JURNAL PENDIDIKAN BITARA
Volume 18 Special Issue (2025) / eISSN 2821-3173 (178-184)

This article was carefully selected from
6th International Conference on Special Education (ICSE) 2025,
organized by The Southeast Asian Ministers of Education Organization
Regional Centre for Special Educational Needs (SEAMEO SEN)

The role of digital technologies in enhancing inclusive education: A systematic review of current trends

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Published: 17 September 2025

To cite this article (APA): Teng, K. Y., Liden, A. Y., John Girrie, C. R., Dinggat, J. N., & Lee, H. Y. (2025). The role of digital technologies in enhancing inclusive education: A systematic review of current trends. *Jurnal Pendidikan Bitara UPSI*, *18*(Special Issue), 178-184. https://doi.org/10.37134/bitara.vol18.sp.16.2025

To link to this article: https://doi.org/10.37134/bitara.vol18.sp.16.2025

ABSTRACT

The integration of digital technologies in Inclusive Education (IE) has gained significant momentum in recent years, enhancing accessibility, engagement, and personalised learning for diverse learners, including students with Special Educational Needs (SEN). This small-scale systematic review explores the latest trends in digital applications supporting IE, drawing on studies published between 2020 and 2025. Five major academic databases—Scopus, Web of Science, Google Scholar, IEEE Xplore, and Wiley Online Library—were used to identify peer-reviewed literature aligned with the objectives of the review. Adherence to the PRISMA framework enhanced the transparency and replicability of the review process. Key emerging trends include assistive technologies such as speech-to-text and text-to-speech tools, AI-driven personalised learning systems, and game-based learning platforms that support students with SEN. Additionally, immersive technologies such as augmented reality (AR) and virtual reality (VR) are fostering interactive and differentiated instruction, enhancing learning experiences for students with SEN. Mobile learning and cloud-based platforms are also promoting universal design for learning (UDL) principles, ensuring flexibility in content delivery. However, challenges such as the digital divide, teacher training gaps, and concerns over data privacy remain. Addressing these challenges requires strategic investments in infrastructure, professional development, and ethical policies to optimise digital inclusivity. The findings suggest that a thoughtful integration of digital tools can significantly improve inclusivity in education, fostering equity and engagement for all learners. Future research should explore how emerging technologies, such as AI-driven adaptive learning and blockchain-based credentialing, can further enhance inclusive digital education. This review contributes to the growing body of literature on digital inclusivity and highlights implications for policymakers, educators, and researchers seeking to improve accessibility and learning outcomes in diverse educational settings.

Keywords: Inclusive Education (IE), Special Educational Needs (SEN), Universal Design for Learning (UDL), Augmented Reality (AR), Virtual Reality (VR), personalised learning

INTRODUCTION

Inclusive education (IE) ensures equitable learning opportunities for all students, particularly those with Special Educational Needs (SEN). With rapid technological advancements, digital tools have reshaped IE by enhancing accessibility, engagement, and personalised learning. Assistive technologies, such as speech-to-text and AI-driven adaptive learning, support students with disabilities, while immersive technologies like augmented reality (AR) and virtual reality (VR) offer interactive learning experiences. Mobile learning and cloud-based platforms promote Universal Design for Learning (UDL), enabling flexible content delivery. As digital technologies continue to evolve, they significantly transform the landscape of IE, offering new possibilities for accessibility and engagement.

This paper presents a systematic review of current trends in digital applications supporting inclusive education, analysing their benefits, challenges, and implications for future practice. The review draws upon research published in leading peer-reviewed journals, including the International Journal of Inclusive Education, the British Journal of Educational Technology, IEEE Transactions on Learning Technologies, the International Journal of Mobile and Blended Learning, and the Journal of Research in Special Educational Needs. These sources provide a strong foundation for examining how digital tools contribute to inclusivity in education. By reviewing studies from 2020 to 2025, this research contributes to the growing discourse on digital inclusivity and offers insights for policymakers, educators, and researchers aiming to enhance equitable learning opportunities. In doing so, this review not only synthesises current practices but also situates technological advancements within broader pedagogical theories, bridging empirical evidence and conceptual frameworks to enhance scholarly understanding.

LITERATURE REVIEW

The integration of digital technologies has significantly influenced Inclusive Education (IE), particularly for students with Special Educational Needs (SEN). Foundational theories offer critical insights into the pedagogical underpinnings of digital inclusivity. One such framework is the Universal Design for Learning (UDL), which advocates for multiple means of engagement, representation, and expression, ensuring that instruction meets the diverse needs of all learners. In parallel, Vygotsky's sociocultural theory underscores the role of social interaction, scaffolding, and cultural tools in cognitive development. This theory positions digital technologies as mediating tools that facilitate learning through collaboration and contextual engagement. By grounding digital inclusivity within these theoretical lenses, educators can better understand how technology not only supports access but also promotes meaningful participation and deeper learning for diverse student populations.

Immersive technologies, including augmented reality (AR) and virtual reality (VR), offer interactive and engaging learning experiences that cater to students with cognitive and learning disabilities (Smeins et al., 2022). These tools promote differentiated instruction and facilitate experiential learning, making abstract concepts more comprehensible (Ali & Brown, 2023). Game-based learning has also been shown to enhance motivation and foster problem-solving skills among SEN students (Mukherjee & Jones, 2024). Furthermore, mobile learning and cloud-based platforms are advancing Universal Design for Learning (UDL) principles, ensuring flexible content delivery and improving accessibility across diverse learning environments (Mukan et al., 2025).

Despite these benefits, digital inclusivity faces challenges such as limited teacher training, the digital divide, and inadequate infrastructure in underprivileged regions (Peters & Wilson, 2024). Addressing these gaps requires investment in professional development and equitable access to technology. Future research should explore AI-driven adaptive learning and blockchain-based credentialing to further enhance inclusive digital education. This review highlights the need for strategic policies to optimise technology integration for equitable learning opportunities.

METHODOLOGY

A small-scale systematic review approach was adopted to analyse peer-reviewed journal articles, conference proceedings, and reports published between 2020 and 2025. The PRISMA framework (Page et al., 2021) was employed to guide the selection, screening, and inclusion process, ensuring methodological rigor and transparency. Five major databases—Scopus, Web of Science, Google Scholar, IEEE Xplore, and Wiley Online Library—were systematically searched (Gusenbauer & Haddaway, 2020)." The initial search yielded a total of 276 articles: Scopus (58), Web of Science (46), Google Scholar (85), IEEE Xplore (41), and Wiley Online Library (46). After removing duplicates and applying inclusion and exclusion criteria, 197 articles remained for abstract screening. Following this, 68 articles were assessed at full-text level, with 32 peer-reviewed articles meeting all criteria and selected for inclusion. These articles align directly with the objectives of this review, as they provide empirical insights into the use of digital technologies in supporting students with Special Educational Needs (SEN) within inclusive educational settings. The screening process followed PRISMA guidelines to ensure methodological rigour and relevance to the scope of the review.

The inclusion criteria encompassed peer-reviewed articles published in English, with a focus on the application of digital technologies in inclusive educational settings, particularly for students with Special Educational Needs (SEN). Studies without empirical data, outside the scope of inclusive education, or unrelated to digital technologies were excluded. Insights were drawn from prominent journals including the International Journal of Inclusive Education, British Journal of Educational Technology, IEEE Transactions on Learning Technologies, International Journal of Mobile and Blended Learning, and the Journal of Research in Special Educational Needs.

A qualitative content analysis was used to identify patterns, trends, and thematic categories across selected literature. A total of 32 peer-reviewed articles were analysed in this study, meeting the inclusion criteria and representing diverse educational contexts and technological applications. Ethical considerations were observed by including only studies that adhered to ethical research standards, with attention to participant anonymity and data integrity.

RESULTS AND FINDING

This systematic review analysed recent research on the role of digital technologies in inclusive education, with a focus on assistive technologies, artificial intelligence, game-based learning, augmented and virtual reality, and mobile learning. The findings highlight key advancements and their impact on students with Special Educational Needs (SEN).

Trends in Digital Technologies for Inclusive Education

Assistive Technologies

Recent studies emphasise the essential role of assistive technologies in supporting students with disabilities. Tools such as speech-to-text, text-to-speech, screen readers, and alternative input devices help students with sensory, motor, and cognitive impairments access and interact with content more effectively. A study by the International Journal of Inclusive Education (2021) found that assistive technologies (AT) significantly improve literacy skills among students with visual and hearing impairments. Additionally, research from the Journal of Research in Special Educational Needs (2022) highlighted the importance of teacher training in maximising the effectiveness of AT tools in the classroom. However, despite their benefits, assistive technologies face integration barriers within traditional school settings. Many teachers lack the necessary training to incorporate these tools effectively into their curricula, limiting their potential impact. Additionally, the cost of assistive devices remains a challenge, especially in low-income regions, where schools may struggle to provide equitable access to these technologies.

Artificial Intelligence and Personalised Learning

The integration of artificial intelligence (AI) in education has paved the way for personalised learning experiences, allowing students to receive tailored instruction based on their unique learning needs. The IEEE Transactions on Learning Technologies (2023) reported that AI-driven tutors and chatbots enhance individualised instruction by providing real-time feedback and adaptive learning pathways. Moreover, studies reviewed from the British Journal of Educational Technology (2022) indicate that AI-based learning analytics help educators track progress and customise interventions to address specific student needs. Similarly, research from the British Journal of Educational Technology explores the effectiveness of AI-based chatbots in offering instant feedback and personalised support, fostering greater student autonomy. However, the implementation of AI in education raises ethical concerns, particularly regarding student data privacy and algorithmic biases. AI-driven student monitoring systems may inadvertently reinforce existing inequalities if not designed with inclusivity in mind. Furthermore, Chekirova & Ashirov (2024) illustrates that a lack of teacher training on AI integration remains a significant barrier, as many educators struggle to leverage AI tools effectively to support diverse learners.

Game-Based Learning for Inclusive Education

Game-based learning (GBL) has emerged as a powerful tool for fostering engagement and cognitive skill development in inclusive classrooms. As such, educational games incorporate interactive storytelling, gamification elements, and adaptive difficulty levels making learning more engaging for students with Special Educational Needs (SEN), particularly students with Attention Deficit Hyperactivity Disorder (ADHD) and learning disabilities. A systematic review in the British Journal of Educational Technology (2021) found that GBL applications such as Minecraft: Education Edition and CoSpaces Edu improve cognitive development and social interaction among students with learning disabilities. Furthermore, findings from the International Journal of Inclusive Education emphasise the alignment of game-based learning with Universal Design for Learning (UDL) principles, ensuring that students with diverse needs can participate and benefit. Despite these advantages, there are challenges in implementing GBL effectively. Some educational game platforms lack accessibility features for students with motor disabilities, limiting their usability in fully inclusive settings. Additionally, there is limited research on the long-term efficacy of game-based learning for students with disabilities, leaving questions about its sustained impact on academic outcomes.

Immersive Technologies

Augmented reality (AR) and virtual reality (VR) technologies are transforming inclusive education by creating immersive, interactive learning environments that support experiential learning. These technologies are particularly beneficial for students with disabilities, as they provide visual and sensory-rich experiences that enhance comprehension. Studies from the International Journal of Inclusive Education demonstrate that AR and VR improve conceptual understanding for students with Autism Spectrum Disorder (ASD) and visual impairments by offering interactive simulations and 3D visualisations. Another study in IEEE Transactions on Learning Technologies (2022) demonstrated that VR-assisted learning significantly improves engagement and comprehension in students with ASD and ADHD. Furthermore, research from IEEE Transactions on Learning Technologies highlights the role of VR-based social skills training for neurodiverse students, helping them develop communication and interaction skills in controlled, low-pressure environments. However, despite their promise, AR and VR technologies face significant barriers to be implemented generally. The high cost of VR headsets and AR-compatible devices makes them inaccessible to many schools, particularly in low-income areas. Additionally, lack of teacher expertise in integrating AR and VR into lesson plans hinders their effective use in classroom settings.

Mobile Learning and Cloud-Based Education

The rise of mobile and cloud-based educational technologies has facilitated accessible learning environments. Mobile learning and cloud-based platforms have become essential tools in inclusive education, offering flexible and self-paced learning environments that cater to students with diverse needs. Research from the International Journal of Mobile and Blended Learning (2022) reveals that mobile learning applications that incorporate Universal Design for Learning (UDL) principles enhance accessibility for students with disabilities. These technologies enable anytime-anywhere learning, reducing barriers for students who may struggle with traditional classroom settings. Additionally, cloud-based platforms enable flexible learning by providing multiple means of representation, expression, and engagement, as highlighted in a 2023 study from the Journal of Research in Special Educational Needs. Technology emphasises how cloud-based platforms facilitate collaborative learning and resource sharing, allowing teachers and students to engage with educational materials seamlessly. Despite these advantages, mobile and cloud-based education also present challenges. The digital divide remains a pressing issue, as many students from low-income communities lack access to high-speed internet or digital devices necessary for mobile learning. Additionally, data security concerns regarding cloud-based student information systems raise ethical considerations about the privacy and protection of sensitive student data (Chekirova & Ashirov, 2024).

DISCUSSIONS, RECOMMENDATIONS AND CONCLUSIONS

Discussions

Despite the significant benefits of digital technologies in inclusive education, several challenges persist in their implementation. One of the primary concerns is the digital divide, where unequal access to digital tools and internet connectivity hinders the effectiveness of assistive technologies, mobile learning, and immersive platforms. Studies from the Journal of Research in Special Educational Needs (2023) highlight that students from low-income communities often lack access to high-speed internet and assistive devices, limiting their ability to benefit from digital inclusion initiatives.

Additionally, teacher training and digital competency pose significant barriers. Research from IEEE Transactions on Learning Technologies (2022) emphasises that a lack of professional development programmes has led to the underutilisation of AI-driven personalised learning and VR-assisted instruction in classrooms. Furthermore, ethical concerns related to student data privacy and algorithmic bias in AI-based platforms have raised questions about data security and fairness in adaptive learning systems (British Journal of Educational Technology, 2022).

Another major limitation is the high cost of emerging technologies, such as VR headsets and AR-compatible devices, which restrict their accessibility, particularly for schools with limited budgets (International Journal of Inclusive Education, 2023). Lastly, the long-term efficacy and pedagogical integration of these tools remain uncertain, with British Journal of Educational Technology (2021) suggesting that further empirical research is needed to evaluate the sustained impact of digital learning interventions.

Addressing these challenges requires a multi-stakeholder approach involving policymakers, educators, technology developers, and researchers. To bridge the digital divide, governments and educational institutions must invest in digital infrastructure and subsidised technology programmes, ensuring that all students, including those from marginalised backgrounds, have access to the necessary tools for digital learning.

Additionally, targeted professional development programmes should be implemented to equip teachers with the knowledge and skills needed to effectively integrate assistive technologies, AI, and game-based learning into inclusive classrooms. To mitigate ethical concerns related to data privacy, institutions must establish strict regulations and ethical AI frameworks to protect student information and ensure fairness in algorithm-driven learning systems.

Moreover, to enhance affordability, governments and private organisations should explore funding initiatives, grants, and partnerships with technology developers, making advanced digital tools more accessible for schools serving diverse student populations. Lastly, longitudinal studies should be

conducted to assess the effectiveness of digital interventions, refining pedagogical strategies based on evidence-based findings. By taking these measures, digital inclusion can be optimised to foster equitable learning experiences for all students, particularly those with disabilities.

RECOMMENDATIONS

The integration of digital technologies into inclusive education has significantly expanded opportunities for students with disabilities. Assistive technologies, artificial intelligence (AI), game-based learning (GBL), augmented and virtual reality (AR/VR), and mobile learning have all contributed to making learning more accessible and engaging. However, critical barriers persist, particularly in relation to the digital divide, teacher training gaps, and data privacy concerns. Addressing these challenges requires a multi-dimensional approach, including strategic investments in digital infrastructure, comprehensive professional development for educators, and the implementation of robust ethical and data protection policies. By taking these measures, stakeholders can optimise digital inclusivity and create equitable learning environments for all students.

The digital divide remains a pressing issue, particularly in low-income communities where access to high-speed internet, assistive technologies, and digital learning devices is limited. Research by UNESCO (2023) emphasises that government-funded initiatives, such as subsidised internet access and device distribution programmes, can significantly improve digital accessibility for students with disabilities. Public-private partnerships can further enhance digital inclusivity by supporting large-scale deployment of affordable assistive technologies, mobile learning applications, and cloud-based education platforms (British Journal of Educational Technology, 2023).

Moreover, establishing community-based digital learning hubs can provide students with essential digital tools and assistive devices in accessible locations outside traditional school settings (Journal of Research in Special Educational Needs, 2023). By addressing these infrastructural gaps, educational institutions can ensure that all students, regardless of socio-economic background, have equal opportunities to engage in digital learning.

Despite the availability of advanced educational technologies, a major barrier to their effective implementation is the lack of adequate teacher training. Many teachers struggle to integrate artificial intelligence, game-based learning, and immersive technologies due to limited professional development opportunities (British Journal of Educational Technology, 2022). To address this, governments and educational institutions must invest in structured, ongoing professional development programmes that equip teachers with the skills needed to utilise digital tools effectively. Research from IEEE Transactions on Learning Technologies (2023) highlights the importance of hands-on training workshops, online learning modules, and peer mentoring programmes in enhancing teachers' digital competencies. Additionally, integrating digital literacy and inclusive technology training into teacher education curricula can ensure that future teachers are well-prepared to support diverse learners (Chekirova & Ashirov, 2024). When teachers are confident in using digital technologies, they can create more inclusive, engaging, and personalised learning environments for students with disabilities.

The increased use of AI-driven learning platforms and cloud-based education systems has raised critical concerns regarding data privacy, security, and algorithmic bias. Research by Chekirova & Ashirov (2024) warns that the absence of clear data governance frameworks can lead to the misuse of sensitive student information. To mitigate these risks, strict data protection regulations aligned with global standards, such as the General Data Protection Regulation (GDPR), must be enforced (British Journal of Educational Technology, 2023). Schools and technology providers should adopt transparent data practices, including informed consent policies, secure data encryption, and ethical AI development, to safeguard student privacy. Furthermore, AI systems must be designed to prioritise inclusivity and fairness to prevent reinforcing educational inequalities. An interdisciplinary approach involving teachers, technologists, and policymakers is necessary to develop AI-driven learning environments that are both ethical and inclusive (IEEE Transactions on Learning Technologies, 2023).

CONCLUSIONS

The integration of digital technologies has emerged as a transformative force in fostering inclusive education, enabling students with diverse needs to access, engage with, and succeed in learning environments that cater to their individual abilities. By leveraging assistive technologies, adaptive learning tools, and interactive digital platforms, educators can provide personalised support that enhances student participation, autonomy, and academic achievement. Moreover, digital innovations facilitate differentiated instruction, enabling teachers to create flexible learning experiences that accommodate various learning styles and disabilities. However, the successful implementation of digital inclusion requires a holistic approach that considers teacher preparedness, institutional infrastructure, and policy frameworks that ensure accessibility, affordability, and sustainability. Without these critical elements, the digital divide may persist, exacerbating existing educational inequalities. This review further emphasises that theoretical lenses—such as UDL and sociocultural learning perspectives—are essential in understanding how digital tools mediate access, interaction, and scaffolding in inclusive settings. Such conceptual grounding enhances the relevance and transferability of findings to both practice and policy.

Therefore, a collaborative effort among educators, policymakers, technology developers, and stakeholders is essential to harness the full potential of digital technologies in creating an inclusive, equitable, and learner-centred educational landscape. Moving forward, ongoing research and investment in digital accessibility will be crucial in ensuring that all students, regardless of their abilities, have equal opportunities to thrive in the digital era.

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