INTEGRATION OF DIGITAL TECHNOLOGY IN MATHEMATICS LEARNING: EFFORTS TO STRENGTHEN NUMERACY OF MADRASAH IBTIDAIYAH STUDENTS

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Abstract: *This study aims to analyze the role of digital technology integration in mathematics learning to strengthen the numeracy skills of Madrasah Ibtidaiyah students. The method used is a literature study through the study of various scientific sources related to educational technology, mathematics learning, and numeracy in elementary education. The results of the study show that the use of interactive applications, simulations, animated videos, adaptive exercise platforms, and educational games can improve understanding of mathematical concepts, learning motivation, and student engagement. Digital technology also facilitates concrete visualizations that are appropriate to the student's stage of cognitive development, thus helping to understand abstract concepts. The success of technology integration depends on teacher competence and adequate infrastructure support. This study concludes that digital technology has great potential to transform mathematics learning and strengthen students' numeracy, noting the need for institutional support, teacher competency strengthening, and adequate ICT facilities.*

Keywords: *Digital Technology, Mathematics Learning, Numeracy, Madrasah Ibtidaiyah*

Introduction

The development of digital technology in the era of the industrial revolution 4.0 has had a significant influence on various aspects of human life, including the field of education. Digital transformation in basic education institutions, especially madrasah ibtidaiyah, is an important part of creating a learning process that is adaptive, effective, and relevant to the needs of the 21st century (Nadhifa Arufah Chafshah et al., 2024). One of the competencies that is highly emphasized by the current curriculum is numeracy skills. Numeracy is not only defined as numeracy skills, but also the ability to understand, analyze, and use number-based information in solving everyday problems (Lubis et al., 2025). In the context of basic education, strengthening numeracy is an important foundation for students' logical thinking and problem-solving skills.

Although important, the numeracy achievement of students in Indonesia still presents considerable challenges. The results of national assessments and international reports such as PISA show that the numeracy ability of Indonesian students is in the low to medium category (Kemendikbudristek, 2022). This condition shows the need for more concrete learning innovations, especially in mathematics learning. The integration of digital technology is seen as one of the strategic solutions because it can provide a more interactive, interesting, and suitable learning experience for the current digital generation. Digital technology not only functions as a

visual aid medium, but also as a means of simulation, educational games, and an adaptive platform that can adjust the difficulty of questions based on students' abilities.

In mathematics learning at madrasah ibtidaiyah, the use of digital applications such as GeoGebra, Matific, Khan Academy Kids, and Learning House has been proven to be able to improve understanding of concepts, strengthen mathematical representation skills, and increase students' interest and motivation to learn (Nurul Aien & Sari, 2025; Wahyuni et al., 2025; (Ilyas et al., 2025). In addition, various studies have shown that technology-based learning strategies, such as the use of game-based learning, interactive simulations, and animated videos, are able to produce significant improvements in students' basic numeracy skills. This is relevant to the characteristics of MI students who like to explore and learn through visualization and interactive activities.

However, the integration of digital technology is inseparable from various challenges. Teachers' digital competence, the availability of devices, internet access, and the readiness of schools in providing a digital learning ecosystem are aspects that need serious attention (Maufiroh & Basith, 2025; Ananda et al., 2025). Teachers play a key role in designing technology-based learning that supports deeper numeracy understanding rather than merely focusing on tools. Therefore, a holistic strategy is needed, including strengthening teacher capacity, developing adaptive curricula, and ensuring a supportive learning environment.

This article aims to examine the role of digital technology integration in mathematics learning to enhance numeracy skills among madrasah ibtidaiyah students through a literature review approach. In addition to highlighting effective digital applications, the article also discusses learning strategies that MI teachers can apply to optimize the use of technology in the classroom.

Literature Review

Numeracy is a basic skill that includes understanding number concepts, mathematical operations, patterns, measurements, and their application in real life. Janrino J.R. Fanggidae & Faisa N. Mahmudah (2024) Numeracy is defined as the ability to apply mathematical concepts and procedures in various contexts to solve problems effectively. In the MI context, numeracy goes beyond basic counting, encompassing logical thinking, understanding representations, and interpreting data. Mastery of numeracy is essential as a foundation for more advanced mathematical skills in higher levels of education.

The characteristics of MI students who are at the stage of concrete operational cognitive development demand an appropriate learning approach. As shown by (Iasha et al., 2024) Learning numeracy requires a visual, contextual, and interactive approach. Recent findings (Cahyono et al., 2024) reinforcing this by showing that MI students need media that can help them understand abstract concepts through visual representations and manipulative activities. It is within this framework that the integration of digital technology has emerged as a strategic alternative to provide a more concrete, interesting, and appropriate learning experience in accordance with their cognitive development needs.

The development of digital technology has brought significant transformation in the world of education, including at the Madrasah Ibtidaiyah (MI) level. In the context of mathematics learning, technology is not only used as a visual aid, but also as a means to develop more interactive exploratory and problem-solving activities. Technology-based mathematics learning is able to provide a more personalized, adaptive, and fun learning experience (Setiawan & Kandaga, 2025). According to a meta-analysis by Schoenherr et al., (2024), The use of interactive visual media such as animation, simulation, and dynamic representation has been shown to be effective in helping students' understanding of mathematical concepts.

Moreover, (Ran et al., 2022) Found that the integration of technology in mathematics learning has a positive influence on students' achievement and numeracy skills through an investigative and project-based approach. Other studies show that the use of digital devices in mathematics learning significantly improves students' academic achievement compared to conventional learning (Study & Demir, 2026).

The integration of technology in learning in madrasah ibtidaiyah is in line with the orientation of Islamic education which focuses on mastery of science, digital literacy skills, and the development of critical thinking. The appropriate use of technology allows teachers to design more participatory, innovative, and collaborative learning, in accordance with the characteristics of digital generation students.

Various forms of digital technology have been shown to be effective in supporting mathematics learning. Dynamic applications such as Geogebra, for example, show a positive impact in helping students visualize abstract geometric concepts more real. Findings (Khotimah, H., & Pradana, 2022) revealed that the use of Geogebra can significantly improve MI students' conceptual understanding of flat and spatial buildings. On the other hand, gamification-based platforms like Quizizz also offer advantages in creating an interactive and fun learning environment. Research (Suryandari, N., & Purnomo, 2023) proving that the integration of Quizizz in learning not only improves math learning outcomes but also effectively awakens students' intrinsic motivation, which is a crucial component of continuous learning.

The effectiveness of technology integration is increasingly optimal when combined with a student-centered learning model. Digital Game-Based Learning (DGBL) approach, as researched by (Fauzi, A., & Rahayu, 2020), proven to be able to significantly improve students' basic numeracy skills. This model not only trains procedural skills, but also encourages the development of logical and creative thinking in problem solving. In addition, the Problem Based Learning (PBL) model that utilizes digital media also shows encouraging results. (Rahmawati, F., & Sari, 2021) found that the combination of PBL with digital resources succeeded in honing students' mathematical problem-solving skills by presenting authentic and contextual problems.

Although it promises many benefits, the implementation of digital technology in MI is not free from challenges. Obstacles such as limited infrastructure, teacher technology competency gap (TPACK), and potential distractions are things that need to be anticipated. Therefore, a planned implementation strategy is urgently needed, which includes continuous teacher training, the selection of digital tools that are in accordance with the developmental characteristics of MI students, and the design of learning activities that meaningfully integrate technology to achieve pedagogical goals, not just as a gimmick. Overall, this literature review underscores that the integration of digital technologies, when supported by the right pedagogical approach, has great potential to transform mathematics learning in MI to be more relevant, engaging, and effective in strengthening students' numeracy foundations.

Method

This study uses a qualitative approach with the library research method to analyze the integration of digital technology in mathematics learning and its contribution to strengthening the numeracy of Madrasah Ibtidaiyah students. According to (Creswell, J. W., & Creswell, 2023) A qualitative approach is suitable for exploring phenomena in depth through textual data. This approach was chosen because the topic of integrating digital technology in the context of basic education has been widely studied in various scientific publications, so a comprehensive literature review is very relevant to identify developing integrative patterns and concepts.

Data collection was carried out by examining various scientific sources, including Sinta-accredited national journals for the 2020-2024 period, reputable international journals, the latest

books on mathematics education and educational technology, and relevant education policy documents. Literature searches are carried out through databases such as Google Scholar, ScienceDirect, SpringerLink, and Garuda Portal using keywords: "digital technology", "mathematics learning", "numeracy", and "Madrasah Ibtidaiyah" (Snyder, 2019) emphasizes the importance of using diverse databases to obtain comprehensive literature.

Data analysis was carried out using a content analysis approach that involves reading, coding, and interpreting the content of the literature to identify patterns and substantive meanings. The analysis process follows the following stages: (1) identification of core concepts, (2) categorization of empirical findings, (3) comparative theories, and (4) integrative synthesis to develop an implementation framework. The data was analyzed deductively and inducively to examine existing theories as well as reveal new findings related to strengthening numeracy through digital technology.

The validity of the research is maintained through the triangulation technique of sources by comparing perspectives from various literature to ensure the alignment and consistency of findings (Bowen, 2017) stating that triangulation of sources can increase the credibility of qualitative research findings. The results of this study are expected to provide a comprehensive understanding of how the integration of digital technology plays a role as a catalyst for strengthening the numeracy competence of Madrasah Ibtidaiyah students.

Results and Discussion

The results of the literature review show that the integration of digital technology in mathematics learning at Madrasah Ibtidaiyah makes a significant contribution to improving students' numeracy skills. Various digital applications, such as visual devices, interactive simulations, and adaptive exercise platforms, are able to facilitate students in understanding mathematical concepts in a more concrete way. The use of technology helps bridge the gap between abstract concepts and real experiences, so that mathematics learning becomes easier to understand and relevant to the cognitive development of students who are still in the concrete operational stage. In addition, technology provides opportunities for students to learn independently through interesting and interactive exploratory activities.

In addition to increasing understanding of concepts, the use of digital technology also has a positive impact on students' learning motivation. Game-based learning and interactive activities are able to create a fun learning atmosphere, so that students are more enthusiastic and involved in the learning process. Elements such as points, challenges, or animated visuals help improve students' focus and diligence in completing numeracy exercises. With a competitive but still positive atmosphere, students are encouraged to repeat the exercises independently so that their mastery of basic mathematical concepts is stronger.

Not only from the affective aspect, the strengthening of numeracy through technology can also be seen from the effectiveness of adaptive platforms and contextual media. Digital applications that provide graded questions help students understand concepts gradually according to their abilities. Meanwhile, the use of videos, simulations, and problem-based activities encourages students to connect math with real-life situations. This makes learning more meaningful because students not only learn the procedure, but also understand the meaning and application of concepts in an applicative manner.

The success of the integration of digital technology in mathematics learning is greatly influenced by the role of teachers. Teachers need to have competence in designing learning that is able to integrate technology with pedagogical goals. The use of technology is not enough just as a tool, but must be integrated into learning strategies that encourage activeness, understanding of concepts, and improved problem-solving skills. Teachers who understand how to use

technology appropriately can create learning that is more effective, efficient, and oriented towards achieving numeracy competencies.

Despite its many benefits, technology integration still faces various challenges, such as device limitations, uneven internet access, and variations in the level of mastery of technology by teachers. These challenges demonstrate the need for systematic support from schools, including the provision of adequate facilities and sustainable teacher competency development programs. Overall, the results of the study confirm that digital technology has great potential to transform mathematics learning in MI into more interactive and meaningful. With the support of competent teachers and adequate infrastructure, technology can be an important instrument in strengthening students' numeracy skills from the elementary education level.

Conclusion

This study shows that the integration of digital technology in mathematics learning has an important role in strengthening the numeracy skills of Madrasah Ibtidaiyah students. Digital technology is able to provide a more concrete, visual, and interactive learning experience, making it easier for students to understand abstract mathematical concepts. The use of digital media, such as simulations, adaptive exercise applications, and educational games, has also been shown to increase student motivation, focus, and engagement in the learning process. Learning becomes more engaging, personalized, and in accordance with the characteristics of the cognitive development of MI students, which require a manipulative and visual approach.

The success of technology integration is highly dependent on the role of teachers in designing meaningful learning. Teachers need to understand how to combine technology with the right pedagogical strategies so that technology is not only a tool, but also supports the improvement of students' understanding and problem-solving skills. However, the implementation of technology still faces challenges in the form of limited devices, internet access, and variations in teachers' digital competencies. Therefore, institutional support and teacher capacity building are important factors to ensure that technology can be used optimally. Overall, the integration of digital technology has great potential to transform mathematics learning in MI and become an effective strategy in strengthening students' numeracy skills from an early age.

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