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SYSTEMATIC LITERATURE REVIEW: ANALYSIS OF MIDDLE SCHOOL STUDENTS' DIFFICULTIES IN SOLVING INTEGER PROBLEMS

Rifqi Aulia Miftahudin[1*], Harry Dwi Putra[2]
[1,22]Departement of Mathematics Education, IKIP Siliwangi, Cimahi, Indonesia
*Correspondence: rifqi.aulia@pustakailmiah.id

ABSTRACT

Middle school students often encounter dificulties in solving integer operation problems, such as understanding concepts like positive and negative integers and correctly applying arithmetic symbols. This study utilizes a Systematic Literature Review (SLR) approach to analyze these difficulties, searching academic databases like Google Scholar, ResearchGate, and Sinta for relevant articles published from 2019 to 2023 and included articles published in 2024 . Articles were selected based on criteria assessing their relevance to the research topic, methodological rigor, and contribution to understanding students' struggles in integer operations. The research identifies three main difficulties: conceptual comprehension, handling factual knowledge, and procedural application. Many students struggle with applying learned concepts, differentiating between positive and negative integers, and using arithmetic symbols accurately. Factors contributing to these difficulties include a lack of seriousness in problem-solving, reliance on peers for answers, and hesitancy in seeking assistance from teachers. The study recommends reinforcing fundamental concepts through diverse teaching methods, fostering student independence in mathematical problem-solving, and developing critical thinking skills to support students in overcoming these challenges and improving their mathematical proficiency.

Keywords : Integer operations, student difficulties, systematic literature review, middle school students.

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PRELIMINARY

Mathematics is a field of study with an emphasis on achieving problem-solving skills, communication, reasoning, and conceptual understanding, alongside several competency standards. Success in learning mathematics involves demonstrating the ability to solve encountered problems. Mathematics has an important role in terms of scientific value, both arithmetic and the application of exact sciences in solving problems in everyday life (Nuha & Subayani, 2024). The abstract nature of mathematics causes many students to struggle in understanding and applying it to given mathematical problems. Mathematics is a human activity involving mental activities such as thinking. Students who successfully solve problems from the teacher correctly, it can be told that the student has successfully learned

in understanding the mathematical concepts given by the teacher (Putra et al., 2020). Therefore, students need to be guided by teachers with proper planning.

Mathematics, as the foundation of various fields of knowledge, plays a central role in life (Febriyani & Setyaningsih, 2024). The subject of integer operations in 7th-grade middle school serves as a foundation or prerequisite for subsequent topics in mathematics, such as algebra and systems of linear equations involving two variables. In the topic of integer operations, problems often appear in narrative form, causing students confusion in drawing conclusions and a lack of conceptual understanding to solve the problems. Teachers design narrative problems to assess students' abilities. However, many students still face difficulties in understanding and solving given problems.

Based on research conducted Yanala et al. (2021), it was concluded that the understanding of mathematical concepts on integer operations for 7th-grade students at SMP Negeri 4 Gorontalo was in the medium category with a percentage of 76%, with a total of 25 students. A similar conclusion was obtained by Melindarwati & Munandar (2022) who analyzed 7th-grade students at SMP Negeri 1 Cikampek and showed that students' ability to solve mathematical problems in integer operations was in the low category because many students completed the problems incorrectly and made mistakes in their answers. Further explained by Yunita & Pratiwi (2022), the difficulty in solving integer operations lies in the students' understanding of concepts, factual stages, and procedural stages. The analysis revealed that many students still struggle with integer operations due to their lack of understanding of mathematical concepts and inability to draw conclusions to solve the problems.

Waskitoningtyas explained that difficulties arise due to students' inability to learn because they have not mastered concepts, facts, principles, and skills (Benge et al., 2021). Concepts, facts, and principles in a topic are information from a phenomenon that can be used as a source to draw conclusions, thereby enabling problem-solving. This lack of mathematical reasoning ability hinders students. Reasoning involves a person's mental process in using the information or knowledge they possess to reach a conclusion or make a decision. Reasoning involves the ability to think logically, rationally, analytically, connect concepts, make assumptions, and draw conclusions based on the presented phenomenon. Efforts to identify students' difficulties in solving problems on integer operations can be carried out by providing diagnostic tests and conducting interviews with students who make many mistakes. The purpose of these tests is to identify the difficulties students face (Benge et al., 2021).

Based on the problem review above, the researcher is interested in focusing the research on middle school students related to the topic of integer operations. This study aims to describe students' difficulties in solving problems related to integer operations by analyzing various articles related to students' mistakes in solving problems on integer operations.

This research has novelty by adopting the Systematic Literature Review (SLR) method, which aims to identify, evaluate, and interpret all relevant research related to students' mistakes in solving integer operation problems. This SLR method ensures that the research is conducted systematically and structurally, providing a comprehensive overview of the issues being studied. Thus, this study not only describes students' difficulties but also identifies common patterns and factors contributing to these mistakes based on existing literature.

This research fills the gap by providing an in-depth and thorough analysis of students' mistakes in integer operations, which may not have been systematically discussed in the literature before. By compiling and analyzing results from various studies, this research is expected to provide stronger and evidence-based recommendations for improving teaching and learning methods of integer operations in middle schools.

METHODS

This research utilizes the Systematic Literature Review (SLR) method. The SLR method is a research procedure that produces a description of the phenomenon being studied. The method involves conducting various stages aimed at identifying, reviewing, evaluating, and interpreting research results in line with the relevant field, topic, and phenomenon, accompanied by several relevant research questions (Triandini et al., 2019)

This study analyzes and describes the difficulties faced by 7th-grade middle school students in solving integer operation problems. Data collection techniques in this study involved gathering various scholarly articles from various journals, especially those focused on mathematics research and mathematics education. To facilitate the search for articles with similar themes, the researcher used databases such as Google Scholar, ResearchGate, and Sinta to aid in collecting articles and reference sources. To align the collected articles, the researcher used keywords like "difficulty analysis" and "integer." These keywords were chosen to ensure that the articles found were relevant to the research focus on the difficulties students face with integer operations.

The study involved planning, data collection, data analysis, data interpretation, and reporting the research results. We conducted data collection by gathering 25 articles published in the last 5 years, from 2019 to 2023, and included articles published in 2024. This was done to ensure that the data and analysis from the articles were current and relevant. Additionally, the articles needed to specifically discuss the difficulties students face with integer operations. Articles that did not focus on this topic were excluded. The selected articles had to be original research, systematic reviews, or meta-analyses, meaning that opinion pieces or brief reports were excluded. Lastly, the articles had to come from recognized or well-indexed journals in the aforementioned databases.

The screening process began with an initial search using the predetermined keywords in each database. Next, titles and abstracts of the found articles were screened to evaluate their relevance. Articles that passed the title and abstract screening were then evaluated in full text to ensure they met all inclusion criteria. From the fully evaluated articles, the 25 most relevant articles that met all inclusion criteria were selected.

The researcher grouped related articles into 3 columns containing the authors' names and article publication years, the journal that published the article, and research results. Subsequently, the researcher reviewed and analyzed the articles in-depth to obtain an overview of the analysis of middle school students' difficulties with integer operations.

RESULT AND DISCUSSION

The data results included in this literature review are summarized from articles published in the last 5 years, from 2019 to 2023, and included articles published in 2024 then documented concerning math difficulties and its effects, presented in the table 1. below:

Table 1. **Research Results on Difficulty Analysis in Integer Operations**

Researcher	Journal	Research Results
(Ratnasari et al., 2023)	JPMI: Jurnal Pembelajaran Matematika Inovatif	Students find it difficult to solve complex operation problems. Factors include: (1) Lack of understanding of operation concepts, (2) unclear teacher explanations, (3) inadequate use of learning the media.
(Benge et al., 2021)	Mega: Jurnal Pendidikan Matematika	Students lack understanding of the concepts involved in adding and subtracting integers and struggle with translating narrative problems into mathematical models.

(Yunita & Pratiwi, 2022)	THEOREMS (The Journal of Mathematics)	Most students experience difficulties in understanding concepts, applying facts, and procedural stages/skills in integer problems.
(Malau et al., 2022)	Jurnal Pendidikan	These learning obstacles include difficulties in understanding concepts, challenges in applying learned facts and procedures, and struggles with interpreting problem statements. Identifying and addressing these obstacles is essential for facilitating effective learning and problem-solving in mathematics.
(Rio & Pujiastuti, 2020)	AKSIOMA: Jurnal Matematika dan Pendidikan Matematika	High, medium, and low-ability students all face challenges in interpreting the problems given by the teacher.
(Yanala et al., 2021)	JAMBURA: Journal of Mathematics Education	The analysis indicates that the comprehension of mathematical concepts in integer operations falls within the medium category.
(Utami & Hakim, 2023)	Jurnal Didactical Mathematics	The mathematical problem-solving ability of 7th-grade students in Karawang is in the medium category for integer and fraction topics.
(Hamapinda et al., 2021)	Edumatica: Jurnal Pendidikan Matematika	Students' weaknesses in solving problems include not writing encountered information and not analyzing problems first.
(Baene, 2024)	Jurnal Pendidikan Tambusai	The conclusions include: (1) Misunderstanding the problem, marked by not writing known and asked parts of the problem, (2) Calculation errors in the problem-solving steps, (3) Errors in determining the final answer.
(Ruben & Desfitri, 2021)	Jurnal Fakultas Keguruan dan Ilmu Pendidikan	The understanding of integer concepts among 8th-grade students at SMPN 18 Padang is divided into three categories: good, medium, and poor understanding.
(Laksono & Diah Pramesti, 2022)	CIRCLE: Jurnal Pendidikan Matematika	Research indicates that students' errors align with the Kastolan stages, encompassing conceptual errors, procedural errors, and technical errors.
(Syavira & Novtiar, 2021)	JPMI: Jurnal Pembelajaran Matematika	This study shows that students can solve problems correctly, but often skip the problem-solving steps.
(Dodo et al., 2023)	IMEIJ: Indo-MathEdu Intellectuals Journal	Students find it difficult and do not fully understand the problems. For problems they understand, they solve them correctly; for problems they do not understand, they only partially write the problem.

(Surbakti et al., 2024)	Jurnal Pendidikan, Sains dan Teknologi	Students still struggle to identify problems and determine steps to solve them. They are also careless in solving story problems.
(Gustia & Erita, 2023)	CONSISTAN: Jurnal Tadris Matematika	Students show a good improvement in solving mathematical problems, though some are slow to understand given problems and face difficulties.
(Siregar, 2024)	EKSAKTA: Jurnal Penelitian dan Pembelajaran MIPA	Students' lack of understanding in dealing with integer problems is due to a lack of time for problem-solving.
(Tahir et al., 2021)	Jurnal Pendidikan, Sains dan Teknologi	Seventh-grade students at SMP Negeri 5 Kota Ternate made errors in integer arithmetic operations, including factual, conceptual, principled, and operational mistakes. 20% of the students made low-category errors and 45% made very low-category errors
(Ridwan & Hairun, 2020)	SAINTIFIK@: Jurnal Pendidikan MIPA	Students made errors in integer arithmetic operations, including factual, conceptual, principled, and operational mistakes. 20% of the students made low-category errors and 45% made very low-category errors
(Meldawati & Kartini, 2021)	AXIOM: Jurnal pendidikan dan Matematika	Based on the research and discussion, it can be concluded that students at SMP Negeri 2 Bangkinang Kota make various types of errors in solving problems involving positive integer exponents include conceptual errors, procedural errors, and calculation errors.
(Rahayuningsih & Astuti, 2020)	LIKHITAPRAJNA Jurnal Ilmiah	Students who make errors in reading the problem will also experience errors in comprehension, transformation, process skills, and encoding the final answer. Reading errors lead to misunderstandings of the question, hindering the ability to create mathematical models, select appropriate procedures, carry out calculations, and record the final outcome accurately.
(Kusumawati et al., 2022)	Nabla Dewantara: Jurnal Pendidikan Matematika	This research indicates that students tend to struggle with comprehending story problems. Their errors in answering these problems stem from their inability to understand the questions' intentions.
(Marqozi et al., 2023)	Journal of Research in Science and Mathematics Education	The types of errors students make in solving mathematics problems related to integers include comprehension errors, formula usage errors, operational solution errors, and inference errors.

(Rahmatia & Sandy, 2023)	ADVANCES in Social Humanities Research	Students commit multiple errors when solving integer arithmetic story problems, including reading and comprehension errors, difficulty in selecting the correct arithmetic operation, miscalculations, and rushed conclusions.
(Wicaksono & Andriati, 2022)	J'THOMS (Journal Of Techonolgy Mathematics And Social Science)	Errors in problem-solving step from a lack of formula understanding, inaccurate application despite knowing the formula, inappropriate problem-solving steps, and calculation mistakes, resulting in incorrect final answers.
(Meirista & Nurhayati, 2022)	JPPK: Jurnal Pendidikan dan Pembelajaran Khatulistiwa	Errors in reading, understanding, and transformation occur in subjects with comparable abilities, while errors in problem-solving processes occur in subjects with lower abilities. Errors in drawing conclusions occur in all subjects with very low abilities.

Based on the results of table 1. research above, researcher identified three indicators of difficulties in solving integer problems. The researcher used categorization techniques in analyzing the obtained data. Categorization techniques are methods used to group data based on specific themes or categories. In this study, the difficulty indicators were categorized into three main groups: difficulty in understanding concepts, difficulty in the factual stage, and difficulty in interpretation. The explanation of each indicator is as follows. Such difficulties are analyzed as follows:

1. Difficulty in understanding the concept. The lack of understanding of integer operation concepts is a major factor causing students' difficulties in mathematics. Ratnasari et al. (2023) highlight how this lack of conceptual understanding directly obstructs students when attempting to solve integer operation problems. Yunita & Pratiwi (2022) further elaborate on this by pointing out that many students struggle not only with understanding the concepts themselves but also with applying the associated facts and procedural steps in integer problem-solving. Benge et al. (2021) contribute by emphasizing the students' struggle to comprehend basic operations such as addition and subtraction of integers and translating narrative problems into mathematical models. In summary, the inability to comprehend fundamental concepts in integer operations stands as the primary obstacle for students, encompassing both understanding and application of concepts and converting narrative problems into mathematical models.
2. Difficulty in the fact stage. Errors in problem-solving in mathematics are often caused by various factors. Ratnasari et al. (2023) illustrate the challenges students face in

tackling complex operation problems. Yunita & Pratiwi (2022) elaborate on these difficulties, highlighting students' struggles with understanding concepts, applying facts, and following procedural steps. Malau et al. (2022) contribute by categorizing the learning obstacles into three types, indicating a diverse range of difficulties encountered by students. Rio & Pujiastuti (2020) further emphasize the widespread nature of the problem, noting that students of varying abilities encounter difficulties in interpreting problems presented by teachers. This section collectively demonstrates how students face hurdles at different stages of problem-solving, from understanding concepts to applying procedural steps.

3. Difficulty in Interpreting. Students encounter challenges in converting narrative problems into mathematical models, as highlighted by (Benge et al., 2021). Rio & Pujiastuti (2020) and Yanala et al. (2021) emphasize the commonality of difficulties in interpreting problems across students with differing abilities. Kusumawati et al. (2022) further add to this by pointing out how students struggle to understand narrative problems, resulting in errors in their answers due to an inability to grasp the problems' intent. This section underscores the importance of students' ability to interpret and translate narrative problems accurately, which is crucial for successful problem-solving.

Overall, the text provides a comprehensive analysis of the difficulties students face in solving integer problems, supported by various research findings. It emphasizes the interconnected nature of these challenges and stresses the importance of addressing fundamental conceptual understanding, procedural skills, and problem interpretation to enhance students' mathematical proficiency.

Several factors experienced by students cause the above difficulties. Below are the factors that may lead to challenges for students in solving integer-related problems.

1. Procedural and Conceptual Skills

Ratnasari et al. (2023) and Yunita & Pratiwi (2022) highlight the importance of conceptual understanding as the basis for procedural skills. If students do not grasp the basic concepts of integer operations, they tend to make errors in applying procedures and problem-solving steps

2. Teacher Role and Teaching Methods

Ratnasari et al. (2023) indicate that unclear explanations from teachers are a major cause of student difficulties. This emphasizes the importance of teachers to explain concepts in ways that students can easily understand. Rio & Pujiastuti (2020) suggest that more interactive teaching methods and the use of varied instructional media can help address this challenge

3. Use of Instructional Media

Ratnasari et al. (2023) emphasize the importance of adequate instructional media use. The use of visual aids and educational technology can help students understand abstract concepts in mathematics.

4. Use of Instructional Media

Malau et al. (2022) found three types of learning barriers faced by students, including conceptual, procedural, and technical errors. Identifying and understanding these types of errors can aid in designing more effective educational interventions. Marqozi et al. (2023) note various types of errors including understanding, formula use, operational solution, and conclusion errors. This indicates the need for a more holistic approach in teaching problem-solving skills

5. Perception and Mathematics Anxiety

Mathematics anxiety often contributes to difficulties in learning mathematics. Although not explicitly mentioned in the table, this factor can influence how students process mathematical information and solve problems

Another factor causing students' difficulty in solving problems is mathematical calculation issues, as students' calculation abilities are still low. They do not understand or differentiate between negative and positive integers and often forget to recheck their answers. Students rely solely on the textbooks provided by the school, which often leads to difficulties because the problems given by the teacher are not exemplified in the book. Students do not complete assignments related to integer problems on their own. They lack an understanding of the concepts, have insufficient factual knowledge, and lack procedural/skill ability. Students lack confidence and rarely practice integer calculation problems at home or during their free time. They only accept what the teacher explains and

do not want to learn further. Students fail to make an effort to inquire with the teacher about material they find challenging to comprehend, as stated by Hamapinda et al. (2021), most students are too shy to ask the teacher about problems they do not understand.

From several studies, it is clear that the primary difficulty students face in integer operations is related to their understanding of basic concepts, inadequate explanations from teachers, and challenges in interpreting word problems. This research also indicates that these issues are systematic and occur across various levels of student ability, highlighting the need for a more effective teaching approach and the use of better instructional media to assist students in understanding mathematical concepts more thoroughly.

CONCLUSION

Research indicates that students experience three indicators of difficulty in solving integer problems. Many students still struggle to understand concepts, especially in applying learned concepts and differentiating between negative and positive integers, leading to errors in problem-solving. Several factors cause these difficulties, including students not taking problems seriously because they believe tests do not affect school grades, dependence on peers for answers, and a lack of initiative to ask teachers for help. Additionally, laziness in understanding the material taught also significantly contributes to students' difficulties.

Therefore, researchers suggest that in the learning process, emphasis should be placed on strengthening basic concepts using various methods and encouraging student autonomy to motivate critical thinking and problem-solving skills. By implementing these suggestions, it is hoped that students can overcome their difficulties in solving integer problems and improve their understanding and skills in mathematics.

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