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STUDENTS' NUMERACY SKILLS IN SOLVING MINIMUM COMPETENCY ASSESSMENT (MCA)-TYPE MATHEMATICS PROBLEMS: A CASE STUDY IN JUNIOR HIGH SCHOOL

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ABSTRACT

Kemampuan numerasi merupakan salah satu kemampuan siswa yang menggunakan matematika sebagai alat untuk menyelesaikan masalah dalam kehidupan sehari-hari. Oleh karena itu, penelitian ini bertujuan untuk menganalisis kemampuan numerasi siswa untuk menyelesaikan soal matematika bertipe AKM. Metode penelitian ini adalah studi kasus di salah satu sekolah negeri di Yogyakarta. Hasil penelitian ini menunjukkan bahwa kemampuan numerasi siswa dalam menyelesaikan soal matematika, khususnya soal bertipe AKM dapat ditunjukkan dari kemampuan siswa dalam memahami tentang fakta, proses, konsep, dan prosedur; kemampuan mengaplikasikan pengetahuan dan pemahaman konseptual dalam menyelesaikan masalah matematika dalam kehidupan sehari-hari; dan kemampuan bernalar dalam menganalisis data dan informasi, membuat kesimpulan, dan memperluas pemahamam. Secara umum, siswa mempunyai kemampuan numerasi berkategori mahir dengan karakteristik meliputi siswa memiliki konsep dasar matematika serta memiliki ide untuk menentukan strategi untuk menyelesaikan masalah yang sangat baik. Kemudian, siswa juga mampu bernalar dalam menyelesaikan masalah kompleks serta nonrutin berdasarkan konsep matematika yang dimiliki. Dengan hal itu, diharapkan siswa dapat menggunakan kemampuan numerasinya tersebut untuk menyelesaiakan masalah dalam kehidupan keseharian yang ditemui.

Numeracy skills is one of the abilities of students who use mathematics as a tool to solve problems in everyday life. Therefore, this research aims to analyze students' numeracy skills to solve the Minimum Competency Assessment (AKM) type mathematics problems. This research method is a case study in one of the state schools in Yogyakarta. The results of this research show that students' numeracy abilities in solving mathematics problems, especially AKM type questions, can be demonstrated from students' ability to understand facts, processes, concepts and procedures; ability to apply conceptual knowledge and understanding in solving mathematical problems in everyday life; and reasoning abilities in analyzing data and information, making conclusions, and expanding understanding. In general, students have numeracy skills in the advanced category with characteristics including students having basic mathematical concepts and having ideas for determining strategies for solving problems very well. Then, students are also able to reason in solving complex and non-routine problems based on their mathematical concepts. With this, it is hoped that students can use their numeracy skills to solve problems they encounter in daily life.

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1. INTRODUCTION

Numeracy is a term used to identify the knowledge and skills needed to effectively use mathematics in personal, work, and societal contexts as informed, reflective, and positively contributing citizens (Geiger et al., 2015). The term "numeracy" is commonly used internationally in countries such as the United Kingdom, Canada, South Africa, Australia, and New Zealand (Geiger et al., 2014). It is often referred to as quantitative literacy or mathematical literacy. Sometimes, it also includes statistical literacy and financial literacy, aiming to reflect the use of mathematics in addressing life aspects that require mathematical thinking.

Although each country may use different terms for numeracy, there is a common consensus that numeracy is not limited to basic arithmetic skills but also includes mathematical thinking in formal settings like classroom learning and real-world problem-solving. Thus, numeracy involves the ability to understand non-mathematical contexts through a mathematical lens, perform critical evaluation, and explore and solve real-life problems (Geiger et al., 2014; 2015).

In Indonesia, numeracy has become a focus of research and educational practice since the country began participating in international assessments such as the Programme for International Student Assessment (PISA). This program aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students in participating countries/economies (NCES, 2020). As such, a country's PISA scores become a basis for its educational policy decisions (Breakspear, 2012). This is also true for Indonesia, as its participation in PISA serves as a benchmark to assess and compare the quality of education over time with other countries.

In assessing Indonesian students' competencies, PISA scores in mathematics are particularly relevant as they reflect students' numeracy skills. Results have consistently shown that Indonesia's scores in mathematics (numeracy) have been below the OECD average since it began participating in the survey in 2000. In the 2022 PISA cycle, Indonesia scored 366 in mathematics, 13 points lower than the 2018 score of 379, while the OECD average was 472 (OECD, 2023). This indicates that 15-year-old Indonesian students struggle with PISA-type math problems. In other words, students have low competency in applying mathematical concepts to solve real-world problems. Supporting this, the 2022 PISA results show that almost no Indonesian students performed at Level 5 or 6 in math, which involves modeling complex situations mathematically and selecting, comparing, and evaluating appropriate problem-solving strategies (OECD, 2023).

Since the beginning of Indonesia's participation in PISA, a key weakness has been students' difficulty in solving math problems related to real-life contexts. Several studies

confirm that Indonesian students find context-based mathematics problems challenging (Hidayatullah & Csíkos, 2022; Putri et al., 2022; Wijaya et al., 2014; Saefudin et al., 2023). To address this, curriculum reforms have been introduced over the years, such as Curriculum 2004, 2006, 2013, and the current Merdeka Curriculum. These reforms also brought shifts in teaching paradigms, including contextual approaches (2004 and 2006), scientific approaches (2013), and differentiated instruction emphasizing real-life contexts at the start of learning (Merdeka Curriculum). In terms of assessment, literacy and numeracy competencies have become central, replacing the National Exam (UN) with the National Assessment (AN).

As part of AN, the Minimum Competency Assessment (AKM) is administered to students to assess reasoning skills in literacy and numeracy, largely based on the PISA framework. In mathematics, the AKM serves as a tool to evaluate students' numeracy in solving context-based problems similar to PISA items. Results from the 2022 National Assessment show that students' numeracy performance across all educational levels (elementary, junior high, and senior high) is still moderate on average (Kemendikbudristek, 2023), indicating that numeracy skills are not yet optimally developed through school learning.

Several studies have examined the AKM (Cahyanovianty & Wahidin, 2021; Sari et al., 2023; Nurmaya et al., 2022), but few have conducted in-depth quantitative and qualitative case studies in specific schools. Therefore, this article aims to analyze students' numeracy skills in solving AKM-type mathematics problems. Mapping students' numeracy abilities will offer insight into how students apply mathematics to address real-life problems. The relevance of sources is indicated by a focus on primary sources from the past 10 years. The research problem, objectives, and significance are described narratively in paragraphs, without special subheadings. If necessary, operational definitions are also explained narratively.

2. METHOD

This study employs a qualitative research approach using the case study method. A case study is an in-depth investigation of a real-life phenomenon related to a person or place (Schoch, 2020). This research investigates junior high school students' numeracy abilities in solving AKM-type mathematics problems.

2.1 Research Subjects

The subjects were 51 eighth-grade students from a public junior high school in Bantul Regency, Yogyakarta Province. Participants were selected using purposive sampling. Selected subjects whose responses were analyzed in-depth were those whose answers reflected different levels of numeracy competency. These subjects were also interviewed to explore their problem-solving processes. The research was conducted in the second semester of the 2022/2023 academic year.

2.2 Data Collection

Data were collected using a numeracy test consisting of 5 AKM-type items. After completing the test, students' answers were assessed based on numeracy indicators, including the ability to use numbers and mathematical symbols to solve real-life problems; analyze information in forms such as graphs, tables, and diagrams; and interpret the results to make decisions (Han et al., 2017). The test instrument was validated by expert judgment with an Aiken's V index score of 0.5, categorized as moderate. Students' answers were then categorized into competency levels: needing special intervention, basic, proficient, and advanced (Asrijanty, 2020). Selected students were later interviewed in depth.

2.3 Data Analysis

Two types of data analysis were used: quantitative and qualitative. Quantitative analysis was used to describe students' achievement levels according to their numeracy competency: needing special intervention, basic, proficient, and advanced. The description of each level is shown in Table 1.

Table 1. Description of Numeracy Competency Levels (Asrijanty, 2020)

Competency Level	Description
Needing Special Intervention (NSI)	Students have limited mathematical knowledge, concept mastery, and computational skills
Basic	Students have basic math skills including simple direct computation, basic concepts, and solving routine problems
Proficient	Students can apply their mathematical knowledge in a variety of contexts
Advanced	Students can reason through complex and non-routine problems using their conceptual understanding

After determining students' numeracy levels, selected responses were analyzed. Qualitative analysis focused on students' responses to AKM-type items based on three cognitive levels of numeracy development:

1) Understanding facts, processes, concepts, and procedures.
2) Applying conceptual knowledge to real-life problem-solving.
3) Reasoning to analyze data/information, draw conclusions, and extend understanding (Kemendikbud, 2020).

Selected students were also interviewed to gain insight into their problem-solving processes.

3. RESULTS AND DISCUSSION

This study yielded two main findings: a description of students' numeracy skills in solving AKM-type problems and an analysis of their problem-solving processes at different cognitive levels.

Description of Students' Numeracy Skills Based on Competency Levels

Based on the data analysis, students' numeracy skills by competency level are presented using an infographic in Figure 1.

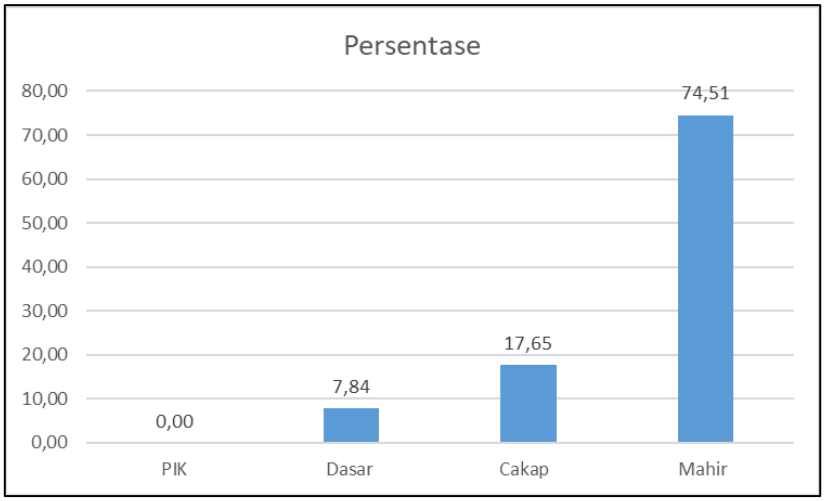

Figure 1. Students' Numeracy Competency Levels

Figure 1 shows that out of the 51 research subjects, none (0%) were categorized as requiring special intervention, 7.84% (4 out of 51) were at the basic level, 17.65% (9 out of 51) were at the proficient level, and 74.51% (38 out of 51) were at the advanced level. These findings indicate that the majority of students tend to be at an advanced level of numeracy competency. This suggests that students are capable of reasoning to solve complex and non-routine problems based on their mathematical understanding. Furthermore, only a small portion of the students demonstrated basic mathematical skills and the ability to apply their knowledge in more diverse contexts.

The results also indicate that AKM-type mathematics problems can enhance students' numeracy through mathematical reasoning. Several studies have shown that students with high numeracy skills (such as those in the advanced category) tend to have strong mathematical problem-solving abilities (Xiao et al., 2019; Davis, 2013; Liljedahl, 2015).

Analysis of Students' Problem-Solving Results Based on Cognitive Levels in Solving AKM-Type Mathematics Problems

To analyze students' problem-solving results based on cognitive levels in the development of numeracy, three indicators are used:

1. The ability to understand facts, processes, concepts, and procedures;
2. The ability to apply conceptual knowledge and understanding in solving real-life problems;
3. The ability to reason by analyzing data and information, drawing conclusions, and expanding understanding.

Understanding of facts, processes, concepts, and procedures

The analysis of numeracy ability for the first indicator focuses on students' understanding of facts, processes, concepts, and procedures. The question used to analyze this indicator is shown in Figure 1. Figure 2 presents the response of subject S1 to question number 1.

1. Ibu ingin membagikan pot bunga kepada tetangga perumahan. Setiap rumah akan mendapatkan 2 pot bunga dengan ukuran yang sama tetapi warna yang berbeda yaitu warna merah dan hijau. Harga pot bunga berwarna merah sebesar Rp55.000,00, sedangkan harga pot bunga berwarna hijau sebesar Rp45.000,00. Jika ibu mempunyai uang sebesar Rp1.500.000,00 (termasuk uang transport sebesar Rp100.000,00), maka berapa jumlah tetangga yang mendapatkan pot bunga tersebut?

Figure 1. Question Number 1

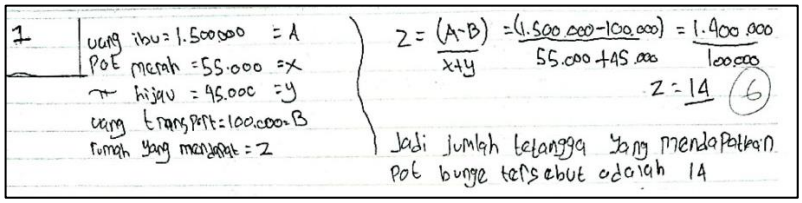

Figure 2. Response of Subject S1

Based on Figure 2, Subject S1 demonstrates the ability to understand facts, concepts, and procedures in solving Question 1, resulting in a correct final answer. The fact presented in the problem is that S1 can represent the algebraic situation using appropriate symbols; the concept involves algebraic operations, and the procedure refers to the techniques or strategies used in performing these operations to arrive at a solution.

Based on the interview results, Subject S1 was able to accurately explain the facts, concepts, and strategies used to solve the problem. S1 provided a reason for the formula applied, stating that the money used to buy flower pots was the remaining amount after deducting transportation costs from the total amount the mother had. Following this reasoning, S1 explained that, because the question asked for the number of neighbors who received the flower pots, S1 divided the remaining money by the price of the two flower pots.

Thus, Subject S1 was able to use numerical values and mathematical symbols, indicating a solid understanding of the relevant facts, processes, and procedures required to solve a real-world contextual math problem. This aligns with the statement by Geiger et al. (2015), who emphasize that students' numeracy skills can be observed through their

ability to understand facts, processes, and appropriate procedures in solving mathematical problems.

Applying Conceptual Knowledge and Understanding to Solve Real-Life Problems

The analysis of numeracy skills based on the second indicator—applying conceptual knowledge and understanding to solve real-life problems—used a different question, shown in Figure 3. One of the responses analyzed is that of Subject S1, whose answer to Question 2 is presented in Figure 4.

Panjang sisi sebuah taman yang berbentuk segitiga adalah $x - 1, 2x + 2$, dan $3x - 3$Jika keliling taman adalah 10 m. Tentukan panjang sisi terpendek dan panjang sisi terpanjang!

Figure 3. Question Number 2

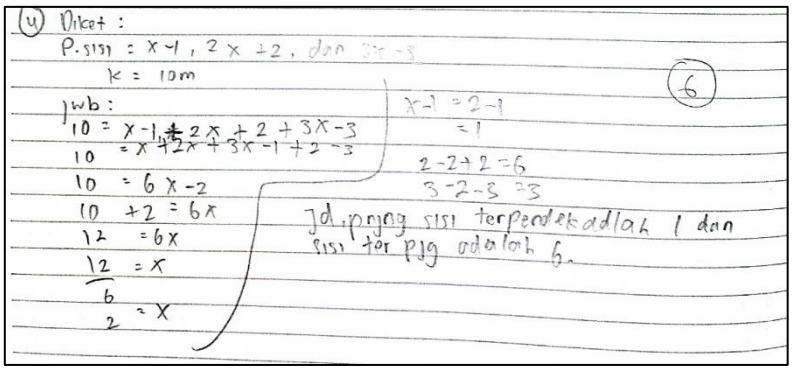

Figure 4. Response of Subject S1

Figure 3 shows that subject S1 was able to present the given facts using a triangle illustration along with the lengths of its three sides. S1 then elaborated on how to determine the value of $x = 2$. This value of x was substituted into the side lengths of the triangle, resulting in side lengths of 1 m, 6 m, and 3 m. Based on the question, S1 concluded that the shortest side is 1 m and the longest side is 6 m. Through this process, the subject was able to accurately state the facts based on the given information and successfully apply conceptual understanding and knowledge to solve real-life problems. Moreover, based on the interview, subject S1 was able to clearly explain the facts and concepts used to solve the problem correctly.

Thus, the subject has fully understood the algebraic concept and demonstrated the ability to use it appropriately to solve real-world problems involving algebraic forms. This situation indicates that the ability of students to apply mathematical concepts in solving everyday problems is an integral component in developing students' numeracy skills (Frankenstein, 2010; Nortvedt, 2011).

Reasoning in Analyzing Information, Drawing Conclusions, and Extending Understanding

The analysis of numeracy skills for the second indicator refers to students' reasoning abilities in analyzing information, making conclusions, and extending understanding. The question used to assess this indicator is shown in Figure 5. The student response analyzed is from subject S1, and the answer to question number 3 can be seen in Figure 6.

3. Berikut daftar tiket beberapa tempat wisata di Indonesia

Tempat Wisata	Wisatawan Lokal		Wisatawan Asing	
	Anak-anak	Dewasa	Anak-anak	Dewasa
Pantai Parangtritis	Rp5.000,00	Rp10.000,00	Rp5.000,00	Rp10.000,00
Candi Borobudur	Rp30.000,00	Rp35.000,00	Rp225.000,00	Rp375.000,00
Museum Vredenburg	Rp3.000,00	Rp5.000,00	Rp15.000,00	
Taman Sari	Rp5.000,00		Rp10.000,00	
Kalibiru	Rp30.000,00			

Wisatawan lokal dewasa menggunakan uang sebesar Rp250.000,00 untuk membeli tiket dari dua tempat wisata Indonesia yang berbeda. Apabila wisatawan lokal dewasa membeli tiket wisata Taman Sari sebanyak 19 tiket, maka berapa tiket tempat wisata yang dapat dibeli dan tempat wisata mana yang bisa dikunjungi selain wisata Taman Sari dengan uang sebesar Rp250.000,00? Berikan alasanmu mengapa tidak memilih tempat wisata lainnya!

Figure 5. Question **Number 3**

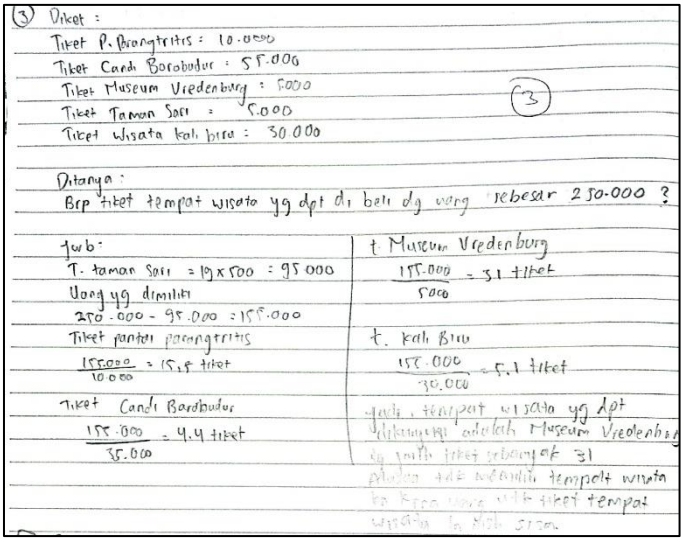

Figure 6. Response of Subject S1

Figure 6 shows that the subject was able to engage in reasoning by analyzing information presented in the table. The subject made accurate and appropriate decisions, accompanied by complete explanations. In this case, the subject demonstrated the ability to analyze information, draw conclusions, and extend understanding, thereby being able to solve problems encountered in everyday life. Furthermore, the researcher conducted an interview to gather additional information related to the subject's response. The results of the interview revealed that the subject could read and interpret the table presented, and use the given facts to solve the problem. The subject also provided a stronger justification for why the remaining money was used to buy an entrance ticket to Vredenburg Museum.

Based on the analysis and discussion of junior high school students' numeracy skills in solving AKM-type word problems, the overall numeracy competence level of subject S1 is categorized as **proficient**. Students with proficient numeracy skills possess a solid understanding of basic mathematical concepts and are capable of identifying effective strategies for problem-solving. Additionally, they can reason through complex and non-routine problems using their mathematical knowledge. Reasoning ability is crucial in solving non-routine, context-based mathematics problems (Braithwaite & Sprague, 2021; Martínez-Pérez & Sanchez, 2022). With strong mathematical reasoning, students also tend to have high numeracy skills (Sunderaraman et al., 2022).

4. CONCLUSION

The conclusions of this study are as follows: (1) Students' numeracy skills in solving AKM-type mathematical problems can be observed through their ability to understand facts, processes, concepts, and procedures; their ability to apply conceptual knowledge and understanding in solving real-life mathematical problems; and their reasoning skills in analyzing data and information, drawing conclusions, and extending understanding, dan (2) In general, the students in this study demonstrated **proficient** numeracy skills—having a solid grasp of basic mathematical concepts, generating effective strategies for problem-solving, and reasoning through complex and non-routine problems using their mathematical knowledge.

This research is expected to open opportunities for further studies examining students' numeracy abilities from other influencing factors, such as parental involvement, classroom environment, and community environment, or psychological factors such as mathematical mindset, mathematical resilience, and others.

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