Evaluating AI-Powered Assistive Technologies in Inclusive Education: A Systematic Review of Literature on Efficacy and Accessibility

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ABSTRACT

This study aims to This study explores the potential of artificial intelligence (AI) tools to enhance accessibility and foster inclusive education for students with diverse learning needs. It also seeks to identify the challenges and limitations in integrating these technologies into educational practices. A comprehensive search was conducted across multiple academic databases, including EBSCOhost, ERIC, JSTOR, ScienceDirect, and Google Scholar, to assure the inclusion of high-quality studies and facilitate a comprehensive literature selection process. The data collected were processed using advanced data mining techniques, which enabled the systematic extraction of meaningful patterns, trends, and relationships from large and diverse datasets. These techniques included text mining for thematic analysis, as well as clustering and classification methods to group similar data points. The results show that AI integration in inclusive education significantly enhances learning outcomes, accessibility, and personalized support for diverse learners. AI technologies hold significant promise for advancing inclusive education by enhancing personalization, support, and learning outcomes for students with diverse needs. While effective in improving academic performance and engagement, successful integration requires addressing challenges such as resource constraints, ethical considerations, and educator readiness. Realizing AI's full potential demands inclusive frameworks and collaboration among educators, developers, and policymakers. Key recommendations include educator training, inclusive design, infrastructure development, cross-sector collaboration, and ongoing evaluation to ensure equitable and empowering learning experiences for all.

Keywords: Artificial Intelligence (AI), Inclusive Education, Assistive Technologies, Students with Disabilities

INTRODUCTION

The cornerstone of a just and equitable educational system is inclusive education. It ensures that students with special needs have equal opportunities to highlight their individual strengths and demonstrate that they can learn and achieve alongside their peers. An inclusive approach to education means we put each individual's needs first, helping everyone participate and achieve together. It's about knowing that every child can learn and has unique traits, interests, skills, and learning styles (UNESCO, 2025).

According to Batanero et al. (2022), Students with disabilities in school face a number of obstacles that make it harder for them to learn and do well in different activities that happen in the classroom. It is important that all students have the same chances to fully participate in society. AI technologies are changing the way we teach by giving students personalized content, feedback in real time, and data-driven insights into how they learn. These powerful tools enable educators to customize instruction for various learning styles, fostering classrooms that are both more inclusive and highly effective. This is particularly impactful for students with disabilities, as AI offers tailored support that addresses their unique cognitive, physical, and emotional needs (Kathram et al., 2020).

AI is changing many fields quickly, and education is one of them. By simulating human intelligence through

machine learning, natural language processing, and data analytics, AI enables the creation of dynamic and responsive learning environments. The use of artificial intelligence (AI) in education is expanding and altering how people teach and learn (Ayeni et al., 2024). Education is consistently discussed and prioritized. It seems that adding AI and VR technology to schools could help solve some of the problems that students with disabilities face. It is especially useful in classrooms with students who have special needs because it makes learning easier and more manageable for them.

"Assistive technology" refers to a broad category of assistive devices and associated systems. By maintaining or enhancing a person's cognitive, communicative, auditory, motor, self-care, and visual functioning, assistive devices promote their health, well-being, inclusion, and engagement (WHO, 2024). In this case, it means any product, equipment, or tool that is usually mechanical or electronic and helps people with disabilities stay independent and improve their quality of life (Shi, 2015). These specialized educational tools have been systematically developed to enhance academic performance, support sustained intellectual growth, and promote lifelong learning across diverse learner populations, including those enrolled in mainstream educational programs as well as individuals with exceptional learning needs.

Even with all the amazing assistive technologies (ATs) available to help students access information, it's clear that many students with special needs still have a tough time getting the information they need when they need it, despite our advanced information age (Abubakar, 2020). In the study of McNicholl, A. et. al. (2019), issues such as insufficient training, limitations of the devices, lack of external support, and the difficulty of managing multiple sources of information can all hinder effective AT use. These challenges may reduce students' ability to fully participate in the higher education environment. Although assistive technologies (ATs) provide valuable support for accessing information, many students with special needs still face difficulties in obtaining timely information. Factors such as limited training, device shortcomings, lack of external support, and challenges in handling multiple information sources can hinder effective AT use. These barriers can significantly affect students' ability to fully engage in higher education.

This study aims to assess the effectiveness, challenges, and limitations of artificial intelligence (AI) tools in enhancing accessibility and inclusive education for students with diverse cognitive, sensory, and physical needs. It seeks to evaluate how AI technologies contribute to promoting accessibility and fostering inclusive learning environments for students facing various challenges. Additionally, the study will identify the key obstacles and limitations encountered in integrating AI into inclusive educational practices, including technical, pedagogical, and ethical concerns. Finally, it will propose strategies for designing and implementing AI solutions that improve learning outcomes and promote fairness and equity for students with disabilities.

Research Objectives

The purpose of this study is to assess the effectiveness, challenges, and limitations of AI tools in enhancing accessibility and inclusive education for students with diverse cognitive, sensory, and physical needs.

1. To evaluate the effectiveness of AI tools in promoting accessibility and fostering inclusive education for students with varying cognitive, sensory, and physical challenges.

2. To identify the challenges and limitations in integrating AI technologies into inclusive educational practices.

3. To suggest ways to create and use AI solutions that improve learning outcomes and fairness for students with disabilities.

LITERATURE REVIEW

Artificial Intelligence in Inclusive Education

Equitable access to quality education is essential for individuals with disabilities, as it supports their personal development, independence, and overall well-being. According to Zdravkova, K. (2022), the right to education

is a fundamental human entitlement and a critical foundation for individual development. To foster independence and holistic growth, individuals with diverse disabilities must be granted equitable access to high-quality education. In parallel, integrating individuals with special needs and disabilities into mainstream education represents a critical objective in global educational reform, aimed at ensuring equitable access and fostering inclusive communities. With the advent of emerging technologies, Artificial Intelligence (AI) has surfaced as a potentially transformative tool, offering significant promise in advancing the implementation and effectiveness of inclusive education (Mitra, 2024).

With the help of sophisticated algorithms that facilitate tasks like classification and personalization, artificial intelligence (AI) is revolutionizing education. Drawing on interdisciplinary knowledge, AI enhances inclusive education by enabling tailored learning experiences and improving access for students with diverse needs (Ahmad et al., 2025). AI uses advanced technologies and knowledge from various fields—like psychology, computer science, and education—to understand and respond to the unique needs of each student. This is especially beneficial for students with disabilities, as AI tools can adapt to their specific learning styles and challenges, helping ensure that everyone has fair access to quality education. Integrating individuals with disabilities into mainstream education is a key goal of global educational reform. Artificial Intelligence (AI) offers promising solutions to support inclusive education by enhancing accessibility and personalized learning (Pagliara et al., 2024).

Artificial Intelligence (AI) is rapidly transforming education by addressing diverse learning needs through data analysis and complex task execution. A notable application is its support for visually impaired students, enhancing their learning opportunities, engagement, and independence (Trivedi, 2025). AI possesses the ability to provide personalized, thought-provoking learning experiences that conform to constructivist approaches, encouraging active learning and customized teaching for high achievers. exceptional learners. Artificial Intelligence (AI)-mediated systems are becoming more important in schools, but it's still up for debate whether they can help students with special needs (Naggar et al., 2024).

AI-Generated Assistive Technologies

AI-powered assistive technologies have shown enormous promise in improving communication between patients and doctors by breaking down long-standing barriers. Real-time translation tools and speech-to-text systems have made it easier for patients with hearing loss and language barriers to communicate, promoting inclusivity (Islam, 2022). It has enormous potential to help people with cognitive disorders communicate better, become more independent, and depend less on outside assistance. However, there are problems that need to be solved, like making things more personal, helping older people learn how to use technology, and making sure that healthcare privacy is protected. AI is changing assistive technology in a big way. It is moving from static tools to smart systems that learn and change to meet people's needs (Giansanti and Pirrera, 2025). These adaptive tools foster independence and inclusivity, but concerns around personalization, digital literacy, and privacy remain.

According to Ok (2018), With the advancement of technology, mobile devices—particularly iPads—emerged in the late 2000s as valuable tools in special education. Their use as assistive technology (AT) has gained significant traction, with professionals recognizing their potential to support students with disabilities through accessible and engaging learning experiences. Assistive technology helps children with special needs enhance learning and function, especially in school settings. In 2015–2016, U.S. Department of Education data showed a rise in special education services for students aged 3–21 (National Center for Education Statistics, Children and youth with disabilities, 2018).

Recent statistics show that more people have cognitive and developmental disabilities. We need to improve and expand special education practices to ensure that everyone receives a fair education. Educational and assistive technologies offer promising solutions. This study reviews 2014–2018 literature on tech integration in special education for these learners. (Olakanmi et al., 2020). Individuals with intellectual disabilities (ID) have a wide range of learning needs, and they frequently struggle to pick up new skills using only conventional teaching resources. By utilizing technology in their education, people with ID can overcome many of their

challenges with the help of assistive technology (AT) (Sulaimani and Bagadood, 2022).

Impact of AI-Generated Assistive Technologies in Inclusive Education

In educational settings, AI tools like robots, simulations, and apps enhance student engagement and support academic and social growth. Intelligent tutoring systems offer targeted interventions for learning challenges such as dyslexia and dyscalculia, showing promising outcomes. Effective integration requires teacher training, infrastructure investment, and strong leadership. Initiatives focused on underserved communities aim to promote equity and access to transformative technologies (Yang et al., 2024). While AI enhances education, ensuring inclusivity is crucial to benefit all learners. AI can play a stronger role in supporting diverse needs, but its impact depends on thoughtful integration within society and education systems (Seldon and Abidoye, 2018).

AI has the potential to significantly improve inclusive education and promote greater accessibility. Nevertheless, its success is contingent upon overcoming these obstacles. This study emphasizes the importance of policies and strategies that guarantee the ethical and sustainable application of AI in inclusive environments (Melo-López et al., 2025). According to Julien, G. (2024), AI technologies enhance education, but inclusivity must be prioritized to ensure quality learning for all. As AI and society are interconnected, their integration should support inclusive practices. This paper provided an overview of AI's role in advancing inclusive education. AI has the potential to enhance inclusive education and accessibility, but its success depends on addressing ethical, strategic, and societal challenges. Research points out that it requires inclusive policies and thoughtful integration to ensure AI supports all learners effectively.

According to Becker et al. (2012), The synthesis of findings indicates that AI-enhanced education has demonstrated significant potential in terms of customizing students' learning experiences. Key components of this transformative approach include adaptive learning platforms, intelligent tutoring systems, and data-driven insights. Students derive advantages from personalized content delivery, immediate feedback, and improved engagement. Students with disabilities widely use tablets and iPads due to their touch interfaces, portability, and customizable assistive apps. Both students and educators benefit from their user-friendly design, which enhances engagement, communication, and skill development (Mukhtarkyzy et al., 2025).Summary of the Reviews

The research above highlights the transformative potential of AI-generated assistive technologies in inclusive education. Tools such as intelligent tutoring systems, adaptive platforms, and mobile devices like tablets and iPads enhance engagement, personalize learning, and support students with disabilities. Studies emphasize that successful integration depends on comprehensive teacher training, infrastructure investment, and inclusive policies. While AI can significantly improve accessibility and equity, its effectiveness relies on ethical implementation and alignment with societal and educational needs. Overall, AI is a powerful enabler of inclusive education when thoughtfully applied.

METHODOLOGY

Research design

This study will utilize secondary data analysis using data mining techniques to examine how AI-powered assistive technologies and personalized learning platforms can be effectively designed and implemented to accommodate diverse learning needs, enhance accessibility, and support inclusive educational practices. The process of systematically finding patterns in data is called "data mining." It is particularly useful for analyzing large datasets that are difficult to examine through traditional methods (Witten, Frank, and Hall, 2011). By analyzing existing datasets and literature, the research identifies key patterns, trends, and gaps in current practices. The findings aim to inform future development and integration of intelligent assistive tools in educational settings.

Search process

A comprehensive search was conducted across multiple academic databases, including EBSCOhost, ERIC,

JSTOR, ScienceDirect, and Google Scholar, to assure the inclusion of high-quality studies and facilitate a comprehensive literature selection process. We utilized two sets of keywords to identify pertinent articles: (1) AI-powered assistive technologies and (2) inclusive education keywords, personalized learning platforms, and students with disabilities. (3) The influence of AI assistive technologies. The search was limited to academic journal articles that were published between 2019 and 2025.

Criteria for Inclusion

A set of inclusion and exclusion criteria was made to help choose the papers that would answer the research questions within the boundaries of the analysis. This technique followed the rules of a thorough literature review methodology, as described by Onwuegbuzie and Frels (2016), to make sure that the sources chosen were in line with the study's goals and were done in a clear and methodologically sound way.

The following inclusion and exclusion criteria were used to select all retrieved studies for review:

Table 1. Inclusion and Exclusion criteria

Criteria Category	Inclusion Criteria	Exclusion Criteria
Population	Studies involving students with disabilities in inclusive education settings	Studies focusing solely on general education students without disabilities
Intervention	Use of assistive technologies (e.g., screen readers, speech-to-text, AI tools)	Studies not involving any form of assistive technology
Study Design	Empirical studies, systematic reviews, qualitative and quantitative research	Editorials, opinion pieces, non-peer-reviewed articles
Language	English	Non-English publications
Time Frame	Published between 2019 and 2025	Published before 2019
Time Frame	Published between 2019 and 2025	Published before 2019

Since this study employs a secondary data analysis approach using data mining techniques, the respondents are not directly involved through primary data collection. Instead, the study analyzes existing datasets and published research related to AI-powered assistive technologies and inclusive education. The respondents in this context refer to the participants represented in the original studies and datasets—typically students with special needs, educators, and institutions involved in implementing assistive technologies.

Screening Process

The PRISMA 2020 flow diagram illustrates the systematic process of identifying and selecting studies for inclusion in this review. A total of 707 records were initially identified through comprehensive database searches, including platforms such as Google Scholar, EBSCO, ERIC, ResearchGate, JSTOR, and Scientific Research. After removing 2 duplicate records, 705 records were screened based on titles and abstracts, resulting in the exclusion of 590 records deemed irrelevant. Of the 115 reports sought for retrieval, 67 were excluded, and 48 were assessed for eligibility. Following a further exclusion of 36 reports that did not align with the research aims and objectives, 12 articles were ultimately included in the final review. This rigorous selection process ensured that only the most relevant and high-quality studies were analyzed to evaluate the effectiveness of AI tools in inclusive education.
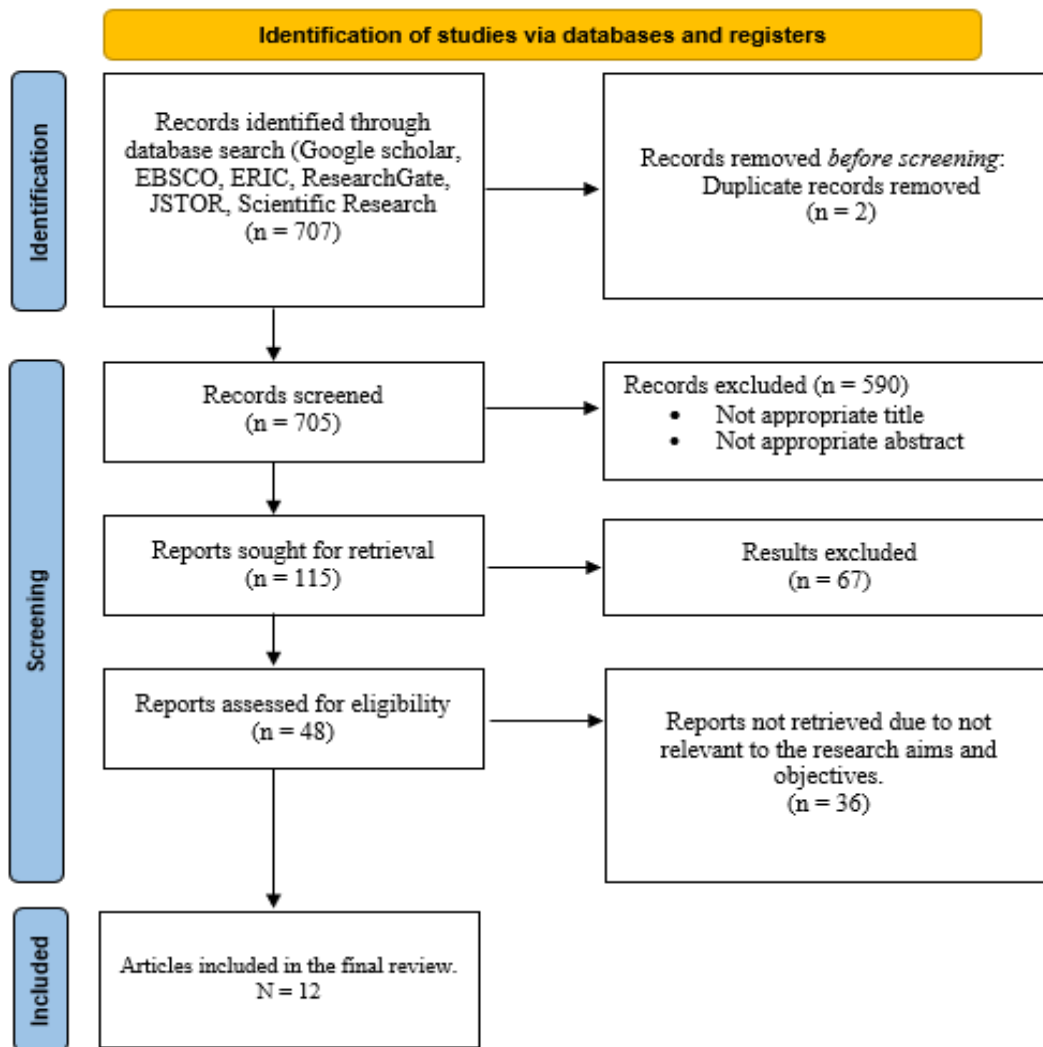
Figure 1. PRISMA flowchart.

This research used advanced data mining methods to process the data we collected. These methods let us find meaningful patterns, trends, and relationships in large and varied datasets in a systematic way. To analyze the data, this study employed advanced data mining techniques, including text mining for thematic analysis, clustering and classification for grouping similar data points, and association rule mining to uncover correlations between variables. These methods enabled the identification of meaningful patterns and relationships within large and diverse datasets. Thematic analysis, as outlined by Braun and Clarke (2006), provided a structured approach to interpreting qualitative data, while machine learning algorithms and natural language processing tools ensured a scalable and rigorous analysis of both qualitative and quantitative inputs. This methodological integration enhanced the depth, reliability, and interpretive power of the findings.

Table 2. Main Characteristics of the Selected Articles

Year	Author(s) & Location	Research Design	Themes	Results
2025	Hussein et al. (Global)	Empirical Study	Personalized AI interventions	Improved academic achievement, communication, emotional regulation, and mobility for students with disabilities
2025	Yusuf (Global)	Case Study	AI in AAC tools	Transformative impact on communication for non-verbal students

2025	Fitas (Global)	Mixed Methods	Engagement & ethical concerns	Enhanced performance and engagement; challenges in access and ethical implementation
2025	Melo-López et al. (Global)	Qualitative	Infrastructure & training gaps	Ethical implementation and equal access remain unresolved
2024	Mustafa et al. (UAE)	Experimental	Assistive tech for visual impairments	Improved reading, writing, and mobility in mainstream classrooms
2024	Gemiharto et al. (Global)	Thematic Analysis	Inclusive design & cultural responsiveness	AI can address inequities; design biases and limited awareness persist
2023	Toyokawa et al. (Japan)	Longitudinal Study	Personalized learning	AI enhances personalized and effective learning experiences
2023	Camparado et al. (Philippines)	Survey & Interviews	Assistive tech reinforcement	Increased motivation and teaching satisfaction; resource and tech challenges
2023	Marino et al. (Global)	Policy Review	Ethical frameworks & inclusivity	Need for culturally sensitive integration; risks of bias and privacy concerns
2023	Vanderpuye et al. (Africa)	Field Study	Resource limitations	Assistive tech is expensive and hard to maintain
2022	Tumelo et al. (Africa, ODeL)	Observational	Geographic barriers	Students face frustration due to limited access and isolation
2019	Ashfin & Ashfin (Global)	Meta-analysis	AI-driven assistive tools	Improved engagement, communication, and skill acquisition; need for ethical use and training

FINDINGS AND DISCUSSION

The findings of this systematic review, which focuses on how artificial intelligence (AI) promotes accessibility and personalization in inclusive education and identifies the challenges face in implementing it, are arranged in accordance with the guiding research questions.

Effectiveness of AI Tools in Enhancing Learning Outcomes

The existing body of literature on AI tools in inclusive education presents several notable strengths, particularly in demonstrating the diversity and adaptability of AI applications. Studies consistently show that assistive technologies—such as voice-activated interfaces, screen readers, AAC tools, and adaptive learning platforms—effectively support students with sensory and physical impairments by enhancing communication and interaction (Ashfin & Ashfin, 2019; Yusuf, 2025). AI-driven platforms like ChatGPT and Bloom AI further extend this support by enabling personalized learning through real-time analytics and flexible content delivery (Marino et al., 2023). Language support tools also play a critical role in promoting inclusivity in multilingual classrooms (Gemiharto et al., 2024). These findings underscore the functional breadth of AI tools and their capacity to address varied learner needs across different educational contexts.

However, while the effectiveness of AI tools is well-documented, the depth of empirical validation remains

uneven across studies. Many findings rely on case studies or small-scale qualitative research, which, although insightful, may limit generalizability. For example, while AAC tools have shown transformative effects for non-verbal learners (Yusuf, 2025), broader, longitudinal studies are needed to assess sustained impact across diverse populations. Similarly, although AI tools are credited with improving academic performance, emotional regulation, and mobility (Hussein et al., 2025; Toyokawa et al., 2023), few studies rigorously compare AI interventions with traditional methods or explore long-term outcomes. This points to a need for more robust, comparative, and longitudinal research designs to strengthen the evidence base.

Another strength lies in the reported improvements in teacher satisfaction and student engagement, which suggest that AI tools not only benefit learners but also enhance instructional practices (Fitas, 2025; Camparado et al., 2023). These findings are valuable for informing teacher training and curriculum development. However, they also reveal a limitation: the lack of focus on implementation challenges, such as infrastructure gaps, ethical concerns, and policy constraints. While some studies acknowledge these issues, they often do so briefly or without proposing actionable solutions. This limits the practical applicability of the findings, especially in resource-constrained settings where such barriers are most pronounced.

In summary, the literature provides compelling evidence of AI's potential to transform inclusive education through personalized, adaptive, and accessible learning tools. Yet, the limitations in methodological rigor, contextual sensitivity, and implementation analysis highlight the need for future research to adopt more comprehensive and interdisciplinary approaches. Addressing these gaps will be essential to ensure that AI technologies are not only effective but also equitable, ethical, and scalable across diverse educational environments.

Challenges and limitations in integrating AI technologies into inclusive educational practices.

The implementation of artificial intelligence (AI) in inclusive education is significantly hindered by infrastructural and pedagogical limitations. In resource-constrained and remote areas, limited access to reliable internet, digital devices, and technical support restricts the deployment of AI tools, thereby excluding many learners from its potential benefits (Tumelo et al., 2022; Vanderpuye et al., 2023). Compounding this issue is the lack of teacher preparedness, as many educators are not adequately trained in AI integration and lack the data literacy required to effectively utilize these technologies in diverse classroom settings (Toyokawa et al., 2023; Melo-López et al., 2025). These gaps in infrastructure and professional development create systemic barriers that undermine the scalability and sustainability of AI-enhanced inclusive education.

Beyond logistical constraints, ethical and design-related challenges further complicate AI implementation. Concerns surrounding data privacy, algorithmic bias, and informed consent are particularly pressing in educational contexts involving vulnerable populations (Hussein et al., 2025; Marino et al., 2023). Moreover, many AI tools lack inclusive design features and cultural responsiveness, resulting in technologies that fail to accommodate the diverse needs of learners with disabilities (Gemiharto et al., 2024). The absence of comprehensive policy frameworks to guide ethical use and inclusive design exacerbates these issues, highlighting the urgent need for collaborative efforts among educators, developers, and policymakers to ensure AI technologies are equitably and responsibly integrated into educational systems.

In summary, the existing literature provides compelling evidence of AI's potential to enhance inclusive education, but it also reveals critical limitations that must be addressed to ensure equitable and ethical implementation. Future research should prioritize context-sensitive studies, especially in underrepresented regions, and focus on developing inclusive design standards, teacher training programs, and policy frameworks that support sustainable AI integration. A shift from isolated case studies to interdisciplinary, multi-stakeholder approaches will be essential to fully realize AI's transformative potential in education.

CONCLUSION

In conclusion Using AI technologies in inclusive education opens many possibilities for improving learning outcomes, making it easier for students with different needs to get help, and making it more personalized. AI-driven tools have demonstrated effectiveness in improving academic performance, communication, and

engagement, particularly for learners with disabilities. However, the successful implementation of these technologies requires addressing persistent challenges such as resource limitations, ethical concerns, cultural sensitivity, and educator preparedness. To fully realize the potential of AI in education, collaborative efforts among educators, developers, and policymakers are essential, alongside the development of inclusive, ethical, and contextually relevant frameworks that ensure equitable access and meaningful learning experiences for all students.

From the research and the discussion that followed, the outlined recommendations are the following to improve the incorporation of AI in the inclusive education: (1) educational institutions must give the highest priority to comprehensive training programs for educators so that they are able to use AI tools effectively and ethically and these should be customized according to learner needs. (2) developers must carry out their work with principles of inclusiveness and cultural responsiveness which help them eliminate bias in their designs and fill in access gaps. (3) infrastructure improvements are highly important especially in resource-limited places to enable access to AI technologies for all. (4) joint efforts of policymakers, educators, technologists, and community stakeholders are very important to come up with solutions that consider locality and context. (4) continuous monitoring and evaluation of AI interventions to improve the practices, protect data privacy, and to be sure that AI educational tools are going to be there to help and empower learners with disabilities.

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