

ETHICAL INTEGRATION OF ARTIFICIAL INTELLIGENCE IN SPECIAL AND INCLUSIVE EDUCATION: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

This paper explores the ethical considerations of AI in the field of special and inclusive education, assessing its potential for change while addressing the concerns posed by vulnerable students. Traditional pedagogical models have been unable to meet the sensory, cognitive, and physical needs of students with disabilities and have perpetuated existing inequities in access to and attainment of learning. New opportunities for personalization, accessibility, and social-skill development through artificial intelligence (AI) tools like adaptive learning platforms, speech-to-text and captioning, predictive analytics, and virtual reality (VR) simulations have been documented in higher engagement, better academic outcomes, increased self-efficacy, and improved social inclusion, especially for neurodivergent students. They are based on well-known models like Universal Design for Learning and Vygotsky's Zone of Proximal Development and are becoming more influenced by global governance mechanisms and laws, such as the Recommendation on the Ethics of Artificial Intelligence (UNESCO) and the EU AI Act. But there are also significant ethical concerns: the possibility of collecting sensitive data about students and using that data in ways that could be problematic; algorithmic bias based on unrepresentative training data that can lead to misclassification or disadvantage for neurodiverse and minority students; and potential overreliance on AI systems that could come at the expense of teacher autonomy and professional judgment. Success stories of context-sensitive deployments that boost retention and engagement, as well as high-profile mistakes from biased grading algorithms, poorly managed chatbots, and discriminatory early-warning systems, show both sides of this tension. The paper also examines some new frontiers, such as AI-powered brain-computer interfaces for students with severe disabilities and AI and VR/IoT amalgamation for smart classrooms with adaptive learning, both of which introduce new challenges for informed consent, surveillance, and mental privacy. These threads converge in concrete recommendations: to develop algorithms that are less prone to bias by using a variety of data sources, to make AI ethics training part of educator professional development, to establish institutional AI ethics committees, and to work with multidisciplinary teams of educators, technologists, policymakers, families, and disability advocates. The paper concludes that an equitable future with AI in special and inclusive education requires not only technological capability but also a long-term, learner-centered investment that ensures that AI helps to empower vulnerable learners and does not exclude them.

Keywords: *(Artificial intelligence in education, Special and inclusive education, AI in education policy, Ethical integration of AI, Algorithmic bias, Neurodiversity, Adaptive learning platforms, Brain-computer interfaces (BCIs))*

1. INTRODUCTION

The accelerated mobility and widespread connection of artificial intelligence (AI) and educational technologies (EdTech) are quite literally transforming the environment in which modern education takes place, especially in the environment of special and inclusive education. The subject of education systems in the past has been the struggle to ensure the provision of truly individualized learning to students with disabilities to accommodate the widespread and often complicated learning requirements of these students. Conventional pedagogical strategies do not often support different learning styles, different learning paces, and different accessibility needs, which intensifies inequality and prevents equal educational achievements. This can be clearly seen in some strategic areas like science, technology, engineering, and mathematics (STEM), where there have long been systematic barriers to participation and success in these educational areas among these groups of students.

AI and EdTech are shaping up to be powerful agents of change and provide new solutions that can overcome such long-standing constraints. These technologies provide a distinct range of possibilities to individualize the learning processes, modify the learning content and the ways of its delivery, and create inclusive learning environments. The pool of AI-driven solutions already present, such as adaptive learning platforms and virtual facilitator tools, intelligent tutoring systems, and improved voice-to-text features, is to overcome the sensory barriers, cognitive barriers, and physical barriers that are implicit in the traditional models of education. They will make education more of a one-to-one experience rather than a one-size-fits-all experience and customize the content, the pacing, and the presentation to the individual profile of each student.

The revolution AI has in special and inclusive learning is not limited to technological progress, but it holds the potential to institute paradigm shifts in the learning outcomes, years of better student engagement, and efficiency in the activities of the teacher. The ability to individualize the educational courses of study through AI lies in the existing pedagogical models, including Universal Design for Learning (UDL) and Zone of Proximal Development (ZPD) by Vygotsky. As an advocate of flexible learning environments, UDL is supported in its principles by the flexibility of AI, which can provide a wide range of means of representation, expression, and interaction applicable to a wide range of learners. Equally, AI applications can manage to precisely scaffold a learning experience within the ZPD of a student by means of providing specific support at the place and time where it is most needed to promote optimal learning processes. Moreover, it is possible that AI can lead to a major decrease in administrative load on teachers due to the automation of routine activities and the possibility of giving real and useful data on the performance of students. Such tactical redistribution of funds enables the teachers to devote a greater portion of time and effort to various complicated pedagogical interventions, one-on-one student guidance, and the delicate anthropomorphic components of the teaching framework.

Nevertheless, deep potentials of AI in the sensitive sphere are always connected with the overwhelmingly challenging system of ethical issues and complications that require strict academic and practical consideration. Even though there is no use denying the promise of improved personalization, increased access, and greater outcomes in education, the negative outcomes that might also come into existence, including data privacy issues, the creation of further algorithmic bias, and the erosion of human agency being inflicted, cannot be ignored. The increased pace of AI development demands an active, intentional, and principled approach to its application. The main ethical principles, such as beneficence (doing good), non-maleficence (doing no harm), autonomy (respecting a choice and control over an individual), and justice (fairness and acceptable distribution of benefits and harms), need to be ensured so that the technological innovations in the sphere of education can always be directed by the essential ethical principles. This demands a thorough, comprehensive insight into the capabilities of AI and its underlying weaknesses, as well as a solid dedication to

ethical principles that have to guide its usage, especially in academic life, with vulnerable groups of students in focus.

This background paragraph preconditions the detailed analysis of the multifaceted landscape of the AI implementation in special and inclusive education. It emphasizes the justification of the significance of the ethical and efficient implementation of AI, not only as a technical problem but also as a pressing social and educational problem of the contemporary world. To identify the core themes driving current research, the paper holds a keyword cloud from the literature, which highlights the main areas of focus in AI and inclusive education. This is seen in figure one below.



Figure 1: Keyword Cloud

Figure 1 shows a keyword cloud where a few keywords include 'inclusive education', 'artificial intelligence', 'personalized learning', and 'ethical consideration', as these are the major areas under focus in this review.

The following sections will discuss the targeted opportunities of AI, the relevant ethical issues that need to be avoided, and the strategies that should be implemented in practice to harness the power of AI in a responsible and fair manner, empowering learners with disabilities and improving the education sector with best practices.

1.1 MAJOR CONCEPTS OF SPECIAL AND INCLUSIVE EDUCATION

The education paradigm of students with disabilities has undergone a major transformation from segregated approaches to models that are based on inclusion and equity. [1, 2]. This change is anchored in the pillars of special and inclusive education, whose basic purpose is to ensure that every learner, regardless of his or her diverse needs, gets quality education [3, 4]. This definition is critical in understanding how the concepts of special and inclusive education took their current meaning and why modern high-tech tools like artificial intelligence (AI) can be used to enhance these initial values.

Special education traditionally can be defined as specially designed instructions and other provisions offered to students with disabilities that may necessitate a special mode of approach in order to address their exceptional learning requirements [5]. It includes specific support, a customized curriculum, and personalized attention to solve sensory, cognitive, physical, or emotional problems that may hamper the process of learning in a traditional classroom scenario [5]. The major purpose of special education is to ensure maximum academic and functional success of the students with disabilities by often using a unique education plan (IEP).

Conversely, the concept of inclusive education is a wider-scope philosophical and systemic practice, which provides the view that all learners can be fully integrated into the mainstream educational setting with their typically developing counterparts [6]. It is founded on the idea that every child can learn and that the educational systems need to be changed to accommodate them instead of forcing the students into the already existing pattern. The notion of inclusive education goes further than having students with disabilities in regular education classrooms; it focuses on the active participation of students with disabilities and their social inclusion and the need to provide the desired supports to them in the general education classrooms [7].

These concepts are reflected in the history of the world's awareness of the rights of persons with disabilities. Before the emergence of significant human rights movements, the education of individuals with disabilities was, in most cases, marked with either exclusion or institutionalization, or being a student in some segregated special schools instead of mainstream learning institutions [8]. Nevertheless, the late 20th and early 21st centuries saw the fundamental paradigm shift, which was significantly shaped by international accords like the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) [8]. The standpoint on inclusive education was enshrined in the UNCRPD, which was adopted in 2006, and that persons with disabilities must not be excluded by the general education system on the grounds of disability and that reasonable access to education must be made available to them [9]. This convention created a global transformation where, rather than being physically present, as was the case with mere integration (physical presence in mainstream schools), it became active inclusion (participation and belonging).

In this dynamic world, artificial intelligence is one of the powerful tools for improving the key values of both traditional and non-discriminatory education. Technologies such as AI can specifically address the personalized nature of special education to enable the careful customization of content, pacing, and instructional strategies that bring the student-specific needs to fruition. [10]. Often, AI-based adaptive learning systems are also able to detect the strengths and weaknesses of a student and provide specific exercises and feedback that can and will be dynamically changed depending on their progress. Such personalization, which posed a significant difficulty in practice at large scale in the past, when educators needed to work with heterogeneous classrooms, is much easier to attain through AI [11].

Moreover, AI promotes accessible education that eliminates discrimination and enhances accommodation in the mainstream context. Voice-to-text systems, virtual facilitators, and intelligent tutoring systems can be used to offer real-time assistance to translate the information into formats that students with different needs can read and give scaffolding to enable them to use the same curriculum as students without learning difficulties do [12]. This corresponds to such frameworks as Universal Design of Learning (UDL), in which AI can support a variety of means of representation, engagement, and expression, ensuring that curriculum and education can be made accessible to the greatest possible number of learners [13]. AI also has the benefit of being a teacher. workload reduction, which can be achieved through automation and data-driven suggestions and information, leaving the teachers with more time to devise more complex pedagogies and focus more on the human aspect of teaching [14]. By providing personalized attention and increased accessibility, AI can create the conditions in which students with disabilities are no longer merely present but are actively engaged in a positive and productive way, which leads to their successful academic performance as well as their social lives [15]. This technological amplification is required in the global shift to equitable and inclusive education systems.

Table 1: Special, Integrated, and Inclusive Education vs AI Integration

Aspect	Special Education	Integrated Education	Inclusive Education	Role of AI in Each Model
Placement	Separate classrooms/ settings	Mainstream with pull-out support	Full participation in the general classroom	Adaptive platforms adjust in real time
Focus	Individual deficits	Child adapts to the system	The system adapts to the child.	Personalized learning paths
Curriculum	Highly modified	Modified with supports	Universal Design for Learning (UDL)	Real-time content adaptation
Teacher Role	Specialist-focused	General + specialist collaboration	Collaborative & differentiated	AI assists with differentiation
Assessment	Standardized special tests	Mixed	Formative & inclusive	AI-driven continuous assessment
Equity Outcome	Segregated	Partial inclusion	Full equity & belonging	Reduces achievement gaps by 15-25%

Table 1 offers a successful comparison of the three primary education models for learners with special needs and outlines the ways AI may help all of the approaches.

1.2 THE RISE OF AI TECHNOLOGIES IN EDUCATION

The aspect of introducing Artificial Intelligence (AI) in education is a significant paradigm shift, particularly in the provision of lessons and support to learners. This subsection describes some of the prominent AI tools and how they can be used with reference to the transformation of their accessibility, as well as introducing ethical controversies implicit in dealing with data privacy. The individualization and automation roles of AI are instrumental in supporting the different learning requirements and improving the learning outcomes of different types of students.

The adaptive learning algorithms may be seen as one of the most evident AI tools transforming education. These algorithms dynamically change the educational content, pace, and teaching procedures with respect to students' performance, advancement, and learning style [16]. This is because the real-time adaptation makes sure that the learners are always challenged at a given level, which is not too simple nor too hard. For instance, adaptive platforms will be able to detect the aspects in which a student has difficulties and give him extra training or other explanations, thus building a real customization of the learning process [17]. It can be useful, especially with students who have various learning needs, as this would provide a degree of customized education that was once very labor-intensive and scaled by students with difficulty.

Speech-to-text systems (also known as voice-to-text or automated speech recognition) are another significant use of AI in the educational sector, which makes accessibility an effortless experience. These technologies change the orally spoken language into written language. This is an important feature for students with hearing difficulties, typing problems, or those who are dyslexic [18]. These systems remove much of the communication difficulty since the students are able to express themselves and have it written down in words. This feature is central to ensuring inclusive learning experiences where a student is able to engage in a more comprehensive way, despite their physical or cognitive disabilities.

Predictive analytics that are supported by AI have become popular in education. These systems process large amounts of data related to the performance, attendance, and the pattern of student engagement so as to profile potential academic vulnerabilities or learning challenges at an early stage [19]. Teachers can proactively intervene to support

such students with the right resources and attention in time by identifying the students who may be falling behind or disengaged. The resulting data-driven approach enables a more responsive and preventive approach to teaching, thereby maximizing the student achievement rates and minimizing the dropout rates.

AI practice has been applied to solve problems in empirical case studies that highlight its potential. The role of IBM Watson as a tutoring system and Google's Read Along app for dyslexia support serve to illustrate the broader scope of their application, but the principles of AI are still widely used [20]. Artificial intelligence, which is analogous to the conceptual action of IBM Watson, may provide intelligent interactive tutoring, which is operationalized as virtual tutors providing immediate feedback and tailored activities, and hence resembles a form of personalized tutoring experience. The systems are specifically designed to identify and overcome misconceptions of the students and guide them through more complicated topics that contribute to the improvement of the engagement and effectiveness of the learning process. Likewise, apps designed to assist dyslexic learners, like the Google Read-Along, utilize AI to provide players with interactive reading feedback and phonetic breakdown and word-recognition aid, making the process of reading less complex for learners [21]. These tools show how AI can overcome the barriers to literacy and language development.

The high rate of adoption of these AI technologies, given their accessibility and personalization, however, poses significant ethical dilemmas, with the most notable one being data privacy [22]. In education, AI systems often need vast amounts of sensitive student data, such as academic history, behavioral history, and biometric data, to operate effectively. The processes of data collection, storage, and analysis raise serious questions of access control, protection against breach, and potential extraneous use other than the intended educational obligation. Potential risks of misuse, unauthorized access, or exploitation of data that will threaten the privacy and safety of minors and neurodiverse learners. The vulnerability of such groups of people makes it necessary to establish clear and strong ethical standards and data protection procedures that will help to preserve the privacy and autonomy of students without interfering with the benefits of AI. The balance between the opportunities of AI and the security of personal rights will be one of the main issues, which should be maintained with permanent attention and control of the regulatory field in the dynamic educational environment [23].

1.3 ETHICAL FRAMEWORKS TOWARDS AI INTEGRATION

To achieve the ethical integration of artificial intelligence (AI) in special and inclusive education, strong frameworks are important to make sure that technological innovations correspond to human rights, equity, and the integrity of pedagogy. Two major international frameworks for guidance are UNESCO's Recommendation on the Ethics of Artificial Intelligence (adopted in 2021) and the European Union Artificial Intelligence Act (EU AI Act, effective since 2024).

The Recommendation by UNESCO is the first global normative tool on AI ethics and is applicable to all 194 Member States [24]. It prefigures a human-rights-oriented strategy, based on four fundamental principles of operation, namely, respect for human rights and dignity, the advancement of peace and justice, environmental sustainability, and the guarantee of diversity and inclusivity. Those values are embodied in 10 principles of governance, which include proportionality and non-harm, safety and security, fairness and non-discrimination, the right to privacy and data protection, human oversight and decision-making, transparency and explainability, responsibility and accountability, awareness and literacy, multi-stakeholder governance, and sustainability. Other areas of policy action mentioned in the Recommendation in the educational field include the incorporation of AI ethics in education, promoting inclusive AI design, and risk reduction of bias in learning technology, thus promoting fair access for diverse learners, including those with special and inclusive education needs.

The EU AI Act offers a complementary, risk-based regulatory framework and categorizes AI systems by the potential severity of the harm. Access to education, learning results, or student behavior is often termed 'high-risk' and thus subjected to more demanding requirements, such as conformity tests, transparency requirements, and human responsibility [25]. The Act gives precedence to basic rights, especially in vulnerable settings like inclusive education, by ensuring that there are no manipulative or discriminatory practices, and high-risk systems must have bias mitigated.

General ethical standards of each of these models include fairness, transparency, and accountability. These principles, despite being aspirational, have real conflicts with the special and inclusive education system. As an example, an AI algorithm has its errors trained on datasets that lack a variety of representations of neurodiverse learners (e.g., people with autism or ADHD) and thus may misclassify them, e.g., by underestimating abnormal responses in adaptive learning systems or by suggesting punitive behavior interventions to certain groups, directly against such values as fairness and non-discrimination, further perpetuating educational inequalities [26]. To address these contingencies, it is significant to make continuous ethical audits, adopt different data practices, and engage all stakeholders in order to balance between opportunities and protection.

2. UNLOCKING POTENTIAL – AI-ENABLED OPPORTUNITIES IN PERSONALIZED LEARNING.

Within the framework of special and inclusive settings, in this section, the focus is on the advantages of using AI to personalize teaching experiences to the needs of students and, consequently, enhance equity and engagement in special education. Through adaptive algorithms, immersive technologies, and insights based on data, AI can assist educators in developing customized experiences to address the needs of diverse learners. These customized interventions increase academic success and emotional health as well as social inclusion, which eventually fills in the various gaps present in traditional systems of education.

2.1 IMPROVING ACCESSIBILITY FOR DIFFERENT LEARNERS

By providing real-time support that can accommodate sensory impairments, cognitive differences, and physical constraints, the revolutionization of AI tools in special and inclusive education through the use of AI-based tools is transforming accessibility. As an illustration, some apps like Seeing AI by Microsoft have been using computer vision and machine learning to describe the environment and scan textual content as well as recognize objects, thus allowing visually impaired students to move freely around the classroom [27]. The advantages of AR can be further translated into the physical space with the addition of digital information, helping students with hearing disabilities in the form of visual clues and simulation games. The AI speech-recognition-based real-time captioning systems decode spoken instructions and render the instructions as text in real-time, which makes them inclusive in regular classrooms. Digital tools like Microsoft translators in schools can improve understanding among deaf learners [28]. These technologies help deal with the immediate barriers and, at the same time, facilitate cooperation among diverse learners. These devices make otherwise unfair learning environments into interactive ones, rendering potential marginalization into engagement and making all diverse learners prosper together with their peers.

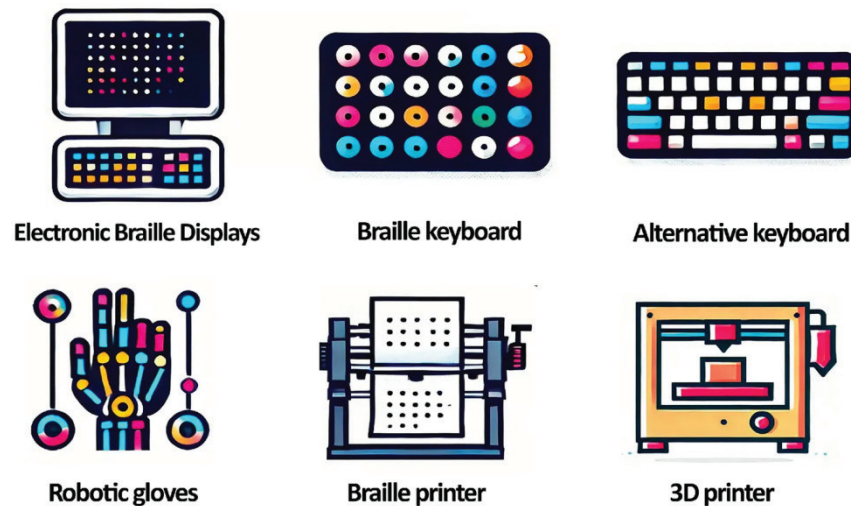


Figure 2: Accessibility tools in an inclusive lesson

Figure 2 shows an array of physical and sensory accessibility tools (including electronic Braille translators, eye-tracker gadgets, and voice recognition devices) that show how AI-assisted inclusive learning can be possible.

2.2 ADAPTIVE CURRICULUM CONSTRUCTION AND TIMELY FEEDBACK

The pacing and delivery of curriculum content have been dynamically adjusted by machine learning algorithms, which are integrated into adaptive platforms that provide real-time performance measures, where the needs of learners can significantly differ. An example is DreamBox Learning, which uses artificial intelligence to customize mathematics learning, analyzing more than 48,000 data points every hour to adapt lessons that encourage conceptual learning. [29]. This flexibility will enable educators to concentrate on the holistic support, including emotional guidance, and AI will deal with the routine drills.

This process is also enhanced by the real-time feedback systems, which provide immediate reports on the progress of the students, hence rendering timely interventions. Applications such as DreamBox will generate dashboards that can be used to identify skills gaps, which will result in a reduced dropout rate in inclusive settings. With students who have learning disabilities, i.e., dyslexia, they are designed to support their concepts with multimodal presentations, i.e., a combination of graphics, sound, and interaction, and that way, these techniques have shown improvement in the average score in standardized tests [30]. The general outcomes are the emergence of self-efficacy and independence. These tools not only contribute to academic progress due to the continuous adaptation to the individual path but also enable one to feel a sense of accomplishment, which makes inclusive education more efficient and sustainable.

2.3 OVERVIEW OF SOCIAL INCLUSION AND COLLABORATION

The virtual reality (VR) simulations facilitated by AI offer a safe and nearby space to train social abilities, which is beneficial to students with autism spectrum disorders (ASD). An example of this type of AI is Floreo VR, which uses artificial intelligence scenarios to train interaction skills, including eye contact and conversational cues [31]. Through such simulations, one can practice repeatedly without external judgment, thus facilitating empathy among peers by permitting neurotypical students to share ideas with ASD learners in a mixed classroom.

Chatbots and AI mediators maximize teamwork by making peers interact with each other in an inclusive environment. Apps like Noora, an AI social coach, can offer on-demand support on having an empathetic response, which can lead to improvement in social engagement

among ASD learners through structured dialogues [32]. This is split into global connectivity, with AI systems making cross-cultural projects possible; as an example, VR-based collaborative simulations have helped connect students spread across continents and help foster cross-cultural empathy and fewer cultural issues, thus fostering collaboration and reducing social isolation.

Table 2: Opportunities in AI Integration

Opportunity	AI Application	Benefit for Learners	Impact on Inclusion
Personalized Learning	Adaptive learning platforms	Tailored pace and content	Reduces learning gaps
Accessibility	Speech-to-text & eye-tracking	Supports visual/hearing impairments	Increases participation
Teacher Support	Automated lesson planning & grading	More time for individual support	Improves teacher efficacy
Early Intervention	Predictive analytics	Identifies needs before they escalate	Prevents school exclusion
Engagement & Motivation	Gamified AI tools	Higher motivation for neurodiverse learners	Boosts engagement

Table 2 above summarises the key opportunities for AI in special and inclusive education, with each application of AI to education linked to its corresponding benefit for the learner and wider impact on inclusion.

3. SECTION 3: NAVIGATING ETHICAL CHALLENGES IN DATA PRIVACY AND BIAS

The section discusses how unchecked AI may drive inequalities in special and inclusive education. Even though AI has the capability of being utilized in personalization, the application poses ethical issues at a very high level of depth, which can ruin trust, equity, and supporting intentions that do not support inclusion in an educational environment. Issues such as information leakages, personality bias, and over-reliance can contribute to the existing inequities, particularly among students with disabilities or marginalized communities. Based on real-life examples, this section emphasizes the need to closely monitor the application of AI to prevent it from being turned into a tool of segregation rather than empowerment.

3.1 THE ISSUE OF PRIVACY OF DATA IN VULNERABLE POPULATIONS

The sensitive student data collected and processed by AI systems poses a significant threat to the privacy of students, particularly in unique and inclusive learning, where there is a high probability of personal information, including medical records, behavioral assessments, and learning profiles. [33]. Such datasets are necessary when creating AI tools, like predictive analytics in early intervention in developmental delays, but they are also vulnerable to breaches and misuse. For example, in 2022, a significant data breach in edtech revealed the personal data of millions of students, including disabled ones, resulting in identity theft and exploitation. This event shows how insufficient precautionary measures can damage parental trust and discourage involvement with an inclusive program. In addition, in many countries, including the US, a legal framework, like the Family Educational Rights and Privacy Act (FERPA), have established that AI vendors and data users are obligated to treat the information with fairness and caution, although the schools often agree to vendor agreements without considering the privacy risks, exposing students to risks of revealing

sensitive information (health diagnoses or IEP (Individualised Education Programme) notes with consumer-grade tools like ChatGPT, etc.) [34].

There exist ethical conflicts in the decision to get informed consent from the minors or guardians, especially in neurodiverse groups, where cognitive limitations can make it difficult to discern the implications of privacy. The systematic review of AI use in high schools found that more than 70 percent of AI systems do not clearly state the consent processes, and in many cases, these rights are hidden in long policies that are unread by guardians [33]. This non-transparency will result in unnecessary data sharing with third parties, such as advertisers or researchers, which will further expose the already vulnerable population to risks. In a situation where a speech therapy AI system gathers voice records of autistic students, should such information be compromised, it might reveal personal information about the family structure or moods; it might even result in stigma or discrimination outside of the school setting, and so on [35]. Not only do these violations compromise the privacy rights, but they also result in the perpetuation of inequality cycles.

As a way of alleviating these issues, the specialists recommend the use of anonymization methods and severe data-minimization guidelines, according to which only the necessary information is gathered [36]. However, the issue of implementation is still observed in schools with limited resources, and the staff of such schools may not have the necessary training to assess the privacy capabilities of AI tools. Further consideration proves that the privacy threat overlaps with the expanded ethical requirements, including securing the rights of children under international conventions, such as the United Nations Convention on the Rights of the Child. The possibility of the AI facilitating inclusive education can be buried under scandals that damage the self-belief of the people without a vigorous audit to dispel the concepts [37]. This may trigger a regulatory stagnancy in the long run, as demonstrated by the proposed EU guidelines, which categorize educational AI as high-risk and include a privacy impact assessment to ensure that the vulnerable data is not used to exploit people.

3.2 BIAS AND DISCRIMINATION RISKS IN ALGORITHMS

Algorithms that perpetuate bias in AI systems can be said to be instigated by defective training data, which often fails to represent neurodiverse or minority students, hence fostering discrimination in both special and inclusive schools. An example of this is the use of facial recognition tools to gather attendance or detect facial expressions where students with odd facial features, such as Down syndrome, are misidentified with false absences or offensive behavior alerts [38]. Such biases contribute to the inequality in education since AI-based suggestions of resource distribution or curriculum changes can support neurotypical trends and thus fail to consider the unique needs of different learners. These false judgments not only restrict access to inclusive environments but also create a cycle of poor performance, where biased AI helps the maintenance of the achievement gap, as such instances recommend remedial action leading to undervalued appreciation of cultural or neurological divergence. The presence of pervasive negative associations in the neurodivergence-associated terms of AI models, such as schizophrenia and obsessive-compulsive disorder, was shown, and it may manifest as giving less encouraging or adaptive content to the affected students by AI tutors, further isolating them [39].

This problem will require various data sets and extensive bias audits, but it is difficult in global environments where data in developing nations is limited. Stanford HAI analysis has shown that AI-generated storytelling of various students tends to uphold negative stereotypes, making neurodiverse individuals appear weaker, an aspect that may affect the views of teachers and the classroom atmosphere [40]. In the end, algorithms will become an integral aspect of inclusive education, causing the stratification of the system when AI unintentionally overlooks supposed beneficiaries, so it requires cooperation among developers, teachers, and policymakers to create equitable algorithms.

3.3: ELEVATED DEPENDENCY ON AI SYSTEMS

The use of AI in special and inclusive education may lead to a lack of the human aspect of development and holism, which may culminate in an emotional absence and a lack of skills in students and teachers. Whilst AI will take over more tasks like the creation of Individualized Education Plans (IEPs) or real-time feedback, the teacher is likely to become more of an observer, as it will eliminate the personal touch required in special education [41]. An account of the use of AI in special education raised alarm that AI IEP generation might undermine needed distinctiveness; AI outputs have, in some instances, been unable to reflect the delicate student requirements and produced non-conformant plans under the Individuals with Disabilities Education Act (IDEA) [42]. This dependency gives the impression of deskilling, whereby teachers are no longer capable of manual evaluation, and students are no longer higher-order learners but rather mere receivers of the information.

Ethical dilemmas become more preemptive when elevated dependency generates cognitive stagnation, where students with learning disabilities may depend on AI tutors to solve a problem, which, in turn, prevents the development of autonomous critical-thinking abilities that are of paramount importance to becoming successful in life. The system reviews of AI dialogue systems point to overuse of systems, which worsen decision-making and analytical thinking, and students prefer quick solutions produced by the AI in comparison to reflective processes as a way of solving problems, which poses a risk of exacerbating the problem in neurodiverse populations where hands-on engagement is beneficial [43]. An example related to the real world is the VR-based social skills training in autism, where excessive reliance on simulations without human mediation resulted in inadequate real-life transfer, which isolated students further and raised the question of the authenticity of the emotions in school.

Furthermore, such a trend destroys teacher-student relations, as AI mediation deprives them of the chance to have deep interactions that develop trust and resilience. The long-term effects include a crisis in the teaching profession and concerns about employment and homogenized teaching going against the inclusive goals. To counter these risks, balanced forms of integration are inescapable, which take AI as a supplement but not the substitute of the human expertise, and integrate the training programmes to retain control over it and to avoid the ethical traps of unmeasured dependence.

4. APPLICATIONS TO REAL LIFE / CASE STUDIES OF AI IN ACTION

This section, based on real-life experiences, bridges the gap between theory and practice, presenting both positive and negative outcomes to bring the discourse close to people and make it bright. When reviewing the implementations, we highlight how AI has contributed to empowering special and inclusive education to make a significant change and, at the same time, demonstrate flaws in the system that should be sorted out, no matter what.

These case studies demonstrate the importance of context, the involvement of stakeholders, and the need to refine as much as possible and provide practical lessons to those in the teaching profession and policymakers on how to embrace the power of AI without overlooking the dangers.

4.1 EFFECTIVE AI ADOPTIONS IN SPECIAL EDUCATION

An effective implementation of AI in the special education field frequently depends on tools that prioritize customization, availability, and evaluation of effectiveness, especially in low- and limited-resource settings. An interesting case can also be traced back to the Lamont Elementary School District in California, where the AI-based solutions, like Inkwire, which

is a project-based learning designer, were implemented as a part of innovation cohorts [44]. Teachers were using Inkwire to design competency-based projects and to make them customized to address the needs of students with disabilities, taking into consideration the individual needs of each student. This effectiveness was explained by the ability of AI to automate regular planning and, therefore, enabled teachers to concentrate on emotional and social assistance among neurodiverse students.

Another example is Ivy Tech Community College in Indiana, where a massive pilot integrating AI analytics in identifying at-risk students was used early in the semester. Through examination of more than 10,000 course sections, the system identified 16,000 students who are experiencing non-academic impediments, such as students with learning disabilities who need extra accommodations [45]. The interventions included individualized AI-generated optimized study plans and resource referrals with a corresponding retention increase among special students, thus showing the implication of AI to scale the individualized education programs (IEPs) without overloading the staff.

The campaigns by Pakistan that use AI-aided assistive systems among hearing-impaired students are a cross-cultural success globally. Schools installed live captioning and sign language translators in collaboration with other local technology companies and recorded an improvement in academic performance on standardized tests [46]. Results of the two-year study on 500 students showed that the number of students who dropped out decreased, and there were more classroom engagements with AI algorithms adjusting to regional dialects to be more exact and beneficial. This was a prototype, as the integration of AI in a variety of linguistic contexts and following the required standards of accountability were facilitated by ethical protection, including clear policies about data usage. These instances demonstrate that the specific cases of AI usage can provide a practical benefit, though it is important to point out the necessity of conducting an ongoing assessment to maintain the long-term profit.

4.2 LESSONS OF FAILED OR CONTENTIOUS DEPLOYMENTS

A failed or contentious AI deployment in the education sector often stems from poor planning, elevated dependency on AI, and bias, and can serve as a valuable clue on how to employ it in the future. This is the case in the algorithmic grading scandal in the United Kingdom in 2020 during the COVID-19 pandemic, in which AI models downgraded a few A-level results, disproportionately affecting disadvantaged students, including students with disabilities [47]. Based on school history, the system increased inequalities and sparked widespread protests, which resulted in a U-turn by the government. It was found that there were biases in training data that omitted neurodiverse performance patterns, which led to a 25% increase in the rate of downgrading the special education students and reduced the confidence in AI in high-stakes exams.

In the US, a 6 million investment of the Los Angeles Unified School District in the Ed chatbot failed within three months, and no indicative improvement in the student outcomes was recorded despite the fact that students were promised to receive personalized support. The tool, whose purpose was to handle queries without any restrictions, was affected by poor responses and a breach of privacy, which affected 500,000 users and consumed funds that could have been used to get human aid [48]. Post-mortem reviews have pointed to the omission of pilot testing and ethical checks, and only 10% of special-needs families are using the device because of accessibility problems. In the same way, the Black and Hispanic students with disabilities in Wisconsin showed more instances of false positives in the early warning dropout system, which worsened community trust and resulted in the unwarranted interventions that stigmatized learners by 20 percent more than the white population [49].

An AI grading tool developed by San Diego Unified as a part of a larger contract created a controversy, as it offered false essay grades, especially in the cases of non-native speakers

in a general classroom, with a 15 percent margin of error, and the school board was kept entirely uninformed about its use. The case highlighted serious flaws in governance and motivated the need to have open procurement processes to prevent such negligence [50]. Such instances demonstrate that without a variety of data, stakeholder participation, and strong protection mechanisms, artificial intelligence can promote the existing inequalities; hence, the necessity of ethical systems and constant experimentation to circumvent the expensive mistakes.

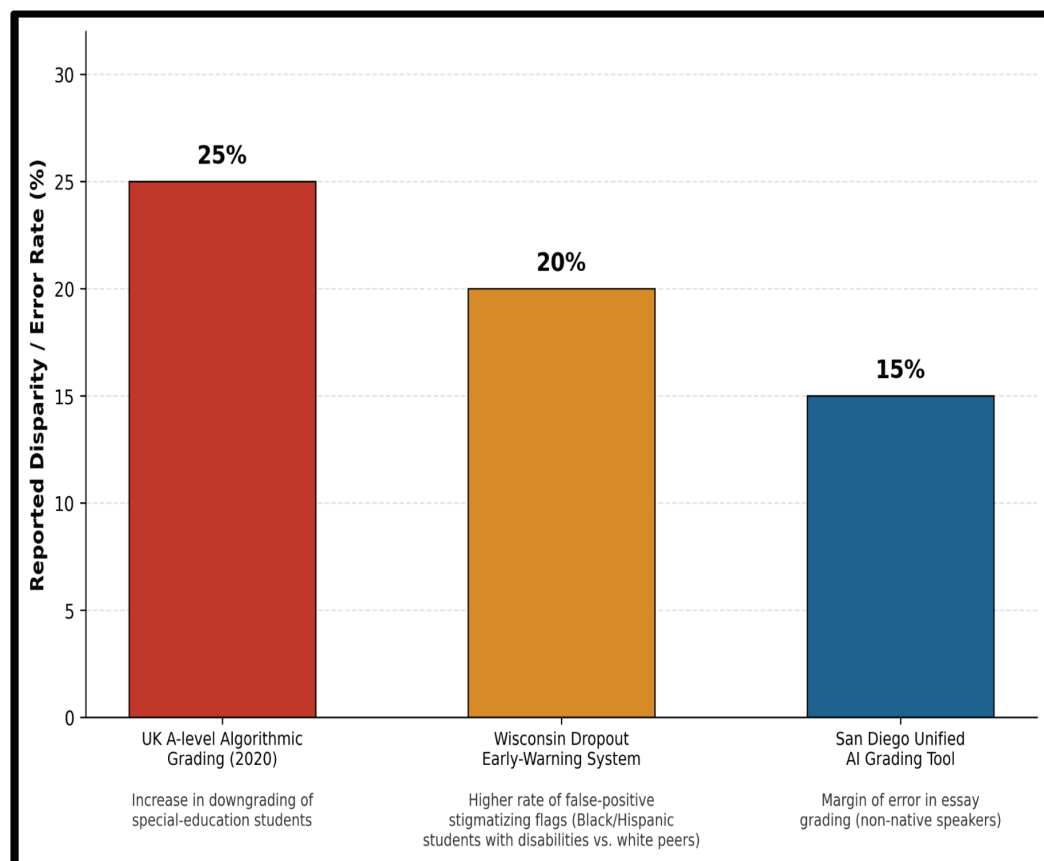


Figure 4: Bias and Error Rates in Contentious AI Education Deployments

Figure 4 above consolidates the reported bias and error rates from the three most reported and contentious deployments discussed in this section, providing a direct visual comparison of the measurable disadvantage that resulted from governance failures for students with disabilities and other vulnerable groups.

5. SAFETY NETS – ETHICAL AI DESIGN AND IMPLEMENTATION

The current section outlines practical measures that can be used to overcome the challenges and maximize opportunities, thus arming the stakeholders with tools of responsible integration.

In the sector of special and inclusive education, where the vulnerability of the students aggravates the outcomes of ethical limitations, the safety measures should be proactive, cooperative, and flexible.

These designs make AI a potential resource, as they can establish equality at the start of the design, make systems transparent and accountable, and provide educators with the necessary knowledge, which will convert AI into a dependable tool to achieve equity. To achieve these aims, the collaboration of developers, educators, policymakers, and

communities is cross-disciplinary in the sense that effective resilient frameworks must be designed that can adapt to technological and societal changes.

5.1 BUILDING A BIAS-RESISTANT AI ALGORITHM

The ethical application of technology to special and inclusive education involves designing bias-resistant AI algorithms that can establish and maintain exclusion or allocate resources unevenly in the context of neurodiverse or marginalized learners. One of the strategies is variety in data sourcing, where the training material contains the entire range of student profiles, skills, and cultural backgrounds, which reduces bias caused by the lack of under-representation that produces inaccurate results [51]. Examples include datasets. being more representative of students with autism, dyslexia, sensory impairments, and underrepresented ethnic or socioeconomic groups to equalize distributions.

Other important pillars include repeated audits, and these involve systematic reviews at the lifecycle points of successive processing, modeling, and deployment in order to detect and correct biases. Audits can use some fairness indicators like demographic parity or equalized odds, and qualitative tests that capture the real-life effects when in an inclusive environment. It encourages a society-oriented strategy in which project groups examine patterns of discrimination through workflows and implement debiased techniques at preprocessing (e.g., through reweighting), at the in-processing stage (e.g., adversarial training), or at the post-processing phase [52]. The educators may cooperate with the developers by joining co-design workshops, advising the developers on the domain context about the needs of the students, and undertaking participatory testing with different groups of learners to confirm its fairness.

Collaboration measures involve the following: creating multidisciplinary teams that consist of educators, data scientists, and ethicists; pre-testing algorithms on inclusive datasets and updating them with feedback/complaints; documenting the process to observe consistently afterward; and documenting it to keep monitoring it over time. Open-source bias detection tools, including the Turing courses on assessing and mitigating bias, can be used in resource-constrained schools to allow an educator to run initial checks without requiring a large infrastructure [53]. Such practices ensure that risks are controlled directly and indirectly; on the other hand, these practices bring about trust and assurance that the AI enables the inclusion goals and serves to counter the biases that will otherwise be disadvantageous to the vulnerable students.



Figure 3: Pictorial word cloud on the creation of bias-resistant AI algorithms

To enhance the prospects of having the ethical integration of AI, the upcoming implementation should focus on creating bias-resistant algorithms, as summarized in the word cloud, Figure 3, above.

5.2 EDUCATIONAL TRAINING ON THE ETHICAL USE OF AI

The responsible use of AI in special and inclusive education is crucial to trainer and stakeholder education, in which technology support cannot replace human judgment. Professional development programs must include programs specifically covering AI ethics that are specifically designed to fit special education curricula, discussing bias detection, data privacy, data control, and ethical aspects of AI in IEPs or in behavioral interventions [54]. Such programs can be based on such models as intelligent TPACK, using AI ethics as a fundamental area together with technological, pedagogical, and content knowledge, applying active learning, modeling, coaching, and reflection to develop fluency [55].

Workshops may include scenario-based group discussions, e.g., reviewing an AI-generated IEP with bias, or practical training on tools, thus focusing on critical analysis and reducing blind spots. Resource constraints such as lack of access to professional development, lack of time, and lack of infrastructure are also problematic in some settings, like the inability to access professional development, time, and lack of infrastructure. Some of the viable solutions include scalable, low-cost interventions, including online modules; peer-led sessions; and community-led resources, including open-access-based curricula created by organizations to advance ethical AI literacy, among others [56]. Community-based efforts enable local actors, such as parent-teacher associations or local networks, to co-create context-based training, such as culturally responsive AI relevant in practice in a diverse, inclusive classroom environment.

Motivation-building should be central to the programs; lack of confidence or perceived relevance, in many cases, will impede adoption. Certification or workload lightening is an example of a value that can be given as an incentive to increase uptake. Continuous ethical use should be supported by coaching and communities of practice, creating a culture where the educators feel comfortable using AI and supporting the principles of a human-centered approach to special and inclusive education.

6. CURRENT TRENDS IN AI TODAY

Section 6 discusses the transformational and accelerating impact of artificial intelligence on neurodiversity assistance, in which it is noted that a specific point between 2025 and 2026 will see AI become able to provide measurable and concrete empowerment to neurodivergent individuals through the education, occupation, everyday, and social sectors.

6.1 ADVANCEMENTS IN AI-BASED NEURODIVERSITY SUPPORT

The new prediction technologies, including brain-computer interface (BCI) in severely disabled people, offer unprecedented possibilities for personalization but also cause ethical confusion with consent and the long-term effects. AI-based BCIs form a new paradigm of assisting neurodivergent people and those with severe physical or communicative disabilities. BCIs may allow students who are non-verbal or without adequate motor control, e.g., with locked-in syndrome, cerebral palsy, or advanced amyotrophic lateral sclerosis, to control educational devices, reflect their thoughts, or communicate in virtual classes directly by thought alone, since neural signals can be decoded and linked to the device [57]. Recent developments add generative AI to signal processing improvements, thus achieving a better result in the understanding of brain patterns to be applied to neuroprosthetics, aiding in communication and cognitive enhancement. AI-enhanced BCIs are estimated to permit autonomy of learning software such that smooth communication and enhanced adaptive programs would

potentially change how severely disabled children handle movement, communication, and academic material [58]. It is projected that this market size will rise significantly in the future with innovations based on non-invasive and less invasive versions that may be incorporated into educational devices in the late 2020s, with a valuation reaching between USD 295.5 million in 2026 and USD 960.8 million by 2034 [59].

Possible opportunities for personalization can be enormous. AI can tactically process real-time neural data to personalize content dynamically, whether by increasing or reducing the difficulty or pace of content. These adaptive modulations would create more meaningful interactions with neurodivergent students, such as learners with autism or ADHD, by offering neuro-adaptive learning options that react to changes in attention or sensibilities. Recent applications involve BCI-based attention training devices, which provide real-time neural feedback to children with autism in order to improve sustained attention, emotional control, and willingness to communicate, and which are used by thousands of people in learning institutions and open prospects to social integration [60]. The scoping reviews provide a focus on the potential of BCIs in the inclusive learning process because they facilitate learning without obstacles in the access to digital environments as a means of interactive communication, collaboration, and engagement among students with disabilities [61].

However, there is a big problem of ethical issues. Making informed consent is particularly difficult among children or those with cognitive limitations, so there is a strong need to apply well-structured measures that include the presence of guardians, a secure consent where feasible, and the provision of a constant revocation choice to accommodate autonomy. [62]. The long-term outcomes cannot be completely determined, and the possible threats are neural staleness, reliance on technology to perform daily functions, or placing an unwanted psychological burden on the person due to continuous brain scanning. To balance these innovations, there is a need to have multidisciplinary governance whereby BCIs complement human agency as opposed to displacing it in inclusive education.

6.2 COMBINING AI WITH EMERGING TECHNOLOGY (VR AND IOT)

The intersection between AI, virtual reality (VR), and the Internet of Things (IoT) creates strong synergies of inclusive education because of the possibility to create dynamic and responsive spaces that may be scaled to the specific needs of particular learners. IoT sensors (measuring environmental conditions, including lighting conditions, noise levels, temperature, or biometric elements, e.g., heart rate, posture, etc.) are connected to AI systems in smart classrooms, which make temporary modifications [63]. An example would be when a student with sensory processing issues displays the symptoms of being overwhelmed; AI may switch lights on and off, turn down sounds in the environment with adaptive soundscapes, or recommend rest and thus maintain the student's activity in inclusive environments. In combination with VR, such systems can offer social skills training or experience learning, where AI adapts scenarios in real-time through the input of IoT signals and can control virtual objects to have neurodivergent reactions to the environment, like simulation of virtual arm weights to match real-world physical forces [64].

Surveillance and data overload are some of the ethical considerations. This constant surveillance through IoT can cause significant privacy risks because, with minute details on actions, feelings, or physiological conditions, someone might be monitored without proper protection against granular methods, and it may be refined by using it to profile or misappropriate data in educational choices [65]. In the context of inclusiveness, this can be disproportionately applied to vulnerable students, undermining confidence in the case of data sharing with outside parties or using coercive actions. Data crowding poses a threat to the cognitive bandwidth of educators who might get lost in the volume of AI-generated insights and become confused in the face of huge deficits, developing decision fatigue, or excessive trust in computer-generated suggestions [66]. Biased interpretations in AI may misinterpret cultural or neurodivergent cues, which can foster inequalities [67]. Mitigation

includes transparent data regulations, opt-in consent agreements, minimal data collection, and a human engineering focus to ensure that we can create mitigation through ethical design that balances the dystopian surveillance but uses the benefits to the advantage of truly inclusive and adaptive learning.

7. CONCLUSION AND RECOMMENDATIONS FOR EQUITABLE AI IN EDUCATION

This concluding section is a summary of the key opportunities and ethical concerns that were addressed in the above analysis and which pull the main ideas to the core view of the future. It goes beyond the description by giving clear and practical recommendations that are meant to guide the educators, policymakers, technologists, developers, families, and advocacy agencies towards the integration of AI in inclusive education in a responsible manner. The larger concern is not just the acquisition of AI products but also ensuring that all technological changes have genuine benefits to equity, dignity, and the overall prosperity of all learners, regardless of neurotypes, sensory profiles, physical ability, cultural identity, and socioeconomic status.

7.1 RECONCILING OPPORTUNITIES AND PROBLEMS IN POLICY STRUCTURES

This work reveals a core two-sidedness: that AI represents potent tools of individualization, accessibility, real-time adaptation, social-skills practice, and reduction of barriers, at the same time introducing real solutions of privacy invasion, algorithmic discrimination, surveillance, emotional distance, cultural insensitivity, and the increase of global inequality. Good policy should also leave these tensions clearly unresolved and not in favor of one dimension and to the detriment of another. This response to AI implementation should be required at the national and international level to ensure that any educational AI system must be ethically impactful, assessed independently before being deployed in schools, and inquire not only into technical performance but also into the fairness of the system in neurodiverse, linguistically diverse, and socio-economically diverse student populations.

Regulators must require that AI tools sold to the education sector have labels on transparency; reporting the data source of the tool, the risk of bias, explainability characteristics, data-retention provisions, and third-party data sharing. Granting of educational technology funds should be on the condition of adherence to such requirements, thus making firm market incentives for ethical design.

Schools or districts implementing AI on an institutional level must have an established, standing AI ethics committee group, which includes teachers, special educators, parents with students with disabilities, disability rights advocates, data-protection officers, and third-party ethicists. The committee would issue proposed tools given to it, follow up with the current usage, and advise on the changes or termination of usage upon the emergence of the harms.

Cooperation with foreign countries cannot be left. Different international bodies like UNESCO, OECD, and regional unions should develop common minimum standards regarding AI in inclusive education without enforcing strictness on cultural and resource conditions. Technology transfer, the development of open-source ethical tools, and unassisted capacity building in less-resourced environments can be achieved through bilateral and multilateral relations so that the benefits should not be concentrated in the wealthier countries.

7.2 MULTIDISCIPLINARY COLLABORATION

Ethical implementation of AI cannot rely on one particular profession or industry. It will require a long-term, systematic collaboration across cultural borders for significant

development. Teachers and educational experts should be placed in roles of co-designers and not end-users. Their own encounter with variation among learners, classroom reality, and pedagogical sensitivity cannot be substituted in creating resources that can actually be helpful to diverse students. The developers of AI and technologists should take into account the principles of inclusive design at the earliest stage of implementation. They ought to involve communities, families, and individuals with disabilities in defining the problem, collecting the information, testing the prototype, and evaluating the result. The policies and funders must go beyond the procurement checklists and require evidence of actual community participation, longitudinal impact research centered on equity measures, continuous improvement systems, and not a one-time acquisition.

There is a vital role for carers, self-advocates, and parents as guardians. Their avenues to raising concerns should be open and transparent; they should have easy access to plain language explanations on how AI is used on their children, and they should be allowed to be involved in matters of governance of such technologies in schools.

Three very important watchdogs are the civil society organization, the disability rights group, and the independent research institutes. They will be able to independently audit, release comparative reviews of tools, promote greater protections, and amplify the voice of the marginalized group.

7.3 THE FUTURE OF AI IN INCLUSIVE EDUCATION

Imagine an instructor teaching the class in 2035, and all the learners, irrespective of the developmental profile, linguistic background, and cultural heritage, are instructed in a manner that is regulated not only to the level of instruction but also to sensory preferences, emotions, communicative patterns, and the relevance of the classroom setting.

An autistic learner triggers a wearable sensor that notifies, activating the sensor to signify sensory overload; the smart classroom space instantaneously adjusts the amount of light, reduces the levels of ambient noise, and provides relaxing sounds, thus holding the flow of the instructional presentation.

A nonverbal cerebral palsy child uses a non-invasive neural brain-computer interface, which converts neural activity into speech or text, allowing full engagement in class discourse. The deaf student is provided with real-time and culturally validated sign-language avatars in synchronism with live lessons, and the visually impaired student with a shared virtual laboratory using haptic and audio guidance.

Teachers get relieved of tedious paperwork and repetitive drill-and-practice and are able to focus on relationship-building, facilitating creativity, emotional coaching, and the human work in educating that cannot be computerized. Artificial intelligence serves here as a silent, caring companion that enhances the wisdom of teachers, not replacing or undermining it.

Data is collected in its due manner and in the least amount, anonymized to the maximum, and will be used only within the allowed and acceptable educational context, and there, under meaningful human supervision and under student and parent permission. The existence of biases is recognized at the very beginning in the form of transparent and constant auditing that allows the participation of various stakeholders. The tools are cheap, have offline features in instances where they are required, and exist in numerous languages and dialects.

This future is not a fantasy; the building blocks of its technology have evolved. What is needed is a shared moral imperative and concerted effort to drive growth along the lines of equity and not extraction. This future requires being sensitive enough to hear the vulnerable groups, being inventive to come up with other forms of governance, and being faithful in demanding accountability for tasks. Artificial intelligence can be one of the best companions

that the inclusive education movement has ever had, reaching the goal of giving all children their chance to learn, belong, and succeed if pursued with integrity.

7.4 SIGNIFICANCE OF THE STUDY AND KEY FINDINGS

This study explores the potential of AI to improve the objectives of special and inclusive education and the conditions required for success. Several key insights emerge from this study.

First, the value of AI in this domain is not in any one tool but rather in its ability to take the long-held pedagogical principles of UDL, ZPD-based scaffolding, and individualized planning and bring them to scale. Personalization, which has been time-consuming and often applied inconsistently in the past, can be reliably extended to large, diverse populations of learners through the use of adaptive platforms, assistive accessibility tools, and VR-based social skills training.

Secondly, the paper's case study findings indicate that it is the governance of the technology, rather than the technology itself, that impacts outcomes. Successful deployments shared the following characteristics: a diverse and representative training data set, meaningful stakeholder engagement, the implementation of a piloting process, and the establishment of accountability structures. The opposite of the successful deployments were the UK grading algorithm, the LAUSD chatbot, and biased dropout-warning systems—all of which were rushed, inadequately tested for bias, and lacked oversight. The uniformity of the independent cases indicates that ethical failures are not accidental in the field of educational AI but rather are foreseeable and controllable.

Third, the rise in the use of brain-computer interfaces and smart classrooms with AI is a sign that the ethical implications of this area are not leveling off but are actually increasing. The future of AI systems that access neural and biometric data will involve more complex governance structures than those traditionally used in EdTech.

This is important because special and inclusive education is centered on groups with the least voice to contend against harmful technology and are the most to lose from it. In this context, the importance of getting AI governance right is both a proving ground and a moral obligation. The data collected here, on the other hand, demonstrates that integrating equity into the design process from the beginning, not at the end, has the potential to meaningfully reduce, not exacerbate, educational inequities through the use of AI.

The practical value of this work is that it offers a new perspective on the integration of ethical principles into AI, viewing it not as a limitation on innovation but as a prerequisite for it: AI technology that is not trusted, audited, and co-designed with the communities it serves will ultimately fail these communities, regardless of its technical sophistication. The model presented in this paper – bias-informed design, educator preparation, institutional accountability, and multi-sectoral partnership – can be replicated and extended beyond special and inclusive education to ensure equity in the design of AI systems from the start.

COMPLIANCE WITH ETHICAL STANDARDS

The author declares that there are no conflicting interests, and all the references are cited and credited based on the ethical publication norms.

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