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MATHEMATICAL ERRORS OF JUNIOR HIGH SCHOOL STUDENTS IN SOLVING STORY PROBLEMS BASED ON THE NEWMAN PROCEDURE

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Abstract. Students frequently encounter difficulties when solving algebraic story problems, often due to limited problem-solving and critical thinking skills. This study aims to analyze the types of student errors in solving algebraic operation story problems based on Newman's Error Analysis and to investigate the underlying causes of these errors. The research employed a qualitative descriptive method, with 30 eighth-grade students from SMP Negeri 26 Pekanbaru as participants. Data were collected through written tests and follow-up interviews, then analyzed using techniques of data reduction, data display, and conclusion drawing. The results revealed five main categories of errors: reading errors (16.67%), comprehension errors (16.67%), transformation errors (8%), process skills errors (19.33%), and errors in writing the final answer (28%). These findings indicate that students face challenges at every stage of the problem-solving process. The causes include poor reading comprehension, difficulty understanding mathematical language, and insufficient mastery of algebraic procedures. It is concluded that addressing these issues requires targeted instructional strategies to strengthen students' skills in each problem-solving phase.

Keywords: *Mathematical Errors, Story Problems, Algebraic form Operations, Newman Theory*

1. INTRODUCTION

Mathematics plays a fundamental role in human life and is widely regarded as a core component of education across all levels [1], [2]. It is not only essential for academic success but also for practical problem-solving in everyday contexts such as financial planning, time management, and spatial reasoning. Mathematics is considered the "parent of all sciences," highlighting its significance as a foundational discipline in every student's educational journey [3]. Its applicability spans from the simplest counting tasks to complex analytical processes encountered throughout life.

Despite its importance, mathematics remains one of the most challenging subjects for students [2], [4]. Numerous studies have shown that many learners—regardless of their academic capabilities—struggle to understand mathematical concepts [5]. This perception of difficulty often arises from abstract concepts, lack of contextualization, and instructional strategies that do not cater to diverse learning needs

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[6], [7]. The acquisition of mathematical skills is non-negotiable, as these skills serve as tools to interpret and solve real-world problems involving numbers, measurements, and logical relationships.

One particular area of concern in mathematics education is the ability of students to solve word problems [8], [9]. Word problems are a central part of mathematics curricula as they encourage students to apply their knowledge to realistic scenarios [10]. Solving word problems requires a multi-step process: understanding the problem context, identifying relevant data, formulating equations, and executing appropriate calculations [11], [12]. Word problems are instrumental in fostering students' mathematical problem-solving abilities [13], [14]. However, these problems are inherently more complex than straightforward computation-based questions, as they demand a high level of reading comprehension, logical reasoning, and translation of linguistic statements into mathematical expressions.

Unfortunately, many students fail to solve word problems accurately due to several types of errors [15]. These include difficulties in understanding the problem, confusion in selecting the correct mathematical operations, and misinterpretation of lengthy problem descriptions [16]. Often, students lose confidence, become disengaged, and resort to imitating peers' work without fully engaging in the problem-solving process. To analyze the types of errors students make, researchers often use Newman’s Error Analysis framework, which categorizes errors into five stages: reading, comprehension, transformation, process skills, and encoding [17]. For instance, reading errors occur when students misread key information, while comprehension errors arise from a lack of understanding of the question. Transformation errors involve the incorrect translation of verbal problems into mathematical representations. Process skill errors occur when students lack the procedural fluency to carry out calculations, and encoding errors reflect failures in presenting the final answer correctly.

Therefore, this study aims to identify and analyze the types of mathematical errors made by junior high school students when solving word problems involving algebraic operations. By understanding the specific stages at which students struggle, educators can develop more effective teaching strategies to improve students’ comprehension, problem- solving skills, and overall mathematical proficiency.

2. RESEARCH METHOD

This study adopted a qualitative approach with a descriptive design, aiming to explore and describe in depth the types of errors made by junior high school students in solving algebraic operation word problems and to investigate the causes of such errors based on Newman's Error Analysis framework. A qualitative approach was deemed appropriate as it enables a comprehensive examination of students' cognitive processes, particularly how they interpret, understand, and solve mathematical problems. By employing this approach, the study sought not only to identify errors but also to gain insight into students' thought processes and the difficulties they encounter at each stage of problem-solving. The research was conducted at SMP Negeri 26 Pekanbaru, a public junior high school located in Indonesia, which has a diverse student population in terms of academic ability. A total of 30 eighth-grade students were purposively selected as research participants. The selection was based on several criteria: (1) students had completed the algebraic operation unit, (2) represented various academic achievement levels (high, medium, and low), (3) were willing to participate, and (4) were able to articulate their thoughts during the interview process. This purposive sampling ensured that the data collected would provide rich and relevant insights into the phenomenon under investigation.

Data collection was carried out using two primary techniques: written tests and semi-structured interviews. The written test consisted of five algebraic word problems that were carefully designed to correspond to the five stages of Newman's Error Analysis: reading, comprehension, transformation, process skills, and encoding (final answer writing). Each problem required students to not only perform algebraic operations but also interpret real- life contexts, translate word problems into mathematical expressions, execute operations, and provide accurate answers. The test was administered under standard classroom conditions with a time limit of 60 minutes. Prior to administration, the test items were validated by two university mathematics educators and one experienced mathematics teacher to ensure content validity and alignment with Newman's framework. Following the test, semi-structured interviews were conducted with nine selected students—three from each achievement group (high, medium, low). The interviews aimed to further explore the reasoning behind students' errors and to clarify any ambiguities in their written responses. Interview questions were developed

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based on students' test results and tailored to each stage of Newman's framework. The interviews were conducted individually in a quiet room to ensure that students could reflect on their thought processes without distractions. Each session was audio-recorded with the participants' consent for subsequent transcription and analysis.

The research instruments included: (1) a written test sheet containing five algebraic word problems, (2) an interview guide with open-ended questions aligned with the Newman error stages, (3) a rubric for classifying errors based on Newman's theory, and (4) recording devices. All instruments were piloted before data collection to refine questions and instructions based on student feedback and expert reviews. Data analysis followed the interactive model proposed by Miles and Huberman, which consists of three main steps: data reduction, data display, and conclusion drawing/verification. During data reduction, the researchers reviewed students' test papers and transcribed interviews to identify recurring patterns of errors. Errors were coded and categorized based on the five Newman stages. For example, if a student misinterpreted key terms in the problem statement, the error was classified under "comprehension error." This process allowed for systematic sorting of data and facilitated a deeper understanding of error distribution and causes.

The second step, data display, involved organizing the reduced data into visual formats such as frequency tables, matrices, and descriptive narratives. This step enabled the researchers to observe patterns and relationships more clearly. The frequency of each type of error was calculated to identify the most prevalent error types. Additionally, quotations from student interviews were presented to support and illustrate the quantitative findings, providing a holistic view of students' mathematical thinking and misconceptions. The final step was conclusion drawing and verification. The researchers interpreted the findings in light of the research questions and existing literature. To enhance the trustworthiness of the results, triangulation was employed by comparing data from different sources (tests and interviews) and by involving peer debriefing sessions among the research team. Furthermore, member checking was conducted by sharing summarized findings with selected participants to confirm the accuracy of the interpretations.

To ensure the credibility and reliability of the study, several strategies were implemented. Credibility was achieved through prolonged engagement with the data, triangulation of data sources, and member checking. Transferability was supported by providing a detailed description of the research context, participant characteristics, and procedures, allowing other researchers to assess the applicability of the findings to different contexts. Dependability was maintained by documenting the research process in an audit trail, including raw data, field notes, and coding schemes. Confirmability was ensured through reflexive journaling and the use of direct quotations to show that interpretations were grounded in participant responses. Ethical considerations were carefully observed throughout the research process. Informed consent was obtained from all participants and their guardians prior to data collection. Participants were assured that their identities would remain confidential and that their involvement in the study was entirely voluntary. Pseudonyms were used in all documentation and reporting to protect student privacy. The research protocol was reviewed and approved by the institutional ethics committee of the researchers' university.

In conclusion, the methodology employed in this study was carefully designed to ensure a comprehensive, rigorous, and ethical examination of students' errors in solving algebraic operation word problems. By combining written assessments with in-depth interviews and employing a robust analytical framework, the study provides valuable insights into how students engage with mathematical problems and where they are most likely to encounter difficulties. The findings from this methodological approach can inform educators and curriculum developers in designing instructional strategies that target specific problem-solving stages and foster deeper mathematical understanding among students.

The data obtained were then analyzed based on the error indicators according to Newman's theory as follows:

Table 1. Indicators of Student Error According to Newman

No.	Procedure Newman	Indicators
1	Reading Errors	a. Students can read or recognize symbols or keywords in the problem. b. Students interpret the meaning of each word, term or symbol in the problem.
2	Comprehension Errors	a. Students understand what is known. b. Students understand what is being asked.
3	Transformation Errors	a. Students know what formulas to use in solving the problem. b. Students know the calculation operations that will be used.

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		c. Students can create a mathematical model of the problem presented.
4	Process Skill Errors	a. Students know the procedures or steps to be used in solving the problem. b. Students can explain the procedures or steps to be used. c. Students can create a mathematical model of the problem presented
5	Endcoding Errors	a. Students can show the final answer to the problem. b. Students can write the final answer in accordance with the conclusion referred to in the problem.

3. RESULTS AND DISCUSSION

3.1 Results

Based on the results of the research, the results of the tests and interviews that have been conducted based on the indicators of student errors according to Newman's procedure are presented in the table as follows:

Table 2. Scoring Student Errors in Solving Descriptive Problems Based on Newman's Procedure

Indicators	**K1**	**K2**	**K3**	**K4**	**K5**
Number of errors	25	25	12	29	42
Percentage of student errors	16,67%	16,67%	8%	19,33%	28%

Based on Table 2, the distribution of student errors in solving algebraic word problems follows a distinct pattern aligned with Newman's Error Analysis framework. Reading and comprehension errors each accounted for 16.67%, indicating that a notable portion of students encountered difficulties in accurately interpreting the text of the problem and understanding its meaning. Transformation errors, which involve converting the problem into a suitable mathematical representation, were relatively lower at 8%, suggesting that students who were able to comprehend the problem generally succeeded in this phase. However, errors related to process skills—applying the correct operations and procedures— were higher, at 19.33%, reflecting challenges in executing algebraic calculations or selecting the appropriate operations. The highest percentage of errors, 28%, occurred at the final stage: writing the final answer. This suggests that many students either misinterpreted the required form of the answer, failed to complete their solutions, or made careless mistakes in presenting their results.

The graphical representation accompanying these results clearly illustrates that the encoding stage poses the most significant obstacle for students. These findings highlight the importance of reinforcing instruction not only on procedural fluency but also on interpreting, organizing, and communicating mathematical solutions effectively.

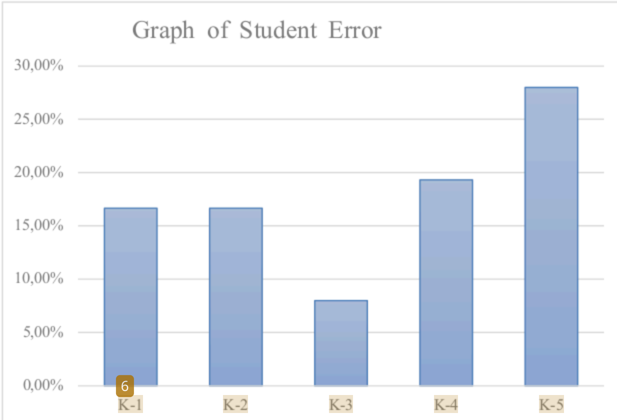

Figure 1. Diagram of the Percentage of Students' Errors in Solving Story Problems of Algebraic Form Operation Material

Based on the data obtained from the results of research on 30 students in class VIII-3 SMP Negeri 26 Pekanbaru, it shows that students make mistakes at the reading stage, the stage of understanding the problem, problem transformation, process ability, and writing the final answer. That student errors in working on math story problems can be divided into five types of errors, namely reading errors, comprehension errors, errors in transformation, process skills errors, and endcoding errors [18].

3.2. Discussion

This study shows that the cause of students making mistakes at the reading stage and the stage of understanding the problem is because students cannot determine what is known and what is asked in the problem correctly and completely. It was even found that several times students ignored it because they felt it was not necessary or not too important to be written into the answer sheet and also students did not write it down because they were in a hurry to do the problem.

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In the error in problem transformation because students cannot make a mathematical model of the problem they are working on. This happens because students are less skilled in making mathematical models due to lack of practice. Furthermore, errors in the problem process ability stage are caused by the transformation of the problem previously carried out incorrectly, students do not understand the concept of algebraic operations and students cannot determine what formula to use in solving algebraic story problems. not infrequently students are even less careful in calculating mathematical operations. Errors in writing the final answer are caused by students not finding the final answer, not being precise in writing conclusions and students ignoring them because they feel unnecessary and in a hurry to solve them so that students are wrong in writing the final answer.

This agrees with Jha and Singh in Dwi Oktaviana (2019), that the cause of students making mistakes understanding the problem because students do not understand the problem in the problem, causing students to be unable to determine what is known and asked about the problem. The cause of problem transformation errors is because students are unable to choose the operation that will be used to solve the given problem. The cause of errors in process skills is that students are unable to perform arithmetic operations with the correct procedures in working on problems. While the cause of errors in the final answer writing stage is the lack of student awareness in re-examining the final answer. Based on the above opinion, it can be concluded that there are several causes of students making mistakes in reading, errors in understanding the problem, transformation, process ability, writing the final answer as stated above.

Students often encounter difficulties when solving algebraic word problems, which can be systematically categorized using Newman's Error Analysis (NEA). NEA identifies five types of errors: reading, comprehension, transformation, process skills, and encoding. A study by Kenney and Ntow [1] revealed that students frequently make comprehension and process skill errors, indicating challenges in understanding problem statements and executing appropriate procedures. Similarly, Indriana et al. [2] found that both male and female students struggled with comprehension and final answer writing, highlighting the pervasive nature of these errors across genders. These findings underscore the importance of addressing foundational reading and comprehension skills to improve problem-solving abilities. Encoding errors, which involve incorrectly writing the final answer, are notably prevalent among students. Previous research results show that students with visual learning styles often made encoding errors, suggesting a link between learning preferences and error types [19]. The other research emphasized that errors in earlier stages, such as comprehension and transformation, often lead to encoding mistakes, indicating a cascading effect of misunderstandings [20]. These insights highlight the need for instructional strategies that reinforce each stage of problem-solving to prevent errors from compounding.

Learning styles and self-confidence significantly influence the types of errors students make. Students with high learning interest still committed encoding and process skill errors, while those with low interest exhibited a broader range of mistakes, including comprehension and transformation errors [21]. The other research reported that students with low self-confidence struggled primarily with reading and comprehension, whereas those with higher confidence levels faced challenges in transformation and process skills [22]. These findings suggest that tailored interventions considering individual learning profiles could enhance problem-solving performance.

Implementing scaffolding techniques has proven effective in mitigating student errors. Previous research demonstrated that providing structured support during problem-solving activities reduced misunderstandings and process skill errors [23]. Their study showed that students benefited from guided instruction that clarified problem requirements and procedural steps. The role of targeted teaching strategies in addressing specific error types identified through NEA. Such evidence supports the integration of scaffolding methods in mathematics education to enhance student comprehension and execution.

The insights gained from NEA studies have significant implications for teaching practices. The importance of diagnosing specific error types to inform instructional design, enabling educators to address student misconceptions effectively [24]. The use of NEA as a diagnostic tool to tailor teaching methods to student needs, thereby improving learning outcomes. By incorporating NEA into regular assessment and feedback mechanisms, teachers can foster a more responsive and supportive learning environment that addresses the diverse challenges students face in solving algebraic word problems.

4. CONCLUSION

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Based on the results of data analysis of students' errors in solving algebraic story problems that have been presented previously, it can be concluded that the errors made by students based on Newman's stage procedures include, (1) Reading errors, students consider that writing known things and things asked on the answer sheet is unnecessary and not very important. In addition, students do not write what is known and asked because they are in a hurry to do the problem, (2) Comprehension errors, students' lack of understanding of the material that has been given or that has been taught by the teacher before and students' lack of accuracy in reading the problem sentence, (3) Transformation errors, students are less skilled and less practiced in converting problem sentences into mathematical models, (4) Process skills errors, students do not understand the material that has been taught before, resulting in students being unable to determine what formula will be used to solve algebraic story problems. In addition, it is not uncommon to find students who are less careful and less thorough in the process of solving algebraic story problems and (5) Endcoding errors, lack of awareness of students in checking the final answer and feel no need to write the conclusion of the answer because they have found the answer to the problem that has been done.

REFERENCES

[1] M. C. Borba, "The future of mathematics education since COVID-19: Humans-with- media or humans-with-non-living-things," *Educ. Stud. Math.*, vol. 108, no. 1, pp. 385–400, 2021.

[2] A. Bakker, J. Cai, and L. Zenger, "Future themes of mathematics education research: An international survey before and during the pandemic," *Educ. Stud. Math.*, vol. 107, no. 1, pp. 1–24, 2021.

[3] S. Ramadhani, L. Leonard, M. A. Nurmantoro, and J. M. Sumilat, "The Development of MONOTIKA (Monopoly Mathematics) Learning Media in Algebraic Material for Junior High School Students in Grade VII," *Form. J. Ilm. Pendidik. MIPA*, vol. 12, no. 1, 2022.

[4] A. Alfarano, F. Charton, and A. Hayat, "Global lyapunov functions: a long-standing open problem in mathematics, with symbolic transformers," *Adv. Neural Inf. Process. Syst.*, vol. 37, pp. 93643–93670, 2024.

[5] S. T. Hamukwaya and Ç. Haser, "'It does not mean that they cannot do mathematics': Beliefs about mathematics learning difficulties," *Int. Electron. J. Math. Educ.*, vol. 16, no. 1, p. em0622, 2021.

[6] M. B. Ciurana and O. M. García, "' Help! I feel unprepared': Exploring university faculty and autistic students' voices on self-efficacy in higher education inclusion," *Teach. Teach. Educ.*, vol. 159, p. 104990, 2025.

ISSN: 2620-4129
E-ISSN: 2621-3885

[7] Y. Song, L. R. Weisberg, S. Zhang, X. Tian, K. E. Boyer, and M. Israel, "A framework for inclusive AI learning design for diverse learners," *Comput. Educ. Artif. Intell.*, p. 100212, 2024.

[8] S. Rahayuningsih, S. Sirajuddin, and N. Nasrun, "Cognitive Flexibility: Exploring Students' Problem-Solving in Elementary School Mathematics Learning.," *J. Res. Adv. Math. Educ.*, vol. 6, no. 1, pp. 59–70, 2021.

[9] V. Manfreda Kolar and T. Hodnik, "Mathematical literacy from the perspective of solving contextual problems.," *Eur. J. Educ. Res.*, vol. 10, no. 1, pp. 467–483, 2021.

[10] L.-M. Hartmann, J. Krawitz, and S. Schukajlow, "Create your own problem! When given descriptions of real-world situations, do students pose and solve modelling problems?," *ZDM–Mathematics Educ.*, vol. 53, no. 4, pp. 919–935, 2021.

[11] D. R. N. Jannah, "Polya's Approach to Analyze Students' Errors in HOTS Mathematics' Story Problems: Case Study in Elementary Schools," *J. Ilm. Sekol. Dasar*, vol. 8, no. 4, pp. 673–685, 2024.

[12] T. P. Mkhatshwa, "Students' thinking about problem solving tasks: the case of initial value problems," *Int. J. Math. Educ. Sci. Technol.*, vol. 55, no. 8, pp. 2025–2045, 2024.

[13] E. Eliaumra, D. P. Samaela, and N. K. Muhdin, "Developing diagnostic test assessment to measure creative thinking skills of Biology preservice teacher students," *REID (Research Eval. Educ.*, vol. 8, no. 2, p. 6, 2022.

[14] N. Kania, Y. S. Kusumah, J. A. Dahlan, E. Nurlaelah, F. Gürbüz, and E. Bonyah, "Constructing and providing content validity evidence through the Aiken's Vindex based on the experts' judgments of the instrument to measuremathematical problem- solving skills," *REID (Research Eval. Educ.*, vol. 10, no. 1, p. 5, 2024.

[15] C. A. Barbieri, L. K. Young, K. J. Newton, and J. L. Booth, "Predicting middle school profiles of algebra performance using fraction knowledge," *Child Dev.*, vol. 92, no. 5, pp. 1984–2005, 2021.

[16] L. H. N. Mutambara and S. Bansilal, "A case study of in-service teachers' errors and misconceptions in linear combinations," *Int. J. Math. Educ. Sci. Technol.*, vol. 53, no. 11, pp. 2900–2918, 2022.

[17] K. M. A. Fauzi and Y. Hia, "Types of student errors in the trajectory of thinking solving analytical geometry questions based on Newman'S Error Analysis (NEA)," in *AIP Conference Proceedings*, AIP Publishing, 2022.

[18] M. Adewiani, T. Rahmat, and H. Fitri, "Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Cerita Pada Pembelajaran Matematika Di Kelas Vii Smpn 1 Lareh Sago Halaban Berdasarkan Tahapan Newman," *Imajiner J. Mat. dan Pendidik. Mat.*, vol. 5, no. 4, pp. 293–300, 2023.

[19] S. M. Ulfa, "Analysis of Student Errors in Solving Mathematical Story Problems Based on Newman's Theory in View of Student Learning Styles," *J. Math. Pedagog.*, vol. 4, no. 2, pp. 97–105, 2023.

[20] M. Zulyanty and A. Mardia, "Do students' errors still occur in mathematical

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word problem-solving?: A newman error analysis," *Al-Jabar J. Pendidik. Mat.*, vol. 13, no. 2, pp. 343–353, 2022.

[21] A. M. Annizar and D. F. Kumala, "Analysis of student problem-solving errors based on Newman's theory in terms of learning interest and gender," *Alifmatika J. Pendidik. Dan Pembelajaran Mat.*, vol. 5, no. 1, pp. 40–56, 2023.

[22] N. Nugraheni, Y. L. Sukestiyarno, W. Wardono, and M. Masrukan, "Newman Error Analysis To Identify Student Errors In Solving High-Order Thinking Skills Problems Based On Self-Confidence," in *International Conference on Science, Education, and Technology*, 2021, pp. 427–433.

[23] A. Upu, P. N. L. Taneo, and F. Daniel, "Analisis kesalahan siswa dalam menyelesaikan soal cerita berdasarkan tahapan newman dan upaya pemberian scaffolding," *Edumatica J. Pendidik. Mat.*, vol. 12, no. 01, pp. 52–62, 2022.

[24] S. L. Chew and W. J. Cerbin, "The cognitive challenges of effective teaching," *J. Econ. Educ.*, vol. 52, no. 1, pp. 17–40, 2021.

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