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PROFILE OF NUMERATION ABILITY IN SOLVING TRIGONOMETRY QUESTIONS IN CLASS X SMK 4 SEMARANG EXAMINED BY INITIAL MATHEMATICAL ABILITY

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ABSTRACT

This study aims to analyze students' mathematical numeracy skills in solving trigonometry problems among 10th-grade vocational high school students, based on their initial mathematical abilities. Students were categorized into three groups based on their initial mathematical ability: (1) high ability, (2) moderate ability, and (3) low ability. This qualitative descriptive study involved 33 students as subjects, with a sample size of 6 students. Data collection utilized test techniques, specifically using summative assessment instruments to assess initial mathematical abilities through trigonometry problems, and numeracy skills through trigonometry-related test questions. Data analysis employed a triangulation technique involving data reduction, data presentation, and conclusion drawing. The findings indicated that in solving trigonometry problems: (1) Students with high mathematical ability were able to fulfill all numeracy skill indicators, evident from their accurate and sequentially correct answers. (2) Students with moderate mathematical ability could not fulfill some numeracy skill indicators, as evidenced by partially correct answers. (3) Students with low mathematical ability could only fulfill some numeracy skills; these students tended to encounter difficulties in problem-solving.In summary, the study demonstrated varying levels of numeracy skills in relation to students' initial mathematical abilities when solving trigonometry problems.

Keywords: Numeracy Ability, Initial Mathematical Ability, SMK, Trigonometry

INTRODUCTION

Proficiency in using technology and information media, as well as the ability to work and survive through life skills, are essential aspects of 21st-century education (Kemendikbud, 2020). A critical prerequisite for developing 21st-century skills is student literacy, where numeracy is a mandatory aspect of literacy (GLN, 2017). Numeracy skills include the application of mathematical operations and the ability to analyze diagrams, tables, and graphs using a mathematical approach (Tyas & Pangesti, 2018). Numeracy skills help individuals to be sensitive to data representations, patterns, number sequences, and train reasoning skills in problem-solving (Sri, 2017). According to the Ministry of

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Education and Culture (Ekowati & Suwandayani, 2019), numeracy skills serve as an early protection barrier against unemployment, low income, and poor health. Mastering these skills is a necessity for students in all aspects of life, whether at home, school, or in the community environment. When these skills are cultivated early on, unemployment rates can be reduced. Given the advancing era and sophisticated technology, almost all information is expressed in graphical or numerical forms. The correct solution is to understand and master basic numeracy skills. Rikka Mononen et al. stated that one of the essential basic skills that everyone must have is numeracy proficiency (Maulyda et al., 2021). This is deemed necessary because a significant portion of daily life activities is grounded in numeracy skills. Counting, understanding place values, and arithmetic are components of basic numeracy skills (Maulyda et al., 2021). These skills greatly assist individuals in daily life and even serve as a prerequisite for understanding higher disciplines. It is crucial to train numeracy skills in students from an early age. The importance of numeracy in today's life is underscored as a primary component in Minimum Competency Assessment (AKM), replacing the National Examination (UN). Numeracy skills are fundamental for learners because they are required to apply their learning in daily life. Numeracy skills are crucial for enhancing individuals' ability to use and interpret mathematics in various contexts. Moreover, they indicate that individuals should not only solve mathematical problems according to procedures but also utilize mathematics effectively in everyday life. Numeracy skills help students cultivate critical thinking and develop their capacity to be more courageous, confident, and better individuals (Alda & Wahidin, 2021).

According to (Han, Santoso, et al. 2017), numeracy proficiency in Indonesia in the year 2015, as assessed by the Programme for International Student Assessment (PISA), revealed that Indonesia ranked poorly in applying numeracy skills, even falling below Vietnam. The results from the PISA test showed a significant disparity between Vietnam and Indonesia. Vietnam, a newly independent Southeast Asian country, achieved a score of 495 with an average of 490, while Indonesia scored 387. The 2018 PISA survey indicated that numeracy skills among Indonesian students were still weak. In that study, the average mathematics score for Indonesian students was 379, compared to the Organisation for Economic Co-operation and Development (OECD) average of 487. This suggests that the average mathematical proficiency of Indonesian students is lower than that of other countries (Kemendikbud, 2019). The difference in mathematical abilities between Indonesian students and the OECD average highlights challenges in mathematics education in Indonesia. Students with low mathematical proficiency struggle to understand mathematical problems and face difficulties in analyzing them. They often fail to plan their work according to instructions, resulting in solutions that do not reflect mathematical concepts accurately. These factors underlie the issue of low numeracy skills among Indonesian students (Ashilla & Hafsah, 2022).

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Several studies have also analyzed numeracy skills and indicated that they are still low. (Apipatunnisa et al,2022) reported in their research that numeracy literacy among 5th-grade students in one elementary school in Tasikmalaya city is still quite low. Similarly, (Ate & Lede,2022) described that overall numeracy literacy among 8th-grade students at St. Josef Freinadementz Junior High School is low. (Likewise et al,2022) concluded that students with very high, high, and moderate abilities do not meet the indicators of numeracy literacy and problem-solving. Conversely, students with low and very low abilities completely fail to meet both indicators.

Trigonometry is one of the subjects taught to students at the high school level (SMA/SMK) and is a branch of mathematics related to triangular angles and trigonometric functions such as sine, cosine, and tangent (Kariadinata, 2018). Trigonometry remains a challenging topic for many students due to its numerous formulas and concepts that are difficult to grasp. Consequently, students often struggle to understand the material, leading to difficulties in solving trigonometry-related problems (Nurfauziah & Sari, 2018; Rohman & Karimah, 2018). The difficulties in solving trigonometry problems are evident in the process itself. According to Dedy S. Priatna, "If students encounter difficulties, they are likely to make mistakes" (Riana et al., 2020). Based on this, the occurrence of errors in solving trigonometry problems is influenced by students' initial mathematical abilities in that subject. When students have lower initial abilities in trigonometry, they are more likely to make errors when working on trigonometry problems.

There are several factors influencing students' success in learning mathematics, including internal factors such as initial abilities, intelligence level, learning motivation, study habits, learning anxiety, and learning motivation, among others. According to (Zuyyina et al,2018), students' initial abilities are crucial in determining their success in learning mathematics. Each individual possesses different learning abilities. Students' initial abilities refer to the skills they already possess before receiving instruction. This indicates their readiness to receive new material presented by teachers. It is useful to assess whether students have the prerequisite knowledge to engage in learning and how well they already understand the upcoming material, enabling teachers to design more effective learning experiences (Mulia et al., 2020). Research findings from (Hevriansyah & Megawanti,2017) and (Khadijah & Setiawan,2018) indicate a significant influence of students' initial mathematical abilities on their learning outcomes.

Numeracy skills and students' initial mathematical abilities are closely related and mutually beneficial. One of their connections lies in the process of analyzing mathematical problems, where strong initial mathematical abilities are essential. This means that initial mathematical abilities serve as the foundation for developing numeracy skills. Because the initial abilities students possess are crucial for facilitating subsequent learning (Muhammad, 2022), without a strong foundation in initial

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mathematical abilities, numeracy skills will also suffer. Hence, strong initial mathematical abilities are fundamental to developing numeracy skills, and both aspects are mutually advantageous. Therefore, to address the existing issues in schools, the researcher aims to understand the extent of students' mathematical numeracy skills based on their initial abilities. The researcher hopes that through this study, students can regain enthusiasm for learning mathematics, achieve desired grades, and develop their numeracy skills effectively.

RESEARCH METHODS

This research method employs qualitative research using a descriptive method. Qualitative research in social sciences involves collecting and analyzing data in the form of words (spoken or written) and human actions, without attempting to quantify the qualitative data obtained, thus avoiding numerical analysis (Afrizal, 2014). The research subjects are sampled from 33 in Class X SMK 4 Semarang SMK 4 Semarang. Subjects are grouped into three levels based on their initial mathematical abilities: high, moderate, and low, with 2 subjects selected from each level. Data collection in this study utilizes two instruments: the first test measures students' mathematical abilities to categorize them into high, moderate, and low ability levels. The second test assesses numeracy skills based on their mathematical ability. The criteria for initial mathematical abilities are detailed in Table 1.

Tabel 1. Criteria for initial mathematical abilities (Sari , 2021)

No.	Score	Criteria
1.	Students with scores ≤ 70	Low
2.	Students with scores between 71 and 80	Moderate
3.	Students with scores ≥ 81	High

The data used by the researcher are the results of summative assessments on trigonometry. The numeracy skills indicators used by the researcher are adapted from (OECD,2017). The indicators of numeracy skills can be seen in Table 2.

Tabel 2. The indicators of numeracy skills (OECD,2017)

No.	The ability	The ability indicators
1.	Communication	The students are able to write down the process of achieving solutions in written form.
		The students are able to draw conclusions from mathematical results.
2.	Mathematization	The students are able to translate contextual problems into mathematical form or vice versa.
		The students are able to use contextual understanding to solve mathematical problems.
3.	Representation	The students are able to convert diagrams, figures, equations, or other mathematical expressions presented into written form.
		The students are able to use diagrams, figures, equations, or other mathematical expressions presented to solve problems..

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4.	Reasoning and arguments	The students are able to create patterns and relationships to solve problems..
		The students are able to provide reasoning for the patterns and relationships they create..
		The students are able to draw conclusions from a statement and explain them logically.
		The students are able to construct logical mathematical arguments.
5.	Choosing strategies to solve problems	The students are able to identify problems..
		The students are able to determine formulas to solve problems.
		The students are able to create solutions plans accurately..
6.	Using language and symbolic, formal, and technical operations	The students are able to use mathematical symbols to perform calculations using formal symbols..

The data processing method used by the researcher is source triangulation. Source triangulation means testing data from various informant sources from which the data will be taken (Andarusni, 2020). The data analysis of this research is based on three stages: data reduction, data presentation, and drawing conclusions on the mathematical numeracy skills of students in solving trigonometry problems in Grade X of Vocational High School, reviewed from their mathematical abilities.

RESULTS AND DISCUSSION

This research was conducted in Grade X of Vocational High School with 33 student respondents. Based on the results of the summative assessment given to the students, it was found that 15% of students had high initial mathematical abilities, 61% had moderate initial mathematical abilities, and 24% had low initial mathematical abilities. Based on these results, the researcher selected two students from each level of initial mathematical ability as subjects for the study. Table 3 below shows the subject data for the research.

Tabel 3. Research Participant Data

No.	Code	Score	Criteria
1.	Rt	96	Low
2.	Dt	92	Low
3.	As	78	Moderate
4	Bs	80	Moderate
5	Ar	68	High
6	Jr	62	High

Six subjects were selected, with each pair representing categories of initial mathematical abilities. These six subjects were given trigonometry numeracy test questions to measure their numeracy abilities. The results of the numeracy test varied among the six subjects in answering the questions. Below is the description of the numeracy test results based on the categorization of initial mathematical abilities

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A. Mathematical numeracy abilities of students reviewed based on their initial mathematical abilities (High).

The results of the answers and the description of numeracy abilities from subjects Rt and Dt will be presented

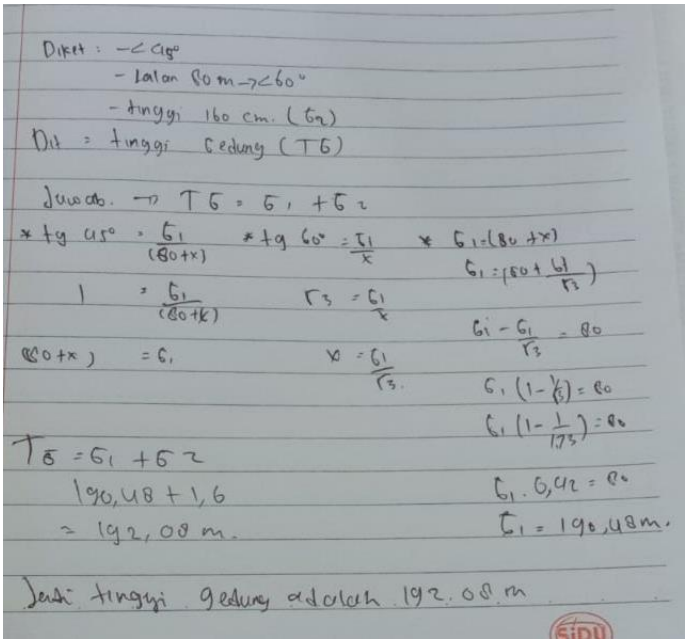

Figure 1. "The results of subject Rt's answers."

Based on the results of subject Rt with high initial mathematical abilities, they were able to solve the problems well and answer them coherently and accurately. Below in table 4, descriptions of each numeracy indicator are presented.

Table 4. Numeracy Skills of Subject Rt

No.	The ability	The ability indicators
1.	Communication	Subject Rt is capable of writing out the process to achieve a solution in written form.
		Subject Rt is able to conclude the results of the issues presented in the problem.
2.	Mathematization	Subject Rt is able to convert contextual problems into mathematical form or vice versa.
		Subject Rt is capable of using contextual understanding to solve mathematical problems.
3.	Representation	Subject Rt is able to convert presented images into written form.
		Subject Rt is capable of using presented images to solve problems.
4.	Reasoning and argument	Subject Rt is able to create patterns and relationships to solve problems.
		Subject Rt is capable of providing reasons for the patterns and relationships established.
		Subject Rt is able to draw conclusions from a statement and explain it logically.

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		Subject Rt is capable of making mathematical arguments logically.
5.	Choosing Strategies to Solve Problems	Subject Rt is able to identify problems.
		Subject Rt is capable of determining formulas to solve problems.
		Subject Rt is able to formulate solutions plans accurately.
6.	Using Language and Symbolic, Formal, and Technical Operations	Subject Rt is capable of using mathematical symbols to perform calculations using formal symbols.

Based on Table 4, it is evident that subject Rt, with high initial mathematical abilities, fulfills all numeracy skill indicators. The subject communicates problems effectively, converts contextual problems into mathematical form and vice versa, and uses contextual understanding to solve mathematical problems. They understand and interpret presented images effectively, using them to solve problems. Additionally, the subject excels in reasoning and provides logical and clear arguments, selects appropriate strategies for problem-solving, and reads mathematical symbols accurately. Consequently, the subject can easily tackle presented problems.

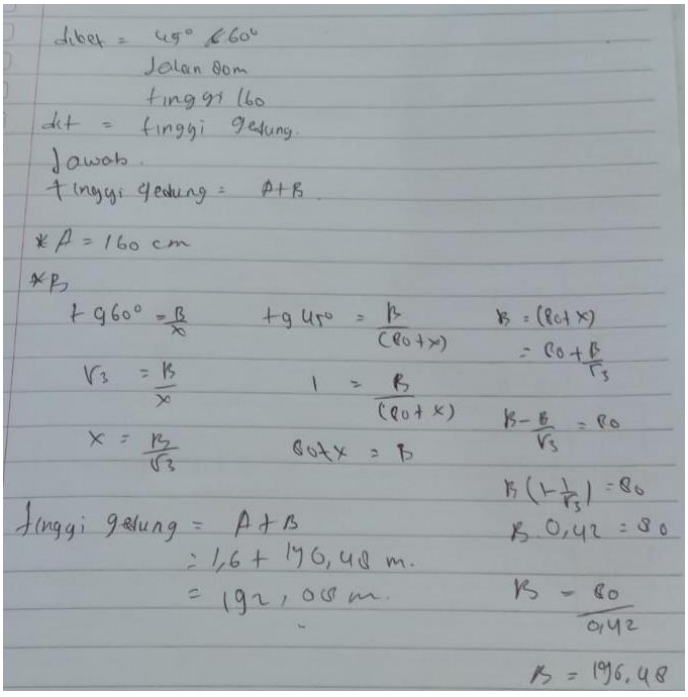

Figure 2. Subject Dt's Response Results

Based on the results of subject Dt with high initial mathematical abilities, they were able to solve the problems well and answer them coherently and accurately. Below in Table 5, descriptions of each numeracy indicator are presented.

Table 5. Numeracy Skills of Subject Dt

No.	**The Ability**	**The ability indicators**

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1.	Communication	Subject Dt is able to write out the process of solving problems in written form.
		Subject Dt is capable of concluding the results of issues presented in problems.
2.	Mathematization	Subject Dt can convert contextual problems into mathematical form or vice versa.
		Subject Dt is able to use contextual understanding to solve mathematical problems.
3.	Representation	Subject Dt is able to convert presented images into written form.
		Subject Dt is capable of using presented images to solve problems.
4.	Reasoning and Argumentation	Subject Dt can create patterns and relationships to solve problems.
		Subject Dt is capable of providing reasons for the patterns and relationships established.
		Subject Dt can draw conclusions from a statement and explain it logically.
		Subject Dt is capable of making mathematical arguments logically.
5.	Choosing Strategies to Solve Problems	Subject Dt is able to identify problems.
		Subject Dt is capable of determining formulas to solve problems.
		Subject Dt is able to create appropriate plans to solve problems.
6.	Menggunakan Bahasa dan Operasi Simbolis, Formal, dan Teknis	Subject Dt can use mathematical symbols to perform calculations using formal symbols.

It can be seen from Table 5 that Dt subjects with high initial mathematical abilities can fulfill all numeracy criteria. Subjects can be effective in communicating about problems, able to change problems from contextual to mathematical form and vice versa, and use understanding of context to solve mathematical problems. Subjects are also able to understand and solve problems presented in the form of images, and have the ability to reason and provide logical and clear arguments. Subjects were able to choose the right strategy to solve problems and understand mathematical symbols well, allowing them to easily solve the given problems.

b. Mathematical numeracy abilities of students reviewed based on their initial mathematical abilities (Moderate).

The results of the answers and the description of numeracy abilities from subjects As and Bs will be presented

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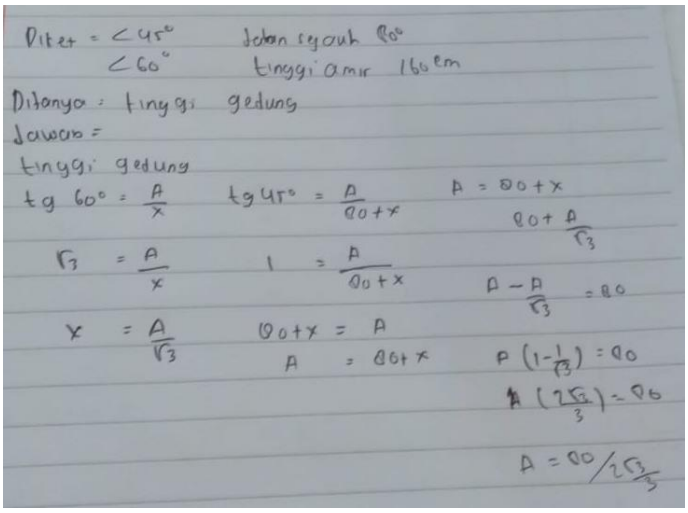

Figure 3. Subject As's Response Results

Based on the answers, subject As shows an initial understanding of mathematical problems and can effectively apply formulas. However, towards the end of the response, they were unable to complete the solution thoroughly. Table 6 provides a description of each numeracy indicator.

Table 6. Numeracy Skills of Subject As

No.	The ability	The ability indicators
1.	Communication	Subject As is capable of documenting the problem-solving process in written form.
		Subject As struggles to draw conclusions from the given problem.
2.	Mathematization	Subject As is able to translate contextual problems into mathematical forms and vice versa.
		Subject As uses contextual understanding effectively to solve mathematical problems.
3.	Representation	Subject As is proficient in converting presented diagrams into written form.
		Subject As effectively utilizes presented diagrams to solve problems.
4.	Reasoning and Argumentation	Subject As is capable of creating patterns and relationships to solve problems.
		Subject As struggles to provide reasons for the patterns and relationships created.
		Subject As can draw conclusions from a statement and explain them logically.
		Subject As can construct logical mathematical arguments.
5.	Selecting Strategies to Solve Problems	Subject As can identify problems.
		Subject As can determine formulas to solve problems.
		Subject As can create a solution plan accurately.
6.	Using Language and Operations Symbolically, Formally, and Technically	Subject As can use mathematical symbols to perform calculations with formal symbols.

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Based on Table 6, Subject As, with moderate initial mathematical ability, fulfills several indicators of numeracy skills. They are effective in communicating about problems, capable of translating problems from contextual to mathematical forms and vice versa, and utilize contextual understanding to solve mathematical problems. Subject As can select appropriate strategies to solve problems and demonstrate a good understanding of mathematical symbols, enabling them to solve given problems effectively. However, Subject As lacks proficiency in drawing conclusions from their problem-solving outcomes. Additionally, they struggle in reasoning and providing logical arguments, as well as in selecting and justifying the strategies used to solve problems.

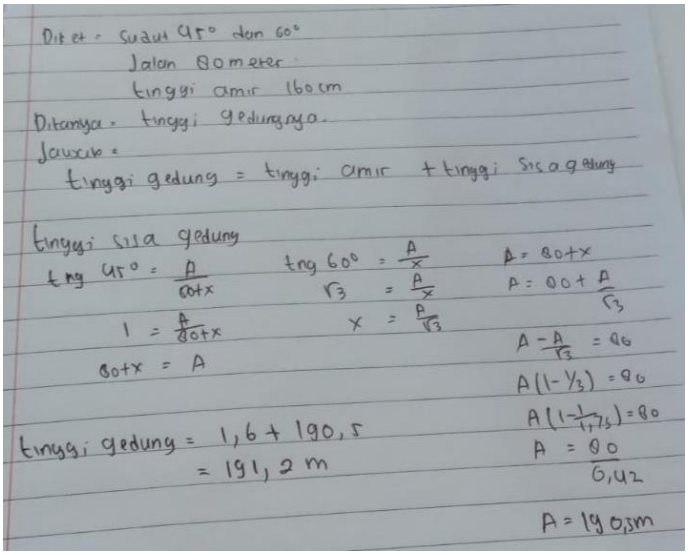

Figure 4. Subject Bs's Response Results

Based on the answers from Subject Bs, who has moderate mathematical ability, they can solve problems effectively and respond to them in a coherent and precise manner. However, towards the end of their responses, the subject tends to round numbers excessively, which affects the final outcome obtained. Below, Table 7 presents the description of each numeracy indicator.

Table 7. Numeracy Skills of Subject Bs

No.	The ability	The ability indicators
1.	Communication	Subject Bs is able to write down the process to reach a solution in written form.
		Subject Bs is less capable in concluding the results of the problems presented.
2.	Mathematization	Subject Bs is able to translate contextual problems into mathematical form or vice versa.
		Subject Bs is capable of using contextual understanding to solve mathematical problems.
3.	Representation	Subject Bs is capable of converting presented images into written form.

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		Subject Bs is capable of using presented images to solve problems.
4.	Reasoning and Argumentation	Subject Bs is able to create patterns and relationships to solve problems.
		Subject Bs is capable of providing reasons for the patterns and relationships established.
		Subject Bs is capable of drawing conclusions from a statement and explaining them logically.
		Subject Bs is capable of making mathematical arguments logically.
5.	Choosing Strategies to Solve Problems	Subject Bs is capable of identifying problems.
		Subject Bs is able to determine formulas to solve problems.
		Subject Bs is able to create precise problem-solving plans.
6.	Using Language and Symbolic, Formal, and Technical Operations	Subject Bs is capable of using mathematical symbols to perform calculations in a formal manner..

Based on Table 7, Subject Bs, with moderate mathematical ability, demonstrates proficiency across several numeracy indicators. The subject effectively communicates about problems, can translate problems from contextual to mathematical forms and vice versa, and utilizes contextual understanding to solve mathematical problems. They can solve problems presented through diagrams. Subject Bs is adept at selecting appropriate strategies for problem-solving, reasoning logically, and choosing mathematical symbols effectively, enabling them to solve problems easily. However, the subject is less proficient in drawing conclusions from problem-solving outcomes

c. Mathematical numeracy skills of students assessed from their mathematical ability (Low)

Below are the responses and descriptions of numeracy skills from subjects Ar and Jr.

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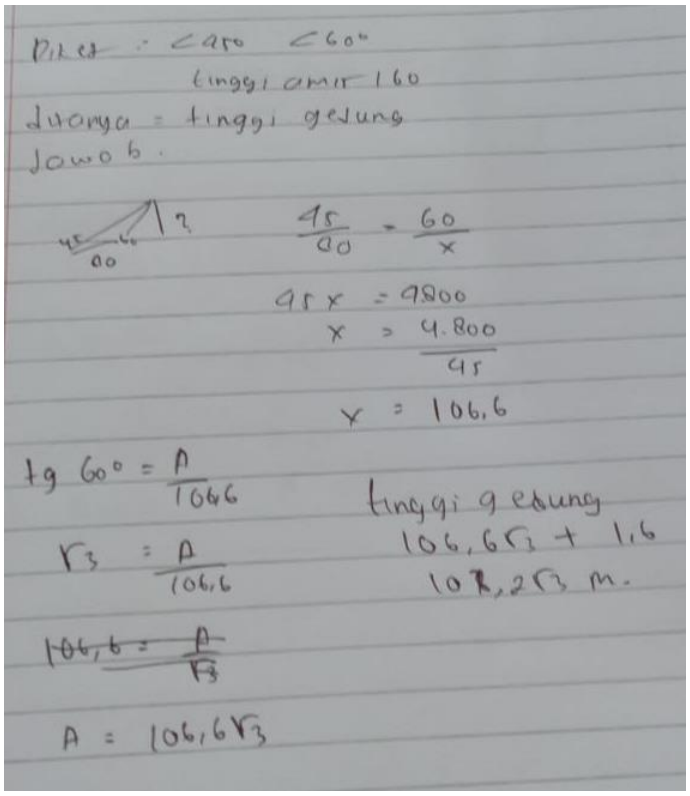

Figure 5. Subject Ar's Response Results

Based on the responses from Subject Ar, who has low initial mathematical ability, they are unable to apply the correct formulas. However, the subject works through the problems systematically, although the final outcomes are not accurate. Below, Table 8 presents the description of each numeracy indicator.

Table 8. Numeracy Skills of Subject Ar

No.	The ability	The ability indicators
1.	Communication	Subject Ar is able to write down the process to reach a solution in written form.
		Subject Ar is less capable in concluding the results of the problems presented.
2.	Mathematization	Subject Ar is able to translate contextual problems into mathematical form or vice versa.
		Subject Ar is capable of using contextual understanding to solve mathematical problems.
3.	Representation	Subject Ar is capable of converting presented images into written form.
		Subject Ar is capable of using presented images to solve problems.
4.	Reasoning and Argumentation	Subject Ar is less capable of creating patterns and relationships to solve problems.
		Subject Ar is less capable of providing reasons for the patterns and relationships established.

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		Subject Ar is capable of drawing conclusions from a statement and explaining them logically.
		Subject Ar is less capable of making mathematical arguments logically.
5.	Choosing Strategies to Solve Problems	Subject Ar is able to identify problems.
		Subject Ar is less capable of determining formulas to solve problems.
		Subject Ar is able to create precise problem-solving plans.
6.	Using Language and Symbolic, Formal, and Technical Operations	Subject Ar is capable of using mathematical symbols to perform calculations in a formal manner.

Based on Table 8, Subject Ar, with low initial mathematical ability, shows deficiencies in several numeracy indicators. The subject struggles with logical reasoning and providing coherent arguments, as well as selecting effective strategies to solve problems. They also exhibit shortcomings in choosing appropriate problem-solving strategies and understanding mathematical symbols well. Furthermore, Subject Ar struggles to apply suitable formulas to solve problems. However, despite these challenges, the subject effectively communicates problems, can translate problems from contextual to mathematical forms and vice versa, and uses contextual understanding to solve mathematical problems. Additionally, Subject Ar demonstrates an ability to comprehend problems presented through diagrams.

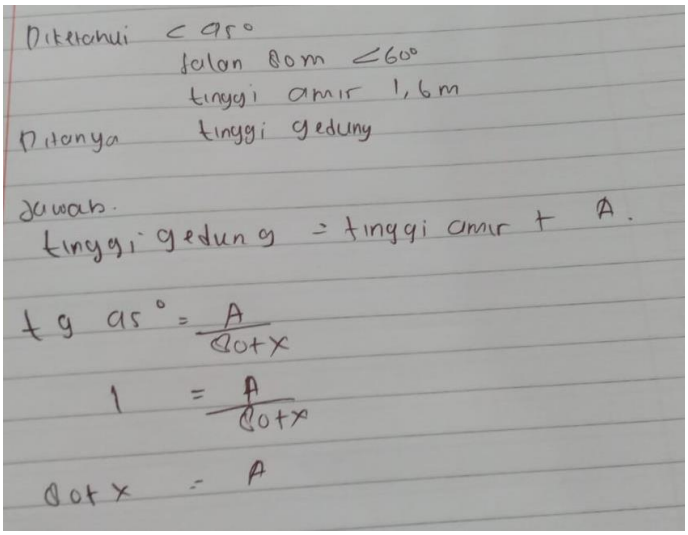

Figure 6. Subject Jr's Response Results

Based on the responses from Subject Jr, who has low initial mathematical ability, they can understand the diagrams presented in the questions. However, the subject struggles to solve the problems effectively. Below, Table 9 presents the description of each numeracy indicator.

Table 9. Numeracy Skills of Subject Jr

No.	The ability	The ability

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1.	Communication	Subject Jr is able to write down the process to reach a solution in written form.
		Subject Jr is less capable in concluding the results of the problems presented.
2.	Mathematization	Subject Jr is less capable of translating contextual problems into mathematical form or vice versa.
		Subject Jr is capable of using contextual understanding to solve mathematical problems.
3.	Representation	Subject Jr is capable of converting presented images into written form.
		Subject Jr is less capable of using presented images to solve problems.
4.	Reasoning and Argumentation	Subject Jr is capable of creating patterns and relationships to solve problems.
		Subject Jr is less capable of providing reasons for the patterns and relationships established.
		Subject Jr is less capable of drawing conclusions from a statement and explaining them logically.
		Subject Jr is less capable of making mathematical arguments logically.
5.	Choosing Strategies to Solve Problems	Subject Jr is able to identify problems.
		Subject Jr is able to determine formulas to solve problems.
		Subject Jr is less capable of creating precise problem-solving plans.
6.	Using Language and Symbolic, Formal, and Technical Operations	Subject Jr is less capable of applying mathematical symbols to perform calculations in a formal manner.

Based on Table 9, it can be seen that subjects with low initial mathematical ability do not meet several indicators in numeracy skills. These subjects struggle in converting problems from contextual to mathematical forms and vice versa, as well as in selecting appropriate problem-solving strategies and understanding mathematical symbols proficiently. They also face challenges in reasoning and providing logical arguments, as well as in selecting effective strategies to solve problems. However, subjects with low initial mathematical ability can effectively communicate about mathematical problems and understand issues presented through diagrams.

According to the description above, subjects with high initial mathematical ability can easily solve numeracy test questions on trigonometry, whereas subjects with moderate initial mathematical ability experience difficulties in solving numeracy test questions. Similarly, subjects with low initial mathematical ability tend to encounter challenges in solving the presented numeracy test questions.

CONCLUSION

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Based on the research findings, it is concluded that students with high mathematical abilities can fulfill all numeracy skill indicators. This is evident from their accurate and sequentially completed answers to the questions,students with moderate mathematical abilities fail to meet some numeracy skill indicators. This can be observed from their answers where some parts may be less accurate, students with low mathematical abilities only meet some of the numeracy skills. Subjects with low initial mathematical abilities tend to experience difficulties in problem-solving. These conclusions highlight the varying levels of numeracy skills among students based on their initial mathematical abilities, underscoring the importance of tailored educational strategies to support their development accordingly.

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