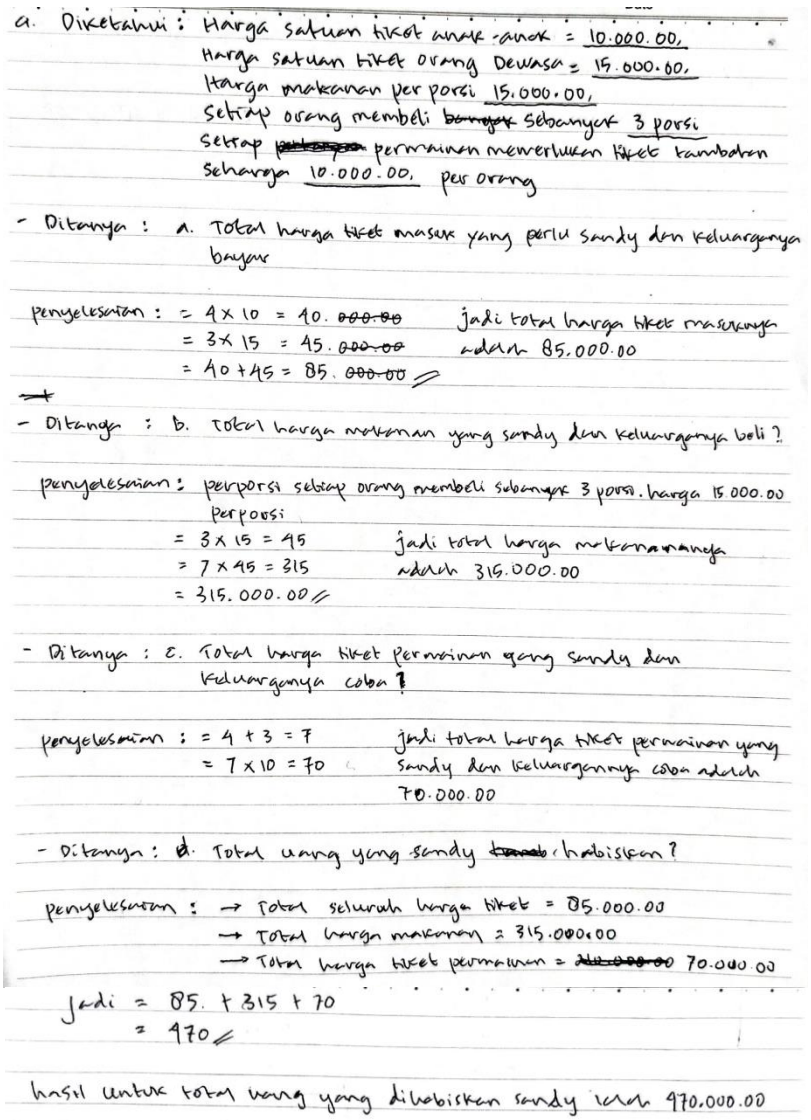


Figure 9. Subject SS's answer on the *process* skill stage

At the process skill stage, subject SS did not make mistakes in computation and was not careless in the calculation process but did not perform the procedures or steps that would be used to solve the problem because subject SS did not make a mathematical model in algebraic form, so no procedures or completion steps were performed. Apart from the wrong formula that subject SS used in part (c), subject SS did not make mistakes

in the calculation process. Figure 10. below displays the SR subject's answer at the process skill stage.

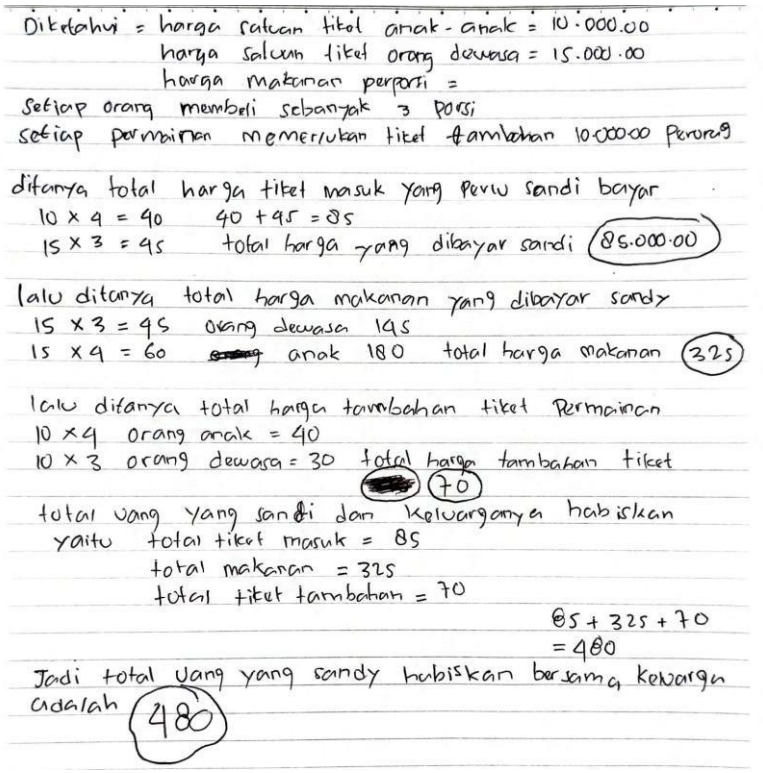


Figure 10. Subject SR's answer on the *process skill* stage

At the process skill stage, the SR subject made a calculation error, namely in question part (b), the total price of food should be Rp315,000, but the SR subject wrote the total price of adult food is 145 which should be 135 the result of multiplication45 × 3 = 135 . This made an error in the total price of food and the total money Sandy and her family spent. In addition, the SR subject did not perform the procedures or steps to solve the problem because the SR subject did not make a mathematical model by entering the algebraic retreat into it. The following is an interview related to the calculation error above.

Table 13: SR subject interview related to process skill errors

	Dialog
P-22	Okay-okay, I want to ask again how do you get 45, then get 60, then 145, then get 180, then get 325, how do you calculate it?
SR-22	I multiply as usual $\frac{15\times}{3}$ then 45 i multiply by 3 again, so the result is 145 for an adults, next $\frac{15\times}{4}$ this 60 I multiply by 3 again, so the result is 180, it's for the children, then 145 i add with 180 so the result is 325

Based on the interview above, the SR subject experienced a calculation error where the result of 45 × 3 = 135 but the SR subject answered 45 × 3 = 145 (SR-22), this made

an error in the final result of the problem part (b) and part (d). Process skill errors occur when computation is wrong, unable to perform procedures or steps that will be used to solve problems, and careless in the calculation process. This is in accordance with the opinion of Mirawati, et al. (2024)) that process skill errors are students unable to carry out the procedures or steps used correctly, and students are unable to carry out the calculation process correctly.

Encoding

In the writing/notation (encoding) stage, ST subject made a mistake, namely not writing conclusions on each problem. The following is an interview excerpt for question part (a).

Table 14. ST subject interview related to writing/notation errors

	Dialog
P-19	Why didn't you write the conclusion sentence of part (a)?
ST-19	I forgot sis, I guess you can't write the conclusion sis

Table 15. ST subject interview related to writing/notation errors

	Dialog
P-25	Why don't you also write the conclusion sentence in part (b)?
ST-25	I forgot too sis

The following is an interview excerpt for question part (b).

Table 16. ST subject interview related to writing/notation errors

	Dialog
P-32	Then here you don't write the conclusion sentence again, why?
ST-32	Yes sis I forgot too

The following is an interview excerpt for question part (c)

Table 17. ST subject interview related to writing/notation errors

	Dialog
P-35	So the total is 610,000, right? Then here you don't write the conclusion again
ST-35	Yes, I forgot to write the conclusion but the result was $Rp610.000$

The following is an interview excerpt for question part (d)

Based on the interview above, the ST subject did not write the conclusion in each part of the problem (a), (b), (c), and (d) because he forgot and thought it was okay if it was not written. At the writing/notation (encoding) stage, the SS subject has written the conclusion in each answer (a), (b), (c), and (d) even though there is a shortcoming, namely not writing the Rupiah currency symbol in the conclusion. The following is an excerpt of the interview for part (a).

Table 18. SS subject interview related to writing/notation errors

	Dialog
P-20	In this conclusion, why didn't you write the symbol "Rupiah"?
SS-20	I don't know, I usually just write it down

Table 19. SS Subject Interview related to writing/notation errors

	Dialog
P-28	Oh I see, then why don't you use the "Rupiah" symbol anymore?
SS-28	Not only sis, like the conclusion of part (a) earlier

The following is the interview excerpt for part (b)

Table 20. SS subject interview related to writing/notation errors

	Dialog
P-35	In the conclusion, you wrote 70,000 not using "Rupiah" anymore.
SS-35	Yes, I forgot to write.

The following is the interview excerpt for part (c)

Table 21. SS subject interview related to writing/notation errors

	Dialog
P-43	Why don't you use "Rupiah" in the conclusion?
SS-35	Yes, I forgot too.

The following is the interview excerpt for part (d)

Based on the interview above, subject SS forgot to write the symbol "Rupiah" in the conclusion (a), (b), (c), and (d) because of the habit of subject SS not writing "Rupiah" (SS-20) and because subject SS forgot (SS-35, SS-43). At the writing/notation (*encoding*) stage, the SR subject made a mistake, namely not separating the answers for each question part (a), (b), (c), and part (d) and not writing the conclusion correctly.

Table 22: SR subject interview related to writing/notation errors

	Dialog
P-18	In the conclusion, why doesn't the 85,000 not use the "Rupiah" symbol?
SR-18	I forgot sis, in a hurry ba write it

The following is an interview excerpt for question part (a)

Table 23: SR Subject Interview related to writing/notation errors

	Dialog
P-24	Ohh yes deck, but why in the conclusion did you only write 325 and then the "Rupiah" symbol too?
SR-24	I was in a hurry so I didn't write thousands and "Rupiah" again.

The following is an interview excerpt for question part (b)

Table 24: SR Subject Interview related to writing/notation errors

	Dialog
P-30	Why did you only write 70 in the conclusion and not the "Rupiah" symbol?
SR-30	Yes, I wrote it quickly so I didn't have time to write the thousands and "Rupiah".

The following is an interview excerpt for question part (c)

Table 25: SR subject interview related to writing/notation errors

	Dialog
P-35	Why did you only write 480 in the conclusion?
SR-35	I'm in a hurry too sir.

The following is an interview excerpt for question part (d)

From the interview excerpts above, it can be seen that the SR subject repeatedly forgot to write the symbol "Rupiah" and thousand units ".000" in his conclusion in all parts of the problem (a, b, c, and d). The reason given was because he was in a hurry (SR-18, SR-24, SR-30, SR-35). Writing/notation errors (encoding) occur when writing notations (negative signs, symbols, equal signs, etc.) inappropriately, not writing variables/units, incorrect use of units, students do not write conclusions. This is in accordance with the opinion of Ramadoni & Shakinah (2023) , that the error in writing answers is due to not making a conclusion, inaccurate in making conclusions and incomplete in making conclusions.

Based on Table 3. about the indicators of student errors based on the Newman procedure, the following are the number of errors that subjects ST, SS, and SR made.

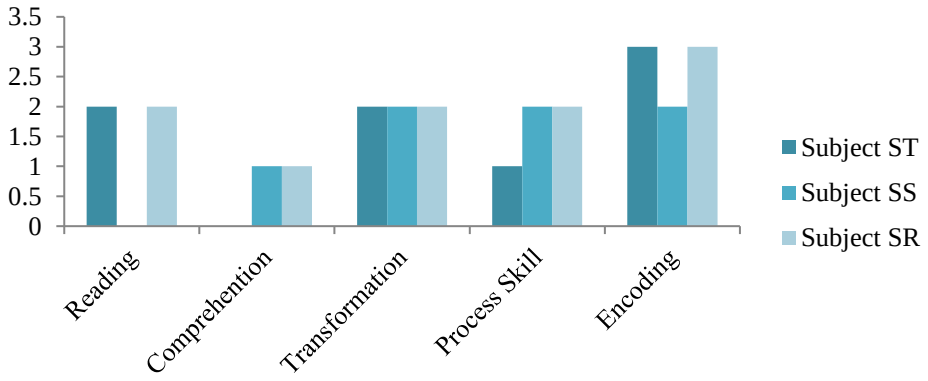


Figure 11. Comparison diagram of errors based on Newman's procedure

There are several factors that cause students to make mistakes in handling algebraic problems, including students who do not understand addition, subtraction, multiplication, and division in algebraic form. Another factor is also stated by Karouw, et al. (2023) in their research, namely the mistakes that students often make when dealing with problems about algebraic operations are also influenced by mathematical thinking skills, namely conceptual errors which are divided into two parts, namely: (1) errors in understanding the meaning of the problem; and (2) errors in understanding the basic concepts of algebra. Second, procedural errors which are divided into two, namely: (1) errors in solving steps

related to prerequisite material that must be understood, and (2) errors in calculating an operation. Furthermore, according to Oroh, et al. (2022) errors made by students when learning mathematics stem from the limitations and abilities of mathematical concepts.

Based on the analysis of student errors in solving math problems using the Newman procedure, it can be seen that there is a relationship between the level of difficulty of the problem and the types of errors made by students (Annisa, et al., 2023). The more difficult the problem given, the more types of errors made by students (Rihy, et al., 2023). In problems that require high concept understanding and transformation skills such as the problem above, students tend to make errors in understanding the problem, transformation errors, process skills, and writing.

Errors made by subjects ST, SS, and SR can also be influenced by student cognitive factors, for example students with independent field cognitive style (FI) tend to make mistakes at the stage of understanding the problem, process skills, and infer conclusions. This is also done by while students with dependent field cognitive style (FD) tend to make mistakes at the stage of understanding the problem, transformation, process skills, and conclusion making (Sofri Rizka Amalia, 2017). Then the factor causing errors of students with high reasoning ability (SKPT) is an error in performing calculations, while the factor causing errors of students with low reasoning ability (SKPR) is not understanding the problem well (Amalia & Hadi, 2020). In addition, the cause of errors of students with reflective cognitive style only at the stage of writing answers, while students with impulsive cognitive style make mistakes at the stage of understanding and writing answers (Pramasdyahsari, et al., 2023).

▪ CONCLUSION

Based on the analysis that has been presented, it can be concluded that students in grade VIII of Madani Integrated Model State Junior High School with different levels of mathematical ability show a variety of errors in solving algebraic story problems, although the types of errors tend to be similar. The main difference lies in the number of errors made. Students with moderate (SS) and low (SR) math ability tend to make more mistakes than students with high math ability (ST). These errors include various stages of problem solving, starting from reading, comprehension, transformation, process skills, to writing/notation (encoding)

The subject of high mathematical ability (ST) made reading errors, namely not reading the problem completely, namely not reading the symbol "Rupiah", transformation errors, namely not being able to change the information in the problem into a mathematical model, namely an algebraic form, process skill errors, namely not performing procedures or steps that ST subjects will use in solving algebraic form problems, and writing/notation errors (encoding), namely not writing conclusions and not writing the symbol "Rupiah". Subjects of moderate mathematical ability (SS) made comprehension errors, namely not mentioning all the information known in the problem completely, transformation errors, namely making the wrong mathematical model, process skill errors, namely not performing the steps or procedures for solving with algebraic forms, and writing/notation errors (encoding), namely not writing the currency symbol "Rupiah" in the solution and conclusion. The subject of low mathematics ability (SR) made reading errors, namely not mentioning the symbol "Rupiah" when reading the unit price and not reading the problem completely, comprehension errors, namely not

mentioning all the known information in the problem completely, transformation errors, namely changing the story problem into a mathematical model, process skill errors, namely calculation errors and performing steps or procedures for solving algebraic form problems, then writing/notation errors (encoding), namely not writing the currency symbol "Rupiah" for each price, not writing the conclusion correctly, and not separating each part of the answer a, b, c and d.

Based on the findings of this study, it is recommended that teachers strengthen students' conceptual understanding of the material studied, provide gradual practice of basic problems to build a strong foundation for students, provide constructive feedback on specific errors made by students, finally by implementing collaborative learning such as group discussions or peer tutors to develop understanding while providing mutual support among students. With this, it is hoped that teachers can help students reduce errors in solving algebraic story problems and improve their understanding of mathematics as a whole. In addition, this research can be applied in the curriculum in a way that the curriculum should explicitly teach metacognitive strategies, such as planning (planning the steps of solving), monitoring (monitoring understanding and progress), and evaluation (evaluating solutions and processes). These strategies help students to be more aware and control their thought processes when solving problems.

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