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An analysis of numeracy ability in plane figures among junior high school students

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ABSTRACT
The low numeracy skills of junior high school students remain a major challenge in Mathematics learning, particularly in plane figures material that requires conceptual understanding, procedural application, and integrated reasoning. This study aims to analyze the numeracy skills of seventh-grade students at SMPN 2 Kasihan using an open essay test. The approach in this study was a descriptive, quantitative design, with 120 students as the main participants. The instrument consisted of seven validated essay questions to measure aspects of mathematical understanding, application, and reasoning. Data were analyzed using descriptive statistics, including maximum, minimum, average, and standard deviation scores, as well as categorization of student achievement. The results showed a very significant variation in ability. Most students were in the low category, and only a few were in the very high category. The highest achievement was in understanding, while application and reasoning were still very low. These findings emphasize the need for innovative, problem-based, context-driven learning, supported by intensive remedial programs and peer tutoring, to comprehensively improve students' mathematical literacy and address the challenges of 21st-century national education.

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ABSTRAK
Rendahnya kemampuan numerasi siswa SMP masih menjadi tantangan utama dalam pembelajaran Matematika, khususnya pada materi bangun datar yang menuntut pemahaman konsep, penerapan prosedur, serta penalaran secara terpadu. Penelitian ini bertujuan untuk menganalisis tingkat kemampuan numerasi siswa kelas VII di SMPN 2 Kasihan melalui tes uraian terbuka. Pendekatan pada penelitian ini adalah deskriptif kuantitatif, dengan 120 siswa sebagai partisipan utama. Instrumen berupa tujuh soal uraian tervalidasi guna mengukur aspek pemahaman, penerapan, dan penalaran matematis. Data dianalisis melalui statistik deskriptif, meliputi nilai maksimum, minimum, rata-rata, standar deviasi, serta kategorisasi capaian siswa. Hasil penelitian menunjukkan variasi kemampuan yang sangat signifikan. Sebagian besar siswa berada pada kategori rendah dan hanya sedikit yang berada kategori sangat tinggi. Capaian tertinggi pada aspek pemahaman, sementara penerapan dan penalaran masih sangat rendah. Temuan ini menegaskan perlunya inovasi pembelajaran kontekstual berbasis masalah yang didukung program remedial intensif serta tutor sebaya guna meningkatkan literasi Matematika siswa secara menyeluruh demi menjawab segala tantangan pendidikan nasional di abad ke-21.
Kata Kunci: *bangun datar; kemampuan numerasi; pembelajaran Matematika; SMP*

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INTRODUCTION

Numeracy skills are among the fundamental competencies in 21st-century Mathematics education (Rahmah & Zulfadewina, 2025). This competence not only requires computational skills but also involves the ability to reason, solve problems, and connect mathematical concepts with real-life contexts encountered by students in their daily lives (Reyna & Brainerd, 2023). The Indonesian government, through the Asesmen Nasional (AN), also emphasizes that numeracy literacy is one of the key indicators of educational quality, alongside reading literacy, as a basic competence that every student must possess. Ideally, junior high school students are expected to understand basic concepts, apply formulas correctly, and reason logically when solving problems grounded in concrete experiences.

However, the reality reveals a significant gap between these ideal conditions and the actual achievements in the field. The results of PISA 2018 show that Indonesian students' mathematical literacy remains below the OECD average, with a score of 379, far below the international average of 489. This data shows that most students still struggle to relate mathematical concepts to real-world contexts. They may be able to solve routine problems but face difficulties when confronted with tasks that require logical reasoning, creativity, or the ability to represent ideas using symbols or diagrams. This finding underscores the need to nurture higher-order thinking skills in modern Mathematics instruction (Fitriana et al., 2025).

Preliminary observations by the researcher at SMPN 2 Kasihan indicate a similar trend: many students still face difficulties with fundamental aspects of geometry learning. Several students appeared confused when distinguishing between area and perimeter formulas and often made errors in selecting the appropriate formula based on the problem's context. Mistakes also occurred when applying the Pythagorean theorem correctly to solve triangle problems. Moreover, when dealing with word problems, students tended to struggle in modeling information into appropriate mathematical forms. This condition indicates that their procedural mastery has not been accompanied by adequate reasoning and generalization skills to solve problems flexibly.

Junior high school students tend to memorize formulas without understanding their conceptual meaning, leading to frequent errors when faced with non-routine problems (Kadarisma et al., 2020). The lack of mathematical representation skills becomes a dominant barrier in solving numeracy-related problems, particularly in the geometry context (Nazarovich & Kurudirek, 2024). Context-based problem designs within the framework of Realistic Mathematics Education (RME) have also proven effective in helping students connect abstract concepts with real-life situations (Susanti, 2025). These findings highlight the importance of learning that goes beyond memorization, fostering deep understanding and practical application in everyday contexts.

Although several studies on numeracy literacy have been conducted, most remain at the macro level, such as national (AKM) or international (PISA) assessments, and tend to focus on secondary education (Almarashdi & Jarrah, 2023; Hasibuan, 2023; Mulyati et al., 2024). Consequently, studies on junior high school students' numeracy skills, particularly in plane figures, remain relatively limited. In fact, geometry is one of the essential domains in

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Mathematics that closely relates to students' daily experiences. Strong understanding at this level greatly influences their readiness for higher levels of education (Gurmu et al., 2024). This research gap indicates the need for a more in-depth exploration of numeracy analysis at the junior high school level.

This condition underscores the need for a more focused research approach to examine junior high school students' numeracy abilities, especially in plane figures, which serve as a crucial foundation for understanding advanced geometric concepts. The research focus should not only identify students' difficulties but also examine their thinking patterns, problem-solving strategies, and conceptual obstacles that arise during learning. Through more comprehensive analysis, this study aims to reveal the real picture of students' numeracy abilities and provide a foundation for teachers to improve their instructional methods (Cantika et al., 2022).

Based on this research gap, the present study analyzes junior high school students' numeracy abilities in plane figures, focusing on three main indicators: understanding, application, and reasoning. Through these indicators, the researcher seeks to map the extent to which students can comprehend basic geometric concepts, apply formulas in relevant contexts, and use logical reasoning to solve non-routine problems. This study is expected to contribute theoretically to enriching the numeracy literacy literature in Indonesia, particularly in the domain of geometry, and practically to assist teachers in designing context-based, problem-solving-oriented learning.

Thus, this research does not merely aim to describe students' weaknesses in mastering numeracy concepts but also seeks to provide new insights for the education field regarding strategies to enhance such abilities. The research findings are expected to serve as a foundation for developing innovative learning models that integrate abstract concepts with real-world contexts and strengthen critical and creative thinking skills. Ultimately, improving junior high school students' numeracy competence will contribute to achieving the national education goal of producing intelligent, adaptive, and globally competitive generations.

LITERATURE REVIEW

Analysis of Mathematics Learning

The analysis of Mathematics learning is widely discussed in educational research as it provides insights into how students construct conceptual understanding and develop procedural fluency. Scholars argue that effective Mathematics instruction requires a balance between conceptual and procedural knowledge to build meaningful long-term competence (Gurmu et al., 2024). Learning environments that emphasize inquiry, reasoning, and representation allow students to engage in deeper mathematical thinking and avoid rote memorization. Additionally, Vygotsky's sociocultural theory in "*Mind in Society: The Development of Higher Psychological Processes*" highlights the critical role of interaction and scaffolding in helping learners internalize mathematical ideas, demonstrating that collaborative learning and guided instruction support cognitive growth.

Recent studies also highlight the significance of formative assessment, technology integration, and student-centered pedagogies in enhancing Mathematics learning outcomes. Formative assessment helps teachers identify misconceptions early and adjust instruction to meet learners' needs (Tarso et al., 2025). Meanwhile, digital tools such as dynamic geometry

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software or interactive visualizations have been found to increase engagement and support understanding of abstract concepts (Sunzuma, 2023). Research on problem-based and inquiry-based learning consistently shows that these approaches strengthen critical thinking skills and promote deeper comprehension of mathematical structures (Rafiq et al., 2023). Together, these findings suggest that analyzing Mathematics learning requires a multidimensional perspective that considers pedagogical strategies, assessment practices, and learning technologies.

Plane Figures

The study of plane figures is foundational in school geometry, as it provides students with the basic structure for understanding shapes, spatial relationships, and geometric reasoning. According to Van Hiele's geometric thinking model in "*Structure and Insight: A theory of Mathematics education*", learners progress through hierarchical levels of understanding, starting from visual recognition to more abstract deductive reasoning. Research shows that many students struggle to identify the properties of shapes, distinguish between similar figures, and apply geometric formulas, often due to insufficient conceptual grounding and overreliance on memorization (Farheen et al., 2024). Thus, instruction in plane figures must incorporate opportunities for students to manipulate shapes, explore properties, and engage in guided discovery to build robust understanding.

Studies also emphasize the importance of contextual and technology-supported approaches in teaching plane figures. Using dynamic geometry environments, such as GeoGebra, allows students to visualize and interact with geometric objects, fostering a better understanding of the relationships among angles, sides, and areas (Ramírez-Uclés & Ruiz-Hidalgo, 2022). Furthermore, real-world applications such as designing simple structures or analyzing everyday objects help students see the relevance of plane-figure concepts and improve their problem-solving abilities (Turmuzi et al., 2023). Research on inquiry-based geometry tasks suggests that students who engage in reasoning, justification, and exploration develop stronger spatial abilities and deeper geometric insight than those taught through traditional lecture-based methods (Haas et al., 2023). These findings underscore the need for instructional designs that integrate visualization, exploration, and contextualization.

Numeracy Ability

Numeracy ability is recognized as a critical competency in modern education, encompassing not only basic arithmetic skills but also the capacity to reason mathematically, interpret data, and apply quantitative knowledge in real-world contexts. The OECD in "*PISA 2018 results (Volume I): What students know and can do*" defines numeracy as the ability to access, use, interpret, and communicate mathematical information effectively to solve a range of problems. Research shows that numeracy is strongly associated with academic achievement, problem-solving skills, and everyday decision-making, making it essential for participation in the knowledge-based economy (Hendriana et al., 2025). Furthermore, studies highlight that numeracy comprises interconnected components, including understanding, application, and reasoning, which must be developed systematically through varied learning experiences.

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Empirical findings indicate that students often struggle with numeracy due to limited exposure to contextual problems and insufficient emphasis on reasoning and interpretation. Effective numeracy instruction requires pedagogical approaches that prioritize inquiry, critical thinking, and authentic contexts, such as problem-based learning and real-life mathematical tasks (Abella et al., 2024). Additionally, formative feedback, targeted remediation, and peer-assisted learning have been shown to significantly enhance numeracy performance, particularly among low-achieving students (Opesemowo et al., 2025). Research also emphasizes the importance of cross-disciplinary numeracy, where mathematical reasoning is embedded in science, social studies, and practical life situations. Collectively, the literature demonstrates that developing numeracy ability requires holistic instructional practices that integrate conceptual understanding, contextual application, and logical reasoning.

METHODS

The research method employed in this study was a quantitative descriptive approach, aimed at describing students' numeracy abilities based on test results without any intervention or specific treatment. The research subjects consisted of all seventh-grade students at SMPN 2 Kasihan, totaling 120 participants. The research instrument was an essay test on plane figures, consisting of 7 validated questions designed to measure three main numeracy aspects: understanding, application, and reasoning. The use of essay-type questions was chosen because it allows for a deeper exploration of students' understanding and provides insight into their problem-solving processes. The collected data were analyzed using descriptive statistics, including maximum, minimum, mean, and standard deviation, to provide an overall depiction of students' performance and the distribution of their abilities.

The research procedure was carried out in several stages. First, the researcher developed the test instrument based on numeracy indicators and conducted validation to ensure its feasibility. Second, the instrument was administered to all students as research subjects, and their responses were collected as primary data. Third, students' scores were analyzed to determine the distribution of values and to categorize numeracy ability levels from *very low* to *very high*. Furthermore, an in-depth analysis was conducted on representative student responses from each category to identify their thinking patterns. This analytical approach aligns with the view that the descriptive method aims to provide a factual, systematic, and accurate depiction of the phenomenon under study. The computation used to analyze students' responses followed the analytical steps outlined below, adapted from previous work.

RESULTS AND DISCUSSION

Results

The descriptive results for the scores obtained by 120 seventh-grade students at SMPN 2 Kasihan were collected through an essay test on plane figures comprising 7 validated questions. This test was specifically designed to measure three main aspects of numeracy: understanding, application, and reasoning. Based on the descriptive statistics, the maximum score was 91, and the minimum was 18, indicating a relatively wide range of scores among students. The average score of 38.91 suggests that students' overall numeracy ability

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remains in the low category. The standard deviation of 14.652 indicates considerable variation in students' performance, suggesting a significant difference between high- and low-achieving students. The percentage breakdown of the numeracy ability test is shown in the following figure.

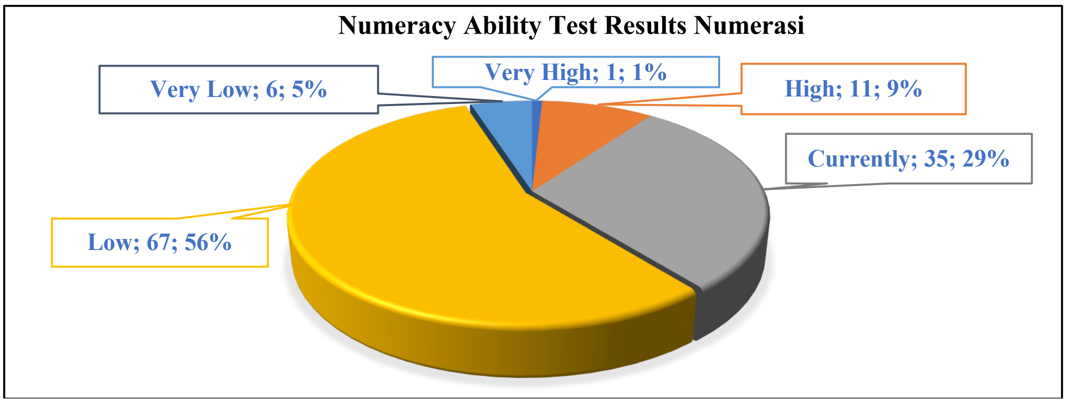

Figure 1. Percentage of Numeracy Ability Test Results
Source: Research, 2026

Based on the diagram in **Figure 1** of the numeracy test results, the majority of students fall into the low category, totaling 67 students (56%). Furthermore, 35 students (29%) are in the moderate category, while 11 students (9%) are in the high category. Meanwhile, 6 students (5%) demonstrate very low numeracy ability, and only 1 student (1%) reaches the very high category. These data indicate that most students still struggle to master numeracy skills, highlighting the need for more effective learning strategies to improve their numeracy competence.

The following discussion focuses on a student with very high mathematical ability, referred to as MAAP, who represents the upper group. The analysis examines how MAAP solves the test problems, including how the student records basic information, selects appropriate formulas, and reasons systematically to conclude, as described below.

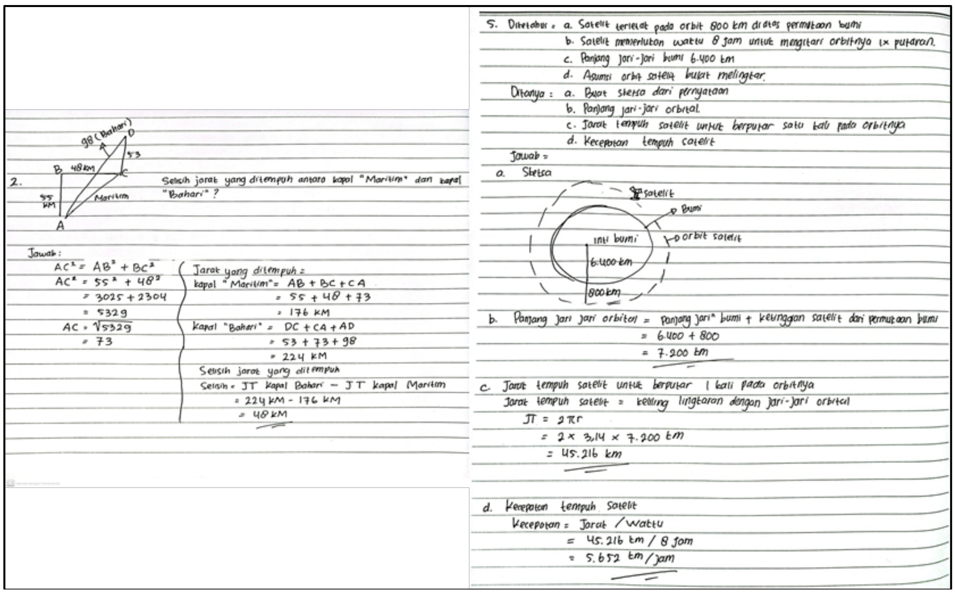

Figure 2. Solving questions 2 and 5 by the MAAP subjects
Source: Research, 2026

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Based on **Figure 2**, the response to question 2 shows that the subject successfully met all indicators of numeracy ability. For the Understanding indicator (comprehending basic information), MAAP translated the problem information into a clear diagram and labeled the sides accurately, consistent with the question's context. For the Application indicator (using appropriate formulas or strategies), MAAP correctly applied the Pythagorean Theorem to determine the hypotenuse length and accurately used the distance-addition strategy to obtain the correct result. Furthermore, for the Reasoning indicator (reasoning, generalization, authentic context), MAAP demonstrated well-structured problem-solving steps, engaged in accurate mathematical reasoning, and formulated a conclusion consistent with the problem's context, specifically, the difference in travel distances between the two ships mentioned in the question. These findings indicate that a student with very high ability can master all three aspects of numeracy in a balanced manner.

In response to question 5, MAAP also demonstrated comprehensive numeracy skills. Under the Understanding indicator, the subject was able to restate the given information through a clear, accurate, and contextually relevant sketch. Under the Application indicator, MAAP applied the concept of adding the Earth's radius to the satellite's altitude to determine the orbital radius, and correctly used the formulas for the circumference of a circle and average speed. For the Reasoning indicator, MAAP presented systematic calculation steps, obtained accurate results, and provided a final answer aligned with the context of satellite motion. After discussing the student with very high mathematical ability, the next section focuses on a student with high mathematical ability, referred to as TA, and analyzes their responses to questions 2 and 5.

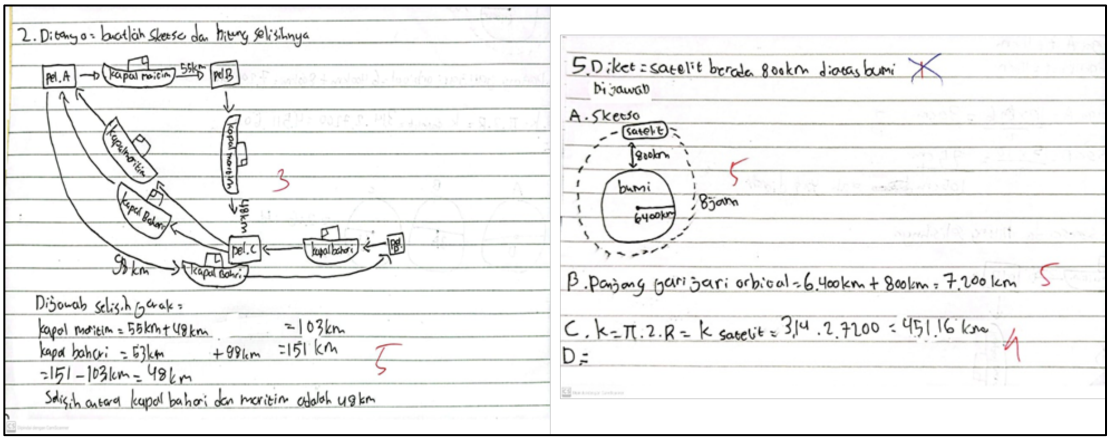

Figure 3. Solving questions 2 and 5 by the TA subjects
Source: Research, 2026

Based on the results in **Figure 3** of the written test completed by the TA for question number two, the TA has not fully met the Understanding indicator (comprehending basic information) because the information provided was not connected to the Pythagorean concept, which should have been used to calculate the length of side AC. TA also did not meet the Application indicator (using the correct formula/strategy) because they did not calculate the distance along AC; instead, they used another representation that directly calculated the difference in travel distance between the two ships, without including the AC path. However, TA successfully met the Reasoning indicator (reasoning, generalization, authentic context) because they realized that both ships traveled the same AC route, making the difference in

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that section equal to zero; thus, the final answer remained correct given the question's context.

Based on the results of the written test for question number five, TA successfully met the Understanding indicator (comprehending basic information) by clearly and accurately sketching the information given in the problem. TA also partially met the Reasoning indicator (reasoning, generalization, authentic context) by correctly calculating the orbital radius and the satellite's travel distance using the concept of the circumference of a circle. However, in point D, TA did not meet the Application indicator (using the correct formula/strategy) and did not fully complete the Reasoning indicator, as they did not use the speed formula (distance divided by time) to determine the satellite's velocity, resulting in an incomplete final answer. After discussing the subject with a student of high mathematical ability, the next analysis focuses on the student with moderate mathematical ability, namely DAP. It examines their responses to questions 2 and 5 as follows.

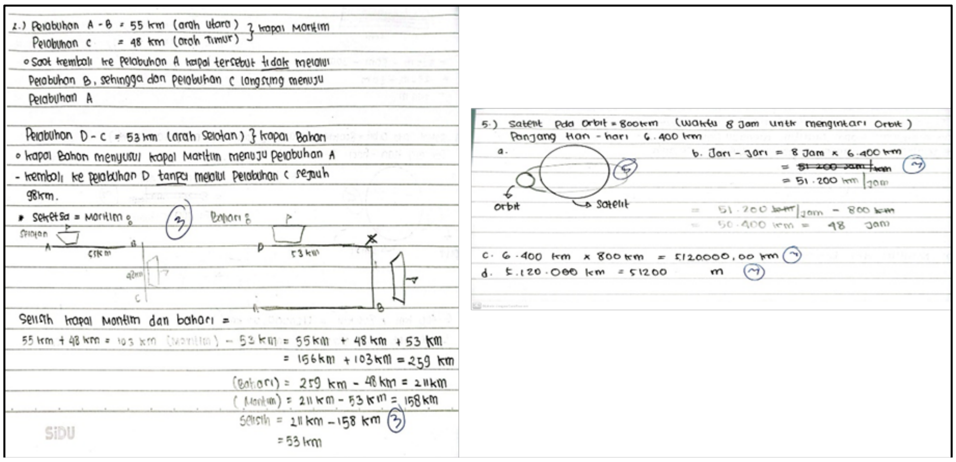

Figure 4. Solving questions 2 and 5 by DAP subjects
Source: Research, 2026

Based on **Figure 4** of the written test completed by DAP for question number two, DAP met the Understanding indicator (comprehending basic information) by restating the information from the problem in written form, although the visual representation was inaccurate. However, DAP did not meet the Application indicator (using the correct formula/strategy) because they did not apply an appropriate solution strategy aligned with the visual representation, leading to incorrect calculation steps. DAP also failed to meet the Reasoning indicator (reasoning, generalization, authentic context) because the problem-solving process was not systematic, and the conclusion drawn did not align with the problem context.

Based on the results of the written test for question five, DAP met the Understanding indicator (comprehending basic information) by restating the known information from the problem in written form, although the visual representation remained inaccurate. DAP did not meet the Application indicator (using the correct formula/strategy) because they did not correctly apply the concepts of orbital radius, orbit circumference, and satellite velocity in the problem-solving process, resulting in an incorrect answer. In addition, DAP did not meet the Reasoning indicator (reasoning, generalization, authentic context) because the problem-solving steps were not coherent, and the conclusion drawn was inconsistent with the problem's context. After discussing the subject with moderate mathematical ability, the next

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discussion focuses on the student with low mathematical ability, namely AMF, and analyzes their responses to questions 2 and 5 as follows.

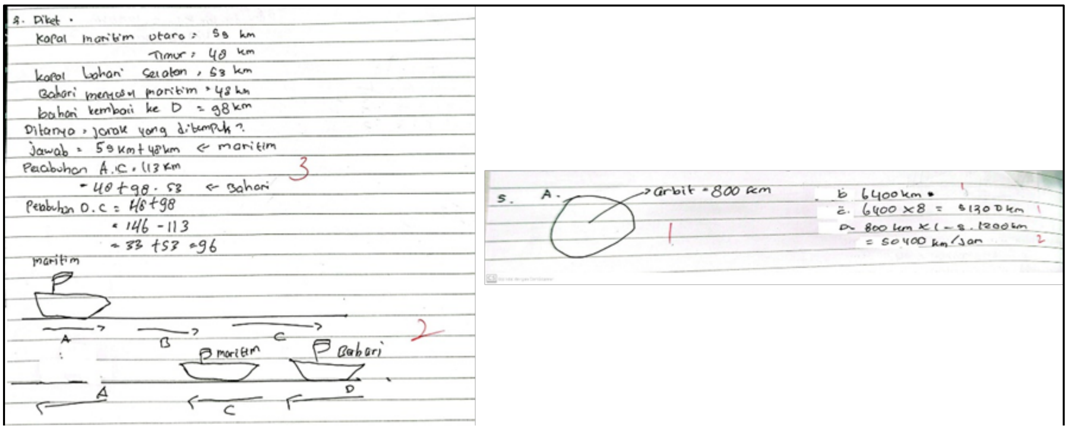

Figure 5. Solving questions 2 and 5 by AMF subjects
Source: Research, 2026

Based on **Figure 5** of the written test completed by AMF for question number three, AMF met the Understanding indicator by restating the information from the problem in writing. However, the visual representation was inaccurate, leading to an incorrect depiction of the relationships between the ports and the directions of the ships' routes. AMF did not meet the Application indicator because the solution process did not employ appropriate strategies or steps consistent with the concept of travel distance, resulting in an incorrect final result. In addition, AMF did not meet the Reasoning indicator, as the problem-solving process was not systematic and the conclusion did not align with the problem context.

Based on the results of the written test for question five, AMF did not meet the Understanding indicator because the problem's basic information was not clearly stated, and the visual representation failed to depict the satellite's orbit accurately. AMF also did not meet the Application indicator because they did not use the correct concepts of orbital radius, orbit circumference, and satellite velocity in their solution steps, resulting in an incorrect answer. Furthermore, AMF did not meet the Reasoning indicator because the problem-solving process lacked coherence, and the conclusion did not align with the problem's context. After discussing the subject with low mathematical ability, the next discussion focuses on the student with very low mathematical ability, namely PRM, with an analysis of their responses to questions 2 and 5 as follows.

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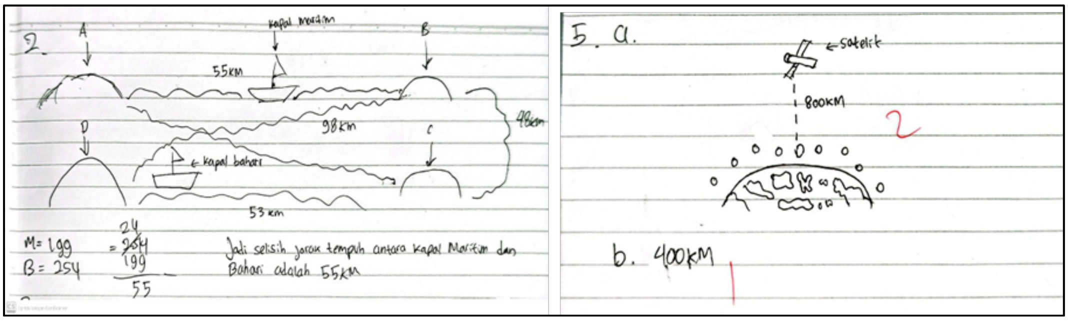

Figure 6. Solving questions 2 and 5 by the PRM subjects
Source: Research, 2026

Based on the results in **Figure 6** of the written test completed by PRM for question 2, PRM did not meet the Understanding indicator (comprehending basic information). Although they attempted to visualize the problem information through a sketch, the drawing was inaccurate and failed to reflect the ships' travel routes as specified. PRM also did not meet the Application indicator (using the correct formula/strategy) because, in calculating the travel distances of the maritime and nautical ships, the problem-solving steps were disorganized and did not employ strategies aligned with the concept of distance. In addition, PRM did not meet the Reasoning indicator (reasoning, generalization, authentic context), as although the final answer obtained was 55 km, the problem-solving process was mathematically incorrect and did not support a conclusion consistent with the problem's context.

Based on the results of the written test for question number five, the student was unable to meet the Understanding indicator (comprehending basic information). This was evident from the response, which consisted only of a simple drawing of a satellite above the Earth's surface labeled "800 km," without visualizing the geometric concepts required to solve the problem. The student also did not meet the Application indicator (using the correct formula/strategy), as no mathematical calculation steps were provided to determine the required distances or other quantities. Furthermore, the student failed the Reasoning indicator (mathematical reasoning in context) because no logical reasoning process was demonstrated, and the final answer (400 km) in part (b) was inconsistent with the problem context and the appropriate calculations.

The percentage of students' numeracy achievement for each indicator shows that the highest achievement was in understanding basic information at 61%. In contrast, the reasoning aspect, which includes reasoning, generalization, and linking to authentic contexts, only reached 25%, and the application aspect, which involves the use of appropriate formulas or problem-solving strategies, recorded the lowest achievement at 23%; these findings indicate that although students tend to be relatively proficient in understanding basic information, they still experience significant difficulties in applying numeracy concepts and engaging in deeper mathematical reasoning.

Discussion

The numeracy skills of seventh-grade students at SMPN 2 Kasihan remain relatively low, with an average score of 38.91. The majority of students fall into the low category (56%), while only 1% reach the very high category. This condition is consistent with previous findings

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showing that Indonesian students' numeracy literacy remains low, especially on problems requiring contextual problem-solving (Asri & Maysarah, 2024; Pratiwi & Murtafiah, 2025). This suggests that numeracy issues remain a serious challenge in Mathematics learning at the junior high school level, underscoring the importance of evaluating teachers' instructional strategies to improve students' numeracy achievement more evenly.

When viewed across the numeracy aspects, students performed better in understanding basic information (61%), while the application (23%) and reasoning (25%) aspects showed lower achievement. These findings support earlier studies reporting that students tend to find it easier to comprehend basic information but struggle when required to apply concepts or engage in mathematical reasoning (Kaplar et al., 2022). The weaknesses in application and reasoning may stem from learning practices that still emphasize memorizing formulas rather than understanding applicable concepts. Therefore, learning should be directed toward contextual problem-solving activities so that students not only understand theories but also apply them effectively.

Further analysis of the student with very high mathematical ability (subject MAAP) showed that all three numeracy aspects were well mastered. MAAP was able to restate basic information, select appropriate formulas, and reason systematically to reach conclusions consistent with the context. This result aligns with studies indicating that high-achieving students tend to demonstrate strategic flexibility and logical reasoning in solving numeracy problems (Singh et al., 2024; Tong et al., 2025). This implies that students with very high numeracy ability can serve as learning models for their peers, for example, through peer tutoring strategies, supporting a more collaborative learning environment.

In contrast, students with moderate to low ability still displayed fundamental weaknesses, particularly in application and reasoning. Subjects DAP and AMF, for instance, were unable to use appropriate problem-solving strategies, resulting in incorrect answers despite understanding the basic information. This phenomenon is consistent with research showing that students often fail to connect foundational concepts with problem-solving strategies, leading to inaccurate reasoning (Jäder & Johansson, 2025; Säfström et al., 2024). Therefore, instruction should strengthen relationships among concepts, strategies, and reasoning through scaffolded practice, ranging from simple to complex problems, enabling students to connect concepts to real-world contexts better.

Meanwhile, students with very low ability (subject PRM) tended to fail in all numeracy aspects. PRM was unable to restate information correctly, did not use appropriate formulas, and did not demonstrate logical reasoning. This finding reinforces studies showing that poor mastery of basic concepts directly affects students' performance in both application and reasoning (Hussein & Csíkos, 2023; Prediger et al., 2023). This condition highlights the need for specialized interventions, such as context-based remedial learning, along with differentiated instruction to provide more intensive, tailored guidance based on students' levels of difficulty.

Overall, this study reveals that students' numeracy skills remain unbalanced, with stronger achievement in understanding but persistent weaknesses in application and reasoning. This aligns with the report, which shows that Indonesian students tend to perform better on procedural items but struggle with tasks requiring complex reasoning. Therefore, Mathematics teachers should implement Problem-Based Learning (PBL) or Contextual

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Teaching and Learning (CTL) approaches to strengthen students' application and reasoning skills. Through these strategies, students' numeracy competence is expected to develop more evenly across all aspects while equipping them with essential critical thinking skills for 21st-century learning. However, this study involved only seventh-grade students from a single school, namely SMPN 2 Kasihan, and therefore, the findings cannot be broadly generalized to junior high school populations in different regions or educational contexts.

CONCLUSION

Based on the study's findings, it can be concluded that the numeracy skills of seventh-grade students at SMPN 2 Kasihan are generally low, with the majority categorized at a low level and only a small proportion reaching the very high level. These findings indicate that students tend to perform better at understanding basic information but remain weak in application and reasoning, which require critical thinking and contextual problem-solving skills. Therefore, more varied instructional strategies oriented toward contextual approaches and problem-based learning need to be implemented to help students develop balanced numeracy skills. Teachers are also encouraged to utilize high-achieving students as peer tutors, provide progressive practice exercises ranging from simple to complex tasks, and offer remedial programs for students with very low numeracy abilities. Through these efforts, it is expected that the quality of Mathematics instruction will improve, equipping students with the numeracy skills needed to meet the demands of the 21st century. Further studies are recommended to investigate the psychological and environmental factors that contribute to students' low performance in mathematical reasoning.

AUTHOR'S NOTE

The author declares that there is no conflict of interest related to the publication of this article. The author also affirms that all data and content presented in the article are free of any plagiarism.

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