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REVIEW ARTICLE

Artificial Intelligence: A Transformative Solution to Educational Accessibility Issues for Learners with Special Needs

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Abstract: Artificial Intelligence (AI) is creating new opportunities to improve educational accessibility for learners with special needs and disabilities. However, barriers such as inaccessible learning materials, communication difficulties, inflexible instruction, inadequate assistive technologies, limited teacher competence, poor infrastructure, and unequal technology access continue to restrict participation. This paper examines AI as a transformative solution to these challenges, focusing on learners with visual, hearing, intellectual, communication, learning, physical, autism, multiple, and emotional or behavioural disabilities. It discusses applications including computer vision, speech recognition, adaptive learning, intelligent tutoring, natural language processing, generative AI, personalised learning, and AI-supported assessment. Despite its potential to improve accessibility, communication, engagement, and independence, concerns remain regarding bias, privacy, affordability, infrastructure, and ethical governance. The paper advocates human-centred, inclusive, and equitable AI implementation.

Keywords: Artificial Intelligence; Educational Accessibility; Learners with Special Needs; Inclusive Education; Assistive Technology.

INTRODUCTION

Education is a fundamental human right and an important instrument for individual development, social participation, economic productivity, and sustainable development (Miao et al., 2021). Contemporary educational systems are expected to provide equitable learning opportunities for all learners, irrespective of disability, socioeconomic status, gender, language, or other individual differences. However, achieving this educational equity for all learners, particularly those with special educational needs, remains a persistent challenge, as many educational environments continue to operate on standardised assumptions about learners' abilities, communication preferences, learning pace, and modes of participation (Wang et al., 2024). Consequently, learners with special educational needs may face barriers that restrict their access to instructional materials, classroom interaction, assessment, communication, and other educational opportunities. These challenges have driven the development of inclusive education and shifted attention from merely placing learners with special needs in regular educational settings to creating learning environments that actively remove barriers to participation and achievement (El Morr et al., 2024).

Educational accessibility is important for learners with special needs because disability can interact with environmental and instructional barriers to produce educational disadvantage. (Jardinez & Natividad, 2024) For example, learners with visual impairment may encounter inaccessible printed and digital materials; learners with hearing impairment may have difficulty accessing spoken instruction; and learners with physical, intellectual, developmental, communication, and specific learning disabilities may require alternative methods for accessing information and demonstrating knowledge (Chemnad & Othman, 2024). El Morr et al. (2024), explain that accessibility should not be understood simply as providing physical admission to schools or classrooms; rather, it involves ensuring that learners can access educational content, interact with learning environments, communicate effectively, participate in instructional activities, and demonstrate learning outcomes. Recent scholarship indicates that digital accessibility remains an important concern because technological environments can reproduce exclusion when they are not designed around the diverse needs of learners with special needs (Panjwani-Charania & Zhai, 2024).

The rapid expansion of digital technologies has created new possibilities for addressing some of these accessibility barriers. Wang et al. (2024) opined that Assistive technologies such as screen readers, speech-recognition systems, text-to-speech applications, electronic Braille displays, captioning systems, and alternative input devices have improved access to information and communication

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for many learners with special needs. Nevertheless, conventional assistive technologies may provide predetermined forms of support and may not adequately respond to the changing needs, abilities, contexts, and learning patterns of individual learners. Moreover, the availability of assistive technology does not automatically guarantee meaningful educational inclusion because issues such as affordability, digital infrastructure, teacher competence, inaccessible content, compatibility, and inadequate institutional support can limit effective utilisation. The continuing development of artificial intelligence consequently provides an opportunity to move from relatively static technological assistance towards more adaptive and responsive educational support (Fu et al., 2025).

ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING EDUCATIONAL ACCESSIBILITY

Artificial Intelligence (AI) has emerged as one of the most influential technological developments shaping contemporary education. AI refers broadly to computational systems capable of performing tasks associated with human cognitive processes, including pattern recognition, language processing, prediction, reasoning, decision-making, and learning from data (Almasri, 2024). Within education, AI applications have expanded considerably to include adaptive learning systems, intelligent tutoring, automated assessment, learning analytics, predictive systems, conversational agents, personalised feedback, and generative educational tools. A systematic review of 2,223 publications demonstrated the breadth of artificial intelligence in education, identifying major areas including adaptive learning and personalised tutoring, intelligent assessment and management, profiling and prediction, and emerging AI-based educational products (Wang et al., 2024). Other reviews similarly demonstrate that AI is increasingly influencing instructional design, assessment, learner engagement, and educational decision-making (Fu et al., 2025).

The importance of AI becomes even greater when its potential is examined from the perspective of learners with special needs. AI can facilitate the transformation of educational information into different accessible formats and can support individualised interaction between learners and learning environments. For example, computer vision and natural language processing can support image description, text recognition, speech interaction, and conversion between different modes of communication (Chalkiadakis et al., 2024). AI-powered adaptive systems can also modify instructional content, provide personalised feedback, identify patterns in learner performance, and recommend learning activities according to individual needs. A systematic review of technologies supporting students with disabilities found that AI has considerable potential to improve educational accessibility, personalisation, and social inclusion, while research on AI and learning disabilities has identified applications such as adaptive learning, intelligent tutoring, communication assistance, and interactive systems (Chalkiadakis et al., 2024).

For learners with visual impairment, AI may provide particularly significant opportunities for reducing information-access barriers. AI-supported optical character recognition can convert printed information into machine-readable text, while computer vision can potentially identify objects, interpret visual scenes, and generate descriptions of images. Such technologies can complement existing accessibility tools by enabling learners to obtain information that has traditionally depended heavily on sighted assistance or prior conversion into Braille or audio formats (Panjwani-Charania & Zhai, 2024). For learners with hearing impairment, automatic speech recognition and captioning can increase access to spoken classroom communication, while learners with specific learning disabilities may benefit from adaptive tutoring, personalised explanations, language-processing systems, and intelligent feedback. Evidence from recent systematic reviews indicates that AI applications are already being explored across different disability groups, although the distribution of research remains uneven and some disability categories receive considerably less attention than others (Chemnad & Othman, 2024; El Morr et al., 2024).

Beyond providing alternative access to educational information, AI has the potential to support personalised learning. Learners with special needs are not a homogeneous population; individuals with the same disability may have substantially different educational strengths, limitations, communication preferences, technological competencies, and support requirements. Consequently, a one-size-fits-all approach may be insufficient for achieving meaningful inclusion. AI-enabled adaptive systems can potentially analyse patterns of learner interaction and performance and use such information to modify instructional difficulty, pacing, feedback, and learning pathways. Research in AI-supported education has identified personalisation and adaptive tutoring as major areas of application, while emerging evidence in inclusive education indicates that AI can support differentiated learning experiences for learners with disabilities (Wang et al., 2024; El Naggar et al., 2024; Chalkiadakis et al., 2024).

AI can also transform the role of teachers in supporting learners with special needs. Teachers frequently face considerable demands associated with identifying individual learning needs, adapting instructional materials, monitoring learner progress, providing differentiated instruction, and preparing accessible resources. AI may assist teachers by generating alternative representations of learning materials, providing preliminary analyses of learner performance, producing personalised feedback, and supporting the development of differentiated instructional activities. Such applications may reduce some routine workload and allow teachers to devote greater attention to pedagogical interaction and individual learner support. However, evidence from the broader AI-in-education literature emphasises that AI should complement rather than replace teachers because effective education involves social interaction, professional judgement, emotional support, ethical decision-making, and contextual understanding that cannot be reduced to automated processes (Wang et al., 2024; Almasri, 2024; Fu et al., 2025).

Despite these opportunities, the use of AI for educational accessibility should not be viewed as an automatic solution to the problems experienced by learners with special needs. AI systems may reproduce existing inequalities when their training data are incomplete, biased, or insufficiently representative of persons with disabilities. There are also concerns regarding privacy, surveillance, algorithmic bias, inaccurate outputs, data security, affordability, digital inequality, and excessive dependence on automated systems. Research on AI and disability has further observed that disability-related AI research may be dominated by narrow perspectives that fail to adequately reflect the social, cultural, and lived experiences of persons with disabilities. Therefore, AI systems intended to promote accessibility must be developed through participatory and human-centred approaches that meaningfully involve learners with disabilities, teachers, families, and other relevant

stakeholders (El Morr et al., 2024; Chemnad & Othman, 2024; Alfredo et al., 2024).

Another important concern is the possibility that AI could widen rather than reduce the digital divide. Learners with special needs in low-resource educational contexts may have limited access to reliable electricity, internet connectivity, appropriate digital devices, accessible software, and trained personnel. Consequently, sophisticated AI applications may remain inaccessible to the very learners who could benefit most from them. UNESCO emphasises that AI in education should promote high-quality educational opportunities for all learners, including persons with disabilities, and should not deepen existing digital inequalities or create new forms of discrimination. This principle is particularly important for developing educational systems in contexts where technological infrastructure and specialist support remain unevenly distributed (Miao et al., 2021; UNESCO, 2025; Chemnad & Othman, 2024).

The emerging literature therefore suggests that the transformative potential of AI in special needs education depends not merely on the availability of advanced technologies but on how those technologies are designed, implemented, evaluated, and governed. Inclusive AI requires attention to accessibility by design, Universal Design for Learning, teacher preparedness, learner participation, data protection, algorithmic transparency, affordability, and continuous evaluation of educational outcomes. A framework for inclusive AI learning design has emphasised the value of Universal Design for Learning principles in creating learning experiences that provide multiple and flexible ways of engaging with content, accessing information, and demonstrating learning. Similarly, research on human-centred AI in education highlights the importance of human control, safety, reliability, trust, and stakeholder participation (Kang et al., 2024; Alfredo et al., 2024; Fu et al., 2025).

Against this background, Artificial Intelligence represents an important opportunity for rethinking educational accessibility for learners with special needs. Its capacity to personalise learning, transform information into accessible formats, facilitate communication, provide adaptive support, assist teachers, and respond to individual learning patterns positions it as more than a conventional instructional technology. Nevertheless, its transformative value will depend on whether AI is implemented within an inclusive, ethical, accessible, affordable, and human-centred framework. There is therefore a need for continued scholarly attention to how AI can be systematically harnessed to address the persistent accessibility challenges confronting learners with special needs, particularly in educational contexts where technological and institutional constraints remain significant. Accordingly, this paper examines Artificial Intelligence as a transformative solution for educational accessibility issues for learners with special needs, focusing on its applications, opportunities, challenges, ethical implications, and the conditions necessary for its effective contribution to inclusive education.

ACCESSIBILITY CHALLENGES FOR LEARNERS WITH SPECIAL NEEDS

Learners with visual impairment experience substantial accessibility challenges because many educational systems continue to depend heavily on visual information. Printed textbooks, diagrams, graphs, maps, laboratory demonstrations, digital interfaces, presentations, and other visual learning resources may be inaccessible when they are not converted into Braille, audio, tactile, or appropriately structured electronic formats (Chemnad & Othman, 2024). Although assistive technologies such as screen readers, Braille displays, magnification software, and optical character recognition have improved access to information, inaccessible digital content, inadequate technological infrastructure, limited availability of accessible materials, and insufficient teacher training continue to restrict participation. (Voultsiou & Moussiades, 2025) A recent systematic review of 60 studies found that students with visual impairment in higher education continue to experience barriers associated with inaccessible content, poor infrastructure, and inadequate faculty training, despite the availability of assistive technologies. These challenges are particularly important in digital learning environments, where visual interfaces may not be compatible with assistive technologies (Gidisu et al., 2026).

Learners with hearing impairment encounter accessibility barriers primarily when educational communication is delivered through speech without adequate visual or sign-language alternatives (Sasu et al., 2026). Conventional classroom teaching may depend on oral explanations, teacher discussions, group conversations, videos, announcements, and audio-based learning resources, making it difficult for learners who are deaf or hard of hearing to obtain complete information. The absence of qualified sign-language interpreters, captioning, hearing-support technologies, accessible multimedia, and teachers competent in inclusive communication can further restrict classroom participation and social interaction (Melo-López et al., 2025). Digital learning environments can also reproduce these barriers when videos lack accurate captions or when automated speech-to-text systems perform poorly with different accents, background noise, or specialised educational vocabulary. Recent research identifies accessibility and equity as major concerns in AI-supported assistive technologies for people with hearing and visual impairments, while systematic evidence on AI in inclusive education indicates that audio transcription and captioning can improve access to instructional content for learners with hearing impairment (Chemnad & Othman, 2024).

Learners with intellectual disability may experience accessibility difficulties because educational content, classroom activities, assessment procedures, and communication are often designed at levels of complexity that do not correspond with their individual cognitive and adaptive functioning (Egan et al., 2022). Long and abstract instructions, rapid presentation of information, complex vocabulary, inflexible curricula, and conventional assessment procedures can make learning difficult even when learners are physically present in the classroom. In addition, some learners require repetition, concrete examples, visual or multimodal representations, structured routines, additional processing time, and frequent feedback. Research on inclusive education demonstrates that appropriate teaching and learning materials, adaptive instructional approaches, supportive teachers, and individualised support are important for improving educational outcomes among learners with disabilities. AI-based systems may potentially address some of these barriers through adaptive learning and personalised instruction, but such technologies must be carefully matched to individual cognitive and communication needs (Voultsiou & Moussiades, 2025).

Learners with communication disabilities may encounter barriers in expressing needs, responding to questions, participating in discussions, completing oral assessments, and interacting with teachers and peers.

Nantaburom and Wetcho (2026) assumed that educational environments that accept fluent speech as the primary means of classroom participation may unintentionally exclude learners who use augmentative and alternative communication (AAC), communication boards, gestures, symbols, electronic devices, or other communication systems. Communication difficulties can consequently affect both academic participation and social inclusion, particularly when teachers and peers lack knowledge of alternative communication methods. Digital technologies and AI offer emerging possibilities through speech recognition, text-to-speech, natural language processing, predictive text, conversational systems, and personalised communication interfaces. However, accessibility depends on the accuracy of these technologies and their ability to recognise diverse speech patterns and communication forms. Consequently, communication accessibility requires both technological support and teachers who understand individual communication preferences (El Morr et al., 2024)

Learners with specific learning disabilities, including dyslexia and other learning difficulties, may experience barriers when instruction relies on a single pace, extensive reading, complex written instructions, or conventional assessment methods. Panjwani-Charania and Zhai (2024), difficulties w ith reading, spelling, writing, processing information, working memory, or numerical reasoning may affect academic performance even when learners possess appropriate intellectual ability. The accessibility problem therefore often lies not in the learner's capacity to learn but in the mismatch between the learner's needs and the way educational information is presented. AI-supported technologies provide opportunities for text simplification, speech synthesis, adaptive tutoring, personalised feedback, and differentiated learning activities.

A systematic review of AI applications for students with learning disabilities identified personalized and adaptive learning systems, game-based learning, intelligent educational support, and other AI-assisted interventions as promising approaches, although the available evidence remains methodologically limited and should be interpreted cautiously (Panjwani-Charania & Zhai, 2024; Paglialunga & Melogno, 2025; Wang et al., 2024).

Learners with physical disabilities may experience accessibility barriers arising from the interaction between their physical functioning and the built, technological, and instructional environment. Inaccessible classrooms, laboratories, libraries, toilets, transportation systems, furniture, computer equipment, and learning platforms can restrict independent participation. (Sedláčková et al., 2025). Difficulties with fine-motor control may also make handwriting, keyboard use, manipulation of instructional materials, or conventional examination procedures challenging. Importantly, physical disability does not necessarily imply cognitive limitation; therefore, educational exclusion may result primarily from environmental and technological barriers rather than inability to learn (Fernández-Batanero et al., 2022). A recent qualitative systematic review found that students with physical disabilities continue to report barriers to accessibility and participation in mainstream educational settings and highlighted curriculum accommodation, appropriate support, and student participation in decision-making as important strategies for improving inclusion. Assistive technologies can further facilitate access by providing alternative input and interaction mechanisms (Egan et al., 2022).

Learners on the autism spectrum may experience accessibility challenges associated with communication, sensory processing, social interaction, executive functioning, attention, and the predictability of learning environments. Highly stimulating classrooms, unexpected changes in routines, ambiguous instructions, excessive sensory input, and socially demanding activities can create barriers to engagement and participation. At the same time, autism is highly heterogeneous, meaning that accessibility requirements differ considerably between individuals. Educational systems that apply a uniform intervention may therefore fail to accommodate individual strengths and support needs. Digital and AI-based technologies may provide structured environments, personalised learning activities, visual supports, conversational assistance, and adaptive feedback, but their effectiveness depends on careful individualisation and appropriate human supervision. Recent systematic research on AI, VR, and large language models in special education indicates growing opportunities for personalised and accessible learning, while also emphasising the need for ethical implementation and evidence-based practice (Voultsiou & Moussiades, 2025; Nantaburom & Wetcho, 2026; Egan et al., 2022).

Learners with multiple disabilities face particularly complex accessibility challenges because they may experience the combined effects of two or more disabilities, such as visual and hearing impairment, intellectual and physical disability, or sensory and communication disabilities. Their educational needs may therefore extend across communication, mobility, sensory access, cognition, self-care, and assistive technology. A support strategy designed for a single disability may be inadequate because the accommodation that improves access for one impairment may not address another. This complexity requires individualised assessment and coordinated support involving teachers, special educators, therapists, families, and technology specialists. Research on disability-inclusive education in African contexts shows that learners experience interconnected educational, environmental, institutional, and support-related barriers, while contemporary research on AI in inclusive education suggests that personalized and adaptive technologies may provide flexible support for diverse learner needs when appropriately designed and implemented (Egan et al., 2022; Li et al., 2025; Voultsiou & Moussiades, 2025).

Learners with speech and language disabilities may experience difficulties understanding language, producing speech, organising ideas, retrieving words, or participating in rapid classroom communication. Conventional teaching and assessment frequently privilege fluent oral and written language, which can disadvantage learners whose primary difficulty involves language formulation or speech production. Classroom discussions, oral presentations, question-and-answer sessions, and timed assessments may therefore fail to provide equitable opportunities for demonstrating knowledge. AI-based natural language processing, predictive text, speech-to-text, text-to-speech, and conversational technologies may provide alternative pathways for communication and learning. Nevertheless, these technologies must be trained and evaluated across diverse speech and language patterns because inaccurate recognition can create additional barriers. The broader literature on AI and disability highlights both the potential of AI-supported communication and the continuing need for inclusive, user-centred design (El Morr et al., 2024; Chemnad & Othman, 2024; Nantaburom & Wetcho, 2026).

Learners with emotional and behavioural disabilities may experience accessibility barriers related to attention, emotional regulation, social relationships, motivation, classroom behaviour, and the ability to maintain engagement in conventional learning environments. Rigid classroom structures, punitive disciplinary practices,

limited psychological support, and teaching approaches that do not accommodate individual regulation needs can reduce participation and academic engagement. These barriers may be intensified when educational systems interpret behavioural differences solely as disciplinary problems rather than considering the interaction between the learner and the learning environment. AI-supported educational systems may potentially provide personalised pacing, adaptive feedback, engagement monitoring, and structured learning experiences; however, automated monitoring also raises important concerns regarding privacy, labelling, bias, and inappropriate interpretation of learner behaviour. Therefore, AI should support–not replace–professional assessment and human relationships in addressing these educational needs (Subban et al., 2022; Wang et al., 2024; Alfredo et al., 2024).

OVERALL ACCESSIBILITY CHALLENGE

Although the specific accessibility barriers differ across disability categories, a common problem is the mismatch between learner diversity and standardised educational environments. Learners with special needs may face inaccessible information, inflexible curricula, inappropriate assessment, inadequate assistive technology, limited teacher expertise, poor infrastructure, negative attitudes, and insufficient individualised support. A systematic review of students with disabilities in low- and middle-income African countries confirms that barriers to educational participation are multidimensional and require attention to the lived experiences of learners themselves. Similarly, research on assistive technology demonstrates that technology can improve inclusion but that teacher preparation, information gaps, accessibility, and implementation conditions remain important barriers. These findings provide a strong justification for exploring Artificial Intelligence as a potentially transformative approach–not because AI can eliminate disability, but because appropriately designed AI can help remove environmental, instructional, communication, and technological barriers that restrict educational participation (Egan et al., 2022; Fernández-Batanero et al., 2022).

CURRENT AI APPLICATIONS FOR EDUCATIONAL ACCESSIBILITY FOR LEARNERS WITH SPECIAL NEEDS

Artificial Intelligence (AI) is increasingly being applied to address educational accessibility barriers experienced by learners with special educational needs and disabilities. Current applications extend beyond conventional assistive technology by incorporating machine learning, computer vision, natural language processing, speech recognition, adaptive learning, generative AI, intelligent tutoring systems, robotics, and large language models (LLMs) (Voultsiou & Moussiades, 2025). Recent systematic evidence confirms that AI-supported technologies are increasingly being used to improve accessibility, personalisation, participation, and social inclusion for students with disabilities (Chalkiadakis et al., 2024; Melo-López et al., 2025). A 2025 systematic review of 139 studies found that AI, virtual reality, and LLM-based technologies are being applied in special education to support personalised learning, social engagement, cognitive development, communication, and independence. Similarly, another systematic review identified personalised learning, cognitive and behavioural interventions, communication support, emotional assistance, and physical independence as major areas of AI application in special education (Hussein et al., 2025). These developments suggest that AI is gradually shifting educational accessibility from static accommodation towards more adaptive and individualised support (Wang et al., 2025; Li et al., 2025).

AI-Powered Accessibility for Learners with Visual Impairment

AI is increasingly being applied through computer vision, optical character recognition (OCR), image recognition, scene description, object recognition, text-to-speech, and intelligent visual assistants. These technologies can analyse printed or digital information and convert it into speech or other accessible formats. Systematic evidence indicates that AI can improve digital accessibility for learners with visual impairments by supporting image description, alternative representation of visual information, and more accessible interaction with educational materials (Chalkiadakis et al., 2024; Melo-López et al., 2025).

AI-powered systems can also identify objects, describe images, recognise people, and provide contextual information about surrounding environments. Such applications are particularly relevant to educational materials containing photographs, diagrams, charts, classroom displays, and other visual information that may not be accessible through conventional screen readers. AI-enabled assistive technologies are increasingly incorporating computer vision, smart devices, voice-based interfaces, and environmental recognition to enhance mobility, information access, and independent participation among people with visual impairments (Sasu et al., 2026). The current literature therefore identifies computer vision, smart glasses, voice-based systems, screen readers, and AI-powered navigation applications as important technologies for improving independence and access among people with visual impairment (Trivedi & Bindewari, 2025).

AI-Based Speech Recognition and Captioning for Learners with Hearing Impairment

AI is being applied through automatic speech recognition, real-time captioning, speech-to-text conversion, and intelligent transcription. These applications can convert classroom speech, lectures, discussions, and multimedia audio into text, thereby providing learners who are deaf or hard of hearing with an alternative pathway for accessing spoken information. Reviews of AI-supported inclusive education identify automated transcription and accessible multimedia representation as important mechanisms through which AI can improve access to instructional information for students with hearing impairments (Chalkiadakis et al., 2024; Melo-López et al., 2025).

AI-generated captions can also support asynchronous learning by making recorded lectures and videos more accessible. AI-powered assistive technologies for people with hearing impairments increasingly incorporate speech recognition and other intelligent communication functions that can support greater independence and information access (Sasu et al., 2026). However, accuracy remains an important consideration because speech-recognition systems may perform differently depending on accent, background noise, specialised vocabulary, speech characteristics, and the quality of the input signal. Ethical and accessibility concerns also arise when AI systems perform unevenly across linguistic or user groups (Sasu et al., 2026). Thus, current AI applications can complement but

should not automatically replace qualified interpreters, sign-language resources, and established accessibility practices (Voultsiou & Moussiades, 2025).

Adaptive Learning for Learners with Intellectual Disabilities

AI is currently being applied to create adaptive learning environments for learners with intellectual disabilities. Rather than providing identical instructional content to all learners, AI systems can analyse learner responses and modify the difficulty, pace, repetition, feedback, and sequence of activities. Such forms of adaptivity are especially relevant because learners with intellectual and developmental disabilities may require individually tailored tasks, materials, learning environments, and instructional interventions (Conde & Rodríguez-Sedano, 2024).

This approach is particularly important for learners who require additional processing time, repeated practice, simplified instructions, or individually structured learning activities. AI-supported systems can potentially identify patterns in learner performance and provide teachers with information that assists in differentiating instruction. Research on learning analytics for students with intellectual and developmental disabilities indicates that learner data can support adaptations in activities, learning content, environments, and feedback, although effective application requires careful consideration of learners' individual characteristics and educational contexts (Conde & Rodríguez-Sedano, 2024). More broadly, research on AI in special education indicates that personalised and adaptive interventions can provide tailored forms of educational support for students with diverse disabilities (Hussein et al., 2025). Recent reviews therefore indicate that personalised learning and adaptive instructional systems are among the most prominent applications of AI in special education, although further high-quality empirical research is required to establish their long-term effectiveness for different intellectual disability profiles (Voultsiou & Moussiades, 2025).

Intelligent Tutoring Systems for Learners with Learning Disabilities

Intelligent tutoring systems (ITS) represent another important application of AI for learners with specific learning disabilities such as dyslexia and difficulties in reading, writing, and mathematics. These systems can provide individualised exercises, immediate feedback, repetition, hints, and adaptive levels of difficulty. Previous systematic research has identified intelligent tutoring, adaptive learning, mastery learning, communication assistants, chat-based systems, and interactive technologies among the principal AI applications used to support students with learning disabilities (Panjwani-Charania & Zhai, 2024).

Recent evidence specifically concerning dyslexia further indicates that AI applications are increasingly being used for personalised learning and intervention, speech and language processing, early identification, and individualized educational support (Yap et al., 2025). These findings support the potential of AI to move beyond generalized instruction toward data-informed learning experiences that respond to individual patterns of difficulty.

Recent systematic evidence is particularly encouraging for this group. A 2025 systematic review identified personalised/adaptive learning systems and game-based learning as the most common AI interventions for students with learning disabilities, with all included studies reporting positive outcomes. However, the authors also found substantial methodological limitations, with none of the included studies judged to have a low risk of bias. This means that AI-based tutoring shows considerable promise, but its effectiveness should not be assumed without stronger experimental and longitudinal evidence (Paglialunga & Melogno, 2025; Ulaş et al., 2025). The broader evidence on AI and dyslexia likewise emphasizes the need for stronger empirical validation, larger and more diverse samples, and careful assessment of accessibility and algorithmic bias (Yap et al., 2025).

Generative AI and Large Language Models for Learners with Special Needs

Generative AI and large language models (LLMs) represent one of the most recent developments in educational accessibility. Tools based on generative AI can generate explanations, simplify complex texts, summarise information, provide alternative examples, create learning exercises, answer questions, and support conversational interaction. Systematic evidence indicates that GenAI is already being used in special education, particularly as a pedagogical assistant, while also offering potential benefits for accessibility and personalised learning (Wang et al., 2025).

For learners with special needs, these capabilities can provide multiple representations of the same learning material. For example, a complex paragraph may be rewritten in simpler language, an abstract concept may be explained using concrete examples, or a learner may interact with an AI system through natural language rather than navigating a complex interface. The wider educational literature on LLMs also identifies intelligent tutoring, accessibility enhancement, personalised assistance, increased engagement, and adaptive educational support among important areas of application, although technical reliability, privacy, fairness, and over-reliance remain significant concerns (Shi et al., 2026).

A systematic review specifically examining generative AI in special education found growing applications but also emphasised the need to understand how GenAI mediates learning, teacher practice, learner interaction, and accessibility (Panjwani-Charania & Zhai, 2024). More recent systematic evidence similarly cautions that, although GenAI may support learning outcomes for students with disabilities, its evidence base remains emergent and concerns regarding ethics, technical reliability, teacher competence, and appropriate human oversight require further investigation (Wang et al., 2025). Therefore, generative AI should be positioned as a flexible educational support mechanism rather than an autonomous replacement for teachers, special educators, or established assistive practices.

AI-Based Communication Support

AI is also being used to improve communication for learners with speech, language, communication, and other disabilities affecting expressive or receptive communication. Natural language processing, predictive text, speech synthesis, conversational agents, and intelligent communication systems can provide alternative methods for learners to express needs, ask questions, participate in learning activities, and interact with teachers (Voultsiou & Moussiades, 2025). AI-enabled communication systems may be particularly useful when integrated with augmentative and alternative communication (AAC) technologies. Current reviews of AI in special education

identify communication support as one of the major application areas, alongside personalised learning and behavioural interventions. However, the effectiveness of such systems depends heavily on accurate recognition of individual communication patterns and meaningful involvement of users during technology design (El Morr et al., 2024).

AI for Autism and Neurodevelopmental Disabilities

For learners with autism and other neurodevelopmental disabilities, AI is currently being explored through social robots, intelligent tutoring systems, conversational agents, virtual environments, emotion-recognition systems, adaptive learning platforms, and personalised interventions. These technologies can provide structured and repetitive learning experiences, simulate social situations, support communication, and adjust activities according to individual responses. A systematic review of AI, VR, and LLM applications in special education identified social engagement and cognitive development as important areas of application. More recent systematic evidence suggests that AI-based interventions may influence cognitive processing, academic performance, engagement and motivation, and social-emotional learning among children with neurodevelopmental disabilities, although the available evidence remains heterogeneous across disabilities and technological approaches (Pittas & Nussbaumer, 2025; Kotsi et al., 2025; Hussein et al., 2025).

AI for Emotional and Behavioural Support

AI is increasingly being investigated as a tool for supporting emotional regulation, behavioural intervention, engagement, and social-emotional learning among learners with special needs. AI-enabled systems can monitor patterns of interaction, provide prompts, offer structured feedback, and deliver personalised activities intended to support engagement or emotional regulation. Some applications combine AI with robotics or immersive environments to create controlled learning experiences in which learners can practise social and behavioural skills. A systematic review of AI applications in special education identified emotional support and cognitive/behavioural interventions as significant areas of development. However, the use of AI to infer emotions or behavioural states raises serious ethical questions concerning privacy, accuracy, consent, and the possibility of misinterpreting disability-related behaviours (Wang et al., 2025; Voultsiou & Moussiades, 2025; Alfredo et al., 2024).

AI-Enabled Assistive Robotics and Physical Independence

AI is also being integrated into assistive robots and intelligent devices to support learners with physical and multiple disabilities. Such systems can assist with interaction, object manipulation, mobility-related tasks, and participation in learning activities. Intelligent robotic systems may respond to voice commands, recognise objects, adapt to user behaviour, or provide physical assistance. This application is important because accessibility extends beyond access to information; learners must also be able to interact physically with their learning environments. Current systematic evidence identifies physical independence as an emerging area of AI application in special education, although the availability, affordability, and scalability of these technologies remain major challenges, particularly in low-resource educational environments (Wang et al., 2025; Voultsiou & Moussiades, 2025; Mukhtarkyzy et al., 2025).

CONCLUSION AND IMPLICATIONS

Artificial Intelligence has the potential to become a transformative component of accessible and inclusive education for learners with special needs. However, transformation will occur only when AI is deliberately designed around human diversity and implemented within supportive educational, technological, ethical, and policy environments. The future should therefore focus on AI for inclusion rather than inclusion for AI that is, technology should be adapted to the educational needs, rights, abilities, and lived experiences of learners rather than requiring learners with disabilities to adapt to technology. Sustainable progress will require collaboration among educators, special education professionals, technology developers, researchers, policymakers, families, and persons with disabilities. Such collaboration can ensure that AI becomes not merely an innovation in education, but a practical instrument for advancing accessibility, participation, independence, equity, and educational opportunity for all learners.

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The authors declare that they have no competing interests.

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Consent to Participate

Informed consent was obtained from all participants involved in the study.

Consent for Publication

Participants provided consent for the publication of anonymised data. The authors also consent to the publication of this manuscript.

Availability of Data and Materials

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Artificial Intelligence-Assisted Technology

No Artificial Intelligence-assisted technology was used in the writing, analysis, or preparation of this manuscript.

Code Availability

Not applicable.

Authors' Contributions

The author contributed to the conception, design, data collection, analysis, manuscript drafting, and approval of the final version of the manuscript.

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ADDITIONAL INFORMATION

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