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Analysis of Students' Difficulties in Solving Story Problems for Whole Number Subtraction

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ABSTRACT

This study investigates the difficulties experienced by seventh-grade students at SMPN 5 Mengkendek in solving word problems involving whole number subtraction. Employing a qualitative case study approach, data were collected through written diagnostic tests, semi-structured interviews, and documentation. Four students who answered all test items incorrectly were selected for in-depth analysis. The findings reveal three primary categories of difficulty: (1) limited mathematical language comprehension, (2) visual perception challenges, and (3) reading and general language comprehension issues. These difficulties are deeply intertwined and affect students' ability to interpret and solve mathematical problems accurately. Implications for instructional strategies are discussed.

Keywords**:** *mathematical difficulties, whole number subtraction, word problems*

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INTRODUCTION

Mathematics is a foundational discipline essential for cultivating logical reasoning, critical thinking, and problem-solving skills. These competencies are vital for navigating the challenges of the 21st century (NCTM, 2014; Kilpatrick et al., 2001). One persistent challenge in mathematics learning, especially at the lower secondary level, is students' difficulty in solving word problems—particularly those involving basic operations such as whole number subtraction.

Several studies have documented this issue, highlighting how students often struggle with the linguistic structure of word problems, symbolic interpretation, and the logical connections required for solution strategies (Fuchs et al., 2008; Martini, 2014; Abdurrahman, 2012). For instance, Montague (2007) and Stylianou (2011) emphasize that word problems pose both cognitive and linguistic demands that overwhelm students' working memory, particularly when visual or representational skills are weak. Similarly, studies by Mullis et al. (2019) and OECD (2022) found that poor reading comprehension and unfamiliarity with mathematical vocabulary significantly affect students' performance on mathematical literacy assessments like PISA and TIMSS.

Despite the existing body of research, there remains a need for context-specific analysis that connects students' difficulties with curricular goals, such as those defined in the Kurikulum Merdeka. This study differs from previous research by focusing not only on categorizing students' difficulties in solving subtraction-based word problems, but also by explicitly analyzing how these difficulties manifest in language comprehension, visual perception, and symbolic representation among Indonesian seventh-grade students.

Preliminary observations conducted at SMPN 5 Mengkendek reveal that many seventh-grade students encounter significant challenges when solving word problems involving whole number subtraction. These difficulties appear to be rooted in limited understanding of mathematical vocabulary, weak symbolic and spatial representation skills (e.g., using number lines), and insufficient reading comprehension. Many students are unable to identify key information in the problem or fail to construct a coherent problem-solving strategy. In some cases, students exhibit confusion in distinguishing between relevant and irrelevant details, leading to misinterpretation of the required operations.

These challenges are in contrast with the objectives of national education as outlined in Indonesian Law No. 20 of 2003 on the National Education System, which emphasizes the development of learners who are intellectually competent, skilled, and capable of logical and creative thought. Solving contextual mathematical problems not only supports cognitive development but also builds students' confidence and autonomy as learners (Kusnandi, 2021). Furthermore, the integration of mathematical and language skills aligns with the broader goals of the Kurikulum Merdeka, which promotes adaptive and meaningful learning experiences.

The state of the art of this research lies in its integrated focus on three interrelated cognitive domains—language comprehension, visual representation, and symbolic reasoning—in the context of subtraction-based word problems. While prior studies have explored each domain independently, this study brings a holistic lens to how these domains interact and contribute to problem-solving failure. It also situates its findings within the broader policy and pedagogical landscape of Indonesian education.

Accordingly, the objectives of this study are to identify and categorize the types of difficulties students experience in solving word problems related to whole number subtraction; to analyze how visual perception, symbolic representation, and language comprehension affect their problem-solving performance; and to uncover the underlying causes of these difficulties to propose relevant pedagogical interventions.

The significance of this study lies in its potential to contribute theoretically, practically, and in terms of policy. Theoretically, it provides insights into the intersection of literacy and numeracy in mathematical problem-solving. Practically, the findings can guide teachers in designing more effective instructional strategies that support students' comprehension and reasoning. In terms of policy, the study supports curriculum development efforts that emphasize the integration of contextual literacy skills within mathematics instruction, in alignment with the goals of the Kurikulum Merdeka and the Indonesian national education agenda.

METHODS

This study adopted a qualitative case study design to explore in depth the specific difficulties students face when solving word problems involving whole number subtraction. This design is particularly suitable for examining complex, context-dependent phenomena within real-life settings (Yin, 2018; Merriam & Tisdell, 2016), allowing the researcher to capture not only students' problem-solving outcomes but also their underlying reasoning and misconceptions. The participants consisted of four seventh-grade students from SMPN 5 Mengkendek, selected through purposive sampling. The selection criteria included students who answered all items on the diagnostic test incorrectly and who were available and willing to participate in follow-

up interviews. Although the number of participants was limited, this small sample size enabled a focused and detailed analysis consistent with the depth-oriented nature of qualitative research (Patton, 2015).

Data collection was conducted using three primary instruments. First, a written test consisting of five open-ended word problems on whole number subtraction was administered to examine the students' procedural and conceptual understanding. This test was reviewed and validated by two mathematics education experts to ensure content validity and alignment with the Grade VII curriculum. Second, individual semi-structured interviews were conducted to explore students' thought processes, difficulties, and interpretations of each test item. The interview protocol was pilot tested and refined, enhancing its construct validity and relevance (Creswell & Poth, 2018). Third, documentation—including students' written responses, researcher field notes, and audio recordings—was compiled to support data triangulation and reinforce the study's credibility and dependability (Bogdan & Biklen, 2007).

Data analysis followed the qualitative framework proposed by Miles and Huberman (1994), involving three steps: data reduction (selecting and simplifying relevant data), data display (organizing the data into matrices and narratives), and conclusion drawing and verification (interpreting findings and validating them across data sources). To enhance the trustworthiness of the study, methodological triangulation was employed along with member checking with participants and peer debriefing with academic colleagues (Lincoln & Guba, 1985). These strategies ensured that the research findings were credible, confirmable, and dependable.

RESULTS AND DISCUSSION

Data collection was conducted on July 16, 2021, involving 23 seventh-grade students at SMPN 5 Mengkendek. Students completed a diagnostic test consisting of five word problems involving whole number subtraction. Based on test results, four students were selected for in-depth interviews to explore their difficulties in problem-solving.

Tabel 1. Types of Difficulties Experienced by Students

Item No	S1			S2			S3			S4			Total		
	PBM	**KPV**	**KMB**	**PBM**	**KPV**	**KMB**	**PBM**	**KPV**	**KMB**	**PBM**	**KPV**	**KMB**	**PBM**	**KPV**	**KMB**
1	✓	-	-	-	✓	-	-	-	✓	✓	✓	-	2	2	0
2	✓	-	-	-	✓	-	-	-	✓	-	-	✓	3	1	1
3	✓	-	-	-	✓	-	-	✓	-	-	✓	-	1	3	0
4	✓	-	-	-	✓	-	-	-	✓	-	-	✓	1	1	2
5	✓	-	-	-	✓	-	-	-	✓	-	-	✓	1	1	2
Total													8	8	5

The analysis revealed three dominant categories of difficulty:

1. Lack of understanding of mathematical language (PBM) – 8 occurrences
2. Visual perception difficulties (KPV) – 8 occurrences
3. Reading and language comprehension difficulties (KMB) – 5 occurrences

Based on Table 1, it can be observed that the most frequent difficulty experienced by students is a lack of understanding of mathematical language, with a total of 8 occurrences. Students struggled to establish meaningful mathematical connections, such as identifying known and unknown elements in the problem and organizing the steps for solving it. This is followed by visual perception difficulties, also with 8 occurrences, where students were unable to visualize mathematical concepts or represent them accurately, resulting in disorganized approaches to

solving word problems. The third most common difficulty was related to reading and language comprehension, occurring 5 times, where students had trouble understanding mathematical terms such as “borrowing” when faced with contextual word problems.

From the entire cohort of seventh-grade students at SMPN 5 Mengkendek who participated in the study, four students were selected for in-depth interviews to further explore the challenges they experienced when solving word problems involving whole number subtraction. These four students were identified as Evandra (S1), Kerenhapukh Cesaria (S2), Drian Pakenden (S3), and Imanuel Sirupang Buranda (S4).

1. Difficulty in Understanding Mathematical Language

Students struggled to identify key elements in the problem, such as what is known and what is being asked. This difficulty stemmed from limited understanding of mathematical vocabulary and sentence structure in word problems. Students often misunderstood terms like “difference,” “remaining,” or “how many more,” which led to incorrect operations.

This finding aligns with previous studies emphasizing the importance of mathematical language literacy in problem-solving (Abdurrahman, 2012; Martini, 2014; Fuchs et al., 2008). Students' difficulties in solving story problems in mathematics are due to their characteristics in the form of reading texts (Novitasari & Shodikin, 2020). Shodikin et al (2024) added that if they are unable to express important facts from the problem being solved and they use commonly used procedures and they believe the answer is correct, it will lead them to misunderstanding. Students need explicit instruction in interpreting mathematical keywords and translating them into appropriate operations.

Students struggled to identify what was known and what was asked in the problem. Phrases such as "how many more" or "difference" were often misunderstood. For instance, S3 stated, "I thought 'difference' means to add, because more is more." This aligns with prior research emphasizing the need for explicit instruction in mathematical vocabulary (Fuchs et al., 2008).

2. Visual Perception Difficulties

Students had difficulty visualizing the abstract structure of subtraction problems, especially when the problems involved negative numbers or required drawing representations. For instance, students failed to use number lines or draw schematic diagrams, which are helpful tools in understanding integer operations (Montague, 2007; NCTM, 2014).

Some students arrived at the correct answers conceptually but wrote them down incorrectly, either omitting units or misrepresenting values. This inconsistency reflects a gap between conceptual understanding and written mathematical communication (Kilpatrick et al., 2001).

Some students understood the context but failed to identify numerical data. S2 admitted: "I know the story but not sure what number to subtract." Weak reading fluency led to procedural errors, confirming OECD (2022) findings on reading-math linkages. These multidimensional difficulties require integrative instructional strategies combining literacy, visualization, and mathematical language instruction (Moschkovich, 2010).

3. Reading and Language Comprehension Difficulties

Even though some students could understand the context of the story, they struggled to identify important numerical data or misread critical parts of the text. Low reading fluency and weak vocabulary comprehension were major contributing factors. These difficulties confirm findings from Mullis et al. (2019) and OECD (2022), which highlight the intersection of reading skills and mathematical performance in international assessments.

Students who were not attentive to detail tended to skip key instructions or guess at answers, leading to procedural mistakes. Poor comprehension and attention undermine problem-solving performance and ultimately affect learning outcomes (Kane & Staiger, 2012).

The image above illustrates the difficulties faced by students, particularly visual perception issues when interpreting mathematical concepts. One of the primary issues observed is students' difficulty in visualizing mathematical concepts, which is evidenced in the way they attempt to solve word problems. For instance, the answers provided by the students show a disorganized approach in structuring their work.

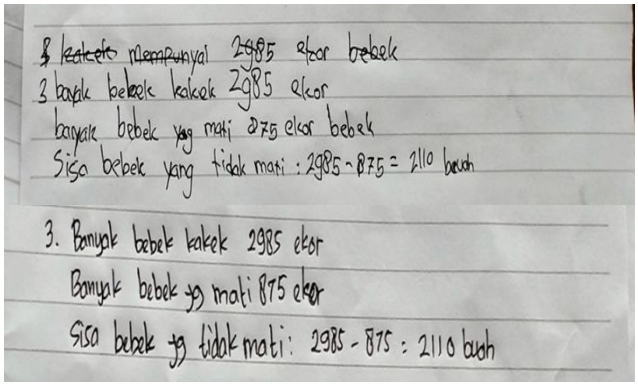

Figure 1. Visual Representation Challenges in Student Problem-Solving

Students struggle to comprehend and visualize the relationships between the given numbers in the word problems. This issue is highlighted by how the student organizes the solution (or lack thereof). Another difficulty experienced by the students is related to their visual perception — they struggle to visualize abstract concepts within a mathematical context. This difficulty stems from their inability to structure and organize the solution process for word problems effectively. An example of this can be seen in the student's answer in Figure 2.

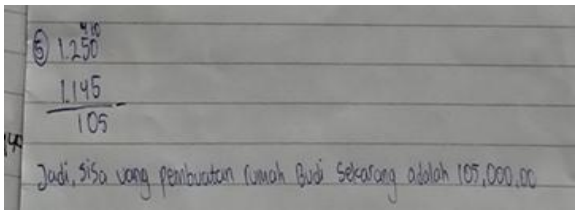

Figure 2. Student's Misstructured Solution Reflecting Visual Difficulties

Students demonstrate an understanding of the content of the problem but struggle with writing and expressing the answers correctly. The mistakes seem to stem from poor attention to detail while reading the problem and a lack of understanding of the problem's underlying concepts.

In addition, reading and language difficulties can be observed. Although the student appears to understand the general meaning of the problem, they still struggle with writing the correct units. This issue is likely due to a lack of careful reading and limited comprehension of the word problem. An example of this can be seen in the student's answer in Figure 3.

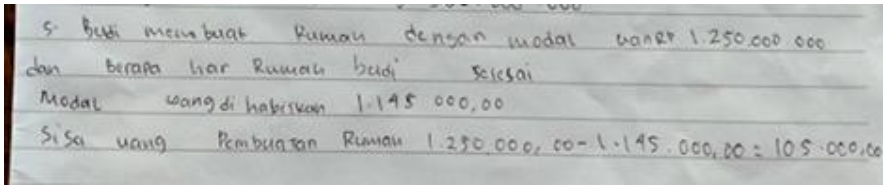

Figure 3. Conceptual and Language Difficulties in Student's Written Answer

The difficulties described above are part of a broader concern in educational psychology, particularly in relation to cognitive load and the role of visual and linguistic processing in mathematical problem-solving. According to research by Sweller (1988) on Cognitive Load Theory, the ability to process and organize information efficiently is critical for students to perform well in problem-solving tasks. Furthermore, studies in mathematical literacy (e.g., OECD, 2013) highlight the importance of both language comprehension and mathematical understanding for effective problem-solving.

The results indicate that students' difficulties are multidimensional and not limited to computational skills. Instead, they stem from a lack of integration between language skills, mathematical reasoning, and visual-spatial representation. These findings support the view that improving mathematical performance requires a holistic instructional approach, incorporating mathematical literacy, visual modeling, and explicit language instruction (Moschkovich, 2010; OECD, 2022).

CONCLUSION

Based on the findings and analysis, this study concludes that Grade VII students at SMPN 5 Mengkendek encounter significant challenges in solving word problems involving whole number subtraction. These difficulties fall into three primary categories: a) Lack of Understanding of Mathematical Language ± 38%). Students struggled to interpret key mathematical terms and phrases, which hindered their ability to identify what was being asked and plan appropriate problem-solving steps. This difficulty was often rooted in weak foundational knowledge and limited exposure to mathematical vocabulary, both in classroom instruction and home study environments. Insufficient familiarity with mathematical language impairs both comprehension and execution. b) Visual Perception Difficulties (± 38%). Students exhibited challenges in visualizing mathematical concepts, such as representing subtraction scenarios using number lines or diagrams. These difficulties led to disorganized solutions and careless errors, even when students understood the operations conceptually. This is consistent with research highlighting the importance of visual-spatial skills in mathematics learning (Montague, 2007; Stylianou, 2011). c) Reading and Language Comprehension Difficulties (± 24%.). Students found it difficult to extract and interpret critical information from text-based problems. Misreading or misunderstanding key terms often lead to procedural errors. Low reading proficiency is a major barrier to solving contextual mathematical problems.

These findings indicate that students' difficulties are not purely computational but deeply connected to language comprehension, visual representation, and conceptual understanding. Therefore, improving students' performance in word problems requires an integrative instructional approach that combines literacy, visualization strategies, and explicit teaching of mathematical language.

Future interventions should involve embedding mathematical vocabulary instruction in daily practice, incorporating visual modeling tools (e.g., number lines, diagrams), and strengthening students' reading comprehension through cross-disciplinary collaboration between math and language teachers.

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