The Transformative Influence of Artificial Intelligence on Modern Education

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Abstract: The integration of Artificial Intelligence (AI) in education has significantly transformed teaching and learning practices, reshaping classrooms, homeschooling, and administrative processes. AI applications, including intelligent tutoring systems, adaptive personalized learning platforms, AI-powered tutoring assistants, and administrative automation tools, have enhanced learning efficiency, engagement, and accessibility for diverse learners. Real-world implementations, such as Khanmigo, Miko, Knewton, Carnegie Learning, and Gradescope, demonstrate measurable improvements in student performance, teacher productivity, and cost-effective education delivery. Furthermore, AI facilitates inclusion by bridging linguistic, visual, and socio-economic barriers. However, the widespread adoption of AI also raises ethical challenges, including data privacy concerns, algorithmic bias, and the exacerbation of the digital divide. While AI offers unprecedented opportunities for personalized, engaging, and efficient education, policymakers, educators, and developers must collaboratively ensure equitable, responsible, and effective implementation. This paper provides an overview of AI's transformative influence on modern education, highlighting both its benefits and critical challenges for future learning environments.

1. Introduction

1.1 Research Background

Artificial Intelligence (AI) is a field of technology that allows computers and machinery to simulate the human process of learning, comprehension, problem solving, decision making, creativity and autonomy [1]. It uses specific algorithms to process enormous amounts of data, learning how to label data and generate new, original content based on input data. As this form of technology matures throughout the years, AI has been implemented to use in multiple industries, and education is no exception. From enhancing personalised learning to automating processes such as grading students' works [2], AI is revolutionizing the way students learn, teachers educate, and institutions operate.

This essay aims to examine how AI has reshaped the educational system in schools and families, causing improved efficiency and better attainment of knowledge, along with the ethical concerns and challenges that come along with using this form of technology. By analysing real-life applications and critical debates, this paper provides an overview on AI's influence in education.

1.2 Historical Context: Technology's Role in Education before AI

Pre the digital era, traditional classrooms often relied on hard copy textbooks, chalkboards, and face to face communication, with instructions given verbally or on paper to students. However, as technology advances, forms of education have taken a gradual shift in becoming more modernized and efficient, as tools such as computers, projectors, and online platforms aid educators in delivering knowledge in a more substantial and accessible way. Students can now complete tasks digitally, receive work in the form of online assignments, and have access to an abundance of educational resources online, be it in the form of videos, eBooks, or articles. The Covid-19 pandemic also facilitated the use of online learning platforms and virtual meetings, such as Google Classroom and Zoom, as students and teachers are able to connect in real time and participate in class despite them not being in the same room physically [3]. The introduction of advanced AI further progressed the

above changes as they are able to address individual learning needs with more flexibility, exposing students and teachers to infinite ideas made possible.

2. Applications and Implementations of AI in Education

2.1 Assisting Teachers and Homeschooling

Currently, AI has been assisting educators in creating original educational content, improving efficiency and relieving workload on teachers. It can also act as a source of direction, supplementing teachers with ideas and outlines of what they could include in their lesson materials and talks. For instance, the Khan Academy content creation team began to use AI for drafting articles and generating questions for exercises [4]. AI is also capable of proofreading work and giving feedback and editing suggestions, enhancing readability, coherency, and quality in general.

Khanmigo, an AI-powered tutoring system, has been proved to be of aid to not only students but also teachers. Teachers have stated that Khanmigo is able to "generate a rubric from scratch", and families also believe that the software has been revolutionary to their homeschool, being "perfect for a family that asks 'why' constantly" [5].

Miko is a consumer electronics company that focuses on developing AI-based companion robots to educate and entertain children, catering to families who seek a cute, safe, and educational companion for their kids. This interactive robot is very durable, moves around easily, delivers videos and stories to children, listens and responds to spoken words, recognises faces, and plays games with your children [6]. Its enhanced encryption system ensures safety, and parents have full control over the robot through parental control applications on their phones. The company states that over a time period of three months, kids who used Miko were 55% more proficient in speaking, 46% more active, and had 55% more engagement with academic activities. The introduction of this robot to the family will empower parenting and help children go through social-emotional learning, developing vital skills necessary for school, life, and work.

It is also noteworthy that although a seemingly new technology, a Study.com survey in 2024 shows that 84% of educators have already begun to use AI tools in their classrooms, with many planning to expand its usage in upcoming years [7]. 65% of teachers also feel more passionate about teaching due to AI, as they hope to increase efficiency and work quality with the aid of this tool.

2.2 Personalised Learning

Many online platforms have been integrating AI into its system, providing students with opportunities for adaptive personalised learning. These platforms can identify students' learning patterns and provide customized learning content based on their strengths and weaknesses [8]. According to a study by Ptatam et al., 88% of students who answered the questionnaire strongly agreed that AI is an important factor affecting learning nowadays, and that personalised learning is of great help to students, addressing identified learning gaps by providing targeted interventions [9].

Knewton, an adaptive learning company, states that their study of more than 10,000 users showed that all students, especially those who were struggling with academics, have shown immense improvement in grades and assignment completion rates [10]. See Fig. 1 for more information.
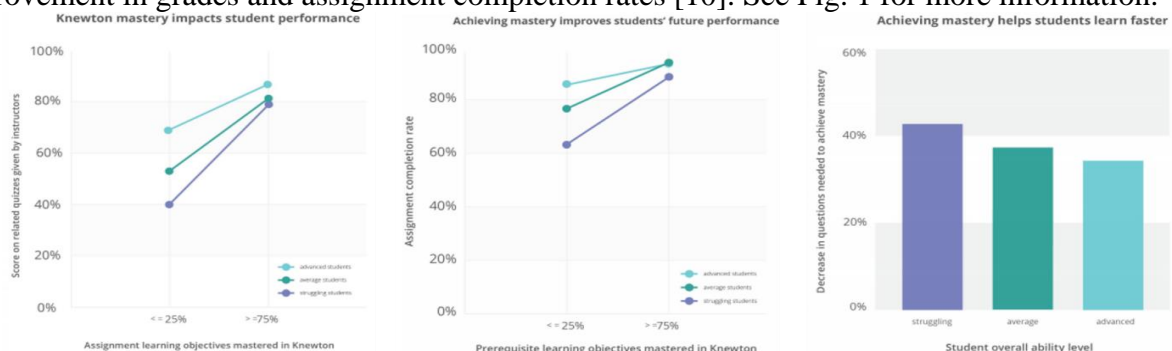

Fig. 1 Image from Source [10]

Knewton has supplemented most of its content from open education resources, successfully lowering costs for students [10]. Teachers are also permitted to upload their own content into the platform, supplementing teaching resources for students. The cost-saving measures AI provides is yet another benefit to its usage in education.

2.3 Intelligent Tutoring Systems (ITS)

Intelligent Tutoring Systems are computer systems that imitate human tutors, providing customised instructions and feedback to learners [11]. Although similar to personalised learning systems, ITS are specifically designed to replicate the tutoring process and relies heavily on AI, whereas personalised learning systems incorporate a broader range of educational tools and resources.

Carnegie Learning is a platform that makes use of ITS integrated with personalised learning systems. A case study shows that after the Struthers City School District began using Carnegie Learning's MATHia software to aid the teaching of the math curriculum, along with the continued usage of traditional textbooks, the scores of 6th graders and 8th graders in the Ohio state exam (2018-2019) have shown a 10.9% and 9.5% improvement respectively [12].

Other softwares that make use of ITS include Khanmigo and AutoTutor. These apps simulate human tutoring by using conversational AI to create interactive, dialogue-driven learning experiences. Similarly, both support open-ended, dialogue-based learning, make use of Natural Language Processing systems (NLP), provide students with real-time feedback, and can be used across a variety of subjects.

On the contrary, some platforms that use ITS, such as Squirrel AI and iTalk2Learn, focus on specific subjects and are task-oriented, meaning they operate input-based with the user solving problems and completing exercises. Utilizing various AI platforms can significantly enhance students' learning experiences by providing them with options to explore the most effective approaches tailored to their individual needs.

2.4 Administrative Automation

Aside from the functions stated above, AI is also able to predict grades and reduce grading time. Carnegie Learning's APLSE meter is able to accurately predict exam scores, indicating likelihood of score improvements [12]. Among the students who got to green or yellow on the APLSE meter, 37 out of 42 have increased their scores on the Ohio state exam. See Fig. 2 for more information.
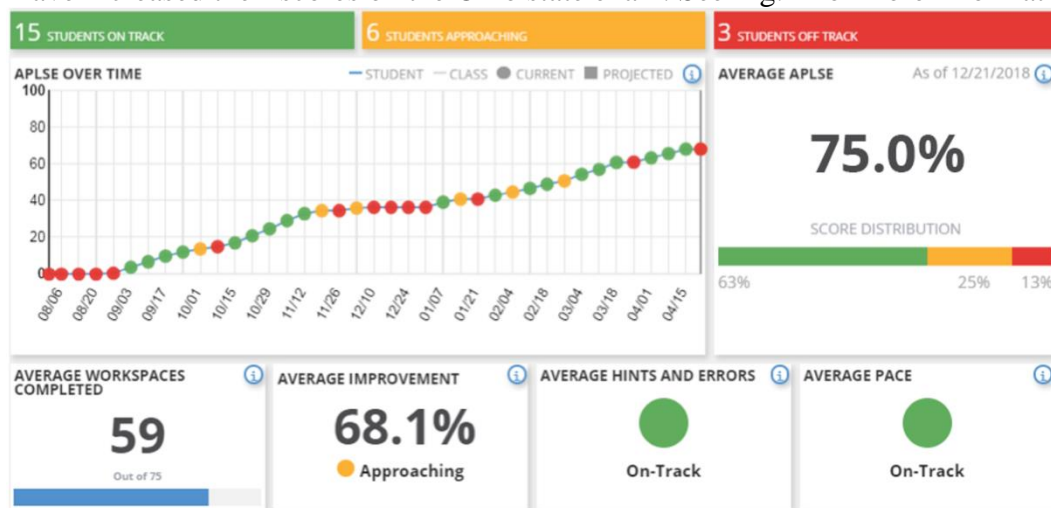

Fig. 2 Image from Source [10]

Gradescope is an American educational software company that offers online, AI-assisted grading tools [13], improving efficiency in marking by up to 80% [14]. It is able to grade assignments in multiple subject fields and send teachers' feedback to students via online, making the process of issuing work back very convenient [15]. Gradescope also provides analytics for teachers on average performances in class and shows overviews for questions, making it easier for teachers to grasp what areas students need to work on and enhancing the efficiency of revision and attainment of knowledge.

As of now, Gradescope has been working with more than 2,600 universities worldwide. Teachers have generally found the tool to be very helpful. As Katie Johnson from Florida Gulf Coast University states, "The statistics really help me understand what I can teach differently next time to help my students learn better." [15]

2.5 Enhancing Accessibility and Inclusion

An important function of AI that deserves more recognition is its ability to enhance accessibility and inclusion for all. This feature is also prominent in the field of education, as real-time AI-powered translators and speech-to-text tools break visual and linguistic barriers between members in diverse communities.

The Microsoft Translator is an AI-powered communication technology that offers automatic speech recognition, converting conversational spoken language, including stutters, into fluent, punctuational text [16]. The technology has been in use at the Rochester Institute of Technology in upstate New York, where nearly 700 students who are deaf and hard of hearing take courses with students who are hearing. The instructor's words were converted real-time into subtitles that were shown on screens, allowing students with difficulties to keep up. Although the captions were occasionally missing crucial information, such as confusion between "I" and "eye", they were "much better than not having anything at all," says Adjei. Such translators are also usable outside the classroom in daily communication, where subtitles become handy when conversations are too fast for lip reading and when people are talking in different languages.

Otter.ai is another AI-powered software that improves lesson accessibility with its multifunctional features [17]. As a tool that records audio in online meetings, takes notes, and automatically captures slides and generates summaries, Otter has assisted over 100,000 students in remote learning [18]. Otter's real-time captions have also helped students with hearing difficulties, especially during the Covid-19 pandemic, where lip reading is impossible with both teachers and students wearing masks.

3. Ethical Challenges and Concerns

3.1 Data Privacy Concerns

Although the usage of AI in education has brought us many benefits, there are still certain challenges and concerns regarding its large-scale implementation. For instance, many users are concerned with AI storing and misusing their data.

On June 20 2023, Group-IB, a cybersecurity company, identified 101,134 hacked devices with ChatGPT credentials [19]. These credentials were found to be traded on dark web marketplaces, allowing the exploitation of personal data and targeted attacks against companies and individuals. With few policies existing that govern AI usage, hackers could target schools that use AI, stealing private data from teachers and students.

3.2 Algorithmic Bias and Discrimination

As AI learns and is trained from given data, limitations in their database could result in disparities, where biases and limited information in data are passed on to the AI [20]. For example, if an AI that recommends literary materials to students is fed with data that focuses on western literature, generated responses may overlook works in the east, hindering students from acquiring diverse selections of literature [21].

Another case of bias involves GPT detectors being biased against non-native English speakers. A case study shows that when 91 TOEFL (Test of English as a Foreign Language) essays from Chinese speakers and 88 US eighth-grade essays were fed into popular GPT detector softwares, the essays from US students were accurately classified, whilst more than half of the TOEFL essays were labelled incorrectly as "AI-generated", reaching an average false-positive rate of 61.3% [22]. However, after using ChatGPT to enhance used vocabulary and simulate writing comparable to that of native speakers, the average false-positive rate of the TOEFL essays decreased by 49.7% (from 61.3% to 11.6%).

Cases of discrimination involve race, gender, and occupation. For example, facial recognition technology may be unable to recognize Black students [23]. Biased language models think that "flight attendants" and "secretaries" are feminine jobs, while "fisherman", "lawyer", and "judge" are masculine [24]. In regards to emotions, "anxious", "depressed", and "devastated" are seen as feminine.

3.3 Digital Divide

Certain poor schools and students are unable to afford AI, deeming the technology's fairness questionable as it actively exacerbates gaps between affluent and underfunded communities. For instance, the estimated percentages of students who have access to broadband internet and devices in different US states varies greatly [23]. See Fig. 3 for more information.
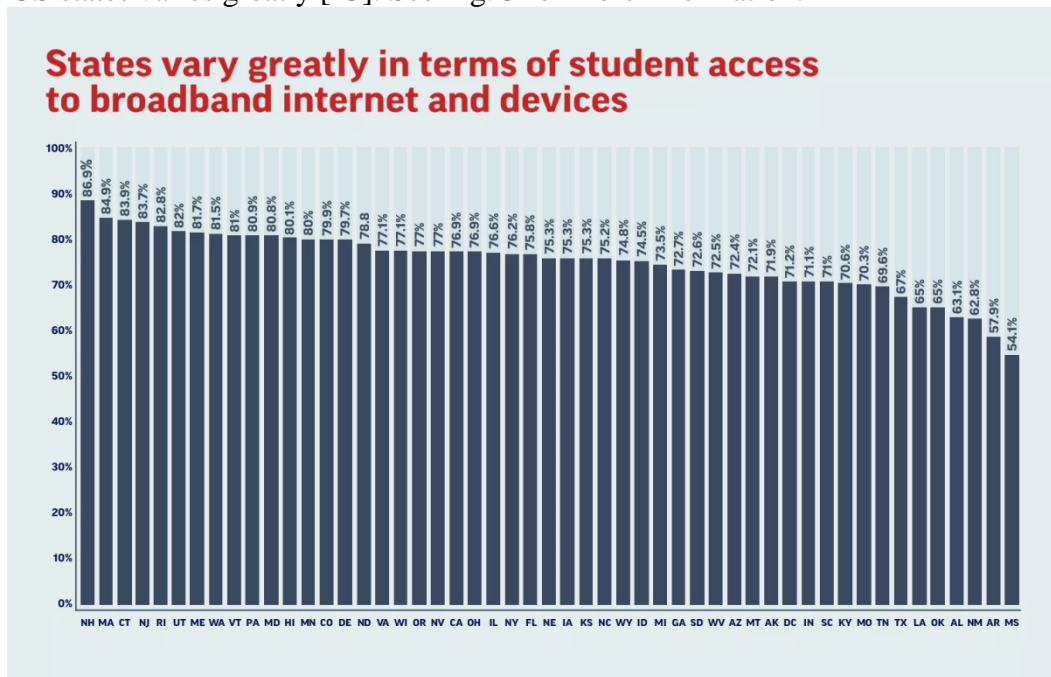

Fig. 3 Image from Source [23]

This disparity reinforces the polarization between the rich and the poor. As underfunded schools lack the financial resources required to implement AI in classrooms, the promise of AI in education risks becoming a privilege for the few rather than a right for all, deepening the digital divide between students of different economic backgrounds.

3.4 Miscellaneous

Aside from the above mentioned factors, teachers are concerned with students using AI to create unoriginal work that does not reflect their own efforts, raising issues regarding academic honesty. Using AI to help create educational resources could ultimately lead to a decrease in quality of work and originality, reducing credibility. AI is also known for falsifying data and crediting made-up sources as real, which causes discrepancies and misleads users.

Beyond these practical concerns, educators emphasize that AI cannot replicate the essential human elements of teaching, such as mentorship, emotional support, and creativity. Such factors are critical when fostering a well-rounded and meaningful educational experience. Learning environments with disregard to human teachers will take a toll on the mental health of students in the long run, as the lack of human interaction and personalised guidance may leave them feeling isolated or unsupported [25].

4. Conclusion

Nowadays, as the process of learning shifts from teacher-centered learning to student-centered learning, AI's integration into education provides students with personalised learning experiences and has helped to reshape the education system of many schools, offering unprecedented

opportunities. Its abilities to assist teachers and homeschooling, provide intelligent tutoring, reduce administrative burdens, and bridge accessibility gaps has shown tremendous promise in the future of education. By leveraging AI, educators can create more inclusive, engaging, and effective learning environments that cater to the individual needs of every student.

However, the introduction of AI in education is not without challenges. To fully utilise the potential of AI in education, policymakers, educators, and technology developers must work together to create a well-formed educational system that prioritises fairness, accessibility, and inclusivity.

Looking ahead, the future of AI in education is bright. As technology continues to evolve, AI has the potential to revolutionize not only how students learn, but also how educators teach and how schools and homeschooling functions. Seeing the current prospects of what AI can do, this technology has the capabilities to create a more dynamic and responsive education system, benefiting future students. By addressing the issues and harnessing the opportunities, we can improve on current AI models and teaching systems, ensuring that this tool becomes highly effective for empowering students, supporting teachers, and building a more equitable and innovative future for education worldwide.

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