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ANALYSIS OF STUDENT ERRORS BASED ON NEWMAN'S ERROR ANALYSIS (NEA) IN SOLVING COMPLEX PROBLEMS RELATED TO FUNCTION MATERIAL

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ABSTRAK

Kesalahan siswa dalam menyelesaikan soal matematika khususnya pada materi fungsi masih sering terjadi dan perlu dianalisis secara sistematis. Penelitian ini bertujuan untuk mengkaji kesalahan siswa dalam memecahkan soal matematika pada topik fungsi berdasarkan prosedur Analisis Kesalahan Newman (NEA). Pendekatan kualitatif deskriptif digunakan dalam penelitian ini. Peserta penelitian adalah 23 siswa kelas XI SMA GKPI Padang Bulan Medan yang sebelumnya telah mempelajari fungsi. Data dikumpulkan melalui tes tertulis yang terdiri dari lima soal cerita dan wawancara lanjutan untuk mengeksplorasi proses berpikir siswa secara lebih mendalam. Data dianalisis menggunakan lima tahap kesalahan Newman, yaitu membaca, pemahaman, transformasi, keterampilan proses, dan pengkodean. Temuan menunjukkan bahwa kesalahan yang paling dominan adalah kesalahan pengkodean (51,30%), diikuti oleh kesalahan keterampilan proses (46,96%), kesalahan transformasi (39,13%), kesalahan pemahaman (34,78%), dan kesalahan membaca (26,09%). Hasil ini menunjukkan bahwa siswa masih mengalami kesulitan pada berbagai tahap pemecahan masalah, terutama dalam menyajikan jawaban akhir secara akurat dan melaksanakan prosedur secara sistematis. Oleh karena itu, strategi pengajaran yang tepat diperlukan untuk meningkatkan pemahaman konseptual siswa, meningkatkan akurasi perhitungan, dan mengembangkan kemampuan mereka untuk mengekspresikan jawaban akhir secara jelas dan sistematis.

Kata Kunci: *Analisis Kesalahan, Analisis Kesalahan Newman, Fungsi, Pemecahan Masalah Matematika.*

ABSTRACT

Students' errors in solving mathematics problems, particularly on the topic of functions, still frequently occur and need to be analyzed systematically.This study aims to examine students' errors in solving mathematical problems on function topics based on Newman's Error Analysis (NEA) procedure. A descriptive qualitative approach was employed in this research. The participants were 23 eleventh-grade students of SMA GKPI Padang Bulan Medan who had previously studied functions. Data were collected through a written test consisting of five word problems and follow-up interviews to explore students' thinking processes in greater depth. The data were analyzed using Newman's five stages of error, namely reading, comprehension, transformation, process skills, and encoding. The findings reveal that the most dominant error was encoding error (51.30%), followed by process skill errors (46.96%), transformation errors (39.13%), comprehension errors (34.78%), and reading errors (26.09%). These results indicate that students still encounter difficulties at multiple stages of problem solving, particularly in presenting final answers accurately and carrying out systematic procedures. Therefore, appropriate instructional strategies are needed to enhance students' conceptual understanding,

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improve accuracy in calculations, and develop their ability to express final answers clearly and systematically.

Keywords: *Error Analysis, Newman's Error Analysis, Functions, Mathematical Problem Solving.*

INTRODUCTION

Education plays a vital role in developing human resources capable of cultivating critical, logical, and systematic thinking skills, which are essential in daily life. One field of study that contributes significantly to the development of these thinking skills is mathematics. Mathematics education not only emphasizes mastery of concepts and procedures but also encourages students to understand, analyze, and solve various problems systematically and rationally (Hartana et al., 2023). Therefore, mathematics learning is expected to help students develop analytical abilities that can be applied in both academic and real-life situations.

One of the key competencies students must possess in the mathematics learning process is problem-solving ability. This ability enables students to apply mathematical concepts in various situations, both routine and complex. However, in practice, many students still struggle when faced with mathematics problems that require a deep understanding of these concepts. These difficulties are often reflected in various errors students make when solving math problems, including errors in understanding the problem, determining a solution strategy, and performing calculations (Andayani et al., 2022). These conditions indicate that students still need guidance in developing effective mathematical reasoning and problem-solving skills.

Mistakes made by students when solving math problems are a common occurrence in the learning process. These mistakes do not always indicate a lack of ability on the part of the students; rather, they can serve as an indicator of difficulties in understanding certain concepts or procedures. Therefore, an analysis of student errors must be conducted systematically so that the types of errors and their underlying causes can be identified. Through error analysis, teachers can gain deeper insights into students' understanding of the material being studied, enabling them to design more appropriate and effective teaching strategies.

One area of mathematics that often poses difficulties for students is the concept of functions. The concept of functions is a fundamental concept in mathematics that is closely related to various advanced topics, such as limits, derivatives, and integrals. A strong understanding of the concept of functions is crucial because it serves as the foundation for mastering other mathematical topics. However, many students still struggle to understand the relationships between variables, determine the form of a function, or solve problems related to functions. These difficulties often lead students to make various errors during the problem-solving process (Heri et al., 2022).

Student errors in solving math problems can be analyzed using various approaches, such as the NEA. This approach is used to identify student errors more systematically through the stages of the mathematical problem-solving process. Newman's procedure classifies student errors into five stages: reading errors, comprehension errors, errors in transforming the problem into a mathematical model (transformation errors), errors in process skills or calculations (process skill errors), and errors in writing the final answer (coding errors). By using this procedure, researchers can gain a deeper understanding of the specific stages at which students experience difficulties in solving mathematical problems (Tanzimah & Sutrianti, 2023).

Previous research has also shown that students make errors when solving math problems. These errors often occur during the stages of understanding the problem and converting it into a mathematical form. This indicates that students not only struggle with

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performing calculations but also with understanding the meaning of the given problem. Additionally, a lack of understanding of basic concepts, inaccuracies, and limitations in students' ability to interpret mathematical information also contribute to errors in solving math problems (Zahiroh et al., 2025).

Although many previous studies on errors made by students when answering math problems have used the Newman method, most of these studies still focus on the general identification of error types, without deeply examining their relationship with the characteristics of the learning material or the difficulty level of the problems. In many studies, error analysis tends to be limited to classification alone, without exploring the influence of question format or difficulty level on students' thinking processes (Nurfalah et al., 2020). This indicates that previous studies have not sufficiently explored the relationship between the types of errors made by students and the contextual characteristics of mathematical problems. Consequently, further research is needed to provide a more comprehensive understanding of students' mathematical errors in different problem contexts.

Furthermore, research that specifically examines students' errors in the area of functions—particularly studies that use complex or unconventional problems requiring advanced thinking skills—remains relatively scarce. Functions are a fundamental concept in mathematics and are crucial for understanding more advanced material. In fact, students still struggle to understand the relationships between variables and to translate problems into mathematical form, which ultimately leads to various errors in the problem-solving process (Daswarman, 2020). This situation demonstrates the importance of conducting further studies on students' difficulties in solving function-related problems.

Based on this, this study is innovative because it uses the Newman approach to analyze the errors made by students at GKPI Padang Bulan High School in Medan when solving complex problems involving function material, which were designed to measure conceptual understanding. This study not only identifies the types of errors at each stage of the Newman framework but also examines how these errors arise when students encounter problems requiring advanced thinking skills. In addition, the study focuses on understanding the relationship between students' conceptual difficulties and the problem-solving process in function material. Therefore, this study is expected to provide deeper insights into students' learning difficulties and serve as a foundation for designing more effective mathematics teaching strategies in the future.

METHODS

This study employed a qualitative approach with a descriptive design to analyze students' errors in solving mathematics problems on the topic of functions, based on Newman's Error Analysis (NEA) procedure. The study was conducted at SMA GKPI Padang Bulan Medan during the second semester of the 2025/2026 academic year. The research subjects were 23 eleventh-grade students selected through purposive sampling based on the following criteria: having studied functions, possessing varying levels of mathematical ability (high, moderate, low), and being willing to be interviewed. The use of purposive sampling allowed the researcher to obtain detailed information regarding the different types of errors experienced by students with diverse mathematical abilities.

The instruments used were a written test and an interview guide. The test consisted of five word problems designed to identify the five types of errors identified by Newman (reading, comprehension, transformation, process skills, and coding). These questions included functional contexts requiring advanced reasoning, such as determining the domain of a

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function, constructing mathematical models of real-world situations, solving functional inequalities, and interpreting final results. The validity of the instrument was tested through content validity by involving three experts (mathematics education lecturers and mathematics teachers). The validators assessed the alignment of the test items with competency indicators, the clarity of the language, and the accuracy of the content. Based on the validation results, which indicated the instrument was suitable with some revisions as suggested by the validators, the instrument was deemed to meet the requirements. The interview guidelines were also validated to ensure the relevance and depth of the information.

Data collection was conducted systematically through: (1) administering written tests to all participants; (2) preliminary analysis of students' responses to identify types of errors based on the NEA; (3) semi-structured interviews with students selected purposively based on variations in error types and ability levels (high, medium, low), as well as documentation of answer sheets. This procedure is based on Febryana et al. (2023). Data analysis utilized the NEA procedure, which classifies errors into five categories: reading, comprehension, transformation, process skills, and coding (Tanzimah & Sutrianti, 2023). Data validity was tested through methodological triangulation (comparing test data, interviews, and documentation) as well as member checking (reconfirming the interview results and the researcher's interpretations with the subjects).

RESULT AND DISCUSSION

Result

Based on an analysis of students' written responses to five mathematical word problems involving functions, data on the types of errors were obtained using the Newman Error Analysis (NEA) procedure. The study sample consisted of 23 eleventh-grade students. The frequency distribution of errors is presented in Table 1 below. The NEA procedure categorizes errors into five levels: reading, comprehension, transformation, process skills, and encoding. This classification allows for a detailed diagnosis of where students encounter difficulties in solving function word problems. The findings from Table 1 reveal which error types are most prevalent, providing valuable insights for improving mathematics instruction at the eleventh-grade level.

Table 1. Frequency Distribution of Student Errors Based on the Newman Procedure

Type of Error	1	2	3	4	5	Total	Percentage
Reading Error	6	4	7	5	8	30	26,09%
Comprehension Error	8	6	9	7	10	40	34,78%
Transformation Error	7	9	8	10	11	45	39,13%
Process Skill Error	10	8	11	12	13	54	46,96%
Encoding Error	11	9	12	13	14	59	51,30%

According to Table 1, errors in writing the final answer were the most frequent type of error, accounting for 51.30% of all errors. This figure is higher than that of other types of errors and indicates that more than half of the students made mistakes in the final stage of solving the problems. In contrast, errors in reading the questions had the lowest percentage, at 26.09%. Meanwhile, in descending order from the highest after errors in writing the final answer, process skill errors accounted for 46.96%, followed by transformation errors (39.13%), errors in understanding the question (34.78%), and errors in reading the question

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(26.09%). This pattern indicates a tendency that as students approach the final stages of answering the questions, the error rate tends to increase.

To gain a deeper understanding, triangulation interviews were conducted with selected students to clarify the reasons behind the errors they made during the problem-solving process. The interviews were used to strengthen the validity of the data obtained from students' written answers. Figure 1 presents examples of students' answer sheets that illustrate the types of errors identified in this study, particularly reading errors. The following are the findings from each stage of the error.

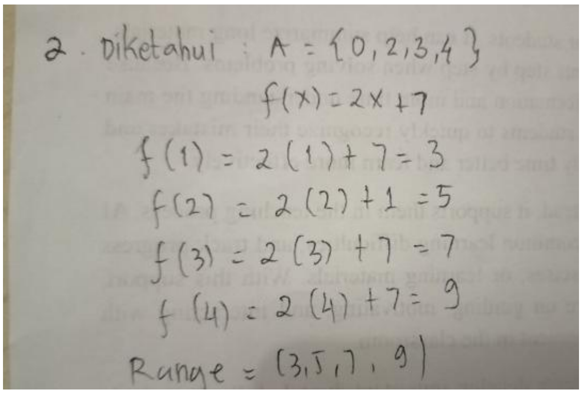

Figure 1. Results of Students' Answer Sheets. Reading Errors

Figure 1 shows that the student misread the problem. The student wrote the domain of the function A = {0,2,3,4}, when the correct answer is A = {1,2,3,4}, and wrote the function f(x) = 2x + 7, when it should be f(x) = 2x + 1. The interview results revealed that students were not careful enough when reading the numbers and symbols in the questions. This lack of care led to the information they wrote down not matching the intended information. Thus, the reading errors occurred not because of an inability to understand the concepts, but rather due to carelessness during the initial stage of reading the questions. Further examples of students' difficulties in interpreting the given information can be seen in Figure 2.

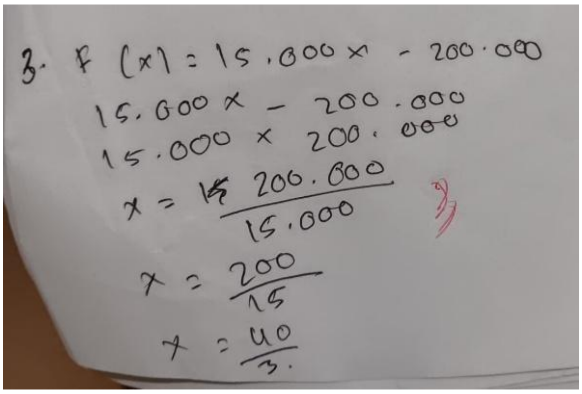

Figure 2. Results of Students' Answer Sheets: Misunderstanding of the Question

The student's work in Figure 2 reveals a misunderstanding of the problem. The student did not grasp the meaning of the phrase "does not incur a loss" and therefore failed to translate it into the inequality f(x) ≥ 0. Instead, the student performed the multiplication operation 15,000 × 200,000, which is irrelevant to the proper solution procedure. Based on the interviews, students admitted that they were confused by the intent of the questions, so the steps they wrote down did not lead to the correct answer. This confirms that fully understanding the meaning of

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the questions remains a challenge for some students. Additional examples of students' difficulties in transforming verbal problems into appropriate mathematical models are presented in Figure 3

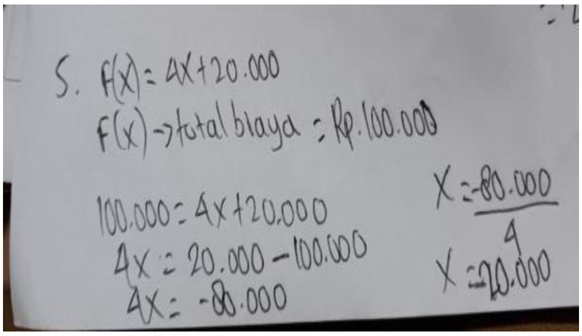

Figure 3. Results of Students' Answer Sheets: Transformation Errors

Figure 3 illustrates the transformation error made by the student. Although the student understood the concept of inverse functions quite well, as evidenced by the initial step of writing 100,000 = 4x + 20,000—an error occurred when moving the terms. The student wrote 4x = 20,000 – 100,000, whereas the correct form is 4x = 100,000 – 20,000. An interview with the student revealed that he had rushed through the algebraic manipulations. As a result of this transformation error, all subsequent calculations were incorrect, even though the initial concepts used were correct. Further examples of errors in carrying out calculation procedures can be observed in Figure 4.

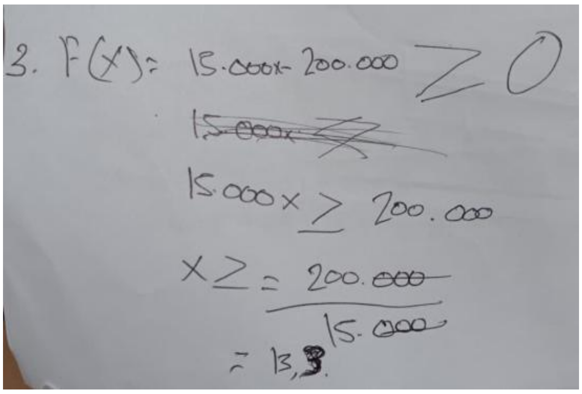

Figure 4. Results of Student Answer Sheets: Process Skill Errors

Errors in process skills are evident in the students' work shown in Figure 4. The students actually understood the solution procedure correctly, as demonstrated by their accurate writing of the inequality 15,000 × – 200,000 ≥ 0. However, in the next step, the students wrote an unsystematic calculation, namely 15,000 × ½ ≥ 200,000. The interviews revealed that students are not accustomed to organizing their calculation steps in a logical sequence and tend to rely on non-standard methods. Although the students ultimately arrived at the value x = 13.33, the procedure they followed did not reflect proper, structured process skills. Figure 5 further demonstrates students' errors in writing the final answers.

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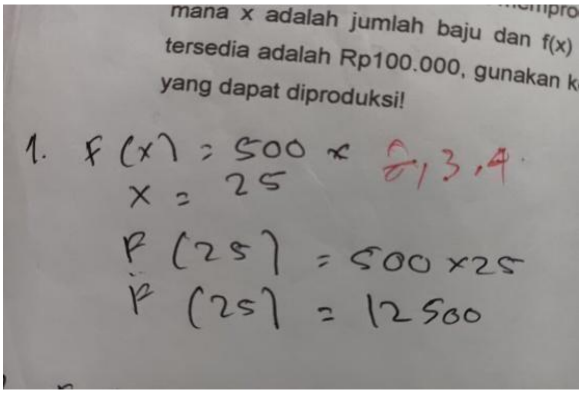

Figure 5. Results of Student Answer Sheets: Errors in Final Answers

In Figure 5, there is an error in the final answer. The student went through the calculation process and obtained the number 12,500 as the result. However, the student did not include the currency symbol (Rp) in the final answer. Additionally, the student did not provide a clear conclusion in response to the question, which asks for the "amount to be paid." Based on the interviews, students admitted that they were not in the habit of writing down units and conclusions because these were often considered unimportant. In fact, providing a complete final answer is an integral part of effective mathematical communication.

Discussion

Based on the results of the diagnostic tests and interviews conducted, it was found that students made all five types of errors identified in Newman's Error Analysis (NEA) when solving math problems. The five types of errors in the NEA procedure do not occur in isolation but form a systematic causal chain. As noted by Muharam & Rahayu (2025) in their analysis of numeracy errors among high school students, numeracy errors occurring during the stages of understanding the problem and transformation are closely linked to errors in the stages of process skills and writing the final answer. In other words, errors that occur in the early stages (reading and understanding) have a cascading effect on the quality of problem-solving in subsequent stages. The following is an in-depth discussion of each type of error, along with its contributing factors, the interrelationships between stages, and its practical implications.

1. Reading Errors

Errors in reading the questions accounted for the lowest percentage of errors in this study, at 26.09%. These errors occur when students are unable to correctly read or understand the words, symbols, or information contained in the questions. As a result, students have difficulty identifying the information needed to solve the problems. Based on the analysis of answer sheets and interviews, the factors contributing to errors in reading the questions include: (1) students are not careful enough when reading numbers and mathematical symbols; (2) students rush through the questions, causing them to overlook important information; (3) students do not understand the mathematical terms or phrases used in word problems. This finding is also in line with the study conducted by Widyasusanti (2024), which revealed that students often experience reading and comprehension difficulties in mathematical word problems because they fail to identify important information and mathematical keywords contained in the questions.

These findings not only confirm the results of the study by Azzahra & Hidayati (2024) that reading errors often occur because students lack an understanding of mathematical terms or sentences in word problems but also indicate that a low percentage of reading errors (26.09%)

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does not necessarily mean that students' reading skills are already strong. Conversely, it is possible that students who do not make reading errors may still fail in subsequent stages due to a lack of deeper understanding. Within the NEA framework, reading errors serve as the foundational starting point; if the information being read is already incorrect, it is impossible for students to arrive at the correct solution in subsequent stages. To address this issue, teachers can train students to read questions using highlighting techniques (marking important numbers and symbols) and get them into the habit of reading the questions twice before beginning to answer them. Additionally, providing word problems with varied sentence structures can help students develop a keen sense of the key information in the questions.

2. Comprehension errors

Misunderstanding the question is a type of error accounting for 34.78% of all errors. This error occurs when students are able to read the question correctly but fail to understand the meaning or intent of the question being asked. Students are unable to accurately identify the given information and the information being asked for in the question. Factors contributing to errors in understanding questions include: (1) students are not accustomed to systematically analyzing the information in the question; (2) students do not write down the given elements and the elements being asked for before beginning to solve the problem; (3) students tend to perform calculations immediately without fully understanding the problem.

The findings of this study support those reported by Febriana et al. (2024) that errors in understanding problems arise because students are not accustomed to analyzing the information in the questions, but also demonstrates that errors in understanding questions are often the result of undetected reading errors. The relationship between reading errors and understanding questions in the NEA is asymmetrical: if a student has misread, they will almost certainly misunderstand; however, conversely, a student who reads correctly does not necessarily understand correctly. In this study, it was also found that some students were able to read all the information accurately but failed to grasp the meaning of the question "does not incur a loss," which should have been interpreted as the inequality $f(x) \geq 0$. In fact, the problem-understanding stage is a crucial step in the mathematical problem-solving process. Without a good understanding of the problem, students will struggle to determine the appropriate solution steps. To improve students' understanding, it is important to encourage them to rewrite the problem in their own words and create a written list of information (what is known and what is being asked) before seeking a solution. Teachers can also use questioning techniques such as asking guiding questions like "What do we know?", "What is being asked?", and "What does that term mean?" to facilitate students' understanding.

3. Transformation Errors

Transformation errors account for 39.13% of all errors. These errors occur when students are unable to convert the information in word problems into the appropriate mathematical model. Students have difficulty determining the appropriate formula or strategy to solve the problem. Several factors contribute to transformation errors, including: (1) students' lack of understanding of the mathematical concepts underlying the problem; (2) students' inability to see the relationship between the problem context and the mathematical concepts used; (3) students' errors in determining the arithmetic operations or formulas to be used. Similar findings were reported by Rohilah et al. (2024), who found that students frequently experience difficulties in transforming verbal information into mathematical

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expressions due to weak conceptual understanding and an inability to connect problem situations with appropriate mathematical operations.

The results of this study not only support the findings of Putri and Murtiyasa (2024) and Putrieny and Setiani (2023), but also demonstrate that errors in transformation are often a logical consequence of prior misunderstandings. This means that if students have misunderstood a problem, their transformation into a mathematical model will inevitably be incorrect. However, an interesting finding from this study is the presence of students who are able to understand the problem correctly but still fail in the transformation due to a lack of mastery of the concept of functions. As stated by Putrieny & Setiani (2023), transformation errors are often caused by students' lack of understanding of the concept of functions as well as the relationships between variables in a mathematical problem. Thus, transformation errors are semi-independent: they can stem from poor understanding or from students' weak conceptual connections to function material. Consequently, students struggle to determine the form of the equation or mathematical model needed to solve the problem. In practical terms, instruction should include intensive practice in translating between different representations (verbal, tabular, graphical, symbolic) so that students become proficient at converting word problems into mathematical models. The use of visual aids and concept maps can also help students see the relationships between variables in a function.

4. Process Skill Errors

Process skill errors are the second most common type of error, accounting for 46.96%. These errors occur during the calculation or problem-solving process. Students make mistakes in arithmetic operations, the application of formulas, or follow unsystematic problem-solving steps. Factors causing process skill errors include: (1) a lack of understanding of basic mathematical concepts; (2) students' carelessness in performing calculations; (3) students' inability to apply calculation rules sequentially according to the solution steps; (4) errors in the transformation stage that result in process errors. This result is also supported by Aswan et al. (2024), who found that students' process skill errors in algebra often stem from inaccuracies in performing calculations, unsystematic procedures, and weak mastery of basic algebraic operations.

The findings of this study not only support the results reported by Zahiroh et al. (2025) but also reveal that procedural errors frequently emerge as a consequence of transformation errors. Within the NEA framework, an incorrect transformation will result in a flawed mathematical expression, so that any subsequent process will still yield an incorrect answer. However, this study also identified cases where the transformation was correct but the calculation process remained incorrect due to carelessness or a disjointed procedure. This implies that process errors can occur independently or serve as a link in a chain of prior errors. This study is also consistent with the findings of Safira et al. (2023), who analyzed students' errors based on the Newman procedure from the perspective of cognitive style. In that study, it was found that students with a Field-Dependent (FD) cognitive style tended to make more process-skill errors than Field-Independent (FI) students, with the main contributing factors being a rush to finish quickly, a lack of precision in computational operations, and a failure to double-check answers. These findings enrich the analysis by showing that, in addition to conceptual understanding, students' cognitive style characteristics also play a significant role in the occurrence of errors at the process skills stage. In classroom practice, teachers need to adapt their scaffolding strategies to students' cognitive styles; for example, providing more time and step-by-step guidance to students with an FD cognitive style. Additionally, reinforcing self-

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checking (reviewing calculation steps) and practicing similar problems with varying numbers are essential for developing procedural consistency.

5. Final Answer Writing Errors (Encoding Errors)

Errors in writing the final answer were the most common type of error in this study, accounting for 51.30%. These errors occurred when students failed to write down the final result accurately. The students have completed the problem-solving process, but have not written down their conclusions or final answers in full. Factors contributing to errors in writing the final answer include: (1) students are not accustomed to writing the conclusion of the calculations they have obtained; (2) students do not yet understand the importance of including units in the final result; (3) students only write the calculation process without including a clear final answer; (4) students do not double-check the answers they have obtained.

The findings of this study are consistent with those of Sutama and Indriyani (2021) and Yanuarto and Romadona (2021), showing that encoding errors often emerge as the cumulative effect of errors in preceding stages. Within the NEA framework, if a student makes a mistake at the reading, understanding, transformation, or process stage, the encoding will automatically be incorrect. However, what is even more interesting is that even students who reach the final stage with correct calculations still make encoding errors because they are not accustomed to writing out complete conclusions. This indicates a weakness in students' mathematical communication skills. This study reinforces the findings of Siregar et al. (2025), who analyzed students' errors in solving quadratic function word problems using Newman's procedure. The results of the study indicate that encoding errors in writing final answers are the most common type of error, accounting for 52.27%, followed by process skill errors at 46.59%. The consistency of findings between these two studies indicates that encoding errors are not an isolated phenomenon in a specific population but rather a common pattern occurring in high school mathematics learning, particularly in the topic of functions Therefore, teachers are expected to guide students to write complete final answers in a clear format: "So, ..." accompanied by the correct units of measurement, and make the completeness of the answer an integral part of the assessment. Providing examples of complete and incomplete answers, along with an analysis of the differences, can also raise students' awareness of the importance of writing a good final answer.

CONCLUSION

Based on the research findings, it was concluded that students still make various types of errors when solving math problems on functions, as determined by Newman's Error Analysis (NEA). Errors in writing the final answer (encoding errors) were the most dominant (51.30%), followed by process skill errors (46.96%), transformation errors (39.13%), errors in understanding the problem (34.78%), and errors in reading the problem (26.09%). These findings imply that students' primary difficulties lie not only in conceptual understanding or calculation but primarily in the inability to present final answers systematically and completely, indicating a weak habit of writing down conclusions, low precision, and a lack of mastery of correct mathematical representations. The high incidence of process skill errors also reflects weaknesses in algebraic procedures and sequential calculations.

Implicitly, these research results require teachers to explicitly train each stage of Newman's problem-solving process, particularly the encoding stage which is often overlooked, as well as to apply an error-based learning approach and provide structured problem-solving worksheets so that students become accustomed to writing out final answers completely;

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formative assessment should also not only emphasize final results but also the completeness of the process and conclusion. The contributions of this study are theoretical specifically, the mapping of students' error distributions in function-related material based on the NEA, an approach that has rarely been undertaken and practical, serving as an empirical foundation for teachers to design interventions focused on the encoding error stage. Future research prospects include the development of specific learning media or models to reduce encoding errors, qualitative research using cognitive interviews to explore underlying causes, and comparative studies across grade levels or subject areas to test the consistency of Newman's error patterns.

REFERENCES

Andayani, D., Suryani, M., & Mardiyah, A. (2022). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Matematika Berdasarkan Kemampuan Akademik Siswa. *AXIOM: Jurnal Pendidikan dan Matematika,* *11*(1), 79–87. https://doi.org/10.30821/axiom.v11i1.9066

Aswan, A., Pratiwi Putri, D. E., Prayoga, H. A., & Oktavi, N. S. (2024). Analisis kesalahan siswa MTs dalam menyelesaikan soal-soal aljabar menggunakan teori Newman. *Jurnal Axioma: Jurnal Matematika dan Pembelajaran,* *9*(1), 27–38. https://doi.org/10.56013/axi.v9i1.2502

Azzahra, A. F., & Hidayati, N. (2024). Analisis kesalahan siswa dalam menyelesaikan soal cerita sistem persamaan linear dua variabel berdasarkan Newman's Error Analysis (NEA). *Phi: Jurnal Pendidikan Matematika,* *8*(1), 103– 112. https://doi.org/10.33087/phi.v8i1.361

Daswarman. (2020). Analisis kesalahan mahasiswa dalam menyelesaikan soal matematika ditinjau dari prosedur Newman. *Jurnal Eksakta Pendidikan (JEP),* 4(1). https://doi.org/10.24036/jep/vol4-iss1/435

Febriana, M., Agustina, S., Valentina, V., Muhammad, R. R., & Anggoro, B. S. (2024). Analisis kesalahan siswa dalam menyelesaikan soal cerita pada operasi bilangan berdasarkan prosedur Newman's Error Analysis (NEA): Case study. *Pendas: Jurnal Ilmiah Pendidikan Dasar,* *9*(4), 363–378. https://journal.unpas.ac.id/index.php/pendas/article/view/19925

Febryana, E., Sudiana, R., & Pamungkas, A. S. (2023). Analisis kesalahan siswa dalam menyelesaikan soal matematika bertipe HOTS berdasarkan teori Newman. *Supremum Journal of Mathematics Education (SJME),* *7*(1), 15–28. https://doi.org/10.35706/sjme.v7i1.6586

Hartana, D. D., Yenni, Y., & Hartantri, S. D. (2023). Analisis Kesalahan Menyelesaikan Soal Cerita Matematika Melalui Prosedur Newman Pada Siswa Sekolah Dasar. *Jurnal Basicedu,* *7*(3), 1539–1548. https://doi.org/10.31004/basicedu.v7i3.5440

Heri, V., Suratman, D., Ahmad, B. S., Nursangaji, A., & Fitriawan, D. (2022). Analisis Kesalahan Peserta Didik Dalam Menyelesaikan Soal Fungsi. *Transformasi: Jurnal Pendidikan Matematika dan Matematika,* *6*(2), 133–142. https://doi.org/10.36526/tr.v6i2.2132

Muharam, D., & Rahayu, I. (2025). Analisis Kesalahan Numerasi Siswa Sma Berdasarkan Tahapan Kesalahan Newman. *SIGMA,* *16*(2), 243-257. https://doi.org/10.26618/sigma.v16i2.15011

Nurfalah, I. A., Novtiar, C., & Rohaeti, E. E. (2021). Analisis Kesalahan Siswa Berdasarkan Kategori Newman dalam Menyelesaikan Soal Materi Fungsi. *JPMI – Jurnal Pembelajaran Matematika Inovatif,* *4* (1), 205-214.

https://journal.ikipsiliwangi.ac.id/index.php/jpmi/article/view/4253/2149

Putri, F. I., & Murtiyasa, B. (2024). Newman's Error Analysis (NEA) dalam menyelesaikan soal matematika pada materi aritmatika sosial. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *8*(1), 621–633. https://doi.org/10.31004/cendekia.v8i1.2398

Putrieny, K., & Setiani, R. (2023). Newman Error Analysis (NEA) dalam pemecahan masalah berdasarkan teori Polya soal cerita bertipe HOTS materi volume balok siswa kelas V SDN 2 Tanggulwelahan. *Jurnal Pendidikan Dewantara*, *9*(2), 64– 71. https://doi.org/10.55933/jpd.v9i2.512

Rohilah, L., Anugraini, A. P., & Kartika, E. D. (2024). Analisis Kesalahan Siswa Dalam Memecahkan Soal Matematika Materi Aljabar Berdasarkan Newman Error Analysis. *Prismatika: Jurnal Pendidikan dan Riset Matematika*, *7*(1), 64-73. http://ejurnal.uibu.ac.id/index.php/prismatika/article/view/174

Tanzimah, T., & Sutrianti, D. (2023). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Pada Materi Peluang Berdasarkan Prosedur Newman's Error Analysis (NEA). *Indiktika: Jurnal Inovasi Pendidikan Matematika*, *5*(2), 191–200. https://doi.org/10.31851/indiktika.v5i2.11469

Safira, D., Wibawa, K. A., & Noviyanti, P. L. (2023). Analisis Kesalahan Siswa Berdasarkan Prosedur Newman dalam Menyelesaikan Soal Tipe Pemecahan Masalah Ditinjau dari Gaya Kognitif FI dan FD. *Jurnal Pembelajaran dan Pengembangan Matematika (PEMANTIK)*, 3(1), 55-68. https://doi.org/10.36733/pemantik.v3i1.6249

Siregar, B. H., Sitorus, G. E., Pratiwi, I. A., Sibarani, K., Samosir, M. I., Sukma, M., Tarigan, S. A., & Sarah, S. (2025). Analisis Kesalahan dalam Menyelesaikan Soal Cerita Fungsi Kuadrat Berdasarkan Prosedur Newman: Studi Kasus di Kelas XI SMA. *Jurnal Didactical Mathematics*, *7*(1), 45-57. https://doi.org/10.31949/dm.v7i1.11989

Sutama, & Indriyani, Y. P. (2021). Analisis kesalahan siswa dalam menyelesaikan soal persamaan garis lurus dan hambatan belajar pada masa PPKM. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 1– 12. https://doi.org/10.24127/ajpm.v10i4.4221

Widyasusanti, M. (2024). Analisis kesalahan siswa menurut teori Newman dalam menyelesaikan soal cerita matematika pada materi penjumlahan dan pengurangan. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(1). https://journal.unpas.ac.id/index.php/pendas/article/view/23768

Yanuarto, W. N., & Romadona, F. (2021). Analisis kesalahan matematis siswa berdasarkan Newman Error Analysis (NEA) ditinjau dari gaya belajar. *Jurnal Pendidikan Matematika*, *3*(1), 1–10. https://journal.umbjm.ac.id/index.php/THETA/article/download/372/224

Zahiroh, U. R., Rangkuti, A. N., & Adinda, A. (2025). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matematika Pada Materi Turunan Fungsi. *Jurnal Pendidikan Tambusai*, *9*(1), 5196–5208. https://jptam.org/index.php/jptam/article/view/27718

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