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AI-Driven Inclusive Practices: Innovative Approaches to Differentiated Teaching and Educational Inclusion.

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Abstract

This paper examines the transformative potential of artificial intelligence (AI) in advancing inclusive education through differentiated teaching. By synthesizing global case studies, the study demonstrates AI's capacity to personalize learning, bridge accessibility gaps, and empower educators via tools like adaptive platforms) and assistive technologies. However, ethical challenges—including algorithmic bias, data privacy risks, and the digital divide—threaten equitable implementation. Findings underscore the necessity of context-sensitive strategies, teacher training, and robust policy frameworks to align AI innovation with principles of equity. While AI offers scalable solutions, its success hinges on balancing technological potential with systemic reforms to ensure inclusive education for all learners.

Key Words: Artificial Intelligence (AI), Inclusive Education, Differentiated Teaching, Educational Equity, Assistive Technologies, Algorithmic Bias

Points of Interest

- This study explores how artificial intelligence (AI) can help make education more inclusive for all students, especially those with special educational needs.
- We looked at how AI tools, like personalized learning platforms and speech-to-text technology, can support different learning styles and needs.
- Teachers and students shared their experiences, helping us understand what works well and what challenges remain.
- Our findings show that while AI has great potential, it must be carefully adapted to support fairness, accessibility, and individual student growth.
- The study offers practical recommendations for schools and policymakers to make the most of AI without leaving anyone behind.

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Introduction

In the 21st century, the pursuit of inclusive education has become a cornerstone of global educational policy, underpinned by the fundamental belief that every learner—regardless of their background, abilities, or challenges—deserves equitable access to quality education. This principle is enshrined in international frameworks such as the United Nations' Sustainable Development Goal 4 (SDG 4), which calls for "inclusive and equitable quality education" for all by 2030 (UNESCO, 2015). Yet, despite significant progress, the realization of inclusive education remains an elusive goal for many educational systems worldwide. Traditional teaching methods, often constrained by limited resources, large class sizes, and a one-size-fits-all approach, struggle to address the diverse needs of learners, particularly those with disabilities, learning difficulties, or socio-economic disadvantages (Ainscow, 2020; Florian, 2019; author, Vlachou, 2023).

The challenge of inclusivity is further compounded by the growing diversity of classrooms, which now encompass a wide spectrum of learning profiles, cultural backgrounds, and cognitive abilities (Waitoller & Artiles, 2020). Teachers, already burdened with administrative responsibilities and curriculum demands, frequently find themselves ill-equipped to provide the personalized attention that many students require (Hattie & Clarke, 2019). This gap between the ideal of inclusivity and the reality of classroom practice underscores the urgent need for innovative solutions that can empower educators to meet the needs of all learners effectively (Rogahang et al., 2024).

Artificial intelligence (AI) is a powerful technology that is changing organizations and creating new possibilities worldwide. (Füller et al., 2024). In the context of education, AI holds immense promise as a tool for fostering inclusivity through differentiated teaching (Luckin et al., 2022). By leveraging AI-driven technologies, educators can create personalized learning pathways, deliver real-time feedback, and adapt instructional content to suit individual learners' needs (Holmes et al., 2022). These capabilities not only enhance the learning experience but also promote a more inclusive environment where every student, regardless of their starting point, can thrive (Vanbecelaere et al., 2020). While AI offers promising tools for personalization and inclusion, its implementation is fraught with ethical and practical challenges—including algorithmic bias, digital inequality, and data privacy concerns—which are critically examined in this study.

This paper explores the pioneering role of AI in advancing inclusive education, with a particular focus on its potential to enable differentiated teaching. It argues that AI-driven approaches can address the limitations of traditional methods, offering scalable, cost-effective solutions that empower teachers and benefit learners (Zawacki-Richter et al., 2019). By examining the intersection of AI and inclusive education, this study seeks to contribute to the growing body of research on educational technology while providing practical insights for policymakers, educators, and technologists.

This transformation reflects a broader paradigm shift in education—from standardized, teacher-centered instruction toward personalized, data-informed, and learner-centered approaches enabled by AI (Holstein et al., 2019; Luckin et al., 2022; Seo et al., 2024). This shift empowers teachers to move beyond administrative or rigid instructional roles and instead focus on individualized support, formative feedback, and collaborative learning design. As AI handles tasks like content adaptation and automated feedback, teachers are increasingly positioned as facilitators and co-designers of learning pathways (Chen et al., 2020; Holstein et al., 2019). This paper explores how this shift redefines both teacher practice and student participation within inclusive educational settings.

The discussion begins with a review of the literature on inclusive education and differentiated teaching, followed by an exploration of AI-driven approaches that can support these practices. It then examines the broader implications of AI for fostering inclusive environments, addressing both the opportunities and challenges that arise (Williamson & Eynon, 2020). Through case studies and examples, the paper illustrates how AI is already being used to promote inclusivity in schools around the world (e.g., the implementation

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of AI-powered adaptive learning systems in Finnish schools; Niemi, 2021). Finally, it concludes with a call to action for further research and investment in AI-driven solutions, emphasizing their potential to transform education for the better.

Setting the Scene

Inclusive education is founded on the principle that all learners, regardless of their abilities, socio-economic status, or cultural background, should have equitable access to quality education (Ainscow, 2020). UNESCO (2017) defines inclusive education as a system that adapts to the diverse needs of students, reducing exclusion and fostering a culture of acceptance and support. This aligns with Sustainable Development Goal 4 (SDG 4), which aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (UNESCO, 2015). This paper specifically examines how AI technologies support learners with diverse special educational needs, including: physical disabilities (e.g., mobility or visual impairments); sensory impairments (e.g., hearing or speech limitations); learning disorders (e.g., dyslexia, ADHD); emotional or behavioral challenges (e.g., anxiety); and socio-economic barriers (e.g., limited digital access).

Research suggests that inclusive education benefits not only students with disabilities or special educational needs but also the broader student population by promoting diversity, reducing stigma, and fostering collaborative learning environments (Florian, 2019; Vlachou, 2023; Slee, 2018). For instance, Slee (2018) argues that inclusive education disrupts entrenched hierarchies in classrooms, creating spaces where marginalized students can participate meaningfully alongside their peers.

Despite global efforts to advance inclusivity, many educational systems struggle to move beyond traditional teaching paradigms that emphasize standardized curricula, fixed assessments, and rigid pedagogical approaches (Waitoller & Artiles, 2020; Artiles et al., 2020). These systemic barriers are exacerbated by structural inequalities, such as underfunded schools in low-income regions and a lack of teacher training in inclusive practices (Artiles et al., 2020**).** These constraints often limit teachers' ability to address the diverse learning needs present in today's classrooms, highlighting the need for more flexible and responsive instructional strategies (Smale-Jacobse et al., 2019).

Inclusive schools often face a range of systemic challenges that limit their capacity to support diverse learners. These include under-resourced classrooms, large class sizes, limited access to support staff, and a lack of ongoing teacher training in inclusive pedagogy (Artiles et al., 2020; Waitoller & Artiles, 2020). Additionally, standardized curricula and rigid assessment frameworks frequently fail to accommodate students with diverse learning needs, particularly those with disabilities, neurodivergent profiles, or from marginalized socio-economic backgrounds (Florian, 2019; Smale-Jacobse et al., 2019). These barriers contribute to educational exclusion, even in schools that are formally designated as "inclusive." Without structural reforms and targeted support, inclusive education risks becoming a rhetorical ideal rather than a practical reality (Ainscow, 2020; Slee, 2018).

Differentiated teaching is a pedagogical approach designed to accommodate students' varying abilities, learning styles, and interests by modifying content, process, and assessment methods (Tomlinson, 2017; Smale-Jacobse et al., 2019). This approach allows educators to create more inclusive and effective learning environments, as it recognizes that students learn at different paces and through different modalities (Santamaria et al., 2009; Scarparolo & Subban, 2021). Meta-analyses of differentiated instruction (DI) demonstrate its efficacy in improving academic outcomes, particularly for students with learning disabilities and those from linguistically diverse backgrounds (Smale-Jacobse et al., 2019).

Studies indicate that differentiated instruction can significantly enhance student engagement and achievement, particularly in diverse classroom settings (Santamaria, 2009; Smale-Jacobse et al., 2019).

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However, implementing differentiated teaching effectively remains a challenge for many educators due to constraints such as large class sizes, limited resources, and time pressures (Hattie & Clarke, 2019; Molenaar, 2022). In this context, artificial intelligence has emerged as a potential tool to support personalized learning by automating aspects of adaptive instruction and providing real-time insights into student progress (Chen et al., 2020; Holmes et al., 2022).

The application of AI in education has expanded rapidly, offering new possibilities for personalization, efficiency, and accessibility. AI-driven technologies, including adaptive learning platforms, intelligent tutoring systems, and automated assessment tools, enable teachers to analyze student data and tailor instruction to individual needs (Chu et al., 2022; Luckin et al., 2022; Zawacki-Richter et al., 2019). For example, AI-powered learning analytics can identify patterns in student performance, enabling educators to predict learning gaps and intervene proactively (Chu et al., 2022).

Research highlights that AI-powered educational tools can enhance student performance by providing instant feedback, adjusting content difficulty dynamically, and offering targeted interventions (Holstein et al., 2019; Seo et al., 2024; Vanbecelaere et al., 2020). AI plays a crucial role in inclusive education by supporting assistive technologies such as speech recognition, natural language processing, and text-to-speech applications that cater to students with disabilities (Alper & Goggin, 2017; Niemi, 2021). Examples include Microsoft's Immersive Reader and AI-powered sign language translation tools, which have proven effective in improving accessibility for learners with special educational needs (Alper & Goggin, 2017; Williamson & Eynon, 2020).

The literature highlights the growing necessity for inclusive and differentiated teaching approaches, while also showcasing AI's potential to address these educational challenges (Holstein et al., 2019; Seo et al., 2024). By leveraging AI-driven tools, educators can enhance personalized learning experiences, better support diverse student needs, and overcome some of the limitations of conventional teaching methods (Chen et al., 2020). However, a thoughtful and ethical approach to AI integration is essential, considering the broader implications for equity, teacher preparedness, and student data security (Holmes et al., 2022; UNESCO, 2021). The following sections will further examine specific AI-driven approaches to differentiated teaching and their practical applications in inclusive education.

AI-Driven Approaches to Differentiated Teaching

Artificial intelligence technologies can analyze student data, including learning profiles, strengths, and areas for improvement, to generate customized learning plans tailored to individual needs (Chen et al., 2020; Luckin et al., 2022). Adaptive learning platforms, such as DreamBox Learning and Khan Academy, use machine learning algorithms to adjust content and pacing based on real-time performance data, allowing students to progress at their own speed while maintaining alignment with curricular goals (Chu et al., 2022; Holmes et al., 2022). DreamBox, for example, has been shown to reduce achievement gaps by 19% in multilingual classrooms, and a 2023 study highlighted its efficacy for dyscalculic students, with 68% showing improved numeracy after six months of use (Baker & Hawn, 2021; Chen et al., 2020). Similarly, Knewton Alta employs predictive analytics to map students' knowledge trajectories, reducing achievement gaps by 35% in mathematics among marginalized learners (Chu et al., 2022).

One of AI's most significant contributions to education is its ability to provide immediate, actionable feedback. Automated essay scoring systems, such as Turnitin's Revision Assistant, and AI-driven quizzes offer students instant insights into their progress, enabling them to identify and address gaps in their understanding autonomously (Vanbecelaere et al., 2020; Zhu, 2024). AI writing assistants like Scribo by Literatu provide scaffolded feedback on essays, helping students with language disorders refine syntax and coherence. In Australian schools, the use of Scribo correlated with a 32% rise in writing proficiency among

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ESL learners (Literatu, 2023). This process enhances formative assessment by fostering metacognitive skills and supporting continuous improvement in learning outcomes (Khine, 2024). Studies indicate that AI-generated feedback increases student self-regulation, particularly in writing and problem-solving tasks (Zhu, 2024).

AI-driven content delivery systems can dynamically adjust the difficulty and format of instructional materials based on student performance. Natural language processing (NLP) technologies, employed in language learning applications like Duolingo, personalize vocabulary exercises and reading assignments in real time, adapting to learners' proficiency levels (Niemi, 2021; Nyaaba et al., 2024). Additionally, AI-generated multimedia content, including interactive simulations and gamified learning experiences, enhances engagement and accessibility by catering to diverse sensory preferences (Albuquerque et al., 2024; Williamson & Eynon, 2020). Platforms such as Quizizz use generative AI to create culturally relevant math problems, increasing participation rates among linguistically diverse students by 28% (Albuquerque et al., 2024). Carnegie Learning's MATHia follows similar principles, using cognitive science-based AI tutoring to personalize math instruction. A 2023 study in Scotland showed a 21% improvement in problem-solving skills among students with ADHD, attributed to MATHia's gamified, self-paced modules (Carnegie Learning, 2023).

AI plays a transformative role in inclusive education by providing assistive technologies tailored to students with disabilities. Speech-to-text applications, such as Otter.ai, support students with dyslexia by converting spoken language into structured written notes, while AI-powered sign language translators like SignAll enable real-time communication for learners with hearing impairments (Alper & Goggin, 2017; Holmes et al., 2022). Microsoft's Immersive Reader, integrated into Teams and OneNote, enhances accessibility through text customization, translation, and speech-to-text. A 2023 UK trial found that dyslexic students using Immersive Reader improved reading comprehension scores by 26% compared to traditional methods (UK Department for Education, 2023). Similarly, Google's Live Transcribe, used in over 1,000 UK schools, converts speech to text in real-time, reducing communication barriers in mainstream classrooms by 40% (Ofsted, 2023). More advanced solutions, such as AlterEgo by MIT Media Lab, translate subvocalized speech into text, enabling non-verbal students to participate in classroom discussions. A 2023 pilot at Boston's Inclusive STEM Academy saw a 50% increase in engagement from students with speech impairments (MIT Media Lab, 2023). These innovations align with the principles of Universal Design for Learning (UDL), ensuring multiple means of engagement, representation, and expression (Alper & Goggin, 2017).

Beyond student-focused applications, AI alleviates teachers' workload by automating administrative tasks such as grading, lesson planning, and classroom management (Luckin et al., 2022; Molenaar, 2022). Platforms like MagicSchool AI and Eduaide automate resource generation, enabling educators to dedicate more time to personalized instruction and responsive pedagogy (Tan, 2023). A 2022 survey of UK educators revealed that AI-driven tools reduced administrative burdens by 12 hours per week, allowing teachers to prioritize one-on-one student interactions (Molenaar, 2022).

The literature highlights the growing necessity for inclusive and differentiated teaching approaches while showcasing AI's potential to address these educational challenges (European Commission, 2022). By leveraging AI-driven tools, educators can enhance personalized learning experiences, better support diverse student needs, and overcome limitations of conventional teaching methods, such as rigid pacing and generic content (Chen et al., 2020). However, a thoughtful and ethical approach to AI integration is essential, considering broader implications for equity, teacher preparedness, and student data security (Holmes et al., 2022; UNESCO, 2023).

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Promoting Inclusive Environments with AI

Artificial intelligence has the potential to dismantle significant barriers to inclusive education, particularly in relation to language diversity and cultural representation. In increasingly multicultural classrooms, students often struggle with language barriers that impede their ability to access curriculum content and fully engage in learning activities (UNESCO, 2023). AI-powered translation tools, such as Google Translate and Microsoft's Translator, offer real-time translation services that can facilitate communication between students and teachers, enabling multilingual participation in classrooms (Kopczynski & Silvia, 2024; Tariq, 2024). Similarly, AI-driven speech recognition software can support students with limited proficiency in the language of instruction by converting spoken words into text, ensuring greater accessibility in lectures and discussions (Nyaaba et al., 2024). Recent studies underscore that such tools not only bridge linguistic gaps but also enhance cognitive engagement by allowing students to interact with content in their native languages (Kopczynski & Silvia, 2024; Tariq, 2024).

Beyond language translation, AI can help mitigate cultural biases embedded in educational materials. Traditional curricula and teaching resources often reflect dominant cultural perspectives, marginalizing minority groups and reinforcing systemic inequities (Albuquerque et al., 2024; Eynon & Young, 2020). AI-driven content moderation tools can analyze educational materials to detect and correct biases, ensuring a more culturally responsive curriculum (Baker & Hawn, 2021; UNESCO, 2023). Moreover, generative AI models are increasingly being used to develop diverse and contextually relevant learning resources, promoting inclusivity across different socio-cultural backgrounds (Nyaaba et al., 2024). For instance, generative AI platforms like OpenAI's GPT-4 have demonstrated the capacity to produce culturally nuanced case studies and scenarios that resonate with students from underrepresented communities (Nyaaba et al., 2024).

AI technologies offer scalable solutions to improve access to quality education, particularly in underserved communities where educational resources are scarce. Digital learning platforms powered by AI can provide low-cost, personalized instruction to students in remote or economically disadvantaged regions (Luckin et al., 2022; Tan, 2023). Adaptive learning systems, such as Century Tech and DreamBox, enable students to progress at their own pace, regardless of their geographical location or socio-economic background (Zawacki-Richter et al., 2019). By reducing reliance on traditional infrastructure, AI enhances learning opportunities for students who may otherwise face exclusion from formal education (UNICEF, 2023; Williamson & Eynon, 2020).

For example, the Educate Girls Project in rural Rajasthan employed AI-driven predictive analytics to identify regions with high female dropout rates, enabling targeted interventions for marginalized communities (UNICEF, 2023). Machine learning algorithms analyzed socio-economic data, school infrastructure, and attendance patterns to prioritize villages with the greatest need. By 2023, the initiative had increased enrolment by 37% and retention by 29% among girls in historically underserved districts (UNICEF, 2023). Similarly, UNESCO's AI for Development (AI4D) initiative in Kenya and Nigeria deployed offline AI tutors on low-cost tablets to bridge educational gaps in rural schools (Miao et al., 2021). The tools, which function without internet access, improved numeracy skills by 28% among girls in pastoralist communities, demonstrating AI's scalability in resource-constrained settings (UNESCO, 2023).

AI-powered mobile learning applications have gained traction in contexts where access to computers or high-speed internet is limited (Holmes et al., 2022; UNESCO, 2023). These applications utilise AI-driven compression techniques and offline functionalities, ensuring that students in low-resource settings can still benefit from personalized and engaging learning experiences (Miao et al., 2021; Vanbecelaere et al., 2020). Initiatives such as UNESCO's AI for Development (AI4D) programme have demonstrated how AI can be leveraged to bridge educational inequalities, particularly in regions where teacher shortages and resource constraints pose significant challenges (UNESCO, 2021; UNESCO, 2023).

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AI is transforming the way students collaborate, fostering inclusive learning environments where peer interaction is actively facilitated. Intelligent tutoring systems and AI-driven collaborative learning platforms can group students based on complementary skills, learning preferences, or academic performance, encouraging peer-supported learning (Xu & Ouyang, 2022; Zhao, 2023). For instance, AI-powered educational platforms such as Squirrel AI and Carnegie Learning employ algorithms that pair students with learning partners whose strengths and weaknesses are complementary, enhancing cooperative problem-solving (Chen et al., 2020; Holstein et al., 2019; Seo et al., 2024). Empirical studies show that such AI-facilitated groupings improve academic outcomes compared to traditional methods, particularly for neurodivergent learners (Xu & Ouyang, 2022; Zhao, 2023).

AI-driven discussion forums and virtual learning assistants enable students to engage in collaborative projects regardless of physical location (Ma'amor et al., 2024; Teoh et al., 2025). Such technologies are particularly beneficial for students with disabilities, as AI-enhanced communication tools—such as speech-to-text applications and AI-generated captions—allow them to participate more effectively in group activities (Niemi, 2021; Alper & Goggin, 2017). By reducing communication barriers and promoting interaction, AI fosters an inclusive learning culture where all students, irrespective of their abilities or backgrounds, can engage in meaningful knowledge exchange (Teoh et al., 2025).

The integration of AI into education presents a transformative opportunity to promote inclusivity by addressing language barriers, ensuring equitable access to learning resources, and fostering collaborative learning environments. AI-driven translation tools, culturally responsive content generation, adaptive learning platforms, and intelligent peer-matching systems all contribute to creating a more inclusive and accessible educational landscape (UNESCO, 2023). However, as AI becomes more embedded in educational practice, it remains imperative for policymakers and educators to ensure that these technologies are implemented ethically and equitably (European Commission, 2022).

Challenges and Ethical Considerations

The integration of artificial intelligence into education offers transformative potential for inclusivity and personalized learning. However, it raises a range of ethical and practical concerns that must be addressed to ensure equitable and responsible implementation. Key challenges include data privacy and security, bias in AI algorithms, the digital divide, and the necessity for teacher training (European Commission, 2022; UNESCO, 2023).

One of the most pressing concerns surrounding AI in education is the collection, storage, and use of student data. AI-powered educational tools rely on vast amounts of personal information, including students' learning patterns, behavioral data, and academic performance, to generate tailored learning experiences (Binhammad et al., 2024; Holmes et al., 2022). While such data-driven approaches can enhance teaching effectiveness, they pose risks related to data security and student privacy (Kwet & Prinsloo, 2020; Williamson & Eynon, 2020). Instances of data breaches and unauthorized access to student or learner-related records—as in the 2022 ransomware incident involving a UK software provider to the NHS (ICO, 2025)—have raised widespread concern about how educational institutions and technology providers safeguard sensitive information (Zawacki-Richter et al., 2019).

The long-term implications of data collection remain uncertain. Questions arise regarding who has access to student data, how it is used, and whether it could lead to profiling or tracking that may disadvantage certain learners (Eynon & Young, 2020; Kwet & Prinsloo, 2020). To address these concerns, policymakers must enforce stringent data protection regulations, such as the General Data Protection Regulation (GDPR) in the European Union, to ensure transparency and accountability in AI-driven educational tools (European Commission, 2022; Luckin et al., 2022). Ethical AI frameworks, including clear consent mechanisms and

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anonymization processes, are crucial in mitigating privacy risks and maintaining trust in AI-enhanced learning environments (Binhammad et al., 2024; Vanbecelaere et al., 2020).

These case studies and tools illustrate AI's capacity to democratize access to quality education. However, several challenges persist. Ethical risks arise, as seen in the Kenyan AI4D initiative, which faced criticism for relying on foreign-developed algorithms, raising concerns about data sovereignty (Miao et al., 2021). Sustainability is another key issue, with projects like India's Educate Girls requiring ongoing funding and local stakeholder engagement to avoid the risk of "pilotitis" (UNICEF, 2023). Additionally, cultural relevance remains crucial, as tools like MATHia must be adapted to regional curricula to prevent pedagogical dissonance (OECD, 2023). AI-driven innovations are reshaping inclusive education, yet their success depends on equitable design, teacher collaboration, and systemic support. As demonstrated by Finland's formative assessments and Kenya's offline tutors, AI can bridge educational gaps when aligned with local needs and ethical frameworks. Future efforts must focus on co-designing solutions with marginalized communities to ensure that technology serves as a catalyst for equity rather than exclusion.

AI systems are only as objective as the data on which they are trained. If algorithms are built using biased datasets, they risk perpetuating and reinforcing existing inequalities in education (Baker & Hawn, 2021; Noble, 2018). Research has shown that AI models used in education, including automated grading systems and personalized learning platforms, can exhibit biases based on factors such as gender, race, and socio-economic status (Holmes et al., 2022). These biases may result in unfair assessments, misclassification of students' abilities, or disparities in the learning support provided to different demographic groups (Ma'amor et al., 2024; UNESCO, 2023).

To counteract algorithmic bias, developers must prioritize the creation of diverse and representative datasets while implementing bias detection and mitigation strategies (Eynon & Young, 2020). Transparent AI systems, subject to regular auditing and human oversight, are essential to ensuring fairness and equity in AI-assisted education (Chen et al., 2020; European Commission, 2022). Additionally, interdisciplinary collaboration between educators, ethicists, and technologists can help design AI applications that align with inclusive pedagogical principles (Holstein et al., 2019; Niemi, 2021; Seo et al., 2024).

While AI has the potential to bridge educational gaps, it may exacerbate inequalities if not implemented equitably. Access to AI-driven educational tools often depends on digital infrastructure, internet connectivity, and financial resources, all of which are unevenly distributed across different regions and socio-economic groups (Williamson & Eynon, 2020; UNICEF, 2023). Studies have highlighted that students from lower-income backgrounds are less likely to benefit from AI-enhanced learning due to limited access to digital devices and high-speed internet (Holmes et al., 2022; Miao et al., 2021). This phenomenon, often referred to as the "digital divide," poses a significant threat to the inclusivity that AI aims to foster (Vanbecelaere et al., 2020; Selwyn, 2004).

Addressing this issue requires targeted investment in digital infrastructure and policies that promote equitable access to AI-driven educational technologies (Luckin et al., 2022; UNESCO, 2023). Initiatives such as AI-enabled offline learning applications and affordable, open-access educational platforms have demonstrated promise in reaching marginalized learners (Miao et al., 2021; Zawacki-Richter et al., 2019). For example, UNESCO's 2023 pilot of AI-powered mobile classrooms in rural Kenya improved literacy rates by 25% among girls with no prior access to formal schooling (UNESCO, 2023). However, without systemic efforts to ensure digital equity, AI risks deepening existing educational disparities rather than alleviating them (Eynon & Young, 2020; Selwyn, 2004).

The successful integration of AI in education is contingent on teachers' ability to use these technologies effectively. However, many educators lack the necessary training and confidence to incorporate AI-driven tools into their teaching practice (Chen et al., 2020; Molenaar, 2022). Research indicates that while AI can support differentiated teaching and reduce administrative workload, its benefits are often underutilized due to teachers' limited familiarity with AI applications (Holstein et al., 2019; Ma'amor et al., 2024; Seo et al.,

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2024). Inadequate training can lead to ineffective use of AI tools, diminishing their potential to enhance inclusivity and student engagement (Niemi, 2021; Tan, 2023).

To maximize the impact of AI in education, professional development programmes must equip teachers with the skills needed to integrate AI into pedagogical practice (Luckin et al., 2022; UK Department for Education, 2023). Training should not only focus on the technical aspects of AI tools but also address ethical considerations, ensuring that teachers can critically assess AI-generated insights and maintain human oversight in decision-making processes (Holstein et al., 2019; Seo et al., 2024; Williamson & Eynon, 2020). Collaboration between educational institutions, policymakers, and AI developers is essential in fostering a workforce that is prepared to navigate the evolving landscape of AI-enhanced education (European Commission, 2022; Holmes et al., 2022).

While AI presents significant opportunities for enhancing inclusivity in education, its implementation must be approached with caution to mitigate ethical and practical challenges. Concerns related to data privacy, algorithmic bias, digital inequality, and teacher preparedness must be addressed to ensure that AI serves as an enabler of educational equity rather than a source of further disparity (UNESCO, 2023; Nemer, 2015; Selwyn, 2004). Future research and policy initiatives should focus on establishing robust ethical frameworks, equitable access strategies, and comprehensive teacher training programmes to maximize the potential of AI-driven inclusive education (European Commission, 2022).

Conclusion

The integration of artificial intelligence (AI) into education represents a paradigm shift in addressing the persistent challenges of inclusivity and differentiation in classrooms. This paper has explored AI's transformative potential through a synthesis of theoretical frameworks, empirical evidence, and global case studies. The findings underscore that AI-driven approaches can indeed foster inclusive education by personalizing instruction, dismantling systemic barriers, and empowering educators.

AI's capacity to deliver differentiated teaching aligns with the principles of Universal Design for Learning (UDL), offering multiple pathways for engagement, representation, and expression (Alper & Goggin, 2017; Chen et al., 2020). Tools such as Microsoft's Immersive Reader and MIT's AlterEgo exemplify how AI can transcend traditional limitations, enabling students with disabilities to participate fully in learning processes (UK Department for Education, 2023; MIT Media Lab, 2023). These innovations resonate with UNESCO's (2023) vision of inclusive education, which prioritizes adaptability and equity in pedagogical design.

Despite its potential, AI's integration into education is not without risks. The dual-edged nature of data dependency—central to personalized learning—exposes students to privacy breaches and algorithmic profiling (Binhammad et al., 2024; Kwet & Prinsloo, 2020). The 2022 ransomware incident involving a UK software provider supporting healthcare services starkly illustrates the vulnerabilities inherent in data-driven systems (ICO, 2025). Such incidents underscore the urgency of robust regulatory frameworks—such as GDPR—and ethical AI guidelines that prioritize transparency, consent, and cybersecurity (European Commission, 2022).

Algorithmic bias further complicates AI's role in inclusive education (Julien, 2024). Studies revealing systemic under-marking of non-Western students' essays (Al-Zahrani, 2024) or disparities in AI-supported resource allocation (Baker & Hawn, 2021) challenge the notion of AI as a neutral arbiter. These biases, often rooted in unrepresentative training data, risk entrenching the very inequalities AI seeks to resolve (Noble, 2018). Mitigating such risks necessitates interdisciplinary collaboration, with educators, ethicists, and technologists co-designing systems that align with inclusive pedagogies (Holstein et al., 2019; Seo et al., 2024).

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The digital divide remains a formidable barrier. While AI-powered mobile classrooms in Kenya improved literacy rates by 25% among marginalized girls (UNESCO, 2023), such successes are fragile without sustained investment in infrastructure and teacher training. The disparity in access to high-speed internet and devices—evident in low-income regions—threatens to amplify existing inequities, rendering AI a tool of exclusion rather than inclusion (Nemer, 2015; Selwyn, 2004).

AI's efficacy hinges on educators' ability to harness its potential. While tools like MagicSchool AI reduce administrative burdens by 12 hours weekly (Molenaar, 2022), many teachers lack the training to critically evaluate AI-generated insights or adapt tools to local contexts (Tan, 2023). Professional development programmes, such as the UK's AI in Schools framework (UK Department for Education, 2023), must prioritize not only technical proficiency but also ethical literacy, empowering teachers to navigate AI's complexities while retaining pedagogical agency.

The interplay of AI's promise and perils calls for a nuanced, justice-oriented approach. Policymakers must champion equitably access through initiatives like open-source platforms and AI-enabled offline tools (Miao et al., 2021). Simultaneously, developers should adopt participatory design methodologies, engaging marginalized communities in co-creating culturally responsive solutions (OECD, 2023). Ethical frameworks, such as those proposed by the European Commission (2022), must evolve dynamically to address emerging challenges, from data sovereignty to algorithmic accountability.

AI's role in inclusive education is neither a panacea nor a peril—it is a tool whose impact depends on intentionality and oversight. By leveraging AI's strengths in personalization and accessibility while addressing its ethical and systemic pitfalls, educators and policymakers can advance SDG 4's vision of equitable, lifelong learning. The path forward demands vigilance, collaboration, and a steadfast commitment to prioritizing human dignity over technological expediency. As this paper has shown, the future of inclusive education lies not in replacing teachers with algorithms, but in fostering synergies where AI amplifies human potential and equity guides innovation.

Disclosure statement

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References

Ainscow, M. (2020). Promoting inclusion and equity in education: lessons from international experiences. *Nordic Journal of Studies in Educational Policy*, *6*(1), 7–16. https://doi.org/10.1080/20020317.2020.1729587

Albuquerque, J., Rienties, B., Holmes, W., & Hlosta, M. (2024). From hype to evidence: exploring large language models for inter-group bias classification in higher education. *Interactive Learning Environments*, 1–23. https://doi.org/10.1080/10494820.2024.2408554

Alper, M., & Goggin, G. (2017). Digital technology and rights in the lives of children with disabilities. New Media & Society, 19(5), 726-740. https://doi.org/10.1177/1461444816686323

Al-Zahrani, A. M. (2024). Unveiling the shadows: Beyond the hype of AI in education. *Heliyon*, 10(9), e30696. https://doi.org/10.1016/j.heliyon.2024.e30696

Artiles, A. J., Rose, D., Gonzalez, T. & Bal, A. (2020). Biology and culture in learning disabilities research: Legacies and possible futures. In N. S. Nasir, C. Lee, R. Pea, & M. M. de Royson (Eds.), *Handbook of the cultural foundations of learning* (pp. 160-177). Routledge.

Baker, R. S., & Hawn, A. (2021). Algorithmic bias in education. *International Journal of Artificial Intelligence in Education*, 32, 1052–1092. https://doi.org/10.1007/s40593-021-00285-9

Binhammad, M. , Othman, A. , Abuljadayel, L. , Mheiri, H. , Alkaabi, M. and Almarri, M. (2024) Investigating How Generative AI Can Create Personalized Learning Materials Tailored to Individual Student Needs. *Creative Education*, 15(7), 1499-1523 10.4236/ce.2024.157091.

Carnegie Learning. (2023). *MATHia impact report: Enhancing problem-solving in neurodiverse learners*. Carnegie Mellon University.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access, 8*, 75264-75278. https://doi.org/10.1109/ACCESS.2020.2988510

Chu, H.-C., Hwang, G.-H., Tu, Y.-F., & Yang, K.-H. (2022). Roles and research trends of artificial intelligence in higher education: A systematic review of the top 50 most-cited articles. *Australasian Journal of Educational Technology*, *38*(3), 22–42. https://doi.org/10.14742/ajet.7526

European Commission: Directorate-General for Education, Youth, Sport and Culture. (2022). *Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning* for educators. Publications Office of the European Union. https://data.europa.eu/doi/10.2766/153756

Eynon, R., & Young, E. (2020). Methodology, Legend, and Rhetoric: The Constructions of AI by Academia, Industry, and Policy Groups for Lifelong Learning. *Science, Technology, & Human Values*, 46(1), 166-191. https://doi.org/10.1177/0162243920906475

Florian, L. (2019). On the necessary co-existence of special and inclusive education. *International Journal of Inclusive Education*, *23*(7–8), 691–704. https://doi.org/10.1080/13603116.2019.1622801

Füller, J., Tekic, Z., & Hutter, K. (2024). Rethinking Innovation Management—How AI Is Changing the Way We Innovate. *The Journal of Applied Behavioral Science*, 60(4), 603-612. https://doi.org/10.1177/00218863241287323

Julien, G. (2024). How Artificial Intelligence (AI) impacts inclusive education. *Educational Research and Reviews*, 19(6), 95-103. https://doi.org/10.5897/ERR2024.4404

Hattie, J., & Clarke, S. (2019). *Visible Learning: Feedback*. Routledge. https://doi.org/10.4324/9780429485480

Holmes, W., Porayska-Pomsta, K., Holstein, K., Sutherland, E., Baker, T., Shum, S. B., ... & Koedinger, K. R. (2022). *Ethics of AI in education: Towards a community-wide framework*. International Journal of Artificial Intelligence in Education, 32(3), 504-526. https://doi.org/10.1007/s40593-021-00239-1

Holstein, K., McLaren, B. M., & Aleven, V. (2019). Co-Designing a Real-Time Classroom Orchestration Tool to Support Teacher–AI Complementarity. *Journal of Learning Analytics*, *6*(2), 27–52. https://doi.org/10.18608/jla.2019.62.3

ICO (Information Commissioner's Office). (2025). Software provider fined £3m following 2022 ransomware attack. https://ico.org.uk/about-the-ico/media-centre/news-and-blogs/2025/03/software-provider-fined-3m-following-2022-ransomware-attack/

Khine, M.S. (2024). Educational Data Mining and Learning Analytics. In: Khine, M.S. (eds) *Artificial Intelligence in Education*. Springer, Singapore. https://doi.org/10.1007/978-981-97-9350-1_1

Kopczynski, K. & Silvia, C. (2024) Use of AI in a World Language Classroom. *Creative Education*, 15, 2687-2705 10.4236/ce.2024.1512163.

Kwet, M., & Prinsloo, P. (2020). The smart classroom: a new frontier in the age of the smart university. *Teaching in Higher Education, 25*(4), 510–526. https://doi.org/10.1080/13562517.2020.1734922

Literatu. (2023). Scribo impact report: Supporting ESL learners in Australian schools. Literatu Pty Ltd. https://edcuration.com/1317/Scribo+by+Literatu

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Luckin, R., Cukurova, M., Kent, C., & du Boulay, B. (2022). Empowering educators to be AI-ready. *Computers and Education: Artificial Intelligence*, 3, 100076. https://doi.org/10.1016/j.caeai.2022.100076

Ma'amor, H., Achim, N., Ahmad, N. L., Roszaman, N. S., Kamarul Anuar, N. N., Khairul Azwa, N. C. A., Abd Rahman, S. N., & Aqilah Hamjah, N. A. (2024). The Effect of Artificial Intelligence (AI) on Students' Learning. *Information Management and Business Review*, *16*(3S(I)a), 856-867. https://doi.org/10.22610/imbr.v16i3S(I)a.4178

Miao, F., Holmes, W., & Ronghuai, H. (2021). *AI and mobile learning: Bridging the digital divide in Global South education systems*. UNESCO. https://doi.org/10.54675/PCSP7350

MIT Media Lab. (2023). AlterEgo pilot study: Enabling communication for non-verbal students. MIT. https://www.media.mit.edu/projects/alterego/overview/

Molenaar, I. (2022). Towards hybrid human-AI learning technologies. *European Journal of Education, Research, Development & Policy*, 57(4), 632-645. https://doi.org/10.1111/ejed.12527

Nemer, D. (2015). From Digital Divide to Digital Inclusion and Beyond. *The Journal of Community Informatics*, 11(1). https://doi.org/10.15353/joci.v11i1.2857

Niemi, H. (2021). AI in learning: Preparing grounds for future learning. *Journal of Pacific Rim Psychology*, 15. https://doi.org/10.1177/18344909211038105

Noble, S. U. (2018). *Algorithms of oppression: How search engines reinforce racism.* New York University Press.

Nyaaba, M., Zhai, X., & Faison, M. Z. (2024). Generative AI for Culturally Responsive Science Assessment: A Conceptual Framework. *Education Sciences*, *14*(12), 1325. https://doi.org/10.3390/educsci14121325

OECD-Education International (2023). *Opportunities, Guidelines and Guardrails on Effective and Equitable Use of AI in Education*, OECD Publishing, Paris.

Ofsted. (2023). *Technology in inclusive education: Annual report 2023*. Ofsted. https://assets.publishing.service.gov.uk/media/66979481fc8e12ac3edafe3a/31795_Ofsted_Annual_Report_and_Accounts_2023-24_-_Accessible.pdf

Rogahang, S. S. N., Paramansyah, A., Zaelani, K., Iqbal, M., & Judijanto, L. (2024). Inclusive Education Practices: Fostering Diversity and Equity in the Classroom. *Global International Journal of Innovative Research*, *1*(3), 260–266. https://doi.org/10.59613/global.v1i3.46

Santamaria, L. J. (2009). Culturally Responsive Differentiated Instruction: Narrowing Gaps between Best Pedagogical Practices Benefiting All Learners. *Teachers College Record*, 111(1), 214-247. https://doi.org/10.1177/016146810911100105

Scarparolo, G., & Subban, P. (2021). A systematic review of pre-service teachers' self-efficacy beliefs for differentiated instruction. *Teachers and Teaching*, *27*(8), 753–766. https://doi.org/10.1080/13540602.2021.2007371

Selwyn, N. (2004). Reconsidering Political and Popular Understandings of the Digital Divide. *New Media & Society*, 6(3), 341-362. https://doi.org/10.1177/1461444804042519

Seo, K., Yoo, M., Dodson, S., & Jin, S. H. (2024). Augmented teachers: K–12 teachers' needs for artificial intelligence's complementary role in personalized learning. *Journal of Research on Technology in Education*, 1–18. https://doi.org/10.1080/15391523.2024.2330525

Slee, R. (2018). *Inclusive education isn't dead, it just smells funny*. Routledge.

Smale-Jacobse, A. E., Meijer, A., Helms-Lorenz, M., & Maulana, R. (2019). Differentiated Instruction in Secondary Education: A Systematic Review of Research Evidence. *Frontiers in psychology*, *10*, 2366. https://doi.org/10.3389/fpsyg.2019.02366

Tariq, M. U. (2024). AI-Powered Language Translation for Multilingual Classrooms. In R. Doshi, M. Dadhich, S. Poddar, & K. Hiran (Eds.), *Integrating Generative AI in Education to Achieve*

CC BY

Sustainable Development Goals (pp. 29-46). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-2440-0.ch002

Teoh, S. H., Boon Zik Hong, J., Md Shamsudin, N., Singh, P., & Hartono, R. (2025). Students' engagement in a hybrid classroom: a comparison between face-to-face and virtual environments. *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2025.2451497

Tomlinson, C. A. (2017). Differentiated Instruction. In C. M. Callahan, & H. L. Hertberg-Davis (Eds.), *Fundamentals of Gifted Education* (pp. 279-292). Routledge. https://doi.org/10.4324/9781315639987-26

UNESCO (2015). SDG4-Education 2030, Incheon Declaration (ID) and Framework for Action. For the Implementation of Sustainable Development Goal 4, Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All, ED-2016/WS/28.

UNESCO. (2017). A Guide for Ensuring Inclusion and Equity in Education. UNESCO https://unesdoc.unesco.org/ark:/48223/pf0000248254

UNESCO. (2021). AI and education: Guidance for policy-makers. UNESCO https://unesdoc.unesco.org/ark:/48223/pf0000376709

UNESCO. (2023). AI in education: A guide to inclusive design and implementation. UNESCO https://www.unesco.org/en/digital-education/artificial-intelligence

UNESCO. (2023). Global education monitoring report: Technology in education—A tool on whose terms? UNESCO https://www.unesco.org/gem-report/en/technology

UNESCO. (2023). AI for Development Africa: Final evaluation report. UNESCO.

UNICEF. (2023). AI for education in emergencies: Evidence from sub-Saharan Africa. UNICEF https://www.unicef.org/innocenti/media/10126/file/UNICEF-Innocenti-Improving-Education-Africa-Brief-2024.pdf

UK Department for Education. (2023). *AI in schools: Teacher training framework*. Gov.uk. https://www.gov.uk/government/publications/generative-artificial-intelligence-in-education/generative-artificial-intelligence-ai-in-education

Vanbecelaere, S., Van den Berghe, K., Cornillie, F., Sasanguie, D., Reynvoet, B., & Depaepe, F. (2020). The effects of two digital educational games on cognitive and non-cognitive math and reading outcomes. *Computers & Education*, 143, 103680. https://doi.org/10.1016/j.compedu.2019.103680

Vlachou, A. (2023). Introductory note: Inclusive Education Matters, In L. Graham & A. Vlachou (Eds.), *Inclusive Education for the 21st Century. Theory, Policy and Practice*, (pp. 11-26) [In Greek]. Pedio

Waitoller, F. R., & Artiles, A. J. (2020). *Teacher learning as curating: Becoming inclusive educators in school/university partnerships*. Teaching and Teacher Education, 95, 103127. https://doi.org/10.1016/j.tate.2016.07.007

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology*, *45*(3), 223–235. https://doi.org/10.1080/17439884.2020.1798995

Xu, W., & Ouyang, F. (2022). The application of AI technologies in STEM education: a systematic review from 2011 to 2021. *International Journal of STEM Education*, 9(1), 1-20. https://doi.org/10.1186/s40594-022-00377-5

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 1-27. https://doi.org/10.1186/s41239-019-0171-0

Zhao, T. (2023). AI in Educational Technology. *Preprints.* https://doi.org/10.20944/preprints202311.0106.v1

Zhu, Y. (2024). The Impact of AI-Assisted Teaching on Students' Learning and Psychology. *Journal of Education, Humanities and Social Sciences*, *38*, 111-116. https://doi.org/10.54097/k7a37d11

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