EDU-MAT: Jurnal Pendidikan Matematika
https://ppjp.ulm.ac.id/journal/index.php/edumat
ISSN: 2338-2759 (print)
ISSN: 2597-9051 (online)

STUDENT ERRORS IN SOLVING MCA NUMERACY PROBLEMS ON UNCERTAINTY AND DATA CONTENT BASED ON NEWMAN'S THEORY REVIEWED THROUGH THE LENS OF ADVERSITY QUOTIENT

Hasbi Ashiddiqi[1], Sukoriyanto[1], Indriati Nurul hidayah*[1]
[1]Universitas Negeri Malang, Kota Malang, Indonesia
*Corresponding Author (indriati.nurul.fmipa@um.ac.id)

DOI: http://dx.doi.org/10.20527/edumat.v14i1.24533
Received : 17 November 2025 **Accepted :** 20 April 2026 **Published :** 30 April 2026

Abstract: This qualitative study aims to describe the student errors made when solving numeracy problems from the Minimum Competency Assessment (MCA) on uncertainty and data content, based on Newman's theory reviewed through the lens of Adversity Quotient (AQ). AQ is categorized into five types: quitter, transition from quitter to camper, camper, transition from camper to climber, and climber. Among the five AQ categories, only three—quitter, camper, and climber—were represented among the 30 eighth-grade students from SMP Negeri 3 Genteng, Indonesia, who were considered prospective subjects in this research. Therefore, one student from each of these three AQ categories was selected as a research subject, each of whom provided complete answers but still made errors when solving the MCA numeracy problems in the uncertainty and data content. Based on the findings, students in the AQ quitter category exhibited reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors. Those in the AQ camper category exhibited comprehension errors, transformation errors, process skill errors, and encoding errors. Students in the AQ climber category demonstrated comprehension errors, transformation errors, and encoding errors.

Keywords: Student Errors, MCA Numeracy, Uncertainty and Data, Newman, Adversity Quotient

INTRODUCTION

Mathematics problems related to real-life situations are often presented in the form of stories or open-ended questions (Nur et al., 2022). These types of problems require students to formulate, apply, and interpret mathematics and are commonly referred to as mathematical literacy questions (Dewi & Maulida, 2023). Mathematical literacy (numeracy) refers to students' ability to formulate problem situations, apply mathematical reasoning, and interpret results within a variety of contexts (Hwang & Ham, 2021; OECD, 2023). In Indonesia, students' mathematical literacy is assessed nationally through the Minimum Competency Assessment (MCA) (Kemendikbudristek, 2023). In Indonesia, students' mathematical literacy is assessed nationally through the Minimum Competency Assessment (MCA) (Kemendikbudristek, 2023). According to Kemendikbudristek (2020), MCA problems require higher-order thinking skills and are contextualized in real-life scenarios.

This is open access article under the CC-BY-ND license
© 2026 EDU-MAT: Jurnal Pendidikan Matematika

Consequently, many students encounter difficulties when attempting to solve MCA problems.

Research by Umam et al. (2023) indicated that students often made various errors when solving MCA numeracy problems. One of the most common content areas where these errors occur is in uncertainty and data (Murtiyasa et al., 2020; OECD, 2023). Ashiddiqi et al. (2024) conducted research at SMP Negeri 3 Genteng, Indonesia, involving 24 eighth-grade students who were given MCA reasoning-level problems in the uncertainty and data content. The results showed that many students still made errors, even though five of them provided complete responses. The errors included misreading, misunderstanding the problems, incorrect procedural steps, and writing the final answers. Thus, this study applied Newman's error analysis theory to identify and categorize the types of student errors in this context. This approach provides more detailed insights than other error analysis theories, thereby assisting teachers and researchers in addressing the specific types of student mistakes (White, 2005).

Newman's theory is widely used to analyze students' mistakes when solving open-ended math problems (Prakitipong & Nakamura, 2006). According to Newman, the five most common types of errors students make are 1) reading error, 2) comprehension error, 3) transformation error, 4) process skill error, and 5) encoding error (Clements, 1980). These errors can be influenced by both internal and external factors (Elastika et al., 2021). Pangma et al. (2009) and Stoltz (2000), noted that, in addition to IQ, EQ, and SQ, students' ability to manage difficulties—known as Adversity Quotient (AQ)—is a significant personal factor that affects problem-solving performance in mathematics.

According to Stoltz (2000), the Adversity Quotient (AQ) is a conceptual framework or a measurable aspect used to understand, enhance, and determine the effectiveness of students' responses when facing challenges. When linked to the causes of several errors made by students, the AQ aspect also influences the success of students' problem solving responses (Agoestanto & Masitoh, 2021). Thus, this research integrated AQ and Newman's theory to describe the types of students' errors when solving MCA numeracy problems involving uncertainty and data content.

Based on the explanation of the research urgency and the problem background outlined above, and supported by several previous studies—such as the study conducted by Yusuf & Ratnaningsih (2022), which examined students' numeracy errors when solving MCA problems on the topic of Systems of Linear Equations in Two Variables (SPLDV)—the findings revealed that students made several errors while solving MCA problems, including errors in understanding information (comprehension errors), errors in creating mathematical models from the information obtained (transformation errors), and failing to write down conclusions from what had been obtained (coding errors). Furthermore, this is also supported by the research by Sonia et al. (2023), who analyzed students' numeracy errors when solving MCA problems in the geometry domain using Kastolan's theory and obtained nearly identical results, namely that students made errors in determining the appropriate formula, errors in performing arithmetic operations, and errors in writing the appropriate units. Therefore, this research is considered important to be conducted. This study aims to provide a more specific description, compared to previous studies, of the types of errors made by students in solving MCA

numeracy questions in the content area of data and uncertainty, based on Newman's theory, as reviewed from the perspective of Adversity Quotient. The findings are expected to serve as an evaluation material for working on MCA numeracy questions, particularly in the content area of data and uncertainty.

METHODS

This research applied a qualitative approach to describe the student errors when solving MCA numeracy problems in the context of uncertainty and data. It used Newman's theory and analyzed them through the framework of the Adversity Quotient. The research instruments include the Adversity Response Profile (ARP) questionnaire, test items, interview guidelines, and documentation. The test items used in this study consisted of three items with different cognitive levels and question formats, aligned with the MCA test components: the first item, at the "knowing" cognitive level, used a complex multiple-choice (true or false) format; the second item, at the "applying" cognitive level, used an essay format; and the third item, also an essay format, was at the "reasoning" cognitive level. All instruments were validated before use to ensure they met the research requirements.

This study was conducted at SMP Negeri 3 Genteng, Indonesia, during the second semester of the 2024/2025 academic year. The prospective research subjects were 30 eighth-grade students selected to participate in the Computer-Based National Assessment (*Asesmen Nasional Berbasis Komputer*/ANBK) for the 2024/2025 academic year. Of the 30 prospective research subjects, three students were selected as research subjects who met each AQ type: quitter, camper, and climber who had complete answers but made mistakes in solving MCA numeracy questions on data content and uncertainty based on Newman's theory and had good communication.

The participants were 30 eighth-grade students selected to participate in the Computer-Based National Assessment (CBNA) for the 2024/2025 academic year. As a first step, students completed the ARP questionnaire to identify their AQ type based on the scores shown in Table 1 (Stoltz, 2000).

Table 1. Adversity Quotient Type Categories

No.	Type AQ	Score AQ	Indicator
1.	Quitter	$\text{Score AQ} \leq 59$	An individual who chooses to give up when facing a problem, despite having the ability to address it.
2.	Camper	$95 \leq \text{Score AQ} \leq 134$	An individual who chooses to remain in their comfort zone when solving a problem, working only within the limits of their current abilities.
3.	Climber	$\text{AQ} \geq 166$	An individual who chooses to keep striving until they achieve success in solving a problem, making full use of their abilities.

After completing the questionnaire, students were given three MCA numeracy test problems related to uncertainty and data. Based on their responses, the researchers analyzed and identified students who provided complete answers but made errors consistent with Newman's error indicators, as listed in Table 2 (Clements, 1980; Singh et al., 2010).

Table 2. Newman's Theory Error Indicators

No.	Error Type	Description
1.	Reading Error	An error made by students when they misread an important word or symbol in a question, preventing further progress.
2.	Comprehension Error	An error made by students when they can read important words or symbols in a problem, but cannot understand the meaning of all the information given in the problem.
3.	Transformation Error	An error made by students when they fail to solve a problem correctly because they do not formulate the correct sequence of mathematical solution steps, or cannot determine the correct arithmetic operations to create a series of mathematical procedures that are orderly and acceptable.
4.	Process Skill Error	An error made by students when they fail to carry out a mathematical procedure correctly, even though the operations (or order of operations) are correct to be used to solve the problem that has been identified.
5.	Encoding Error	An error made by students when they fail to provide an acceptable written form of answer, even though they have completed the mathematical task accurately and correctly.

From the results of the categorization of AQ types and error analysis of the answers of prospective research subjects based on Newman's theory, the researchers chose one student from AQ quitter, camper, and climber categories as a research subject so that overall there were three research subjects with different AQ types who had complete answers but made mistakes and had good communication skills.

The data analysis techniques used in this research followed the model proposed by (Miles et al., 2014), which includes data reduction, data display, and conclusion drawing, all of which are aligned with the research focus. To ensure the validity of the findings, methodological triangulation was applied by comparing students' written responses with interview data (Creswell, 2023).

RESULT AND DISCUSSION

Based on the instrument validation results, the test items obtained a validity percentage of 87.17%, indicating they are highly valid. The interview guide instrument achieved a validity percentage of 88.88%, which is considered highly valid. Therefore, both instruments were deemed appropriate for data collection in this research.

According to the ARP questionnaire results, the 30 prospective subjects met the criteria for the three AQ categories—climber, camper, and quitter—as detailed in Table 3.

Table 3. AQ Category Distribution Among Prospective Research Subjects

No.	AQ Type	Number of Students	Percentage
1.	Quitter	5	16.6%
2.	Camper	19	63.3%
3.	Climber	6	20%

Results from the MCA numeracy test on uncertainty and data content show that many prospective research subjects made errors as classified by Newman's theory. Of 30 students, three were identified as research subjects—coded as BDR, MNFA, and AA—who provided complete answers yet still made errors. This is presented in Table 4:

Table 4. Results of Research Subjects Selection

Research Subject	ARP Questionnaire Score	AQ Type	Types of Errors Based on Newman's Theory
BDR	57	Quitter	R, C, T, P, E
MNFA	127	Camper	C, T, P, E
AA	181	Climber	C, T, E

Notes:
R: Reading error
C: Comprehension error
T: Transformation error
P: Process skill error
E: Encoding error

Following the selection of research subjects (Table 4), the researchers conducted interviews with the three subjects regarding the errors in their answers to the MCA numeracy problems in the uncertainty and data content.

Student Error: AQ Quitter Type

Based on the test responses and interview results, the student with quitter-type AQ (BDR) committed all five types of errors identified in Newman's theory. These are elaborated as follows:

Reading error

The first error committed by BDR was a misreading of information in Question 1, a true-or-false type item containing the statement: "More individuals traveled for homecoming using airplanes than by rental cars." BDR misread the objects in the statement, confusing "cars" and "rental cars." This is evident from the interview excerpt below:

Transcription 1

Transcript

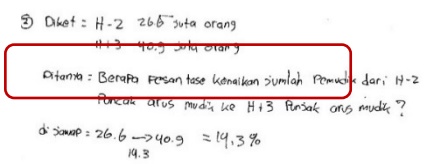
Q	*: Please take a look at Question 1. What is your answer to the second statement in that question?*
BDR	*: The answer is false, Mr.*
Q	*: Why is it false? Can you show me the supporting information?*
BDR	*: Here, Mr., in the transportation options, planes are 5.67%, and cars are 18.29%.*
Q	*: Look at it again carefully. Is your answer really correct?*
BDR	*: I think so, Mr. The percentage for planes is only 5.67%, while cars are 18.29%. So, there should be fewer planes.*

Transcription 1 indicates that the reading error made by the BDR subject was a mistake in reading the words asked in the question statement, namely regarding the words car and rental car. Based on the information in the question, the two words are two different modes of transportation but with the same percentage being greater than the

percentage of the airplane mode of transportation. However, suppose the reading error made by the BDR subject is done on a similar question that has different information from the test question that the researchers gave. In that case, it is likely that the answer given by the BDR subject is wrong and will affect the next completion process. Purnamasari et al. (2019) stated that students with the AQ quitter type are still confused about reading questions, which affects the results of their work. In addition, according to Siskawati et al. (2021), one of the causes of errors that occur in students in reading is a lack of attention, so the words or meanings read are not appropriate.

Comprehension error

The next error committed by the subject BDR was a comprehension error, which refers to the subject's failure to understand the critical information presented in the problem. Specifically, BDR did not grasp the meaning of the key information required to solve the question, leading to an inaccurate identification of what needed to be known. The subject's response to Question 2 is presented in Figure 1.



2. Given: D-2: 26.6 million people

D+3: 40.9 million people

Asked: What is the percentage increase in the number of homecoming travelers from D-2 of the homecoming flow peak to D+3 of the homecoming flow peak?

Figure 1. Subject BDR's Answer Result

As shown in Figure 1, the error made by subject BDR involved an inaccurate articulation of the information needed to solve the problem in Question 2, which asked: "Based on the information regarding the number of travelers on D-2 (two days before the peak travel period) and D+3 (three days after the peak travel period), what is the percentage increase in the number of travelers from D-2 to D+3?" In addition, BDR misunderstood the terms "D-2" and "D+3" in the problem statement, as demonstrated in the following interview excerpt:

Transcription 2

Transcript

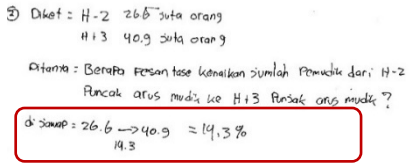
Q	*: Let us look at Question 2. What information is needed to solve this problem?*
BDR	*: The number of people on D-2 and D+3.*
Q	*: Okay. What do you think "D-2" and "D+3" refer to?*
BDR	*: I think the date information is related to the peak travel period.*
Q	*: All right, do the numbers following "D" make a difference? For example, D-10, D-1, D+10, D+1?*
BDR	*: I'm not sure; I think it does, but I don't really understand.*

Transcription 2 indicates that BDR's comprehension error in Question 2 stemmed from a lack of understanding of the terminology "D-2" and "D+3" presented in the question. The information in question is the term D-2 homecoming flow peak and D+3

homecoming flow peak contained in the information on question number 2. As a result, this misunderstanding affected the subsequent steps taken to solve the problem. This finding is consistent with Kristianti & Retnawati (2020), who stated that students who commit comprehension errors are often unable to explain the known information in a problem. Similarly, Suratih & Pujiastuti (2020) noted that comprehension errors may result from students' inability to understand key terms in a question and their failure to identify important embedded information.

Transformation error

The transformation error made by BDR in Question 2, which asked, "What is the percentage increase in the number of travelers from D-2 to D+3 during the peak travel period?" involved the incorrect selection of the mathematical operation needed to calculate the increase in travelers from D-2 to D+3. The subject's response is presented in Figure 2.



2. Given: D-2: 26.6 million people

D+3: 40.9 million people

Asked: What is the percentage increase in the number of homecoming travelers from D-2 of the homecoming flow peak to D+3

Figure 2. Subject BDR's Answer Result

Figure 2 shows that the error made by BDR was subtracting the number of travelers on D+3 from the number on D-3 to determine the increase. This subtraction method led to an incorrect result, which was reflected in BDR's final answer. The subject acknowledged this error during the following interview:

Transcription 3

Transcript

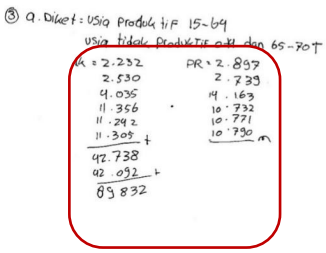
Q	*: What is being asked in Question 2?*
BDR	*: The percentage increase in the number of travelers from D-2 to D+3.*
Q	*: Okay, can you first show how to calculate the increase before finding the percentage?*
BDR	*: To calculate the increase, I think we can subtract.*
Q	*: Alright, show me what values you subtracted.*
BDR	*: This one (number of travelers on D-2, 26.6 million) minus this one (number of travelers on D+3, 40.9 million).*
Q	*: What is the result if you subtract 40.9 from 26.6?*
BDR	*: (attempting calculation) It doesn't work.*
Q	*: Why not?*
BDR	*: It can't be subtracted.*
Q	*: Then why did you calculate it that way earlier?*
BDR	*: I don't know; I was in a hurry.*

Transcription 3 indicates that the transformation error made by subject BDR in question number 2 resulted from a misunderstanding of the information provided in the question. Consequently, subject BDR incorrectly determined the mathematical

operation required to calculate the increase in the number of travelers. Additionally, another contributing factor to this transformation error was that subject BDR appeared to be rushing while answering question number 2. This aligns with Widiawati et al. (2020), who stated that transformation errors may occur when students cannot determine the appropriate procedure for solving a problem.

Process Skill Error

Subject BDR also committed a process skill error. The error in question occurred when the subject failed to accurately calculate the number of people in the non-productive age group in question 3, part (a). The question specifically asked, "Determine the average number of people in the non-productive age category in Indonesia!" To illustrate the process skill error made by subject BDR in question 3a, the researcher presents the subject's answer in Figure 3.



3. Given: Productive age 15-64 years

LK: Male: $2.232 + 2.530 + 4.035 + 11.356 + 11.242 + 11.303 = 42.738 + 42.092 = 89.832$

PR: Female: $2.897 + 2.739 + 4.163 + 10.732 + 10.771 + 10.790 =$

Figure 3. Subject BDR's Answer Result

Figure 3 reflects that the error made by subject BDR lies in the inaccurate calculation of the population in Indonesia's non-productive age group, both male and female. The actual number of people in the non-productive age group is 42.698 million males and 42.092 million females, making the correct total 84.79 million individuals. The subject's miscalculation is further supported by the following interview excerpt:

Transcription 4

Transcript

Q	*: Please take a look at question 3a. Your answer is 89.832, right? What does that number represent?*
BDR	*: As far as I know, that's the total number of males and females, Mr. "LK" is for male, and "PR" is for female.*
Q	*: Okay. So, is that answer correct? Please check and recalculate here.*
BDR	*: (looking at the answer) I think it is correct. I was just confused, Mr, because there were too many numbers.*

The transcript 4 shows that the miscalculation in question 3a occurred because subject BDR was overwhelmed by the number of figures, which led to the incorrect addition of the male population and, subsequently, of both male and female populations.

This is in line with Gestikatama et al. (2024), who found that process skill errors most commonly occur during calculation

steps when students are working toward a final answer. Such errors may involve students who can select the correct formula but cannot perform the necessary calculations (Firmansyah et al., 2021). Furthermore, Silvatama et al. (2023) stated that students with a quitter AQ (Adversity Quotient) type tend to give up or stop working when faced with tasks they perceive as difficult or confusing.

Encoding Error

The encoding error committed by subject BDR involved failing to write a conclusion or final answer based on the result obtained. The subject's answer is shown in Figure 4.

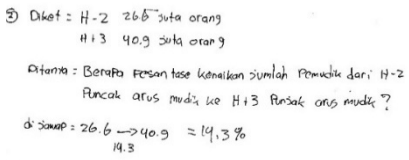


Figure 4. Subject BDR's Answer Result

Figure 4 indicates that the error lies in subject BDR's omission of a final answer or conclusion when solving question number 2, which asked, "What is the percentage increase in the number of travelers from D-2 (two days before the peak) to D+3 (three days after the peak)?" The subject did not provide a final conclusion, as explained in the following interview:

Transcription 5

Transcript	
Q	*: Based on your response to question number 2, is it complete?*
BDR	*: I believe it is complete, Mr.*
Q	*: Are there no additional answers?*
BDR	*: No, Mr.*
Q	*: What is the conclusion of your response to question number 2?*
BDR	*: So, the answer to question number 2 is 14.3%.*

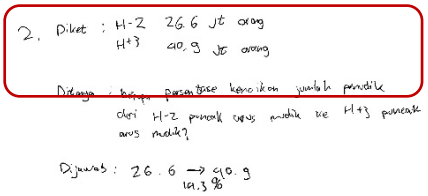
Transcription 5 shows that encoding error committed by participant BDR was due to a lack of understanding or knowledge regarding how to formulate a conclusion upon obtaining a final result. Moreover, the concluding statement provided by participant BDR was also inaccurate and inappropriate as a summary of the response to question number 2. This further confirms that participant BDR indeed committed an encoding error. This finding is consistent with Kristianti & Retnawati (2020), who asserted that an encoding error is characterized by students being able to solve a problem correctly but failing to write the final answer correctly, draw a conclusion, or express that conclusion properly.

Student Error: AQ Camper Type

The test responses and interview results show that the participant identified as an AQ camper (MNFA) committed four types of errors, as categorized by Newman's theory and as elaborated by the researchers below:

Comprehension Error

Participant MNFA demonstrated a comprehension error, which involves misunderstanding or failing to grasp the information presented in the question. Specifically, MNFA failed to understand the meaning of key information that needed to be identified, leading to an inaccurate description of the relevant data. Below is the participant's answer to question number 2 as presented in Figure 5.



2. Given: D-2: 26.6 million people
D+3: 40.9 million people
Asked: What is the percentage increase in the number of homecoming travelers from D-2 of the homecoming flow peak to D+3 of the homecoming flow peak?
Answered: $26.6 \rightarrow 40.9 = 14.3\%$

Figure 5. MNFA's Response to Question 2

Figure 5 clearly shows that MNFA failed to correctly identify and articulate the necessary information in the question. The appropriate formulation of the required information should be, "The number of travellers on D-2 of the homecoming flow peak was 26.6 million, and on D+3 it was 40.9 million." Furthermore, another comprehension error identified was MNFA's misunderstanding of the terms D-2 and D+3 in the question, as revealed in the following interview:

Transcription 6

Transcript

Q	*: Please read question number 2. Based on the information in the question, what needs to be identified?*
MNFA	*: The number of travellers on D-2 and D+3, Mr.*
Q	*: Alright. What is being asked in that question?*
MNFA	*: It's asking for the percentage increase in the number of travellers from D-2 to D+3 of the homecoming flow peak.*
Q	*: Before we discuss your answer, do you know what D-2 and D+3 mean in this context? This will affect your answer.*
MNFA	*: I don't really understand, Mr., but I've seen those terms (D- and D+) before.*

Transcription 6 indicates that the subject actually knew what information needed to be known in the question, but when writing the answer, it was not quite right. In addition, for the comprehension error made by the MNFA subject on question number 2, namely, the subject misunderstood the terms D-2 homecoming flow peak and D+3 homecoming flow peak contained in the question information because the subject misunderstood and forgot, so it had an impact on the steps or process of working on the next question. It was in line with Suratih & Pujiastuti (2020), who stated that students' comprehension errors with the AQ camper type occurred because they could not understand the keywords in the question, so they did not know what important information needed to be known and asked.

Transformation Error

The transformation error committed by MNFA occurred in question number 2, which asked, "What is the percentage increase in the number of travellers from D-2 to D+3 of the homecoming flow peak?" The error lay in choosing the incorrect operation to calculate the increase, as illustrated in Figure 6 below.

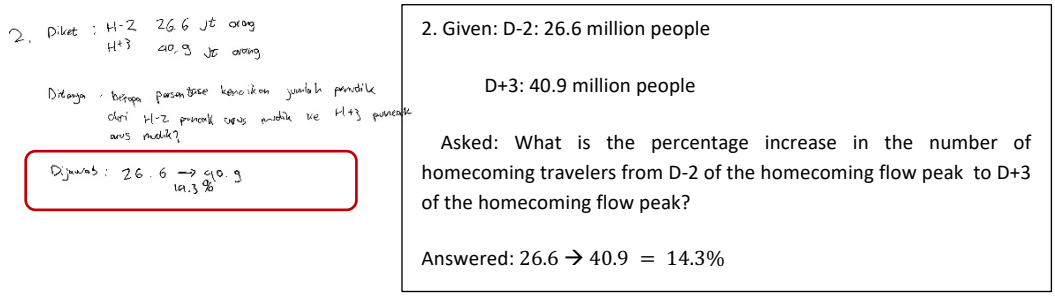


Figure 6. Subject MNFA's Answer Result

Figure 6 shows that the error made by the MNFA subject was in subtracting the number of homecoming travelers to find the increase in question 2. The MNFA subject made the subtraction error, namely subtracting the number of homecoming travelers on D+3 of the homecoming flow peak from D-2 of the homecoming flow peak to find the increase in the number of homecoming travelers. In fact, if the subtraction operation were used like that, the results obtained would not be in accordance with those written in the subject's answer results. The error made by the BDR subject is evident from the subject's statement in the following interview:

Transcription 7

Transcript

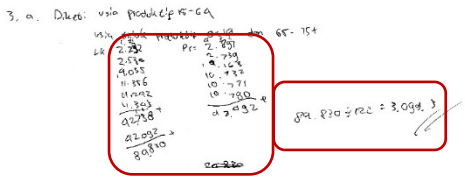
Q	*: How did you calculate the increase in the number of travellers from D-2 to D+3*
MNFA	*: I subtracted it, Mr.*
Q	*: Could you show which figures you subtracted?*
MNFA	*: I subtracted 40.9 million from 26.6 million.*
Q	*: To confirm, you subtracted the number of travellers on D-2 from the number on D+3, correct?*
MNFA	*: Yes, Mr.*
Q	*: Alright. Please calculate 40.9 million subtracted from 26.6 million. Is the result 14.3?*
MNFA	*: (Calculates). No, Mr. It turns out to be a negative number. So it should be 40.9 minus 26.6, Mr.*
Q	*: Why did you make that mistake at the time?*
MNFA	*: I was struggling and in a rush, so I wasn't being careful.*

Transcription 7 indicates that the transformation error made by MNFA in question number 2 was primarily due to a misunderstanding of the information in the question. Another contributing factor was the participant's difficulty and haste during the problem-solving process, which led to a lack of accuracy. Consequently, MNFA applied the

wrong mathematical operation—by reducing the number of travelers on D-2 with the number of travelers on D+3 of the homecoming flow peak. In line with Angco (2021) who argued that transformation errors occur when students are unable to comprehend the question and thus fail to identify the correct mathematical operation to solve the problem.

Process Skill Error

The subject MNFA also made a process skill error. The process skill error occurred in question number 3, point (a), which asked, "Determine the average population in the non-productive age category in Indonesia." The subject made a calculation error, as shown in Figure 7 below.



3. a. Given: Productive age 15-64 years

Unproductive age 0-14 and 65-75+ years

Lk: Male: $2.232 + 2.530 + 4.035 + 11.356 + 11.242 + 11.303 = 42.738$

Pr: Female: $2.897 + 2.739 + 4.163 + 10.732 + 10.771 + 10.790 = 42.092$

$= 42.738 + 42.092$

$= 84.830$

$= 84.830 : 12$

$= 3.099.3$

Figure 7. Subject MNFA's Answer Result

Figure 7 indicates that the error committed by MNFA was a miscalculation when summing the male population of Indonesia within the non-productive age category. The actual total number of males in the non-productive age group was 42.698 million, whereas MNFA's answer was 42.738 million. However, the calculation for the female population was accurate, with MNFA correctly identifying it as 42.092 million. Additionally, MNFA made a division error: the correct result of dividing 84.830 by 12 is approximately 7.069 million, while the subject's answer was 3.099 million. This miscalculation was corroborated by the subject's interview responses:

Transcription 8

Transcript

Q *: Could you show how you calculated the average population in the non-productive age category?*

MNFA *: The non-productive age group includes people aged 0–14 and 65–75+, so I added the number of people in those age groups and divided it by the number of data.*

Q *: What was the result?*

MNFA *: The total was 84.830, and I divided it by 12, so the result was 3.099,3.*

Q *: Was your calculation accurate?*

MNFA *: I think it was accurate.*

Q *: Alright, now could you calculate the total number of males only? What is the result?*

MNFA *: (Calculating) Oh, it's wrong. The correct result is 84.790. There were too many numbers, so I got confused and rushed.*

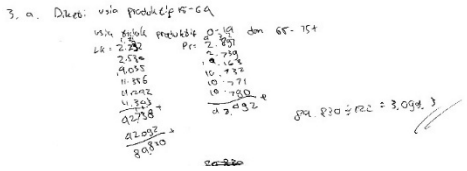
Q *: And about the division—does 84.830 divided by 12 really equal 3.099,3?*

MNFA *: I'm not very good at long division, but I'll try to calculate it again.*

Transcription 8 shows that the error made by MNFA in calculating question 3(a) was primarily due to the subject feeling overwhelmed by the large numbers and experiencing confusion, haste, and a lack of accuracy during the summation. Furthermore, the division error stemmed from the subject's insufficient mastery of long division methods so that when dividing 84.830 by 12, the MNFA subject did not do the calculation correctly. This finding is consistent with Labibah et al. (2021), who stated that process skill errors among students with the AQ camper type often arise due to low proficiency in basic arithmetic operations (addition, subtraction, multiplication, and division).

Encoding Error

The encoding error committed by MNFA involved failing to provide a final conclusion or answer based on the results obtained, as shown in Figure 8.



3. a. Given: Productive age 15-64 years
Unproductive age 0-14 and 65-75+ years
Lk: Male: $2.232 + 2.530 + 4.035 + 11.356 + 11.242 + 11.303 = 42.738$
Pr: Female: $2.897 + 2.739 + 4.163 + 10.732 + 10.771 + 10.790 = 42.092$
$= 42.738 + 42.092$
$= 84.830$
$= 84.830 : 12$
$= 3.099.3$

Figure 8. Subject MNFA's Answer Result

Figure 8 indicates that MNFA did not write a final answer or conclusion after completing question number 3a. This error occurred because the subject did not realize that a conclusion should be written after reaching the final result and the subject did not include the unit for the answer obtained. This explanation is supported by the following interview:

Transcription 9

Transcript

Q *: Have you completed your answer to question number 3a?*

MNFA *: I think it's finished because the question asked about the average population in the non-productive age category.*

Q *: So, does nothing need to be added to your answer?*

MNFA *: I don't think so.*

Q *: Alright. Then, could you tell me what your conclusion from the answer would sound like?*

MNFA *: The conclusion is that the average population in the non-productive age category is 3.009.3 population.*

Q : *Why didn't you write that conclusion?*
MNFA : *Because the question didn't ask for it.*

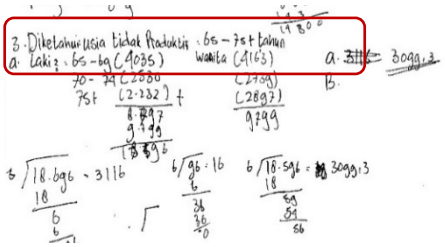
Transcription 9 shows that although MNFA was able to state the final conclusion accurately, they did not include it in their written response because the question did not explicitly request a conclusion. Additionally, the subject failed to include the unit for the result, which should have been "3.099.3 thousand people" or "3.0993 million people". Another likely contributing factor, based on the interview, was that the subject was not accustomed to writing conclusions when solving mathematics problems. This finding aligns with Mukhith & Fitri (2022) who explained that encoding errors occur when students are able to determine the correct result but fail to write a concluding statement. In addition, Seng (2020) also argued that encoding errors may arise due to a lack of teacher guidance, indicating that students are not routinely encouraged to write conclusions when solving mathematical problems.

Student Error: AQ Climber Type

Based on the test answers and interview responses from a subject with the AQ climber type, subject AA, three types of errors were identified, in accordance with Newman's theory, as described below:

Comprehension error

A comprehension error was committed by subject AA in question number 3(a), which asked, "Determine the average population in the non-productive age category in Indonesia." The subject misunderstood the information presented in the question, resulting in an incorrect identification of the required information, as shown in Figure 9.



3. Given: Unproductive age 65-75+ years

Laki2: Male:

$(65-69\ years)\ 2.232 + (70-74\ years)\ 2.530 + (75+years)\ 4.035 = 8.797$

Wanita: Female:

$(65-69\ years)\ 2.897 + (70-74\ years)\ 2.739 + (75+years)\ 4.163 = 9.799$

$= 8.797 + 9.799$

$= 18.956 : 6$

$= 3.099{,}3$

Figure 9. Subject AA's Answer Result

Figure 9 reflects that the subject failed to accurately state the required information and did not clearly identify what the question was asking. The main discrepancy lay in AA's interpretation of the age range of Indonesia's citizens, which is considered non-productive. The correct range for non-productive age in Indonesia is 0–14 years and 65–75+ years. The question specifically asked, "Determine the average number of people in the non-productive age category in Indonesia." However, the

subject's answer suggests a misunderstanding of these categories. This interpretation error is supported by the following interview:

Transcription 10

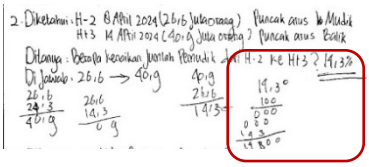
Transcript

Q	*: Look at question 3(a). What information do you need to know, and what is being asked?*
AA	*: We need to know the population in the non-productive age category because the question asks about the average number in that group.*
Q	*: Before calculating the average, can you show me which ages are productive and non-productive?*
AA	*: The productive age group is the green one here (15–64 years), and the non-productive group is the upper one (65–75+ years).*
Q	*: What about the lower one (0–14 years)? Which category does that belong to?*
AA	*: I'm not sure, maybe it's the growing age group?*

Transcription 10 indicates that the comprehension error committed by AA in question 3(a) stemmed from an incorrect understanding of the categorization of productive and non-productive age groups in Indonesia. According to the subject, only individuals aged 65–75+ fell into the non-productive category, while other age groups was not included. However, the question clearly stated that the productive age group is 15–64 years, meaning that any age outside this range should be considered non-productive because in the question there is no information regarding other types of categories. Therefore, the comprehension errors made by the subjects and AA gave an impact to the next steps or process of working on the questions. This finding is in accordance with Zamzam & Patricia (2018) who asserted that comprehension errors occur when students fail to understand essential information in the question, leading to difficulty in solving it. It also aligns with Shinariko et al. (2020), stating that errors in understanding occur because students cannot fully grasp the meaning of the question; in this case, the students misinterpret what the question is asking.

Transformation Error

The next type of error made by subject AA is a transformation error. This occurred in response to question number 2, which asked, "What is the percentage increase in the number of travelers from D-2 during the homecoming flow peak to D+3 during the homecoming flow peak?" Subject AA incorrectly identified the appropriate mathematical operation needed to calculate the percentage increase in the number of travelers from D-2 to D+3, as illustrated in Figure 10 below.



2. Given: D-2 → 26.6 million people

D+3 → 40.9 million people

Asked: How much did the number of travelers increase from D-2 to D+3? 14.3%

Answered: $40.9 - 26.6 = 14.3$

Percentage: $14.3 .100 = 1430$

Figure 10. Subject AA's Answer Result

Figure 10 shows that the transformation error made by subject AA in calculating the percentage increase in travelers from D-2 to D+3 lies in simply multiplying the increase (14.3 million people) by 100, resulting in 1430%. However, this final result was not written in the subject's answer. The correct operation for calculating the percentage increase in this problem is to divide the increase in travelers (14.3) by the number of travelers on D-2 (26.6), then multiply by 100.

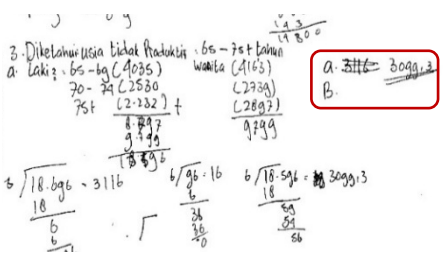
Transcription 11

Transcript	
Q	*: Can you show how to calculate the increase in the number of travelers from D-2 to D+3?*
AA	*: To calculate the increase, we subtract the number of people on D-2 from those on D+3; the result is 14.3 million.*
Q	*: Okay, and how do you calculate the percentage of that increase?*
AA	*: I'm not really sure how to get the percentage, but I remember it should be multiplied by 100.*
Q	*: Could you show the steps? What exactly is multiplied by 100?*
AA	*: I think the 14.3 should be multiplied by 100. But I'm not sure; I forgot how to do it.*

Transcription 11 indicates that the transformation error made by subject AA on question number 2 was due to a lack of understanding and forgetfulness in calculating percentages. Therefore, if the interview results are linked to the results of subject AA's work in finding the percentage increase in the number of homecoming travelers from D-2 to D+3 of the homecoming flow peak, it is evident that the subject experienced a transformation error due to a lack of understanding and memory of the correct procedure. This is consistent with Prakitipong & Nakamura (2006,) who stated that transformation errors occur when students understand the problem's requirements but fail to identify the correct mathematical operation to solve it. Similarly, Sumule et al. (2018) argued that transformation errors arise when students cannot determine the correct formula or plan an appropriate solution.

Encoding Error

Subject AA made another error, based on Newman's theory: an encoding error. This occurred in question number 3, part (a), which asked, "Determine the average number of people in the non-productive age category in Indonesia!" Subject AA failed to write a final conclusion or answer based on the calculation, as shown in Figure 11 below.



3. Given: Unproductive age 65-75+ years

Laki2: Male:

$(65-69\ years)\ 2.232 + (70-74\ years)\ 2.530 + (75+years)\ 4.035 = 8.797$

Wanita: Female:

$(65-69\ years)\ 2.897 + (70-74\ years)\ 2.739 + (75+years)\ 4.163 = 9.799$

$= 8.797 + 9.799 = 18.956 : 6 = 3.099{,}3$

Figure 11. Subject AA's Answer Result

Figure 11 shows that subject AA did not write a final answer or conclusion after completing the problem in question 3a. Additionally, the subject did not include the unit for the answer obtained. This error likely occurred because the subject did not realize that a conclusion must be written after arriving at the final result. This is further supported by the subject's statements in the interview:

Transcription 12

Transcript	
Q	*: Based on your answer to question 3a, is there anything that needs to be added?*
AA	*: I think it's already complete, because the question asked for the average, so once the average is found, that's it.*
Q	*: What would it be like if there were instructions on how to write a conclusion for your answer?*
AA	*: The conclusion would be that Indonesia's average number of people in the non-productive age category is 3.099.3.*
Q	*: Why didn't you write the conclusion you just stated?*
AA	*: I'm sorry, I didn't know it had to be written. So, I didn't write it because there were no instructions on how to do so.*

Transcription 12 indicates that subject AA could state the correct conclusion but did not include it in the written answer due to not knowing it was required. Additionally, the subject failed to include the unit for the result, which should have been "3.099.3 thousand people" or "3.0993 million people." This encoding error likely stems from the subject's lack of habit in writing conclusions when solving math problems and a tendency to omit answer units. This aligns with Wijaya et al. (2014), who stated that encoding errors occur when students cannot interpret their results following what the question is asking.

CONCLUSIONS

The research findings on student errors in solving MCA numeracy problems related to uncertainty and data at SMP Negeri 3 Genteng, Indonesia indicate that many students made errors. These errors varied depending on their Adversity Quotient (AQ) type. According to Newman's theory, the types of errors made by students with different AQ types are as follows: AQ Quitter: reading error, comprehension error, transformation error, process skills error, and encoding error; AQ Camper: comprehension error, transformation error, process skills error, and encoding error; and AQ Climber: comprehension error, transformation error, and encoding error. The causes of these errors include carelessness, forgetfulness, lack of focus, and unfamiliarity with MCA-style questions.

This research is expected to be an evaluation tool for schools, particularly for eighth-grade mathematics teachers. Implementing learning activities that include MCA numeracy problems, especially on content areas where students commonly make mistakes, is expected to reduce such errors, as identified by Newman's theory: reading, comprehension, transformation, calculation process, and conclusion or final answer. There are several suggestions from the research that the researchers have conducted: (1) The research results obtained regarding student errors in solving MCA numeracy questions on data content and uncertainty indicates that the error always made by the three AQ types was an error in understanding the information in the questions.

Therefore, the researchers' suggestion for mathematics teachers at SMP Negeri 3 Genteng is to get used to giving questions in narrative form (word problems or MCA numeracy questions) so that students are used to understanding the information given and can write down any important information needed to solve a problem in mathematics; (2) In addition, another error made by the three AQ types was an error in writing the final answer because they were not used to writing conclusions from the results of the calculations obtained. Therefore, the researchers suggest that in every mathematics lesson, especially in mathematics lessons that require reasoning skills, teachers provide notes so that students write conclusions from the results of the calculations that have been obtained; (3) The researchers want mathematics teachers, especially grade VIII teachers, to pay more attention to students with the AQ quitter type, such as providing motivation or encouragement to study and special practice questions so that the mistakes made by students with the AQ quitter type can be minimized, especially when completing MCA type questions; and (4) Future research may build upon or refine this study using different theories, perspectives, or subject matter.

ACKNOWLEDGEMENTS

This study was supported by the Institute for Research and Community Service (*Lembaga Penelitian dan Pengabdian Masyarakat*/LPPM) Universitas Negeri Malang under contract No. 24.2.831/UN32.14.1/LT/2025.

REFERENCES

Agoestanto, A., & Masitoh, S. (2021). Mathematical creative thinking ability viewed from students' learning interest and adversity quotient through creative problem-solving learning model. *Journal of Physics: Conference Series*, *1918*(4). https://doi.org/10.1088/1742-6596/1918/4/042074

Angco, R. J. N. (2021). Error Analysis in Integral Calculus: A Modified Newman's Approach. *American Research Journal of Humanities Social Science (ARJHSS)*, *04*(09), 38–52.

Ashiddiqi, H., Sukoriyanto, S., & Hidayah, I. N. (2024). Kesalahan Peserta Didik dalam Menyelesaikan Soal AKM pada Level Kognitif Reasoning Berdasarkan Teori Newman. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *10*(2), 247–260. https://doi.org/10.24853/fbc.10.2.247-260

Clements, M. A. (1980). Analyzing children's errors on written mathematical tasks. *Educational Studies in Mathematics*, *11*, 1–21. https://doi.org/10.1007/BF00369157

Creswell, J. W. (2023). Research Design, Qualitative, Quantitative and Mixed Methods Approaches. In *SAGE Publications,Inc.: Vol. Sixth Edit* (Issue 1).

Dewi, N. R., & Maulida, N. F. (2023). The Development of STEM-nuanced Mathematics Teaching Materials to Enhance Students' Mathematical Literacy Ability Through Information and Communication Technology-Assisted Preprospec Learning Model. *International Journal of Educational Methodology*, *9*(2), 409–421. https://doi.org/10.12973/IJEM.9.2.409

Elastika, R. W., Sukono, & Dewanto, S. P. (2021). Analysis of factors affecting students' mathematics learning difficulties using sem as information for teaching improvement. *International Journal of Instruction*, *14*(4), 281–300. https://doi.org/10.29333/iji.2021.14417a

Firmansyah, M. A., Nopitasari, D., Syarifah, L. L., & Yulianah, R. (2021). Error Procedure Analysis Based on Newman in Solving Logarith M

Questions Review Student'S Beginning Mathematics Ability. *Prima: Jurnal Pendidikan Matematika*, *5*(2), 16. https://doi.org/10.31000/prima.v5i2.4491

Gestikatama, E., Hamidah, D., & Hidayah, N. (2024). Analysis of student errors based on newman's error analysis in terms of gender. *At- Ta'lim : Jurnal Pendidikan*, *10*(2), 16–27. https://doi.org/10.55210/attalim.v10i2.1237

Hwang, J., & Ham, Y. (2021). Relationship between mathematical literacy and opportunity to learn with different types of mathematical tasks. *Journal on Mathematics Education*, *12*(2), 199–222. https://doi.org/10.22342/JME.12.2.13625.199-222

Kemendikbudristek. (2023). *Framework Asesmen Kompetensi Minimum (AKM)* (2023rd ed.).

Kristianti, L. W., & Retnawati, H. (2020). An analysis of students' error in completing the contextual problems based on Newman's procedure. *Journal of Physics: Conference Series*, *1511*(1). https://doi.org/10.1088/1742-6596/1511/1/012036

Labibah, N., Damayani, A. T., & Sary, R. M. (2021). Analisis kesalahan siswa berdasarkan teori newman dalam menyelesaikan soal cerita pada materi pecahan kelas V madrasah ibtidaiyah. *Journal for Lesson and Learning Studies*, *4*(2), 208–216. https://doi.org/10.23887/jlls.v4i2.33265

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook (Third Edition)*. SAGE Publications.

Mukhith, A., & Fitri, A. (2022). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Spldv Berdasarkan Newman's Error Analysis Ditinjau Dari Minat Belajar Siswa. *Prosiding Konferensi Ilmiah Pendidikan*, *3*, 665–676.

Murtiyasa, B., Rejeki, S., & Ishartono, N. (2020). *Profile of Students' Error in Solving Mathematics Word Problems Based on PISA Frameworks*. *467* (Semantik 2019), 135–137. https://doi.org/10.2991/assehr.k.200827.131

Nur, A. S., Kartono, K., Zaenuri, Z., & Rochmad, R. (2022). Solving mathematical word problems using dynamic assessment for scaffolding construction. *International Journal of Evaluation and Research in Education*, *11*(2), 649–657. https://doi.org/10.11591/ijere.v11i2.22535

OECD. (2023). *PISA 2022 Results (Volume I)*. https://doi.org/https://doi.org/10.1787/53f23881-en

Pangma, R., Tayraukham, S., & Nuangchale, P. (2009). Causal Factors Influencing Adversity Quotient of Twelfth Grade and Third-Year Vocational Students. *Journal of Social Sciences*, *5*(4), 466–470. https://doi.org/10.3844/jssp.2009.466.470

Prakitipong, N., & Nakamura, S. (2006). Analysis of Mathematics Performance of Grade Five Students in Thailand Using Newman Procedure. *Journal of International Cooperation in Education*, *9*(1), 111–122.

Purnamasari, F. E., Sujadi, I., & Slamet, I. (2019). Effect of adversity quotient of junior high school students on reflective thinking process in mathematical problem solving. *Journal of Physics: Conference Series*, *1321*(2). https://doi.org/10.1088/1742-6596/1321/2/022128

Seng, N. B. (2020). Newman Error Analysis For Errors In Mathematical Word Questions Among Year Three Students In Sekolah Kebangsaan Taman Kluang Barat. *International Journal of Novel Research in Education and Learning*, *7*(2), 58–63.

Shinariko, L. J., Saputri, N. W., Hartono, Y., & Araiku, J. (2020). Analysis of students' mistakes in solving mathematics olympiad problems. *Journal of Physics: Conference Series*, *1480*(1). https://doi.org/10.1088/1742-6596/1480/1/012039

Silvatama, M. A., Yustika, U. N., Nuriah, D., & Wahyuni, I. (2023). Analisis Kemampuan Berpikir Lateral Siswa Berdasarkan Adversity Quotient(AQ) dalam Pemecahan Masalah Geometri. *Indonesian Journal of Science, Technology and Humanities*, *1*(1), 1–12. https://doi.org/10.60076/ijstech.v1i1.7

Singh, P., Rahman, A. A., & Hoon, T. S. (2010). The Newman procedure for analyzing Primary Four pupils errors on written mathematical tasks: A Malaysian perspective. *Procedia - Social and Behavioral Sciences*, *8*(5), 264–271. https://doi.org/10.1016/j.sbspro.2010.12.036

Siskawati, E., Zaenuri, & Wardono. (2021). Analysis of students' error in solving math problem-solving problem based on Newman Error Analysis (NEA). *Journal of Physics: Conference Series*, *1918*(4). https://doi.org/10.1088/1742-6596/1918/4/042108

Sonia, A., Suanto, E., Kartini, & Maimunah. (2023). Analisis Kesalahan Siswa Menurut Kastolan dalam Menyelesaikan Soal Tipe AKM Numerasi pada Domain Geometri. *AXIOM : Jurnal Pendidikan Dan Matematika*, *12*(1), 34–45. http://dx.doi.org/10.30821/axiom.v12i1.15549

Stoltz, P. G. (2000). *Adversity quotient: Turning obstacles into opportunities*. John Wiley & Sons.

Sumule, U., Amin, S. M., & Fuad, Y. (2018). Error Analysis of Indonesian Junior High School Student in Solving Space and Shape Content PISA Problem Using Newman Procedure. *Journal of Physics: Conference Series*, *947*(1). https://doi.org/10.1088/1742-6596/947/1/012053

Suratih, S., & Pujiastuti, H. (2020). Analisis kesalahan siswa dalam menyelesaikan soal cerita program linear berdasarkan Newman's error analysis. *Pythagoras: Jurnal Pendidikan Matematika*, *15*(2), 111–123. https://doi.org/10.21831/pg.v15i2.30990

Umam, K., Chusnudhin, R. M. F., & Sari, A. F. (2023). Kesalahan Siswa dalam Menyelesaikan Asesmen Kompetensi Minimum (AKM) Numerasi SMA Topik Trigonometri. *Jurnal Penelitian Pendidikan*, *15*(1), 39–47. https://doi.org/10.21137/jpp.2023.15.1.5

White, A. L. (2005). Active mathematics in classrooms: Finding out why children make mistakes--and then doing something to help them. *Square One*, *15*(4), 15–19.

Widiawati, M., Surya, A., Istiyati, S., & Sukarno. (2020). Error analysis of fifth-grade students of elementary school in geometry problem solving based on Newman's procedure. *Universal Journal of Educational Research*, *8*(5), 1676–1682. https://doi.org/10.13189/ujer.2020.080503

Wijaya, A., Heuvel-Panhuizen, M. van den, Doorman, M., & Robitzsch, A. (2014). Difficulties in Solving Context-Based PISA Mathematics Tasks : An Analysis of Students' Errors Let Us Know How Access to This Document Benefits You . *The Mathematics Enthusiast*, *11*(3), 555–583. https://doi.org/10.54870/1551-3440.1317

Yusuf, R. M. M., & Ratnaningsih, N. (2022). Analisis Kesalahan Numerasi Peserta Didik dalam Menyelesaikan Soal Assesmen Kompetensi Minimum. *Jurnal Paedagogy*, *9*(1), 24. https://doi.org/10.33394/jp.v9i1.4507

Zamzam, K. F., & Patricia, F. A. (2018). Error analysis of newman to solve the geometry problem in terms of cognitive style. *University of Muhammadiyah Malang's 1st International Conference of Mathematics Education (INCOMED 2017)*, 24–27.