

Review Article

Developing Adaptive Learning Technologies with AI for Students with Disabilities

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Abstract

Traditional educational frameworks, characterized by standardized curricula and a uniform pace of instruction, frequently struggle to meet the varied learning requirements of students with disabilities. This systemic rigidity contributes to a persistent gap in educational outcomes and reveals the limitations of existing non-AI assistive tools, which are often static and unable to adapt to a learner's progress. The purpose of this article is to address this critical issue by examining the development of adaptive learning technologies driven by Artificial Intelligence (AI) to provide genuinely individualized educational experiences. It proposes a systematic approach for creating effective and ethical systems tailored to students with diverse needs. The methodology for this conceptual work involves a systematic review of the existing body of knowledge, which informs the introduction of a new development framework. This proposed framework outlines the essential components for robust adaptive systems, including: dynamic user profiling to create a rich, continuously updated understanding of a student's learning patterns; generative AI models for the real-time creation and modification of educational content; immediate and constructive feedback mechanisms; and longitudinal progress monitoring to inform educators and guide long-term learning trajectories. The article concludes that while AI offers powerful tools to build more inclusive and equitable educational environments, its potential can only be realized through responsible and ethical implementation. The development process must be guided by a firm commitment to mitigating algorithmic bias, ensuring transparency and explainability in AI-driven decisions, establishing clear lines of accountability, and upholding robust data privacy standards. Ultimately, the successful integration of these advanced technologies depends on a foundation of ethical principles and human oversight to ensure fair and effective support for all students.

Keywords

Artificial Intelligence, Special Education, Assistive Technology, Students with Disabilities, Personalized Learning, Educational Technology, Ethical AI

1. Introduction

Educational settings present numerous difficulties for students with disabilities. Standardized curriculums often fail to account for different learning paces and styles of processing information. Classroom instruction frequently assumes a

uniform level of background knowledge among all students. This approach can leave many learners behind. Physical barriers in schools, such as inaccessible infrastructure, can also impede a student's ability to participate fully in the learning

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Received: 4 October 2025; **Accepted:** 14 October 2025; **Published:** 31 October 2025



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environment. Social interactions may be confusing or hard to navigate, leading to feelings of isolation. These combined challenges mean that students with disabilities are often at a disadvantage in a traditional classroom setup. Teachers, despite their best efforts, may not always have the specific tools or training needed to provide tailored support for every student's individual requirements. A one-size-fits-all model of education is insufficient. The need for more personalized approaches is clear and urgent. This situation calls for new tools and methods to create more equitable learning opportunities.

Artificial intelligence offers a promising avenue for addressing these long-standing issues. AI can be used to develop learning technologies that are responsive to the user. These systems can move beyond a static curriculum. They can offer instruction and support that is shaped by the student's own actions and progress. This represents a move away from generalized teaching methods toward highly individualized educational experiences. Specific technologies like machine learning and natural language processing are central to this development. Machine learning algorithms can analyze patterns in a student's learning data to identify areas where they are struggling or excelling. Natural language processing allows for more fluid and natural interactions between the student and the learning system [13]. These technologies are not merely digital versions of old teaching tools. They make possible entirely new ways of presenting information and supporting the learning process. The purpose of this article is to examine the development of these AI-driven technologies. It will detail their potential applications for students with disabilities. It will also carefully consider the critical ethical questions that must be addressed during their creation and implementation.

The movement toward individualized educational experiences is part of a larger paradigm shift towards "precision education," which leverages machine learning and analytics to enhance both teaching quality and learning effectiveness. A core principle of precision education is the early identification of at-risk students and the provision of timely, targeted interventions. This approach moves beyond simple personalization to encompass diagnosis, prediction, and prevention of learning difficulties [5]. For students with disabilities, this means that AI systems should not only adapt to their current performance but also anticipate challenges and provide proactive support, thereby augmenting human intelligence with machine intelligence to serve the welfare of the learner.

The necessity for such advanced support is rooted in the unique cognitive models of students with significant disabilities. Foundational research highlights that these students may face specific challenges in areas like working memory, metacognition, and the transfer of knowledge to new contexts [16]. For example, limitations in working memory can be mitigated by instructional strategies that "chunk" information into smaller, more manageable segments. An adaptive AI can implement this strategy dynamically, breaking down complex

topics in real-time. Similarly, AI can foster metacognition, or "thinking about thinking", by prompting students to self-evaluate and use explicit problem-solving steps, thus making their cognitive processes more visible and manageable [16]. By grounding AI development in these cognitive principles, we can create tools that address the foundational barriers to learning, not just the surface-level symptoms.

2. Statement of the Problem

The central problem is that conventional educational models are frequently ill-equipped to meet the diverse and specific needs of students with disabilities. These models are often rigid. They depend on a standardized curriculum and a uniform pace of instruction that does not serve every student well [25]. For learners with disabilities, this rigidity can create significant barriers to education. Difficulties may arise from many sources, including physical, sensory, cognitive, or social challenges. A traditional classroom environment can be overstimulating for some, while for others, the mode of instruction may not align with how they process information. The expectation that all students will learn the same material in the same way and in the same amount of time is a foundational flaw. This approach overlooks the reality of human diversity in learning. It results in an educational system that is not built for a substantial portion of the student population, creating an environment where many are unable to reach their full potential.

This is a critical issue because it leads to a persistent and measurable gap in learning outcomes between students with disabilities and their non-disabled peers. Research has shown that, on average, students with disabilities perform significantly below their peers on key academic measures. This achievement gap is not a reflection of the students' capabilities. It is a result of an educational system that often fails to provide them with the necessary conditions and support to succeed. This disparity has long-term consequences, affecting graduation rates, opportunities for higher education, and future employment. The failure to provide an appropriate education for all students perpetuates social and economic inequities. Addressing this gap is not just an educational goal. It is a matter of civil rights and social justice. All students deserve the opportunity to learn and develop their skills in a supportive environment.

Current assistive technologies that are not driven by AI, while helpful, have considerable limitations. Tools like text-to-speech software, digital recorders, or graphic organizers provide valuable support for specific tasks. However, they are typically static. They perform a set function and do not change their behavior based on the student's progress or changing needs. A text-to-speech program will read text aloud, but it does not know if the student is understanding the material. A digital graphic organizer can help structure ideas, but it cannot offer feedback on the quality of those ideas. These tools often require a teacher or another expert to identify the

need, select the right tool, and configure it for the student. This reliance on manual intervention makes them less dynamic. There is often a significant distance between the potential of these technologies and their actual benefit in a classroom setting, due to factors like inadequate training and insufficient planning [6]. They act as aids but do not create a truly interactive and responsive learning environment.

The static nature of many current assistive tools stands in stark contrast to the dynamic needs of learners with disabilities. Traditionally, support has often come in the form of low-tech, non-adaptive prompts like picture books or paper checklists designed to guide students through daily living or academic tasks. While beneficial, these tools lack the ability to adapt as a learner gains proficiency [8]. The promise of AI is to transform this model by creating technology-mediated self-prompting systems. For example, a student learning a vocational skill could receive prompts from a smartphone app; as they master each step, the AI could gradually fade the prompts, reducing their intrusiveness and fostering greater independence. Research has shown that such interventions are effective for improving proficiency across a range of skills and settings [8]. The core problem, therefore, is not just the absence of technology but the absence of *intelligent* technology that can provide a scaffolded path toward autonomy.

This brings the core issue of this article into focus: the urgent need for more dynamic and truly individualized learning systems. The limitations of both traditional teaching methods and static assistive technologies highlight a clear deficiency. What is required are systems that can assess a student's needs in real time. These systems should provide customized content and feedback. They must be able to modify the presentation of material, the pace of instruction, and the type of support offered based on a continuous flow of information about the student's performance and engagement. The goal is to move from providing simple accommodations to creating a learning environment that is built around the individual student from the ground up. This requires a new generation of educational technology, one that uses the power of artificial intelligence to offer a level of personalization that was previously not possible. The development of such systems is the primary subject of this work.

3. Research Questions

This article is structured around a set of core inquiries designed to examine the creation and application of AI-driven learning technologies for students with disabilities. The investigation seeks to provide a clear picture of the possibilities and the associated responsibilities. The first central question addresses the fundamental mechanics of these systems. How can AI be used to create learning materials that adjust to the specific needs of students with different disabilities? This question looks at the technical processes involved in generating and modifying educational content in real time. The second question concerns the real-world effects of these

technologies on the learners themselves. What are the effects of these AI-driven systems on student engagement and learning outcomes for this population? This inquiry moves from the technical design to the educational impact, seeking to understand if these tools genuinely improve the learning experience. The final question confronts the critical societal and individual safeguards that must be in place. What are the ethical considerations that must be addressed when creating and using these technologies? [1]. This question explores the necessary principles to guide development and deployment, ensuring these systems are used responsibly.

4. Methodology

The approach of this article is conceptual, combining a systematic review of existing literature with the proposal of a new framework for development. This method was chosen because the field is still emerging, and a strong theoretical and practical foundation is needed before large-scale empirical studies can be effectively conducted. The work first gathers and synthesizes current knowledge from multiple disciplines. It then uses this foundation to build a structured, actionable guide for researchers, developers, and educators. The goal is to provide a coherent picture of the current state of the field and to offer a clear path forward for future work. This approach allows for a thorough treatment of the technical, pedagogical, and ethical dimensions of the topic in a single, unified discussion. The result is not just a summary of what has been done, but a carefully constructed argument for how it should be done in the future.

The initial phase of this work involved a systematic literature review to identify relevant scholarly and technical publications.

The process was designed to be broad and inclusive of various fields. Digital libraries and databases such as IEEE Xplore, the ACM Digital Library, Google Scholar, and PubMed were searched extensively. Search terms included combinations of "artificial intelligence," "special education," "assistive technology," "disability," and "machine learning." The criteria for including studies were specific. All included works were peer-reviewed articles or conference papers published within the last fifteen years to ensure currency, following guidelines similar to the PRISMA 2020 statement [21]. The studies had to focus directly on the application of AI technologies for students with diagnosed physical, cognitive, sensory, or learning disabilities. General papers on AI in education without a specific focus on this population were excluded. This process of careful selection ensures that the arguments presented in this article are based on a solid body of recent and relevant research, reflecting current thinking and evidence in the field.

The main contribution of this article is a proposed framework for the development of these specialized AI technologies. This framework is intended to serve as a guide for creating systems that are effective, ethical, and centered on the student.

It is composed of several interconnected components, each addressing a critical aspect of the system's design and function. The first component is dynamic user profiling. This goes beyond a static label of a disability. It involves creating a detailed and continuously updated profile of each student's learning patterns, strengths, and specific areas of difficulty. This profile is the foundation upon which all personalization is built. The second component is generative AI models for content creation. These models would use the student's profile to produce or modify learning materials on the fly. This could mean simplifying text, generating visual aids, creating audio descriptions, or designing unique practice exercises tailored to the student's current level of understanding. A third component is the implementation of immediate and constructive feedback mechanisms. The system would be designed to identify a student's errors or misconceptions in real time and provide targeted hints or alternative explanations, guiding them toward a correct understanding. The final component is longitudinal progress monitoring. The system would collect and analyze data over time to track a student's development, identify long-term trends, and provide educators with detailed reports to inform their teaching strategies [7].

To make the concept of *Dynamic User Profiling* more concrete, consider how AI systems analyze learning behaviors in online environments. Researchers have successfully used deep neural network models to predict student learning outcomes based on behaviors such as how they interact with course videos. By tracking metrics like video completion rates, time spent on videos, frequency of pauses or replays, and the regularity of study sessions, the AI can build a rich, data-driven profile of a student's engagement and comprehension [17]. Applying this to special education, an AI could identify a student who repeatedly rewinds a specific segment of a science lecture, flagging the underlying concept as a potential area of difficulty. This behavioral data is far more nuanced than a simple quiz score and allows the system to make proactive adjustments to the learning path long before a formal assessment reveals a problem [17].

Similarly, the capabilities of *Generative AI Models for Content Creation* can be illustrated through research-based strategies for adapting video content for students with intellectual disabilities. Instead of just simplifying text, a generative AI could implement a suite of proven multimedia adaptations. This includes *video "chunking"*, where longer videos are broken into shorter, more focused segments to reduce cognitive load. The AI could also provide *alternative narration*, replacing complex vocabulary and sentence structures with simpler language while preserving the core information. Furthermore, it could generate various forms of *captioning*, such as highlighting key text as it is spoken or adding picture symbols to support nonreaders [9]. Finally, the AI could embed *interactive features*, allowing students to pause the video and search for answers to comprehension questions, a technique that has been shown to significantly improve both factual and inferential understanding [10]. These specific, evidence-based adaptations demon-

strate how generative AI can move beyond simple text generation to become a powerful tool for creating accessible and effective multimedia instruction.

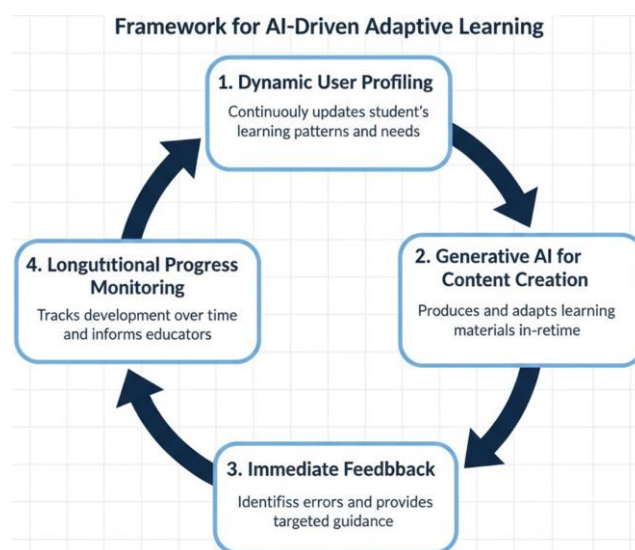


Figure 1. The proposed cyclical framework for developing adaptive AI learning technologies. The system continuously refines its understanding of the student to personalize content, provide feedback, and monitor long-term progress.

To operate effectively, the proposed framework would depend on the collection and analysis of specific kinds of data. The system's ability to provide individualized support is directly tied to the quality and richness of the information it receives. Primary among these data types are student interaction patterns. This includes information such as the time a student spends on a particular task, the number of attempts made to answer a question, the features of the software they use most frequently, and the paths they take through the learning materials. Performance metrics are also crucial. These include traditional measures like scores on quizzes and assignments, but also more fine-grained data like accuracy rates on specific types of problems or the speed of completion. In some highly specialized applications, the system might also incorporate data from other sources, such as eye-tracking technology to understand a student's reading patterns or speech recognition to analyze verbal responses [3]. The careful collection and use of this data are what would allow the AI to make informed decisions and truly respond to the individual learner. However, the gathering of such detailed personal information makes the ethical considerations of data privacy and security of utmost importance.

5. AI-Driven Learning Systems for Diverse Needs

The creation of individualized learning trajectories is a central function of advanced AI in education. Machine learning

algorithms are designed to analyze vast amounts of data related to a student's performance. They track correct and incorrect answers. They monitor the time taken to complete tasks. They record the types of hints or support materials a student uses. This continuous analysis allows the system to build a detailed model of the student's current knowledge and skills. Based on this model, the AI can construct a unique path through the curriculum for that learner. If a student masters a concept quickly, the system can introduce more advanced topics. If a student is struggling, the system can provide additional practice, background information, or present the material in a different way. This stands in sharp contrast to a fixed curriculum where all students proceed at the same pace. A key application of this approach is found in intelligent tutoring systems. These systems provide customized instruction and immediate feedback on a student's work, acting much like a human tutor [19]. The difficulty of tasks can be adjusted in real time, moment by moment. This ensures the student is consistently challenged but not overwhelmed, creating conditions suitable for steady learning and building confidence.

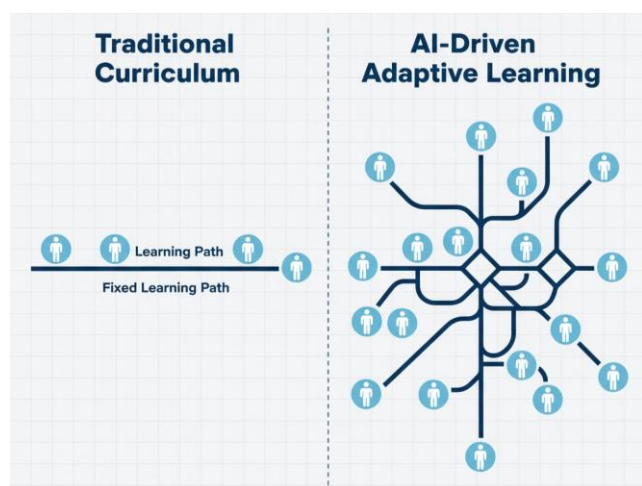


Figure 2. A comparison of a rigid, traditional learning path versus a flexible, AI-driven adaptive path. The adaptive model provides individualized routes through the curriculum based on student performance and needs.

Beyond adjusting the curriculum, AI systems must also address the affective and motivational factors that are critical to learning, especially for students who have experienced repeated academic failure. Many students in remedial settings suffer from math anxiety, task avoidance, and a lack of motivation, which are often overlooked in system design [15]. To address this, AI can be embodied in Virtual Change Agents (VCAs)—animated, human-like characters designed to provide emotional and motivational scaffolding. These agents can interact with students to regulate emotions and promote a positive mindset. For instance, if a student is struggling with a difficult problem, a VCA might initiate a dialogue, acknowledge the student's frustration as a normal part of

learning, and offer strategies for managing anxiety or reappraising the task's value [15]. By providing this automated, dynamic, and personalized affective support, AI can help create a learning environment where students feel understood and are better equipped to persist through challenges.

For students who are deaf or hard of hearing, a key barrier is accessing spoken information in real-time. AI-powered Intelligent Speech Recognition (ISR) offers a transformative solution. Advanced ISR systems can provide highly accurate, realtime transcription of classroom lectures and discussions, displaying the text on personal mobile devices or large smart blackboards [26]. This technology directly enhances teaching presence by ensuring students do not miss critical information and cognitive presence by allowing them to more easily process and understand abstract concepts. Furthermore, by making communication more seamless, ISR can significantly improve social presence, reducing feelings of isolation and enabling hearing-impaired students to participate more fully in classroom interactions [26]. This application demonstrates how AI can directly dismantle specific sensory barriers to create a more inclusive and effective learning experience.

For students with autism spectrum disorder, a primary challenge often lies in developing social-communication skills. AI-powered social robots and chatbots are emerging as powerful tools in this domain. These systems can provide a predictable and non-judgmental environment where students can practice social interactions, such as turn-taking in conversations or interpreting emotional cues [5].

A social robot might be programmed to model appropriate greetings or engage in simple, structured dialogues, providing immediate and consistent feedback. Because these AI agents can be patient and repetitive, they offer a safe space for learners to build foundational social skills at their own pace. This practice can lead to improved confidence and better generalization of these skills to interactions with human peers and teachers [2, 5]. Beyond creating custom learning paths, artificial intelligence can power a new generation of assistive technologies specifically designed for students with certain disabilities. These tools are not static aids but active participants in the learning process. For students with visual impairments, AI offers functions that go far beyond simple screen readers. New text-to-speech systems use more natural-sounding voices, making long periods of listening less fatiguing. Object recognition tools, often using a smartphone's camera, can identify and describe objects, text, and even people in the student's physical environment, providing a richer sense of their surroundings [11]. For students who are deaf or hard of hearing, AI-driven speech-to-text transcription can provide a real-time written record of classroom lectures and discussions. These systems are becoming increasingly accurate, capturing spoken language with a high degree of fidelity [22]. Students with learning disabilities such as dyslexia can also find support from AI. There are tools that can help with reading by highlighting text as it is read aloud or by altering fonts and spacing

to improve readability. For writing, AI can assist with spelling, grammar, and organizing thoughts, allowing students to focus on their ideas without getting stuck on the mechanics of composition [23]. These technologies help to lower specific barriers to accessing information and expressing knowledge.

AI-Powered Assistive Tools for Diverse Learners		
Disability	AI-Driven Support	Benefits
 Visual Impairment	Object Recongition Natural Text-to-Speech	Enhanced Navigation Access to Information
 Hearing Impairment	Real-Time Speech-to-Text	Improved Communication
 Learning/Cognitive Disability	Adaptive Reading Aids AI Writing Assistants	Enhanced Comprehestion Academic Assistance

Figure 3. Examples of specialized AI-driven assistive technologies that address specific barriers faced by students with different types of disabilities.

Difficulties with communication and social interaction present another area where AI systems can offer support. For students with communication disorders or those on the autism spectrum, navigating social situations can be a source of great anxiety. AI-powered applications can provide a controlled and predictable environment for practicing these skills. This could take the form of AI companions or conversational agents. These agents can be programmed to model appropriate social cues, such as turn-taking in conversation or understanding facial expressions. A student can interact with the AI agent without the fear of social judgment, allowing them to practice and build confidence at their own pace [2]. The system can provide simple, direct feedback on the interaction, helping the student to understand the unwritten rules of social exchange. The goal of such tools is not to replace human interaction. It is to provide a safe and repeatable training ground where foundational social skills can be developed, making real-world interactions less daunting. The development of these powerful systems requires a serious examination of the ethical questions that arise. One of the biggest challenges is grappling with the issue of fairness. AI systems learn from data, and if the data used to train them contains existing societal biases, the system will reproduce and may even worsen those biases. The data might underrepresent students with certain types of disabilities or reflect lower expectations for their academic performance. This could lead

to an AI tutor that offers less challenging material to a student with a disability, limiting their educational growth based on a prejudiced pattern in the training data [4, 20]. Working to remove this bias is a critical task. It requires careful selection and cleaning of training data. It also demands the creation of testing and validation procedures specifically designed to detect and measure unfair outcomes across different student groups. Developers must be proactive in their search for potential biases and transparent about their methods for addressing them.

Things get complicated when the inner workings of AI systems are not clear. Many advanced machine learning models operate as 'black boxes', meaning that even their creators cannot fully explain why the system made a particular decision. This lack of transparency is a major problem in an educational context. An educator or a parent has a right to know why a learning system has placed a student on a particular learning path or why it has assessed their work in a certain way [12]. If a student is consistently being marked as incorrect, but the human teacher cannot understand the AI's logic, it is impossible to know if the system is genuinely helping or if it is malfunctioning. The need for explainable AI is therefore very high in this area. Systems should be designed so that their decisions can be reviewed and understood by the people responsible for the student's education. This might mean choosing simpler models over more complex ones or building specific features into the system that allow it to report on its own decision-making process.

Finally, it is really about grappling with who is responsible when an AI tool makes a mistake. The question of accountability is central to the responsible use of AI in special education. If an AI learning system provides incorrect information to a student, or if its biased operation leads to a negative educational outcome, who is at fault? Is it the software developer who created the code? Is it the school district that purchased the system? Is it the teacher who chose to use it in their classroom? Without clear lines of responsibility, students are left unprotected. Establishing a framework for accountability is a necessary step before these technologies are widely deployed. This involves creating clear regulations and standards for AI educational tools. It also requires that school systems develop explicit policies regarding the use of AI, including procedures for what to do when a system appears to be failing a student [18]. Human oversight must always be a part of the process. Teachers and administrators must have the final say and the ability to override the system's recommendations.

The use of AI in this context also requires the collection and analysis of large amounts of highly sensitive student data. This information, which can include everything from test scores to moment-to-moment interaction patterns, is essential for the system to function. However, its collection raises serious data privacy and security concerns. This data must be protected from unauthorized access and misuse. Strong measures are needed to safeguard student information. All data should be anonymized or de-identified whenever possi-

ble, removing personal identifiers so that the information cannot be linked back to an individual student. The data must be stored on secure servers with robust encryption both in transit and at rest [14]. Schools and developers must have clear data governance policies that specify who has access to the data, for what purposes, and for how long the data will be

retained. Parents and students should be given clear information about what data is being collected and how it will be used, and they should have the right to consent to its collection. Without these protections, the use of AI in education could put students at risk, undermining the very trust that is necessary for these systems to be effective.

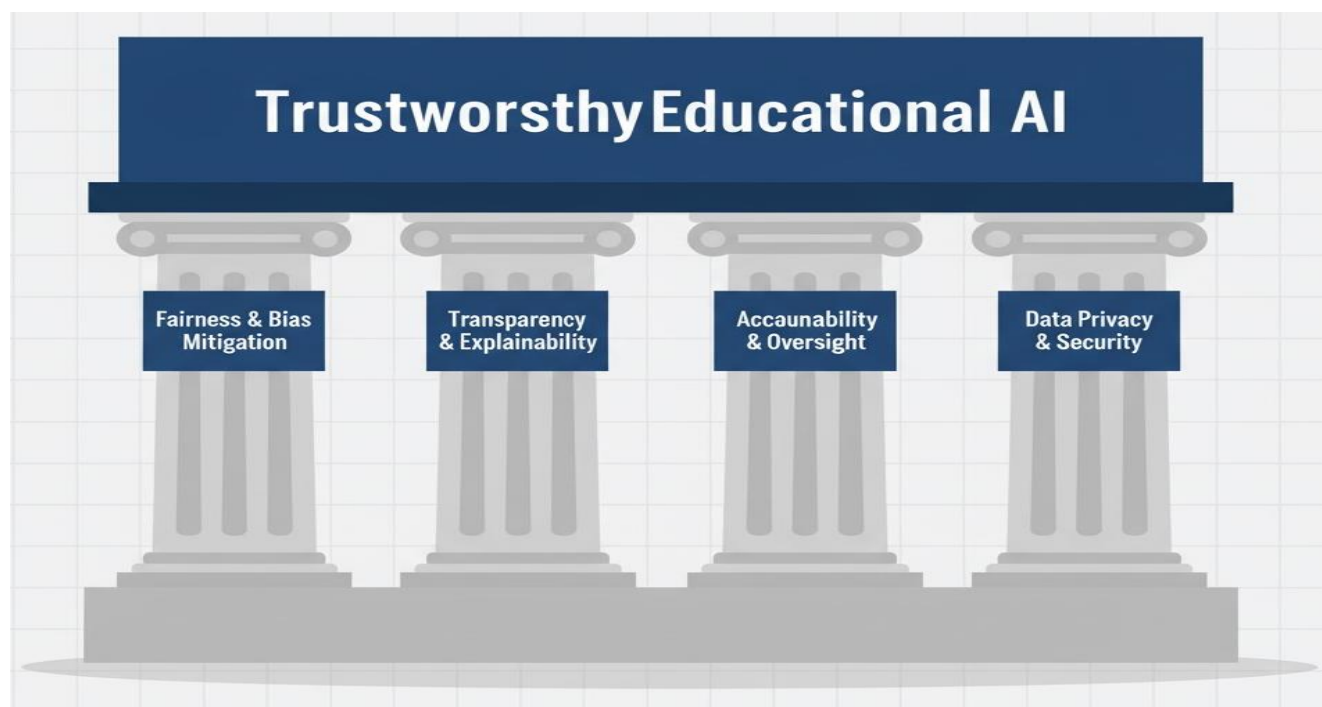


Figure 4. The foundational ethical pillars required to build trustworthy and responsible AI systems for use in special education. The failure to uphold any one of these pillars compromises the entire structure.

6. Conclusion

This article has examined the development of learning technologies using artificial intelligence for students with disabilities. It began by outlining the central problem. Traditional educational models, with their standardized curricula and uniform instructional pace, often fail to provide the necessary support for learners with diverse needs. This systemic issue results in a persistent gap in academic outcomes. The proposed solution involves the creation of AI-driven systems capable of offering highly individualized educational experiences. The discussion reviewed the key benefits of this approach. These systems can construct personalized learning paths, adjusting the difficulty and presentation of material in real time. They can also power a new generation of assistive tools, from advanced text-to-speech services to real-time transcription, directly addressing specific barriers to learning. The potential to support the development of communication and social skills was also noted. However, the creation of these tools is accompanied by serious challenges. The ethical dimensions of fairness, transparency, and accountability must

be at the forefront of the development process. The risk of algorithmic bias, the problem of 'black box' systems, and the question of responsibility for AI-driven errors are substantial hurdles. The critical need for robust data privacy and security measures to protect sensitive student information was also a primary point of discussion. Artificial intelligence holds great promise for building more inclusive and effective learning environments. Its ultimate success, however, is not a matter of technical capability alone. It depends on a firm commitment to responsible design and ethical implementation to ensure these powerful tools serve all students justly.

7. Future Directions

Looking ahead, several areas require further work to ensure the successful and equitable integration of these technologies into educational practice. The most pressing need is for more longitudinal research. While many studies demonstrate the short-term benefits of specific AI tools, there is a lack of long-term studies that track the effects on student learning, engagement, and well-being over multiple years. Rigorous, long-term research is needed to understand the sustained

impact of these systems on academic achievement and the development of self-directed learning skills. Researchers should investigate how interactions with these systems affect students' confidence and their relationships with teachers and peers over time. Such studies would provide the solid evidence base that school districts and policymakers need to make informed decisions about adopting these technologies.

Progress in this field will also depend on greater interdisciplinary collaboration. The creation of effective educational AI is not solely a task for computer scientists. It requires the active partnership of educators, special education specialists, disability advocates, cognitive scientists, and ethicists. Educators bring an essential understanding of pedagogy and the day-to-day realities of the classroom. Computer scientists provide the technical skill to build the systems. Policymakers must create the regulatory frameworks that ensure safety and accountability. This collaborative approach ensures that the technologies are not only technically sophisticated but also pedagogically sound, ethically responsible, and aligned with the actual needs of students with disabilities. Workshops, joint research projects, and integrated design teams are all avenues for building these necessary collaborations.

This interdisciplinary approach should be formalized within a Human-Centered AI (HCAI) framework for education. The goal of HCAI is to design systems that augment, rather than replace, human capabilities and align with human values [5]. Future research should therefore focus not just on the technical performance of AI models but on the quality of the human-AI interaction. This requires close collaboration among AI engineers, educational psychologists, sociologists, and designers to build systems that are technologically sound, pedagogically innovative, and sensitive to learners' diverse social and emotional needs. A key direction will be exploring "co-learning," where humans learn to interact with and teach the AI, and the AI, in turn, learns to better explain its reasoning to its human partners [5]. This symbiotic relationship is the future of truly effective and ethical educational AI.

Finally, the practical issues of scalability and cost must be addressed to prevent these advanced tools from worsening educational inequality. A significant danger is that these technologies will only be available to wealthy, well-resourced schools, creating a new form of digital divide. Future development should focus on creating solutions that are not only effective but also affordable and easy to implement in a variety of educational settings. This might involve the use of open-source software, the development of platforms that can run on less expensive hardware, and the creation of clear and accessible training materials for teachers. Without a conscious effort to ensure broad and equitable access, there is a risk that the students who could benefit most from these technologies will be the ones with the least opportunity to use them [24]. The goal must be to make these powerful tools available to every student who needs them, regardless of their school's budget or location.

Abbreviations

AI	Artificial Intelligence
HCAI	Human-Centered AI
HLEG	High-Level Expert Group on Artificial Intelligence
ISR	Intelligent Speech Recognition
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
VCAs	Virtual Change Agents

Author Contributions

Mohammed Zeinu Hassen is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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Biography



Mohammed Zeinu Hassen is a researcher at the Department of Social Sciences at Addis Ababa Science and Technology University, where his work focuses on the intersection of technology, education, and social equity. He specializes in the application of Artificial Intelligence to develop

adaptive and assistive technologies for students with disabilities. A central theme in his research is the ethical and responsible implementation of AI in educational settings. He addresses the critical need to move beyond one-size-fits-all educational models, advocating for personalized learning systems that can adapt to the diverse needs of learners. Hassen's work emphasizes the importance of building trustworthy AI frameworks that proactively mitigate algorithmic bias, ensure data privacy, and maintain human oversight. Through his research, he proposes systematic approaches for developing technologies that are not only innovative but also inclusive, aiming to close the achievement gap and create more equitable learning opportunities for all students.

Research Field

Mohammed Zeinu Hassen: Artificial Intelligence, Special Education, Assistive Technology, Students with Disabilities, Personalized Learning, Educational Technology, Ethical AI.