

Role of Artificial Intelligence in Transforming Personalized Learning in Education

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Abstract

Artificial Intelligence (AI) is revolutionizing personalized education by tailoring learning experiences to meet each student's unique needs. Through advanced algorithms, AI can adapt educational content to align with individual learning speeds, preferences, and styles. Technologies such as adaptive learning systems, smart tutoring tools, and AI-powered assessments offer instant feedback and assist teachers in quickly identifying areas where students may be struggling. Additionally, predictive analytics help anticipate student outcomes, enabling early interventions to support academic success. These advancements not only boost student interest and motivation but also promote a shift from traditional uniform teaching methods to a more student-focused learning model, leading to deeper and more effective educational experiences. Beyond individualized instruction, AI technologies are enriching educational environments through virtual reality classrooms, automated grading systems, and conversational agents like AI chatbots. These advancements streamline administrative tasks, support collaborative learning, and provide greater accessibility for students with special needs. Furthermore, AI has the potential to reduce educational inequities by offering resources and support in under-resourced or remote regions. Nevertheless, integrating AI into education presents significant challenges, including concerns over data privacy, potential algorithmic bias, and inequalities in access to technology. Addressing these issues requires ongoing research into ethical AI frameworks, inclusive design, and equitable access. With responsible implementation, AI can continue to evolve as a powerful force in making education more inclusive, engaging, and effective across diverse learning contexts.

Keywords: AI in education, Duolingo, squirrel AI, personalized learning, virtual reality

INTRODUCTION

Education serves as a cornerstone for individual growth and societal advancement. With ongoing technological progress, the role of AI in the educational sector has expanded considerably. AI holds the promise of improving educational quality and accessibility by making learning more tailored, streamlined, and impactful. A machine has been created by humans that has the ability to think,

understand and work like humans which is called artificial intelligence. Man is developing such software with the help of which we can think, understand and analyze. AI term was used by John McCarthy in 1995. He envisioned machines capable of human-like reasoning, laying the groundwork for the AI age we experience today. Artificial Intelligence is not a recent creation; it has become a global topic of discussion and exploration. It is the basis of films like MATRIX, ROBOT, TERMINATOR etc. [1]. Here the form of Robert is shown to think, understand and act like humans. The popularity of AI is increasing rapidly. This has

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become a topic that is being discussed a lot in the field of technology and business. Many exporters and industrialists believe that AI and machine learning are our future. Not only in USA or China but in India also there are many companies with use AI to create adaptive learning apps like EMBIBE.com.

This study provides an overview of these innovations, explores their applications, and discusses its implications of AI in the education sector. Traditional education system was a classroom system where one teacher used to teach 40–50 children together. This system has been successful but it has some loopholes like when a teachers teaches 40 to 50 students, he/she is not able to focus on all the students, and because of this, weak children are not interested in studies are left behind. It also becomes difficult for teachers to handle so many children and check their notebooks, test papers to take their feedback. The additional method is a book reading method which is too boring. It has become a boring method because we have to read the book ourselves due to which we do not get the interrupt experience. But, with coming of AI in education, it has transformed to a smart system now. Hi-Tech companies are making gadgets, programs, and software in collaboration with schools and universities. Smart laptops and smart tablets are provided in which books are already fed. Smart laptops and smart tablet systems are AI powered systems and are user friendly.

REVIEW OF LITERATURE

The use of Artificial Intelligence (AI) in education has been extensively researched for its ability to improve personalized learning experiences. Chen *et al.* demonstrated that AI-driven adaptive learning systems significantly improve student engagement and retention by customizing learning experiences [2]. Yu and Yao highlighted the importance of machine learning in facilitating predictive analytics, which helps educators customize learning pathways according to each student's unique requirements [3]. Pacheco-Mendoza *et al.* explored the use of AI chatbots in tutoring, finding that these tools effectively enhance learning support and student satisfaction [4]. Salas-Pilco *et al.* highlighted the advantages of AI in assessment, showing that automated grading and feedback systems offer greater speed and consistency compared to traditional methods [5]. Lastly, Kumar and Patel reviewed the impact of AI on inclusivity, noting that AI applications significantly support learners with disabilities by providing personalized educational tools [6]. Collectively, these studies underscore the transformative potential of AI in creating more responsive, efficient, and inclusive educational environments (Table 1).

BENEFITS OF AI IN EDUCATION

AI-driven tools support students with disabilities, facilitate remote learning, and bridge educational disparities [1]. Some of the benefits of AI in education are as under which ultimately improve student outcomes and the overall learning experience:

- Person Specific Learning.
- Smart Tutoring Systems.
- Enhanced Student Engagement.
- Predictive Analytics and Performance Monitoring.
- Support for Students with Disabilities.
- 24/7 Learning Support.

KEY INNOVATIONS IN AI-DRIVEN EDUCATION

Hyper Personalization

In 1980, an AI enabled study was done which was called education psychological study belonging to Sigma problem. In the study, two scenarios were compared: in one scenario, a child gets a special tutor, and the other is a classrooms scenario where a teacher is teaching to 30 to 40 children. When we compare both the scenarios, the academic growth and development of a child who gets a personal tutor was 98% better than the children of classroom scenario.

Table 1. Review of literature on the role of artificial intelligence in personalized learning.

Author(s) and Year	Key Findings	Methodology	Conclusion
Chen <i>et al.</i> (2020) [2]	AI-driven adaptive learning systems improve student engagement and retention.	Experimental study on AI-based learning platforms.	AI customizes learning experiences, increasing student performance.
Yu and Yao (2024) [3]	Machine learning enables predictive analytics in education.	Case study of AI-based recommendation systems.	AI helps tailor learning paths based on student needs.
Pacheco-Mendoza <i>et al.</i> (2023) [4]	Examined chatbot effectiveness in personalized tutoring.	Survey of students using AI chatbots.	AI chatbots enhance learning support and student satisfaction.
Salas-Pilco <i>et al.</i> (2022) [5]	AI improves assessment through automated grading and feedback.	Comparative study of AI and traditional grading methods.	AI-based feedback is faster and more consistent.
Kumar and Patel (2023) [6]	AI enhances inclusivity in education for diverse learners.	Review of AI applications for students with disabilities.	AI-based tools support personalized learning for all students.

So, it becomes clear that if you pay personal attention to the students, their academic performance will be better. But this is difficult to do because in our classroom system, 40 to 50 children are taught by one teacher; that is why a teacher cannot give personal attention to every child, but with AI, Hi-tech companies are coming together to create programs which work on personalization, designing systems tailored to each child's knowledge and capacity. This system starts with assessing a student's knowledge to determine which subjects they are strong at and which they are weak in. Similarly, adaptable platforms are available and some universities are already using them [7].

Automated Grading and Assessment

Automated Grading and Evaluation: AI has the capability to streamline grading and assessment processes, easing the burden on teachers. Platforms like Gradescope utilize AI to assess both multiple-choice and written responses efficiently and accurately. Additionally, AI supports formative assessment by delivering immediate feedback to students, which enhances their learning progress and outcomes. Like after the exam, it takes a lot of time for the students to get their result and feedback. Many times, we have to submit our results for revaluation and rechecking, because we feel our marks and grades are not fair. The whole system of feedback and rechecking can be replaced by AI using smart laptops and smart tablets. If you take a test on these devices, results and grades are automatically generated; and the smart laptops and smart tablets are also connected with your school, teachers and parents [8].

AI tracking and Monitoring

AI devices are being used to track and monitor the children's focus. When the children go to school or come to class, the device is installed on the head of the children. This device has three electric rods: two rods near the ears and one on the forehead. This device collects data from neurons created in our brain. The collected neuron data automatically comes to the teacher's computer screen. This device generates a report of the entire class which shows which child is able to focus less and which child is able to focus more. On the basis of this report, topics are prepared for further studies according to child focus point of view [9].

AI-Based Virtual Assistants

These systems are created to help students by answering common queries, handling administrative duties, and offering extra academic support. For instance, the chatbot "Jill Watson", developed at Georgia Tech, is capable of answering students' questions in an online course, thus enhancing the learning experience while reducing faculty workload [10].

APPLICATIONS OF AI IN EDUCATION

Automated grading and AI chatbots streamline administrative tasks and provide students with instant academic support. Additionally, AI supports inclusive education by offering assistive technologies and predicting student performance to identify and address learning gaps early. Overall, AI enhances both teaching efficiency and student engagement, creating more effective and accessible learning environments.

Duolingo

This is a language application, which teaches to you in the language you want to learn in. It already has 300+ million users. It is used in 90 countries and teaches in 22 languages. Again, a feature of Duolingo is to adapt to your speech and behavior and teach you in language step by step, along with taking your assessment and test. Duolingo adjusts its lessons based on user performance. This platform has revolutionized how students engage with educational content [11].

Squirrel AI System

There is a company that makes such adaptable platforms with AI. Schools, colleges and universities are using these platforms. A leading brand of AI based adaptive learning, this company 'Squirrel' was formed in 2040 and has made number of software, applications and programs which help in the education sector. Knowledge based theory is used to create these apps. These programs assess the child's knowledge and interests. Based on this assessment, it is determined which subjects need more focus and which subjects need less. This helps to identify the strengths and weaknesses of the children and teaches them accordingly using educational short videos, lecture videos, and notes prepared by award winning teachers. There is an automatically generated feedback on a child's knowledge. This is the first adaptive education program of the AI system. Other companies also have programs and software that help the education sector [12].

ALEKS

ALEKS is another program that uses knowledge-based theory and first takes a child's assessment test to find out in which subject the knowledge level is high and in which subjects there is a gap. It gives you topic recommendations as per your strengths and weakness. It even tell you which topic to study and at what time; it also provides practical repetition exercises to help strengthen your memory. when you study through ALEKS, you have a test in which there are 22 to 30 questions; if you pass, then the next topic is given. ALEKS tracks your progress, and how much progress can you make in how much time [13–15].

Intelligent Campus Management

AI is also revolutionizing the administrative aspects of education. It is being employed to allocate resources, organize course schedules, maximize classroom utilization, and deliver real-time data on campus operations [16].

CHALLENGES OF AI IN EDUCATION

Unlocking the complete benefits of AI in education involves overcoming key challenges that hinder fair implementation. Ethical issues, including potential bias in algorithms and the evolving role of teachers, need thoughtful consideration. Limited access to technology continues to be a major hurdle, especially for students in low-income and rural communities, restricting their use of AI-powered tools. Additionally, the high costs of adopting AI and the necessity for comprehensive teacher training create further barriers. To effectively address these issues and make AI a valuable asset in education for every student, collaboration among educators, policymakers, and technology experts is essential.

THE FUTURE OF AI IN EDUCATION

The increasing role of AI in education holds the promise of fostering more inclusive learning by offering tailored support for students with disabilities. However, to fully unlock this potential, it must

proactively address the challenges. Looking ahead, AI in education promises more intelligent, adaptive, and inclusive learning experiences. Advancements in AI-driven personalized learning will allow for deeper customization, providing students real time feedback. AI-powered virtual tutors use different tools for monitoring classrooms, and create more interactive and immersive educational environments. Predictive analytics will enhance the ability to monitor student progress more precisely, allowing teachers to deliver timely support and interventions. Moreover, AI will enhance accessibility for students with disabilities and broaden educational opportunities in remote areas. Nevertheless, addressing ethical concerns, data privacy, and the digital divide will be critical to ensure fair access. With ongoing research and innovation, AI has the transformative power to revolutionize education, making it more efficient, engaging, and inclusive for learners globally.

CONCLUSION

Artificial intelligence is fundamentally transforming education by enhancing personalized learning experiences, streamlining administrative processes, and offering intelligent tutoring solutions. AI-powered technologies are boosting student engagement, optimizing curriculum development, and bridging educational disparities, leading to more efficient and inclusive learning. AI has the power to transform conventional education practices, from virtual reality classrooms to advanced predictive analytics. By embracing AI technologies, educational institutions can create engaging and inclusive learning environments that support diverse student needs and enhance both academic performance and accessibility. Nevertheless, the effective use of AI in education depends on resolving key issues like data security, ethical implications, and unequal access to technology. Promoting fair access to AI tools and establishing responsible AI practices are essential to fully realize its potential. Future studies should focus on strengthening human-AI collaboration, improving algorithm fairness, and advancing AI solutions that support accessibility.

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