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CHATGPT'S IMPLICATIONS FOR MATHEMATICAL LITERACY IN MATHEMATICS EDUCATION STUDENTS AT PGRI YOGYAKARTA UNIVERSITY

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Abstract

This study is a case study exploring the relationship between the use of ChatGPT and the quality of mathematical literacy among Mathematics Education students at Universitas PGRI Yogyakarta. The research employs a descriptive qualitative approach, with a population of 70 students from the 2022 and 2023 cohorts. A random sample of 26 respondents was selected, all of whom completed the questionnaire. Data were collected through a survey using a questionnaire related to the use of ChatGT in mathematics learning that examined aspects such as frequency of use, effectiveness, and the impact of ChatGPT on conceptual understanding and mathematics learning outcomes. The findings indicate that the majority of students use ChatGPT several times a week, primarily for completing assignments (27.8%) and solving mathematical problems (19.2%). A total of 69.2% of respondents found ChatGPT effective in supporting learning, particularly in solving problems, although 53.8% encountered difficulties in its use. Additionally, 57.7% of students reported significant benefits to their learning outcomes. Despite challenges related to the clarity of explanations provided by ChatGPT, this study suggests that AI can serve as a valuable support tool in enhancing students' mathematical literacy. The findings are expected to provide comprehensive insights into ChatGPT's capabilities and offer practical recommendations for educators and researchers to effectively integrate this technology into research writing and mathematics learning processes.

Keywords: Artificial intelligence, ChatGPT, mathematics education, mathematical literacy

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Introduction

Mathematical literacy remains a key focus of educational policy in Indonesia, especially after the 2022 Programme for International Student Assessment (PISA) results showed a significant decline compared to three years earlier. This decline was largely due to the impact of the COVID-19 pandemic, which forced students to transition to online learning as an emergency measure to prevent learning loss (Lukas & Yunus, 2021). While online learning was intended to minimize disruptions in education, it did not effectively maintain students' mathematical literacy levels. As a result, Indonesia experienced a noticeable decline in mathematical literacy, highlighting the need for improved learning strategies.

As a fundamental skill that every student must possess, mathematical literacy encompasses the ability to analyze, reason, communicate knowledge, apply mathematical skills appropriately, and effectively identify and interpret solutions to mathematical problems (Madyaratri et al., 2019). The primary goal of mathematical literacy is to facilitate better decision-making in real-life situations by enabling individuals to use mathematical skills to identify, interpret, and apply contextual resources effectively (Hamidah et al., 2024). A strong foundation in mathematical literacy enables efficient problem-solving and logical reasoning with numerical data.

In the era of the 4.0 Industrial Revolution, rapid advancements in information and communication technology have led to various innovations in the field of education (Kurniati & Wiyani, 2022). One of the most notable innovations is ChatGPT (Generative Pre-trained Transformer), an Artificial Intelligence system developed by OpenAI to assist individuals in solving various problems through language-based interactions. (Patac & Patac, 2025). ChatGPT possesses extensive capabilities in understanding and generating text, making it an attractive tool for students, as it can assist with academic tasks and enhance their comprehension of a given subject. (Kasneci et al., 2023). ChatGPT's ability to explain, solve problems, and provide step-by-step solutions has made it popular among students.

ChatGPT has become a widely discussed topic across various social media platforms, with numerous reviews exploring its functionality in different fields, including mathematics (Moundridou et al., 2024). Many students and educators have begun utilizing ChatGPT as a supplementary tool for academic support, particularly in solving mathematical problems and understanding complex concepts (Hussain, 2024). This technology is considered a potential solution for addressing academic inquiries; however, the extent to which ChatGPT can improve students' mathematical literacy remains an open question (Almarashdi et al., 2024). While some believe that ChatGPT offers a more interactive and responsive learning experience, others argue that traditional resources such as textbooks, Google, or Wikipedia provide more reliable information (Isiaku et al., 2024).

Recent studies suggest that the use of ChatGPT can impact various aspects of student learning. For instance, research conducted by Murcahyanto & Mohzana (2023) examined the role of ChatGPT in fostering student learning autonomy and found that this technology significantly influences students' independent learning. Additionally, ChatGPT has been reported to assist students in grasping mathematical concepts more efficiently by providing clear explanations and multiple problem-solving approaches (Pepin et al., 2025). However,

studies specifically addressing the impact of ChatGPT on mathematical literacy remain limited, making it difficult to draw definitive conclusions.

Based on these considerations, this study aims to evaluate the relationship between ChatGPT usage and mathematical literacy among Mathematics Education students at Universitas PGRI Yogyakarta. This study seeks to determine the extent to which ChatGPT contributes to improving students' mathematical literacy skills. Additionally, it explores the patterns of ChatGPT usage in mathematics learning. Thus, this research is expected to provide a comprehensive overview of the role of artificial intelligence in mathematics education. Therefore, a systematic evaluation is required to understand both the effectiveness and challenges of using ChatGPT in this context.

Methods

This study is a case study focusing on Mathematics Education students to explore the relationship between the use of ChatGPT and the quality of mathematical literacy. The method employed in this research is a descriptive qualitative approach. According to Sugiyono (2019), Descriptive qualitative research is an approach based on post-positivist philosophy, aiming to understand phenomena in their natural context, with the researcher serving as the primary instrument for data collection. The research sample was determined using a random sampling technique, focusing on students from the Mathematics Education department. Out of 50 distributed questionnaires (71.43% of the total population), only 26 were fully completed and deemed valid, resulting in a total of 26 usable samples for this study.

Data collection in this study was conducted through surveys by distributing questionnaire related to the use of ChatGT in mathematics learning to respondents, students of the Mathematics Education program at PGRI Yogyakarta University, as well as through a literature review. The research instrument used was a questionnaire consisting of 10 questions related to the use of ChatGPT about students' mathematical literacy skills, as outlined in Table 1 below.

| | Table 1. Questionnaire question grid |
|----|--|
| No | Question Grid |
| 1 | Frequency of ChatGPT usage in mathematics learning |
| 2 | Purpose of using ChatGPT in mathematics learning |
| 3 | Effectiveness of ChatGPT in aiding conceptual understanding of mathematics |
| 4 | Clarity and adequacy of ChatGPT explanations in answering mathematical questions |
| 5 | Impact of ChatGPT usage on mathematics learning outcomes |
| 6 | The Effect of ChatGPT in accelerating the completion of math exercises |
| 7 | Difficulties or challenges in using ChatGPT for mathematics learning |
| 8 | Improvement in mathematical skills after using ChatGPT |
| 9 | Frequency of using ChatGPT to overcome difficulties in mathematical concepts |
| 10 | Frequency of using ChatGPT for practicing math problems |

The questionnaire is designed to collect data relevant to the research objectives, ensuring that each question is systematically and purposefully structured to obtain valid and in-depth information from respondents.

Results

The data obtained from the distribution of questionnaires to 26 Mathematics Education students at PGRI Yogyakarta University is presented in a figure for each statement in the questionnaire. The following are the results obtained.



Figure 1. (a) Frequency of using ChatGPT; (b) Purpose of using ChatGPT

Based on Figure 1, most users access ChatGPT several times a week (46,2%) or once a week (38,5%) for learning mathematics, while daily usage is only 3,8% and monthly usage accounts for 11,5%. The primary purposes are completing assignments and finding references (27,8%), followed by problem-solving (19,2%), conceptual understanding (15,4%), and discussions (8,5%). This highlights the significant role of ChatGPT in supporting mathematics learning, particularly in assisting with assignments and providing references.



Figure 2. (a) Effectiveness of ChatGPT in understanding math concepts; (b) Clarity and adequacy of ChatGPT explanation

Based on Figure 2, ChatGPT has proven to be effective in supporting mathematics learning, particularly in problem-solving (69,2%), understanding mathematical concepts (26,9%), and completing assignments (3,8%). In terms of clarity and adequacy of explanations, 50% of users reported that ChatGPT often provides clear answers, 42,3% stated that it is sometimes clear, while 7,7% felt that it rarely offers sufficient explanations. These findings indicate that ChatGPT plays a significant role in enhancing mathematical understanding, although there is still room for improvement in the clarity of responses.

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Figure 3. (a) Effect of using ChatGPT; (b) Impact of ChatGPT on speeding up math problem-solving

Based on Figure 3, the use of ChatGPT in mathematics learning has a positive impact on learning outcomes, with 57,7% of users frequently experiencing its benefits, 38,5% occasionally benefiting from it, and only 3,8% rarely noticing its impact. Additionally, ChatGPT helps accelerate problem-solving in mathematics, with 38,5% of users experiencing significant benefits, 57,7% feeling adequately assisted, and only 3,8% perceiving minimal advantages. These findings indicate that ChatGPT plays a significant role in enhancing learning efficiency and problem-solving in mathematics.



Figure 4. (a) Difficulties or Problems in Using ChatGPT; (b) Improvement After Using ChatGPT

Based on Figure 4, 53,8% of users experienced difficulties in using ChatGPT for learning mathematics, while 46,2% did not encounter any issues. Nevertheless, ChatGPT contributes to the improvement of mathematical skills, with 11,5% of users experiencing a significant improvement, 65,4% noticing a moderate improvement, 15,4% reporting a slight improvement, and 7,7% seeing no improvement. These findings indicate that despite some challenges in its use, ChatGPT still has a positive impact on most users in enhancing their mathematical skills.



Figure 5. (a) Difficulties or Problems in Using ChatGPT; (b) Frequency of Using ChatGPT for Math Practice

Based on Figure 5, the use of ChatGPT in overcoming difficulties with mathematical concepts shows that 30,8% of users frequently use it, 61,5% use it occasionally, and 7,7% rarely use it. Meanwhile, in practicing mathematical problem-solving, 30,8% of users experienced a significant improvement in understanding, 38,5% reported a moderate improvement, 26,9% experienced a slight improvement, and 3,8% did not notice any improvement. This indicates that ChatGPT contributes to supporting mathematics learning, particularly in helping users understand concepts and complete practice problems.

Discussion

ChatGPT plays a significant role in supporting mathematics learning among Mathematics Education students at PGRI Yogyakarta University. The majority of students access ChatGPT multiple times a week for academic purposes, particularly for completing assignments and finding references. This indicates that students' mathematical literacy is improving with access to digital resources that help them gain a deeper understanding of the subject matter. According to the OECD (2023), Mathematical literacy includes an individual's ability to formulate, apply, and interpret mathematics in various contexts. In this regard, the use of ChatGPT can be categorized as part of students' efforts to enhance their mathematical literacy through technology.

Beyond serving as an academic reference, ChatGPT is also effective in helping students solve mathematical problems and understand mathematical concepts. Research data shows that 69,2% of users find ChatGPT highly beneficial for solving problems, while 26,9% use it to understand mathematical concepts. These findings align with Darmayanti (2024), Salami & Spangenberg (2025) and Siswanto et al. (2024). They suggest that digital tools can enhance student engagement in mathematics learning and accelerate the comprehension of complex concepts. Thus, utilizing ChatGPT can be an effective strategy for students to improve their mathematical literacy, particularly in problem-solving and concept analysis.

Although ChatGPT has been proven to be beneficial for students in understanding mathematics, the clarity and adequacy of its explanations remain a challenge. While 50% of students state that the answers provided are often clear, 42,3% find that the clarity varies. A study by Abedi (2023) and Bilynska et al. (2024) also highlights that the effectiveness of digital

technology in education depends on users' ability to interpret the information provided. In the context of mathematical literacy, students must develop critical skills to evaluate AI-generated information so they can understand and apply it correctly in problem-solving.

The use of ChatGPT has also been shown to positively impact students' learning efficiency in solving mathematical problems. A total of 57,7% of students frequently experience the benefits of ChatGPT, particularly in accelerating problem-solving processes. Research by Cirneanu & Moldoveanu (2024) and Maulida et al. (2024) Found that digital technology can enhance learning effectiveness by providing faster and more efficient solutions for solving mathematical problems. This suggests that integrating technologies such as ChatGPT into mathematics learning can improve students' mathematical literacy by offering a more interactive and responsive learning experience tailored to individual needs.

However, despite the benefits ChatGPT offers to the majority of students, 53,8% still experience difficulties in using it. These challenges may stem from various factors, such as a lack of understanding of how AI works or difficulty interpreting the answers provided. Some students struggle to differentiate between correct and misleading responses, which can affect their learning outcomes. This aligns with Herlinda et al. (2024), Kintoko et al. (2022) and Wahyuni et al. (2024). They stated that the effectiveness of digital technology utilization often depends on users' level of technological literacy. Without sufficient technological literacy, students may not fully benefit from AI-assisted learning tools. Therefore, additional training is needed to enable students to optimize their use of ChatGPT as a learning tool for mathematics.

Regarding mathematical skill improvement, most students reported progress after using ChatGPT. A total of 65,4% experienced moderate improvement, while 11,5% reported significant improvement. This indicates that ChatGPT contributes to students' ability to grasp mathematical concepts and solve problems more efficiently. Egara & Mosimege (2024), Qawaqneh et al. (2023) and Wardat et al. (2023) suggested that AI-based technology in mathematics learning can enhance learning efficiency and help students grasp complex concepts more easily. In addition to problem-solving assistance, ChatGPT also supports conceptual understanding by providing step-by-step explanations. Thus, ChatGPT not only serves as a tool for solving problems but also as a medium that supports the development of critical thinking skills in mathematical literacy.

Overall, the findings of this study indicate that ChatGPT has a positive impact on students' mathematical literacy, both in terms of conceptual understanding and problemsolving efficiency. However, challenges remain in its utilization, particularly regarding answer clarity and technical difficulties experienced by some students. Therefore, a more strategic approach is needed to integrate this technology into mathematics learning, including training programs to enhance students' ability to effectively utilize AI-based technology. By doing so, ChatGPT can become a more optimal tool in supporting the development of mathematical literacy in the digital era.

Conclusion

This study shows that the majority of Mathematics Education students at Universitas PGRI Yogyakarta use ChatGPT several times a week, primarily for completing assignments and finding references. This technology has proven effective in supporting mathematics learning, particularly in problem-solving and conceptual understanding, while also improving learning

efficiency by accelerating problem resolution. However, challenges remain in its use, such as insufficient clarity of answers and technical difficulties faced by some students. Despite these issues, most students have experienced an improvement in their mathematical skills after using ChatGPT. The findings of this study also indicate the need for further development of AI-based learning, as well as a more interactive learning approach that combines technology use with group discussions and consultations with lecturers.

For future research, several aspects can be explored further, such as the effectiveness of ChatGPT in a problem-based learning model to enhance students' problem-solving and critical thinking skills. Further studies can also focus on developing AI-based learning modules that are more interactive and adaptive to students' needs. With continued research, the integration of AI in mathematics education is expected to evolve and provide greater benefits for students.

Conflicts of Interest

The authors declare that there is no conflict of interest in this research. The entire process of planning, implementing, and reporting research results was carried out independently without any personal, commercial, or institutional interests that could affect the objectivity of the research results.

Author Contributions

Kintoko: Developed the concept, formulated the idea, wrote the initial draft, created the visualization, collected data, conducted formal analysis, and designed the methodology; **St. Budi Waluya & Iwan Junaedi:** Contributed to concept development, writing, and reviewing, and was responsible for validation and supervision; **Nuriana Rachmani Dewi & Deny Hadi Siswanto:** methodological guidance, and conducting final review and editing of the article manuscript. All authors have read and approved the final submitted manuscript.

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