

AI AGENTS FOR EDUCATION AND TRAINING

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ABSTRACT

Artificial intelligence (AI) agents have begun to play an important role in educational contexts, acting in different ways for learners and educators and adapting to their unique needs. These AI-driven technologies integrate into various learning environments, offering scalable and adaptive learning solutions. The current study discusses various approaches related to the application of AI agents in education and training, with a focus on current technological developments in the last few years. Different types of AI agents are explored and classified based on their roles in supporting students and educators. The study also presents the benefits and challenges of implementing AI agents, highlighting their potential to enhance and transform traditional education.

INTRODUCTION

Artificial intelligence is finding various applications in the field of education that are transforming traditional methods of teaching and helping in personalized learning (Dogan et al., 2023). AI agents are autonomous software systems or programs designed to perform tasks on behalf of users or other systems (Gutowska, 2024). In the context of education, AI Agents use advanced algorithms, including machine learning, natural language processing, and data analytics, to adapt their responses and effectively support learners and educators (Miao & Holmes, 2023). These agents can be in many different forms, such as virtual tutors, chatbots and intelligent learning systems. Most often they provide personalized support, facilitate content delivery and even automate administrative tasks (Ouyang & Jiao, 2021). The essence of AI agents lies in their capability for imitation of human intelligence and responsiveness. This makes them useful tools for enhancing the educational experience, improving engagement and addressing the diverse needs of learners in a scalable and effective way.

As the integration of AI agents into educational environments continues to grow, it is changing the roles of both teachers and students. With the increasing availability of big data and further development of deep learning techniques, AI agents can better understand complex student behaviour, predict learning outcomes and adapt educational content to meet individual learning needs (Chen et al., 2020; Vasilev & Sulova, 2023). This dual role of benefiting educators and personalizing learning is a significant change from the one-size-fits-all approach in traditional education to more student-centered adaptive learning ecosystems. Moreover, AI agents often find applications outside the classroom, for example in online learning platforms, corporate training programs and lifelong learning initiatives (Pavitra & Agnihotri, 2023; Palenski et al., 2024). Their implementation in different educational contexts reveals their flexibility and potential transforming power in various learning environments.

The aim of this paper is to analyze recent advances in AI agents for education and training. The study provides a review of the existing literature, highlighting the effectiveness of AI agents in transforming learning and teaching processes. Different types of agents and their pedagogical impact are discussed. The benefits, challenges and some future trends in the use of these technologies are identified.

1. LITERATURE REVIEW

The scientific literature on AI agents in education has grown significantly in the last few years. The main topics being researched in this area prove their huge potential to improve personalized learning, teacher support, continuous assessment, engagement and inclusivity.

AI agents are increasingly being deployed to develop personalized learning environments by customizing content tailored to individual needs. A group of scientists (Luckin et al., 2022) highlight in their study the effectiveness of AI tools in providing personalized content delivery, which significantly improves student engagement and understanding. These agents use data-driven methods to create adaptive learning paths, addressing the diverse needs of students and offering differentiated instruction.

Conversational agents and chatbots are also widely used tools for facilitating learning, especially in large-scale online courses. Labadze et al. (2023) mention that AI-driven chatbots, when properly integrated, significantly save instructors' time and workload, and also increase student engagement. Bozkurt (2023) further notes that conversational agents reshape education by providing personalized support to each student, ensuring excellent learning experiences. These agents benefit not only students but also help educators improve their efficiency. Some authors point out that AI tools assist with automating routine administrative tasks, such as grading and classroom management. This allows teachers to focus more on creative instructional activities (Williamson & Eynon, 2020; Chen et al., 2020). This type of support contributes to more efficient classroom management and higher teaching quality.

Furthermore, AI enables continuous assessment and real-time evaluation, allowing for early interventions when students struggle. Gašević et al. (2023) discuss how AI systems offer continuous assessment with immediate feedback and personalized evaluation. This capability is particularly useful in STEM courses where iterative learning and timely correction are critical for mastering complex concepts.

Ethical concerns regarding AI usage in education have been a significant area of discussion. Different studies examine the risks of biases in AI algorithms, which can lead to unfair educational outcomes if not addressed properly (Sywelem & Mahklouf, 2024; Wu, 2023; Barnes & Hutson, 2024). Privacy concerns are also a major issue, as AI agents handle vast amounts of student data for analysis. Despite these concerns, AI agents play a role in keeping learners engaged by creating personalized and interactive experiences. Kim et al. (2020) observe that AI teaching assistants helped students feel more comfortable participating in online discussions, reducing anxiety about being judged. This encourages higher participation and enables students to explore their questions in a supportive environment.

Despite their many benefits, AI agents have limitations that need to be addressed. Recent studies emphasize that AI agents struggle to replicate the emotional support provided by human educators, which is crucial for motivating and engaging younger students (Luckin et al., 2022; Nacheva, 2023). Furthermore, AI systems lack contextual understanding, limiting their ability to handle open-ended, complex problem-solving tasks.

Although much progress has been made in integrating AI agents into education, much of the current research focuses on specific issues without considering their broader implications. This study offers a critical review of the role played by AI agents for both students and educators, considering their benefits and challenges. It can be useful in guiding future implementations and policy decisions to ensure the effective use of AI technologies for improved educational outcomes.

2. TYPES OF AI AGENT IN EDUCATION AND TRAINING

AI agents can be classified based on their intended audience and functionality. This classification helps educators, institutions and developers understand the various roles AI agents play in the learning environment and ensures that the appropriate tools are used effectively to maximize educational outcomes. The classification is divided into two main categories: **AI agents for students** and **AI agents for teachers**.

AI agents targeted at students focus on offering enhanced learning experiences through personalized and adaptive learning approaches. These include Intelligent Tutoring Systems (ITS), Conversational agents and chatbots, Virtual learning assistants and AI agents for inclusive education.

Intelligent Tutoring Systems are designed to deliver content that adapts to each student's learning pace and style. Using AI algorithms, these systems diagnose gaps in student understanding and dynamically adjust the content. ITS can significantly improve student proficiency by providing personalized instruction tailored to individual needs.

Chatbots offer on-demand support to students, answering questions related to course content, deadlines and assignments. Li and Zhao (2022) demonstrate that the integration of conversational agents into online courses can improve student retention by providing timely help. Examples include Edubot and Botsify, which use Natural Language Processing (NLP) to understand and respond to student queries.

Virtual learning assistants help students organize tasks, send study reminders and provide feedback on assignments. These systems support learners in scheduling study sessions, suggesting appropriate resources, and tracking their learning progress. This can lead to increased productivity and better management of learning activities.

AI agents for inclusive education are designed to support students with special needs, offering adaptive tools such as speech-to-text systems, intelligent screen readers and customized lesson formats. For example, AI-powered captioning systems provide real-time lecture transcriptions for hearing-impaired students. Research by Khan (2024) demonstrates that such AI tools significantly improve accessibility, allowing students with disabilities to fully participate in mainstream educational settings.

AI agents designed for educators handle administrative tasks, classroom management and provide data-driven insights into student progress. In this group can be included Automated Grading Systems, Classroom Management Systems and Pedagogical Insights Generators.

Automated grading tools use AI to evaluate student assignments, providing instant results and reducing teachers' workload. AI-based grading systems improve assessment efficiency and accuracy, allowing teachers to focus more on interactive teaching activities.

Classroom management agents help educators track attendance, monitor participation and evaluate student engagement levels. These systems offer real-time dashboards to help teachers identify students who may need extra support.

Pedagogical insights generators can provide detailed insights into individual student progress and overall classroom dynamics. These systems use predictive analytics to forecast which students may be at risk of falling behind, enabling early intervention. This form of analytics is especially valuable in managing diverse classrooms where personalized attention is challenging.

The following table summarizes the different types of AI agents used in education based on their primary functionality and key benefits. Example platforms for each type are also presented.

Table 1.

Classification of AI agents in education

AI agent type	Main functionality	Key benefit	Example platform
Intelligent tutor	Adaptive content delivery	Personalized learning	Khan Academy, Carnegie Learning
Chatbots	Question answering	Increased engagement	EduBot, Botsify, SnatchBot
Virtual assistant	Task management	Time efficiency	IBM Watsonx Assistant, Amazon Alexa
AI agents for inclusive education	Accessibility support	Enhanced participation	Microsoft Immersive Reader, Otter.ai
Automated grader	Evaluation of assignments	Reduced teacher workload	Gradescope, Socrative
Classroom manager	Monitoring & attendance	Improved classroom control	HMH Classcraft, GoGuardian
Pedagogical insights	Analytics on student progress	Early intervention	Moodle Analytics, Edsight

Source: Own elaboration

The effectiveness of AI agents is closely related to educators' readiness and ability to use these tools. Therefore, it is important to emphasize the need for training teachers to understand the functionalities of AI agents. This will allow them to effectively integrate AI technologies into their teaching methods. Such learning initiatives can ensure that teachers feel comfortable using AI-driven insights, enabling better decision-making when adapting instructional strategies.

3. BENEFITS OF AI AGENTS IN EDUCATION

AI agents transform the entire educational landscape by offering several distinct advantages that enhance both teaching and learning processes. These technologies provide solutions to many of the challenges faced by traditional education systems – from personalizing instruction to managing large groups of learners. Below are some of the key benefits of implementing AI agents in educational settings.

Personalized learning. One of the most significant strengths of AI agents is their ability to adapt content to each student's performance and learning pace. Personalized instruction can address the unique needs of students, leading to improved learning outcomes. Personalized AI-driven learning modules help students understand complex concepts better through tailor-made solutions and individualized feedback. This level of customization supports each student according to their abilities, maximizing their learning potential. An example of such a platform is DreamBox Math, which provides personalized, adaptive instruction and support for learning math (DreamBox, 2024).

Scalability. Another notable benefit of AI agents in education is scalability. AI-driven platforms can support learning in large-scale settings, ensuring personalized attention for students even in classrooms with hundreds or thousands of learners. Platforms like Coursera or edX can serve simultaneously massive numbers of learners, providing customized content and minimizing the need for constant instructor intervention. This scalability makes AI agents particularly useful in online courses, Massive Open Online Courses (MOOCs) and other educational formats with large audiences.

Continuous assessment and feedback. AI agents enable continuous assessment and real-time feedback, which benefits both students and instructors. Continuous assessment is crucial for monitoring student progress and ensuring they don't fall behind in their learning. AI-enabled assessments provide timely and personalized feedback, allowing teachers to adjust their instructional strategies and offer support as needed (Yesilyurt, 2023). By helping educators identify learning gaps early, AI agents enhance the learning experience and help students address issues before they become obstacles to progress. For example, tools like Gradescope facilitate continuous assessment in STEM courses (Gradescope, 2024).

Engagement and motivation. Student motivation and engagement are essential for successful learning. AI agents foster these aspects through conversational agents and gamified learning platforms. By providing interactive, game-like elements and immediate support, AI agents make learning more appealing. Li and Zhao (2022) find that students who interacted with AI chatbots participated more actively in online discussions and completed their assignments on time. The immediate feedback and personalized responses provided by conversational agents create a supportive environment, keeping students motivated and engaged throughout their learning journey.

Data-driven insights. Another key benefit of AI agents is their ability to generate data-driven insights about student performance and behavior. AI can analyze large volumes of learning data to identify trends, strengths and weaknesses among students. These insights enable educators to make informed decisions about instructional strategies and provide targeted interventions to improve learning outcomes. Gašević et al. (2023) find that predictive analytics provided by AI agents allowed teachers to early identify students who are at risk and offer timely support.

The following table clearly shows how AI agents contribute to education, categorized by the main beneficiaries: Students and Educators.

Table 2.

Benefits of AI agents in education by target audience

Main beneficiary	Benefit category	Specific benefit
Students	Personalized learning	Adaptive content delivery, tailored learning paths, individualized feedback, pacing based on student performance
	Continuous assessment and feedback	Real-time quizzes, automated feedback loops, personalized progress tracking, early identification of learning gaps
	Engagement and motivation	Increased interaction, gamified learning platforms, real-time problem-solving, encouraging student participation in discussions
	Support for diverse learners	Accessibility tools such as text-to-speech, language translation, real-time captioning, personalized support for students with disabilities
	Emotional and social support	Emotional analytics to recognize student stress levels, AI-driven emotional feedback, personalized strategies to maintain student well-being
Educators	Scalability	Managing large student populations with automated instruction, personalized content distribution, scaling support across online learning platforms

	Reduced administrative burden	Automated grading systems, attendance tracking, scheduling assistance, report generation, freeing up time for teaching activities
	Data-driven insights	Predictive analytics on student performance, visual progress reports, identification of at-risk students, data-based decision-making
	Improved classroom management	Real-time student participation monitoring, engagement analytics, attendance tracking, intervention notifications for disengaged students

Source: Own elaboration

4. CHALLENGES AND LIMITATIONS

Though AI agents bring about a number of advantages in educational contexts, there are also a number of challenges and limitations associated with their integration. Some of the major issues involved are ethical considerations, human-interactive problems and privacy risks. A balanced approach that considers both the pros and cons of AI agents is essential to ensure equity and effectiveness in educational outcomes.

Ethical concerns and bias. AI models used in education may contain inherent biases that often result from existing inequalities present in the datasets on which they are trained. If not addressed, these biases can lead to unequal learning experiences that may place certain groups of students at a disadvantage. For example, AI algorithms may amplify stereotypes or may not pay attention to the cultural or socioeconomic differences existing among learners. These risks are reasons why more diverse training data need to be offered and validation of AI algorithms should be conducted more often. If not approached proactively and strategically, the use of AI can exacerbate existing inequalities and potentially make them worse.

Lack of human interaction. Despite the many advantages that AI agents provide, there is concern about the lack of human interaction. Teachers offer emotional and social support that is an essential part of the learning process, especially for younger students. The current AI systems attempt to imitate emotional support and encouragement in education (Lucero Fredes et al., 2022). The lack of empathy and understanding can lead to a less engaging learning environment for students who need personal attention. Future developments should focus on making AI systems more emotionally aware and able to respond to students' emotional needs. In this way the differences between AI-driven and human-centered learning experiences can be bridged.

Privacy concerns. The use of AI agents in education needs to collect a lot of data to provide personalized services. This often leads to potential privacy risks. AI systems require the collection and analysis of sensitive information such as learning behavior and personal data of students. Therefore, it is extremely important that data is used more strictly in cases of educational context and also that clear policies are directed towards students to know how their data is used and stored. Addressing these privacy concerns is important in order to ensure trust in AI systems and protect the rights of students in learning environments.

Technical limitations, reliability, and resistance. AI provides some powerful educational tools, which in turn come with some technical limitations that make these systems unreliable. Issues such as system downtime, inaccuracies in speech or text recognition and the need for hardware and software with high quality can be obstacles to the effective deployment of AI agents. These technical challenges can hinder learning, especially in areas with limited technological infrastructure or

unreliable Internet access. Furthermore, maintaining and updating these systems requires significant resources, which can create financial and operational challenges for institutions.

In addition, some teachers and students are reluctant to adopt and use AI technologies. Many educators are concerned that AI may replace their roles or that they lack the necessary training to use these systems effectively. Students may also resist learning with AI if they are used to traditional teaching or if they do not feel comfortable interacting with technology. To overcome these challenges, teachers need to be well trained, communicate clearly about the nature of AI as a tool to support education, not a substitute for it, and create a culture of acceptance of technology in the learning environment.

CONCLUSION

AI agents have the potential to significantly transform education and training. They benefit both learners and educators by providing personalized, scalable and adaptive learning experiences. Knowing the existing types and functionalities of AI agents can ensure their effective application in learning environments and maximize educational outcomes. However, some challenges remain to be addressed. Dealing with them is essential to ensure that AI systems promote equitable education and lead to improved learning outcomes and greater student satisfaction.

AI agents are expected to evolve. Future work in the area should focus on more exciting developments in AI-powered education such as increased personalization, seamless integration with learning management systems and improved emotional intelligence of AI systems. Also, establishing standardized ethical guidelines for their use in educational contexts is important to maintain trust in AI systems.

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