STUDENTS' NUMERACY SKILLS IN GEOMETRIC SEQUENCES AND SERIES: A CASE STUDY BASED ON LEARNING MOTIVATION

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ARTICLE INFO	ABSTRACT
	Literacy and numeracy are both very important abilities to support students' academic success and future life skills. This study aims to analyze the numeracy skills of vocational students in terms of learning motivation. The method used in this research is descriptive qualitative method. This research was conducted at SMKS Malaka by involving 53 students in grades X and 6 as subjects in this study, each of which represents high, medium, and low motivation levels. The instruments used are ability tests, motivation questionnaires, interviews used to explore more in-depth information about students' strategies, obstacles and attitudes in solving mathematics. Based on the results of this study, it shows that students with high and medium levels of learning motivation can meet the indicators, namely being able to implement various kinds of numbers and symbols related to basic mathematics to solve problems in various contexts of daily life, analyze the information presented, and interpret the results of the analysis to predict and make decisions. Whereas students with low levels of motivation can only fulfill one indicator, namely only being able to interpret various numbers and symbols related to basic mathematics.
	Literasi dan numerasi merupakan kedua kemampuan yang sangat penting untuk mendukung keberhasilan akademik dan keterampilan hidup siswa di masa depan. Penelitian ini bertujuan untuk menganalisis kemampuan numerasi siswa SMK ditinjau dari motivasi belajar. Metode yang digunakan dalam penelitian ini menggunakan metode kualitatif deskriptif. Penelitian ini dilakukan di SMKS Malaka dengan melibatkan 53 siswa kelas X dan 6 sebagai subjek pada penelitian ini yang masing-masing mewakili Tingkat motivasi tinggi, sedang, dan rendah. Instrumen yang digunakan berupa tes kemampuan, angket motivasi, wawancara yang digunakan untuk menggali informasi lebih mendalam tentang strategi, hambatan dan sikap siswa dalam menyelesaikan matematika. Berdasarkan hasil dari penelitian ini menunjukkan bahwa siswa dengan motivasi belajar tingkat tinggi dan sedang dapat memenuhi indicator yaitu mampu mengimplementasikan berbagai macam angka dan simbol yang terkait dengan matematika dasar untuk memecahkan masalah dalam berbagai macam konteks kehidupan sehari-hari, menganalisis informasi yang disajikan, dan menafsirkan hasil analisis untuk memprediksi dan mengambil Keputusan. Sedangkan siswa dengan motivasi tingkat rendah hanya dapat memenuhi satu indikator yaitu hanya dapat menginterpretasikan berbagai angka dan simbol yang berhubungan dengan matematika dasar.

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1. INTRODUCTION

Literacy and numeracy are two essential skills that play a crucial role in supporting students' academic success and future life competencies. Literacy and numeracy form the basis of the Minimum Competency Assessment, where the ability to reason using language is referred to as literacy, and the ability to reason using mathematics is known as numeracy (Amidi, 2024; Pusmenjar, 2020; Rachmawati et al., 2024). Numeracy skills also serve as a measure of a nation's educational quality. It is the responsibility of the government, educational institutions, society, and individuals to improve literacy and numeracy skills.

(Zakaria et al., 2023). According to the results of PISA, Indonesia still ranks relatively low in mathematical literacy, including numeracy literacy. Out of 81 participating countries, Indonesia is positioned at 65th with an average score of 372, which is significantly below the international average score of 472 (OCDE., 2022). The low results may be due to students experiencing difficulties in learning, particularly in developing their numeracy skills (M. Novita et al., 2021; Suparya et al., 2022; Yusmar & Fadilah, 2023).

In this era of rapidly advancing technology and information, mathematical numeracy has become one of the essential skills that every individual must master, especially vocational high school (SMK) students who are preparing to enter the workforce. According to Putri et al., (2023) Regarding numeracy skills, there are several key aspects: (1) understanding and applying numbers, (2) problem-solving, (3) making accurate decisions, (4) critical thinking, and (5) social engagement.(Jihan & Hendriana, 2023; Kajori & Hendriana, 2023; Sidiq et al., 2023). These points related to mathematical numeracy can serve as essential components in solving mathematical problems.

Numeracy skills are one of the key indicators in assessing students' readiness to face global challenges (Anggraini & Setianingsih, 2022; Fajriyah, 2022; Musanadah et al., 2024). Research has shown that many vocational high school (SMK) students face difficulties in understanding basic mathematical concepts and applying them to real-world problems, which can affect their academic performance. Numeracy skills can be effectively mastered by students if they have high learning motivation. Motivation serves as a vital element that can inspire students to engage in the learning process. Learning motivation can be defined as a drive or force that originates either internally or externally to encourage students to learn (Rigusti & Pujiastuti, 2020). Low learning motivation can negatively impact students' academic success (Zega & Mendrofa, 2023).

The advantage of learning motivation lies in the emergence of internal drive within the students themselves, making the motivation more stable and less likely to fade. However, the drawback of student motivation stems from the differing characteristics of each learner, which requires appropriate instructional strategies to ensure an optimal learning process (Firmansyah, 2021). There are two types of motivation that influence students in learning: internal drive that arises naturally from within the student without external influence, known as intrinsic motivation (Anis Faristin & Saptadi Ismanto, 2023; Julyanti, 2021; Prasetyo & Dasari, 2023). Meanwhile, motivation that is formed as a result of external stimuli from the surrounding environment is referred to as extrinsic motivation (Marniati et al., 2021; Simbolon dkk., 2025).

The enthusiasm for learning can develop through motivation that comes from within. Both motivation and learning must originate internally, and when combined, they significantly influence students' academic achievement. Learning motivation refers to the overall force within a student that drives them to engage in the learning process and provides direction to their learning activities, with the goal of achieving desired outcomes. Learning motivation consists of three main components: (1) motive, (2) expectation, and (3) intensity (R. K. Sari et al., 2021).

Research on numeracy skills has been widely conducted at the elementary and secondary education levels; however, studies focusing on vocational high school (SMK)

students remain very limited and are rarely undertaken. Numeracy skills are influenced by affective factors such as curiosity. However, this study has yet to explicitly examine how learning motivation affects students' numeracy achievement in the learning process (Cahyani et al., 2022). Numeracy skills and learning motivation jointly influence students' academic achievement. However, this research has not yet specifically examined the aspect of numeracy within vocational education environments (D. Novita, 2017).

Based on the background above, the researcher is interested in conducting a study entitled *"Students' Numeracy Skills in Geometric Sequences and Series: A Case Study Based on Learning Motivation".* The research question posed in this study is: How are the numeracy skills of vocational high school (SMK) students in the topic of geometric sequences and series influenced by their learning motivation. The objective of this research is to describe the numeracy skills of SMK students in the topic of geometric sequences and series, viewed through the lens of their learning motivation.

2. METHOD

The research method applied in this study is a **descriptive qualitative method** with a **case study approach**. This approach was chosen to gain an in-depth understanding of vocational high school students' numeracy skills in relation to their learning motivation.

2.1. Reseacrh Subjects

The subjects of this research were tenth-grade students at SMKS Malaka, with an initial total of 53 participants. To conduct a more in-depth analysis, six students were selected to represent the three levels of learning motivation (high, medium, and low) using purposive sampling. This technique involves deliberate selection based on clusters of learning motivation categories, while also considering the clarity of each student's learning profile and their willingness to participate in further interviews. The identities of the selected subjects are presented as follows:

Table 1. Research Subject

No	Subject Code	Categoriess of learning motivation
1	BLY	High
2	AMZ	High
3	RA	Medium
4	RW	Medium
5	ML	Low
6	R	Low

2.2. Data Collection

In this study, data were collected using three types of instruments, including: a written test consisting of four numeracy questions that referred to three predetermined indicators: (1) Implementing various types of numbers and symbols related to basic mathematics to solve problems in a variety of real-life contexts, (2) nalyzing information presented in different forms (such as graphs, tables, charts, diagrams, etc.), and (3) Interpreting the results of the analysis to make predictions and informed decisions. Next, a learning motivation questionnaire based on a 1–4 Likert scale was used, consisting of 19 statements aimed at measuring students' level of motivation toward learning mathematics. In addition, interview guidelines were employed to gather more in-depth information

related to students' strategies, challenges, and attitudes in solving numeracy problems. These interviews were conducted after students had completed the numeracy test and the motivation questionnaire. The instruments used in this study were validated by several experts, including two mathematics lecturers, and were tested for validity with students. The results of the validity test indicated that the instruments were appropriate and suitable for use in the research. The study was conducted in accordance with research ethics, including obtaining written consent from the school, maintaining the confidentiality of all collected data, and using coded identifiers to protect the anonymity of the selected subjects.

2.3. **Data Analysis**

Data analysis was conducted using a qualitative descriptive approach. The data obtained from the numeracy tests, motivation questionnaires, and interviews were analyzed to assess the achievement of numeracy indicators based on students' learning motivation levels (high, medium, and low). Each type of data numeracy test results, learning motivation questionnaire responses, and interview outcomes was analyzed through the following steps:

1. Data Reduction
   This step aimed to filter and extract important information from the test results, questionnaires, and interviews. The focus was on identifying responses that indicated either achievement or lack thereof in relation to the numeracy skill indicators.
2. Data Display
   Once data reduction was completed, the information was organized in the form of score tables, pie charts (for the questionnaire), and summarized interview results. This presentation was intended to facilitate comparison among the three groups of subjects based on their respective levels of learning motivation.
3. Conclusion Drawing and Verification
   Conclusions were drawn after the data had been presented. This step was used to examine the alignment between test results and numeracy achievement. The researchers cross-referenced test outcomes with students' responses during interviews to support interpretation and ensure accuracy of the findings.

3. Results And Discussion

3.1. Results

Based on the data analysis from the research on students' motivation in learning mathematics in Grade X at SMKS Malaka, the results are presented in the form of a descriptive table showing the percentages after data collection through the questionnaire. The data were obtained from questionnaires completed by 53 students, and the results are illustrated in the diagram below:
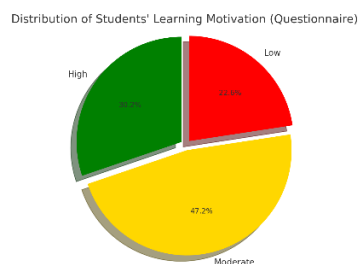

Figure 1. level of learning motivation

Based on the image above, it shows the level of learning motivation of Grade X students at SMKS Malaka in mathematics learning. The image indicates that there are three levels of student learning motivation in Grade X at SMKS Malaka: 16 students or 30.19% have a high level of motivation, 25 students or 47.17% have a moderate level of motivation, and 12 students or 22.64% have a low level of motivation. For each level of learning motivation, two subjects were selected for interviews. The results of the selection for each level are as follows:
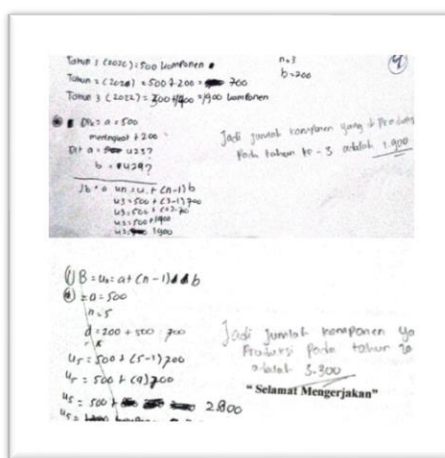
Table 2. Reserach Subject

No	Subject Code	Categoriess of learning motivation
1	BLY	High
2	AMZ	High
3	RA	Medium
4	RW	Medium
5	ML	Low
6	R	Low

The selected subjects were given a numeracy skills test, a questionnaire, and an interview containing several questions related to the indicators of numeracy skills. The following is a discussion of the analysis.

3.2. Discussion
Numeracy Skills of a Student with High Learning Motivation (Subject 1)

Figure 2. BLY's Answer

Based on the findings from the student's test answers and interview results regarding the numeracy skills of students with a high level of motivation, subject BLY was able to analyze data and correctly implement information in various forms. This includes understanding and identifying key information presented. The next step, in accordance with the indicators of students' numeracy skills, is implementing numerical concepts and mathematical symbols to solve real-life problems. Student BLY was able to construct a mathematical model by assigning variables to the components based on the given information. BLY demonstrated excellent performance in identifying number patterns from the quantity of components and determining the total number of components produced. The subject was also able to draw a conclusion from the results by accurately stating the total production for the year in question. Based on BLY's responses and the

interview—categorized under high motivation—the student demonstrated outstanding ability in solving numeracy problems. This is evidenced by the fulfillment of all three indicators of numeracy skills: interpretation, analysis, and conclusion-drawing. The subject effectively implemented the information presented in the problem, analyzed the situation systematically, and interpreted the results logically and argumentatively. hese skills reflect that high learning motivation positively impacts the quality of thinking and mathematical problem-solving, particularly in the context of numeracy. Students with high motivation are capable of achieving all numeracy indicators and can effectively structure the problem-solving steps, applying the appropriate approach to reach accurate solutions in mathematical tasks (Sinaga & Simanjorang, 2024; Taqwani et al., 2024).

Numeracy Skills of a Student with High Learning Motivation (Subject 2)

Figure 3. AMZ's Answer

Based on the findings from the student's test responses and interview results, Subject AMZ, who possesses a high level of learning motivation, was able to analyze data and accurately implement information presented in various forms, particularly by understanding and identifying key information. The next step, in accordance with the indicators of students' numeracy skills, is the application of numerical concepts and mathematical symbols to solve real-life problems. However, Subject AMZ was unable to construct a mathematical model by representing the product components based on the given information. Therefore, it can be concluded that Subject 2, within the high motivation category, demonstrated **fairly good ability** in solving numeracy problems. This is indicated by the student's inability to translate information into mathematical models using symbols or numerical expressions. Nevertheless, the subject fulfilled two of the three numeracy indicators: **analysis** and **drawing conclusions**, both of which were carried out adequately.

Numeracy Skills of a Student with Medium Learning Motivation (Subject 1)

Figure 4. RA's Answer

Based on the findings from the student's test responses and interview, Subject RA, who has a moderate level of learning motivation, was unable to apply number concepts and mathematical symbols to solve real-life problems. The student also struggled to construct a mathematical model by representing the product components based on the information provided. The next step, in accordance with numeracy skill indicators, involves the ability to analyze data and implement information in various forms, including understanding and identifying important details presented in the problem. While RA's overall solution was generally on the right track, it lacked precision, leading to several inconsistencies or incorrect results. This can be seen, for example, in point (b), where RA wrote the calculation as $\mathbf{500 + (4-1)700 = 500 + (3)700 = 2.600}$, However, the correct calculation should be $\mathbf{500 + (5-1)700 = 500 + 4.700 = 3.300}$. Furthermore, with regard to the final indicator, RA was unable to interpret the results of the data analysis. This suggests that students within the moderate motivation category were not able to meet all the numeracy indicators, particularly in making predictions and drawing conclusions (Setiawati et al., 2023; Taqwani et al., 2024; Trigita et al., 2023).

Numeracy Skills of a Student with Medium Learning Motivation (Subject 2)

Figure 5. RW's Answer

Based on the findings from the student's test responses and interview, Subject RW, who is categorized as having a moderate level of learning motivation, was unable to apply number concepts and mathematical symbols to solve real-life problems. The subject did not construct a mathematical model by representing the product components from the provided information, and was also unable to interpret the results of the data analysis. However, RW was able to analyze data and implement information in various forms, including identifying and understanding key information presented in the problem. In the solution provided, RW gave correct answers. This contrasts with Subject 1 (RA) in the same motivation category, where RA's work was reasonably well-developed but included calculation errors, while RW's answers were accurate and well-executed. This shows a difference between the two students in the moderate motivation category—RA had a fairly good understanding but inaccurate answers, whereas RW had both a good understanding and correct responses. These findings indicate that students in the moderate motivation category generally struggle to fully meet the numeracy indicators, particularly in terms of making predictions and drawing conclusions (Setiawati et al., 2023; Taqwani et al., 2024; Trigita et al., 2023).

Numeracy Skills of a Student with Low Learning Motivation (Subject 1)

Figure 6. ML's Answer

Based on the findings from the student's test responses and interview, Subject ML, who has a low level of learning motivation, was unable to analyze data or implement information in various forms to understand and identify key information presented. ML was only able to apply numbers and mathematical symbols to attempt to solve the problem; however, the solution did not align correctly with the given question. This occurred because the student did not fully understand the problem and was unable to determine the appropriate formula to use. Furthermore, the student was not yet able to clearly express their solution in writing and tended to rush through the task, aiming to finish quickly without thoroughly thinking through the problem (Khotimah et al., 2024; Setyaningsih & Munawaroh, 2022). These results indicate that the student has a limited understanding of the given problem, lacks skill in applying numbers and mathematical symbols, struggles to analyze information presented in various forms, and is unable to translate the results of data analysis into accurate conclusions based on interpretation.

Numeracy Skills of a Student with Low Learning Motivation (Subject 2)

Figure 7. R's Answer

Based on the findings from the student's test responses and interview, Subject R, who falls under the low learning motivation category, was unable to apply various forms of numbers and mathematical symbols to solve the problem. However, the student was able to analyze data and interpret information presented in various formats with the aim of understanding and identifying key details. Nevertheless, there were errors in explaining the results of the data analysis, and the student was unable to interpret the analysis outcomes correctly. This was primarily due to the student's lack of understanding of the problem and an inability to grasp the formula needed for solving it. Additionally, the student was not yet able to present their answers clearly in written form and tended to rush through the task in an effort to finish quickly without properly engaging with the problem (Khotimah et al., 2024; Setyaningsih & Munawaroh, 2022). These results indicate that the student has a limited understanding of the given problems, lacks skill in applying numbers and mathematical symbols, struggles to analyze information presented in various

forms, and is unable to translate the results of data analysis into accurate conclusions based on proper interpretation.

Based on the above discussion, there appears to be a strong correlation between students' level of learning motivation and their numeracy skills. Subjects with high motivation demonstrate better abilities in developing strategic steps, understanding contextual problems, and drawing clear and accurate conclusions. In contrast, subjects with low motivation tend to be hesitant, passive, and unwilling to engage in forming problem-solving strategies.

Argumentatively, these findings support the notion that motivation not only influences students' participation in learning but also significantly impacts the quality of their mathematical thinking. Highly motivated students appear to be more reflective and capable of evaluating the solutions they develop, whereas students with low motivation tend to focus solely on completing tasks quickly, without careful or logical consideration.

These findings are consistent with the study by (Wulansari et. al.,) which found that students with high learning motivation are able to meet all numeracy indicators. This includes their ability to utilize various numbers and symbols related to basic mathematics, analyze presented information, and interpret the results of analysis to make predictions and informed decisions. In comparison to the quantitative study by (D. Novita, 2017) which identified a correlation between motivation and mathematics achievement, the present research complements those findings by offering a qualitative perspective that illustrates the students' cognitive processes in solving numeracy problems.

4. CONCLUSION

Based on the findings of this study, it can be concluded that students with high and moderate levels of learning motivation are able to fulfill the key indicators of numeracy skills. These include the ability to apply various numbers and symbols related to basic mathematics to solve problems in diverse real-life contexts, analyze presented information, and interpret the results of analysis to make predictions and informed decisions. Meanwhile, students with low levels of motivation were only able to meet one indicator namely, interpreting numbers and symbols related to basic mathematics.

This conclusion implies that improving students' numeracy skills in vocational high schools (VHS) cannot be separated from efforts to enhance their learning motivation. These efforts may include the use of contextual learning strategies and the implementation of instructional approaches that are engaging and meaningful for students.

However, this study has certain limitations. These include the sample scope, content coverage, and research duration. The research was conducted in only one school, involving a limited number of subjects and focusing on three representative students, which restricts the generalizability of the findings. The study also focused solely on the topic of geometric sequences and series, thus not covering the full spectrum of numeracy skills. Additionally, the research was conducted over a limited period of time, without observing the development of students' numeracy skills longitudinally or over a longer term.

Therefore, it is recommended that future studies conduct longitudinal research to observe the development of numeracy skills among vocational high school students with varying levels of motivation over an extended period. Further research should also be conducted in several vocational schools with different characteristics to enhance the generalizability of findings. Moreover, combining quantitative and qualitative approaches is suggested to gain a more comprehensive understanding. Future studies should explore numeracy skills across various mathematical topics relevant to industrial and workplace needs, examine the influence of other factors such as socioeconomic background and learning styles, and design targeted intervention programs aimed at improving students' learning motivation and numeracy abilities in vocational education settings.

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