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Harnessing TikTok for learning: Examining its impact on students' mathematical numeracy skills

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ABSTRACT

Mathematical numeracy is a fundamental skill that students need to develop. Social media platforms like TikTok have the potential to support students in enhancing their mathematical numeracy skills. This study examines the effect of using TikTok on students' mathematical numeracy skills through a quantitative approach with a pre-experimental design. The research sample consisted of 30 class XI science students from Senior High School of Muhammadiyah Mlati, Yogyakarta, selected using a nonprobability sampling technique. The learning process integrated TikTok as a supplementary learning medium, and learning outcomes were assessed using pretests and posttests with validated instruments. Data collection involved a questionnaire (10 items) regarding learning experiences with TikTok and a numeracy test (5 items). Simple linear regression analysis, conducted with SPSS-25, confirmed normal data distribution and a linear relationship between TikTok use and numeracy skills. The regression analysis yielded a significance value of 0.015 (<0.05), indicating a significant effect of TikTok on students' mathematical numeracy skills. The R Square value of 0.195 suggests that TikTok accounts for 19.5% of the improvement in numeracy skills, with the remaining 80.5% attributed to other factors. The n-Gain test result of 0.63 classifies the numeracy skill enhancement as moderate. These findings highlight TikTok's effectiveness as an alternative learning medium for improving mathematical numeracy skills. This study implies that TikTok can be integrated into the teaching process as a supplementary tool to effectively enhance students' mathematical numeracy skills.

1. Introduction

The era of the Industrial Revolution 4.0 is characterized by the significant role of technology in human life, particularly in education (Tavares et al., 2023). Therefore, the learning process must integrate technology comprehensively. Today, teachers must continuously innovate and find new ways to utilize technology in the classroom (Mashudi, 2021). This aims to ensure that the learning process achieves the desired outcomes. In mathematics education, technology is crucial in helping students understand the concepts and procedures being taught (Hatmoko et al., 2024). Various technological tools and applications enable teachers to enhance students' understanding and skills in mathematics, creating a more interactive and engaging learning environment (Pulungan et al., 2024; Wahyuni et al., 2024).

Currently, technology has become a fundamental element in education. Using devices such as computers, tablets, and educational software provides opportunities for teachers to present learning materials more engaging and dynamic. Moreover, technology fosters a more interactive and lively

learning environment, allowing students to actively participate in simulations, educational videos, and various other interactive activities (Rahayu & Maryani, 2023). By integrating technology, teachers can create a more innovative and dynamic learning environment (Putri & Siswanto, 2024; Setianingrum & Da Costa, 2023). Therefore, the role of teachers as innovators in implementing technology has become increasingly crucial, particularly in helping students access subjects perceived as challenging, such as mathematics (Goos et al., 2023).

Mathematics is a discipline taught from elementary to higher education and plays a crucial role in the educational curriculum (Siswanto & Hanama, 2024). The primary objective of mathematics education is to introduce numerical concepts and equip students with independent thinking skills and a deep understanding of applying these concepts in daily life (Kaushik et al., 2021). Mathematics is a foundation for developing critical thinking skills, problem-solving abilities, and understanding fundamental structures in life. However, many students still struggle to grasp mathematical concepts due to a lack of conceptual understanding and awareness of the benefits of learning mathematics. Consequently, many students exhibit low numeracy skills (Carandang et al., 2024).

Therefore, the approach to mathematics education should not be limited to providing formulas or concepts to be memorized but should also incorporate methods that enable students to solve problems more comprehensively (Siswanto & Susetyawati, 2024). This approach aims to help students develop a deeper understanding of concepts and apply them in various real-life contexts. As a result, students not only master the material but also enhance their critical and analytical thinking skills, with numeracy skills serving as the primary foundation in the learning process.

A problem-solving-oriented learning approach is expected to significantly enhance students' numeracy skills (Pisriwati et al., 2024), equipping them with the ability to navigate complex mathematical challenges in the future. This approach fosters procedural fluency in mathematical operations and a deeper conceptual understanding, allowing students to internalize mathematical principles and apply them with flexibility across diverse real-world contexts. Students develop critical thinking, logical reasoning, and adaptive strategies for tackling academic and practical problems by engaging in problem-solving activities. Consequently, mathematics is not merely an academic discipline but also a fundamental tool for informed decision-making, analytical reasoning, and effective problem-solving in everyday life and future endeavours.

One effective way to enhance students' numeracy skills is by incorporating technology into the learning process and optimizing its use (Yogyanto et al., 2024). Therefore, selecting appropriate technology that aligns with the subject matter is crucial. The rapid advancement of technology has influenced human perspectives on daily activities, including social and communication aspects. Technology provides tools that make mathematics learning more interactive and engaging, creating opportunities to explore mathematical concepts more profoundly and comprehensively (Georgiou & Ioannou, 2021). With the appropriate use of technology, teachers can establish an effective and enjoyable learning environment that supports the development of students' numeracy skills.

Today, social media has become an integral part of society, serving as a primary means of socialization and communication. Social media functions as a communication and interaction tool and serves as a medium for expression and learning (Suryani et al., 2024; Tarso et al., 2025). In this context, TikTok, one of the most popular social media platforms, holds great potential as a learning tool. With its distinctive short-video format and diverse content types, TikTok can present information creatively and engagingly, including educational content. This opens up new opportunities for educators and students to utilize TikTok as a supplementary learning tool that is both entertaining and educational (Suryatama et al., 2024).

Based on the data obtained, students' interest and understanding of learning, particularly in mathematics, remain relatively low. Many students struggle to comprehend mathematical concepts, which impacts their arithmetic skills. Additionally, the lack of innovative learning media utilization has hindered students' understanding of the material. Therefore, this study examines how using TikTok as a social media platform influences high school students' numeracy skills in mathematics learning. The findings of this research are expected to provide new insights into how TikTok can be utilized to enhance students' understanding and numeracy skills in mathematics learning and contribute to developing more creative and effective teaching strategies to improve students' mathematical competencies.

2. Method

2.1. Research design

This study uses a quantitative approach with a pre-experimental design to examine the effect of using the TikTok application on students' mathematical numeracy skills. The pre-experimental design was chosen because it allows researchers to observe the impact of the intervention in natural classroom conditions without fully randomizing subjects. This study uses a pretest-posttest model with one group, where students are given tests before and after the TikTok-based learning intervention.

2.2. Participants of the research

Participants in this study were 30 students from one class, namely class XI Natural Sciences in Senior High School of Muhammadiyah Mlati. Participants were selected using a nonprobability sampling technique, which considered ease of access and the availability of research subjects in the context of ongoing learning. This class was chosen because they already had experience in using digital media in the learning process, thus facilitating the implementation of learning interventions using TikTok.

2.3. Data collection tools

The instruments used in this study consisted of two types, namely questionnaires and numeracy tests. The questionnaire consisted of 10 questions that measured students' perceptions of learning using TikTok, including aspects of engagement, understanding, and effectiveness of learning media. In addition, the numeracy test instrument consisted of 5 questions designed to measure students' mathematical numeracy skills before and after TikTok-based learning interventions. This instrument was developed based on numeracy indicators that are relevant to the applicable curriculum.

2.4. Research procedure

This research was carried out in several stages. First, a preparation stage is carried out, which includes instrument development, expert validation, and instrument testing. Second, the implementation phase begins with giving a pretest to students to measure their initial numeracy skills. Furthermore, TikTok-based learning is implemented in several sessions, where students use the TikTok application to access and study mathematics material in short video format. After the intervention was completed, a posttest was given to measure improvements in students' numeracy skills. Finally, pretest, posttest, and questionnaire data were collected for further analysis.

2.5. Data analysis technique

Data analysis in this study was conducted using SPSS-25 statistical software. First, a validity and reliability test of the instrument was conducted to ensure that the measuring instrument had adequate accuracy and consistency. Furthermore, a normality test was conducted to determine whether the data was normally distributed, which is a requirement in selecting statistical analysis techniques. Statistical hypothesis testing used regression analysis to measure the contribution of TikTok use in learning to students' numeracy skills. In addition, a gain analysis was conducted to measure the improvement in students' numeracy skills after the intervention.

3. Results and Discussion

Validity testing is conducted before the study's commencement or before the pretest and posttest data collection. This process ensures that the instruments used accurately measure the intended variables. In this study, validity and reliability tests were performed using SPSS-25. The instruments were tested on Grade XII Science students at Senior High School of Muhammadiyah Mlati, who had already covered the relevant material. A question is considered valid if the Pearson Correlation coefficient $r_{count} > r_{table}$ is deemed reliable if Cronbach's Alpha significance value is more significant than 0.05. Table 1 shows the validity and reliability tests for the questionnaire and test instruments using SPSS-25.

Table 1. Recapitulation of expert assessments

Questionnaire			Test		
Items	**r_{count}**	**Sig.**	**Items**	**r_{count}**	**Sig.**
1	0.432	0.423	1	0.438	0.312
2	0.521		2	0.693	
3	0.443		3	0.466	
4	0.354		4	0.523	
5	0.542		5	0.474	
6	0.334				
7	0.466				
8	0.498				
9	0.369				
10	0.512				

Based on the table 1, it can be seen that all questionnaire and test questions are said to be valid because the value $r_{count} > r_{table}$ (0.361) for all questions, and the reliability test on the questionnaire instrument gets a sig. 0.423 > 0.05 and the test gets a sig. 0.312 > 0.05. So, it can be said that both instruments are valid and reliable and can be used in research. Previously, students did the pretest first, then in the class, TikTok assisted learning, then they filled out the questionnaire given, and finally, students did the posttest. After getting the data, the normality will be tested with the following results, shown in Table 2.

Table 2. Normality test results

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		30
Normal Parameters	Mean	.0000000
	Std. Deviation	10.13228713
Most Extreme Differences	Absolute	.122
	Positive	.100
	Negative	-.122
Test Statistic		.122
Asymp. Sig. (2-tailed)		.200

Based on the table 2, it can be seen that the Asynp. Sig. (2-tailed) value is 0.200 > 0.05, so it can be said that the data is normal. Next, a linearity test will be carried out to show whether the sample data comes from a population with a similar variability level. The test results are available in the Table 3.

Table 3. Linearity test results

Numeration * TikTok		Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)	1572.800	12	131.067	1.481	.223
	Linearity	99.566	1	99.566	1.125	.304
	Deviation from Linearity	1473.234	11	133.930	1.514	.214
Within Groups		1504.000	17	88.471		
Total		3076.800	29			

Based on the table 3, it can be seen that the sig. Deviation from the Linearity value is 0.214 > 0.05 so it can be said that there is a significant linear relationship between the use of TikTok and students' mathematical numeracy. Next, find the regression coefficient in Table 4.

Table 4. Regression coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	118.940	13.078		9.095	.000
	TikTok	-.469	.180	-.441	-2.602	.015

From the table 4, a sig. value of 0.015 <0.05 was found. Therefore, it indicates a positive and significant relationship between the use of TikTok and students' mathematical numeracy skills. The magnitude of the influence of the use of TikTok on students' mathematical numeracy skills can be seen in the Table 5.

Table 5. Magnitude of influence

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.441	.195	.166	9.40660

Based on Table 5, it can be seen that the R Square value is 0.195, which shows that pocket money contributes 19.5% to the desire to learn mathematics, while 80.5% is influenced by other factors that were not studied. Meanwhile, the increase in students' mathematical numeracy can be seen from the students' pretest and posttest scores in Figure 1.

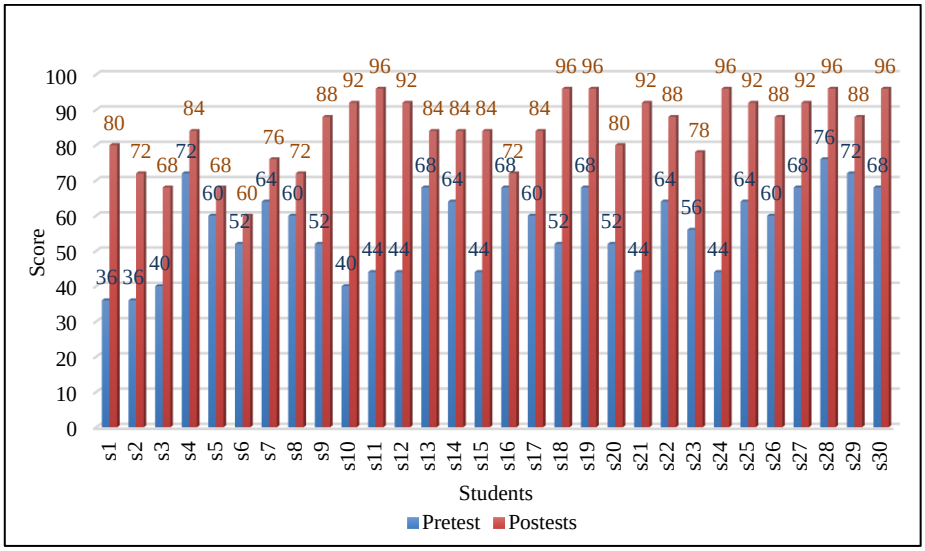

Fig. 1. Pretest and posttest results

Based on the Figure 1, the posttest score obtained a maximum score of 96, a minimum score of 60, an average (mean) of 84.21, and a total of 2442. Meanwhile, the pretest score obtained a maximum score of 76, a minimum score of 36, an average (mean) of 57.10, and a total of 1656. To find out the criteria for improving students' mathematical numeracy skills, the n-Gain test can be used with the following calculation.

$$\langle g \rangle = \frac{S_{post} - S_{pre}}{SMI - S_{pre}} = \frac{84.21 - 57.10}{100 - 57.10} = \frac{27.11}{42.90} = 0.63$$

The results of our analysis indicate that the gain score of 0.63 demonstrates a significant impact of TikTok usage on the mathematical numeracy abilities of class XI students at Senior High School of Muhammadiyah Mlati. This score falls within the moderate category, suggesting that while the influence is notable, it is not at an extreme level. These findings highlight the potential of social media platforms like TikTok as educational tools to enhance students' numeracy skills.

The results of this study indicate that the use of TikTok in mathematics learning has a significant impact on improving the numeracy skills of 11th-grade students at Senior High School of Muhammadiyah Mlati. The validity and reliability of the instruments, tested using SPSS-25, ensure that the data obtained is reliable for measuring the variables under investigation. All questionnaire and test items were found to be valid and reliable, providing a strong foundation for further analysis. After collecting pretest and posttest data, a normality test was conducted, which showed that the data was normally distributed with an Asymp. Sig. value of 0.200 > 0.05. Furthermore, the linearity test results indicated a significant linear relationship between TikTok usage and students' numeracy

skills, with a significance value of 0.214 > 0.05, meaning that the independent and dependent variables had a suitable correlation for further analysis.

These findings align with previous research, which suggests that using social media as a learning tool can enhance students' understanding and engagement in the learning process (Lasekan et al., 2024; Sharma et al., 2023). As a short-video-based platform, TikTok provides a more interactive and contextual learning experience than conventional teaching methods. Research by (Setiawan et al., 2024) also indicates that integrating digital technology in education can help improve students' critical thinking and problem-solving skills (Moningka et al., 2024). This study supports those findings by demonstrating a significant increase in posttest scores compared to pretest scores, reflecting TikTok's effectiveness in enhancing students' numeracy skills.

Based on the regression analysis, the significance value was found to be 0.015 < 0.05, indicating a positive and significant relationship between TikTok usage and the improvement of students' mathematical numeracy. The R Square value of 0.195 suggests that 19.5% of the improvement in numeracy is influenced by TikTok usage, while the remaining 80.5% is influenced by other factors not examined in this study. This finding is consistent with research by (Asbari, 2024; Tang et al., 2022), which found that while digital technology can enhance learning outcomes, other factors such as motivation, teacher engagement, and instructional strategies also play a crucial role in students' academic success. Therefore, although TikTok has been proven beneficial, its use should be combined with other teaching strategies for optimal results.

The n-Gain test result was also 0.63, placing the improvement in the moderate category. This indicates that while TikTok can help students understand numeracy concepts, its effectiveness still depends on how it is implemented in the learning process. Previous research by (Putri et al., 2025) and (Tarso et al., 2024) emphasizes that multimedia-based learning is more effective when it follows cognitive principles such as information segmentation, cognitive load reduction, and active student engagement. Therefore, teachers must ensure that the content presented through TikTok is relevant, structured, and aligned with students' learning needs to maximize its impact on learning outcomes.

Overall, this study contributes significantly to understanding the role of digital technology, particularly social media, in mathematics education. The findings support previous research (Siswanto et al., 2024) on the effectiveness of technology in education and demonstrate that TikTok can be a valuable tool for improving students' numeracy skills when used with the right strategies. The implications of these findings highlight the need for broader technology integration into curricula and teacher training on utilizing social media for educational purposes. Thus, this study provides insights into the benefits of TikTok in learning and opens opportunities for further exploration of how technology can be more effectively applied in education.

4. Conclusion

This study shows that the use of TikTok in mathematics learning has a significant effect on improving the numeracy skills of 11th-grade students at Senior High School of Muhammadiyah Mlati. The research instrument that has been tested for validity and reliability ensures that the data obtained is reliable, with the results of statistical analysis showing a positive relationship between the use of TikTok and the improvement of student numeracy, as indicated by the results of the regression test with a significance value of 0.015 < 0.05 and an R Square value of 0.195. Although TikTok contributes to the improvement of numeracy, other factors such as student motivation, teaching methods, and teacher involvement also play an important role in the success of learning. In addition, the results of the n-Gain test of 0.63 which is included in the moderate improvement category indicate that the effectiveness of TikTok in mathematics learning depends on how it is used in the learning process. The use of TikTok in line with the principles of multimedia learning, such as information segmentation and reducing cognitive load, can further increase its effectiveness. Therefore, it is important for educators to ensure that the learning content presented through TikTok is relevant, well-structured, and in accordance with student needs so that its impact on improving learning outcomes is more optimal.

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