Eğitimde Yapay Zekâ Ajanlarının Kullanımı

The Use of Artificial Intelligence Agents in Education

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Özet

Teknolojik ilerlemeler, eğitim sistemlerini dönüştürerek öğrenme süreçlerine yeni boyutlar kazandırmaktadır. Yapay zekâ (YZ) ajanları, kişiselleştirilmiş öğrenme deneyimleri sunma, öğretmenlere destek olma ve eğitim süreçlerini daha verimli hale getirme potansiyeline sahiptir. Makale, yapay zekânın eğitimdeki temel teorik çerçevesini, Vygotsky'nin Sosyal Öğrenme Kuramı, Piaget'nin Bilişsel Gelişim Kuramı ve Çift Modelli Öğrenme Kuramı bağlamında ele almaktadır. Yapay zekâ destekli uyarlanabilir öğrenme sistemleri, doğal dil işleme (NLP) tabanlı sohbet botları ve otomatik değerlendirme mekanizmaları gibi teknolojiler, öğrencilere bireysel öğrenme yolları sunarak öğrenme süreçlerini desteklemektedir. Bununla birlikte, yapay zekânın eğitimde kullanımı, etik kaygılar ve pedagojik yaklaşımlar açısından bazı zorlukları da beraberinde getirmektedir. Öğrenci verilerinin gizliliği, algoritmik yanlılık ve öğretmenlerin yapay zekâ araçlarını benimseme düzeyi, bu teknolojilerin etkin kullanımını belirleyen kritik faktörlerdir. Makale, yapay zekâ destekli eğitim sistemlerinin avantajlarını, karşılaşılan sorunları ve gelecekteki gelişim yönlerini detaylı şekilde ele almaktadır. Sonuç olarak, yapay zekânın eğitimde etkili ve etik bir şekilde uygulanabilmesi için öğretmen eğitimine yatırım yapılmalı, veri güvenliği politikaları güçlendirilmeli ve öğrenci merkezli sistemler geliştirilmeye devam edilmelidir.

Anahtar Kelimeler: Yapay Zekâ, Eğitimde Yapay Zekâ, Uyarlanabilir Öğrenme, Doğal Dil İşleme, Eğitim Teknolojileri, Etik Sorunlar, Pedagojik Yaklaşımlar

Abstract

Technological advancements are transforming education systems, adding new dimensions to learning processes. Artificial intelligence (AI) agents have significant potential to provide personalized learning experiences, support teachers, and enhance educational efficiency. This article explores the theoretical framework of AI in education, discussing concepts such as Vygotsky's Sociocultural Theory, Piaget's Cognitive Development Theory, and the Dual Process Theory. AI-powered adaptive learning systems, Natural Language Processing (NLP)-based chatbots, and automated assessment mechanisms offer personalized learning paths for students, enhancing the learning experience. However, the implementation of AI in education also raises ethical concerns and pedagogical challenges. Issues such as student data privacy, algorithmic bias, and teachers' adoption of AI tools are critical factors determining the effectiveness of these technologies. The paper provides a comprehensive discussion on the advantages, challenges, and future perspectives of AI-assisted education systems. In conclusion, to ensure the effective and ethical integration of AI in education, investments should be made in teacher training, data security policies must be strengthened, and student-centered AI systems should be continuously developed.

Keywords: Artificial Intelligence, AI in Education, Adaptive Learning, Natural Language Processing, Educational Technologies, Ethical Concerns, Pedagogical Approaches

Highlights

- AI enables personalized and adaptive learning experiences.

- AI tools reduce teachers' workload through automation.

- Ethics and data privacy are crucial in educational AI use.

Introduction

Technological advances are transforming education systems and bringing new dimensions to learning processes. Artificial intelligence (AI) agents have significant potential, especially in providing personalized learning experiences, supporting teachers and making educational processes more efficient (Holmes, Bialik & Fadel, 2021). Today, AI is used in many fields such as learning analytics, adaptive education systems, natural language processing (NLP)-based chatbots, and automated assessment mechanisms (Zawacki-Richter et al., 2019).

However, the use of AI in education is not limited to technical advances; multidimensional factors such as pedagogical approaches, ethical concerns, and the educational efficiency of systems also shape this process (Luckin, 2018). Issues such as privacy of student data, bias in AI systems, and teachers' level of adoption of these technologies are critical elements that determine the future of AI applications in education (Popenici & Kerr, 2017).

This article details the use of artificial intelligence agents in education and comprehensively examines the advantages, challenges and possible future developments of these technologies. The role of artificial intelligence in the digitalization process of education will be discussed based on the theoretical framework and evaluations will be made in the light of the existing academic literature.

Artificial Intelligence and Pedagogical Foundations in Education

Artificial intelligence (AI) in education is a broad research area that can be addressed from different theoretical perspectives. Various theoretical approaches positioned at the intersection of disciplines such as cognitive sciences, educational psychology and artificial intelligence engineering are used to understand the effects of technology on learning processes (Zawacki-Richter et al., 2019).

The main theoretical approaches that form the basis of artificial intelligence applications in education are as follows:

Artificial Intelligence Based Learning Theories

Vygotsky's Social Learning Theory

Vygotsky's (Sociocultural Theory of Learning) social learning theory emphasizes that an individual's learning process is shaped by social and cultural interactions (Vygotsky, 1978). Artificial intelligence-based education systems overlap with Vygotsky's theory by interacting with students and guiding their cognitive development. In particular, chatbots and virtual tutors enable students to be supported within the zone of convergent development (ZPD) (Luckin, 2018).

Piaget's Theory of Cognitive Development

Piaget (1952) argued that learning progresses depending on the individual's mental developmental stages. AI-supported learning systems align with this theory by providing adaptive learning experiences in accordance with students' age and cognitive levels (Holmes, Bialik & Fadel, 2021). For example, AI-based adaptive learning systems can make the learning process more effective by personalizing content according to children's cognitive developmental stages.

Machine Learning and Cognitive Models

Machine Learning (ML) and Adaptive Learning

Machine learning algorithms analyze students' performance and provide personalized recommendations to optimize individual learning paths (Zawacki-Richter et al., 2019). Learninganalytics systems can evaluate students' academic performance, identify their strengths and weaknesses, and create rapid feedback mechanisms (Li et al., 2025).

Natural Language Processing (NLP) and Conversational Learning

Natural language processing (NLP), a subfield of, contributes to the development of chatbots and virtual tutors in education. These systems are used to understand student questions, generate contextual responses, and provide immediate feedback to students (AlYounas & El-Dakhs, 2025). NLP-supported teaching tools facilitate the learning process by reducing cognitive load while guiding students (Yıldırım-Erbaşlı, et. all. 2025).

Dual Theory (Dual Process Process Theory)

The Dual Model Learning Theory put forward by and West (2000) suggests that individuals

process information through two different cognitive processes: fast, intuitive thinking (System 1) and slow, analytical thinking (System 2). AI-supported educational tools support students' interaction between these two systems and improve their critical thinking and problem-solving skills (Stanovich Popenici & Kerr, 2017).

Can make System 2 work more effectively by offering different strategies according to. Thus, the learner's capacity for deep learning and long-term comprehension can be increased (For example, adaptive learning systems the student's learning speed and knowledge levelLi et al., 2025).

Artificial Intelligence and Cognitive Processing Theory in Education

Cognitive load theory examines how an individual's mental capacity is used during learning (Sweller, 1988). AI-supported instructional systems help students focus by reducing unnecessary cognitive load. In particular, chatbots, automated assessment systems and adaptive learning software can be designed to help students process only meaningful information (Goldston, 2025).

Uses of Artificial Intelligence Agents in Education

Artificial intelligence (AI) agents in education have great potential to individualize teaching processes, provide support to teachers, and offer students an active learning experience (Zawacki-Richter et al., 2019). Today, AI is widely used in various fields such as personalized teaching systems, virtual tutors, automated assessment mechanisms, and gamified education models (Holmes et al., 2021). Below, the main uses of artificial intelligence in education are detailed.

Intelligent Instructional Systems and Personalized Learning

AI-based intelligent tutoring systems are systems that can provide personalized content by analyzing student data. These systems determine students' learning speeds, strengths and weaknesses and create customized study plans (Li et al., 2025). Developed using machine learning (ML) and learning analytics, these systems can track student progress and provide real-time feedback (Luckin, 2018).

For example, teachable teachable AI AI agentsagents, known as, can analyze students' cognitive processes and guide them according to their level of understanding. Holmes et al. (2021) emphasize that such AI systems play an important role in improving students' academic achievement.

İncrease their engagement (Yıldırım-Erbaşlı, et. all. 2025). Recent studies have shown that personalized learning experiences increase students' motivation, improve their self-regulation skills and in the learning process

Chatbots and Virtual Tutors

AI-powered chatbots and virtual tutors make learning processes more accessible by providing 24/7 support to students (Malik & Shah, 2025). Thanks to Natural Language Processing (NLP) technologies, these systems can answer student questions, explain course content, and provide individualized learning recommendations (Younas & El-Dakhs, 2025).

Especially in distance education, AI-supported tutors enable students to have a more interactive and customized learning experience. According to research, the use of virtual tutors has been found to increase students' interest in the lessons and their participation in the learning process (Luckin, 2018).

For example, online education platforms such as Academy guide students using AI-based chatbots. Such systems offer a more flexible structure compared to traditional teaching methods by allowing students to be guided according to their individual needs during the learning process (Coursera and Khan Zawacki-Richter et al., 2019).

Gamified Education Models

One of the most effective ways to increase student motivation is through gamified learning strategies. AI-supported gamification systems make the learning process fun by enabling students to interact more (Stasolla & Passaro, 2025).

AI-based gamification systems offer reward mechanisms and create individualized tasks by analyzing student performance (Li et al., 2025). Such systems are widely used, especially in the field of STEM (science, technology, engineering and mathematics) education.

Artificial intelligence-based educational tools developed especially for students with neurodevelopmental disorders provide a significant improvement in learning processes. AI-supported gamification systems in special education help students improve their cognitive and motor skills by increasing their attention (Stasolla & Passaro, 2025).

For example, Minecraft Education and Duolingo offer AI-enabled learning experiences based on gamified learning models. These platforms create customized tasks with artificial intelligence for students to achieve specific goals (Holmes et al., 2021).

Evaluation and Feedback Mechanisms

In education, artificial intelligence-supported automated assessment systems are used to lighten the workload of teachers and provide faster feedback to students (Yıldırım-Erbaşlı, et. al. 2025).

AI-based assessment mechanisms can analyze student performance and provide customized feedback. In particular, natural language processing (NLP) supported systems can automatically evaluate text-based assignments by analyzing student responses and provide meaningful feedback (Younas & El-Dakhs, 2025).

Especially in large-scale exams, automated assessment systems reduce the assessment burden on teachers and provide an objective grading process. Research shows that artificial intelligence-based assessment systems increase student achievement and provide faster progress in the learning process (Goldston, 2025).

In the future, AI-assisted assessment systems such as biometric assessment, facial recognition technology and sentiment analysis are expected to be used more in education (Li et al., 2025)

Advantages of Artificial Intelligence Agents in Education

The use of artificial intelligence agents in education provides significant advantages in terms of making learning processes more effective, reducing the workload of teachers and providing students with more personalized educational experiences. While traditional teaching methods usually present the same content to all students, AI-supported systems create a customized learning environment by analyzing students' individual learning speeds, strengths and weaknesses (Li et al., 2025). These systems can increase academic success by identifying the subjects that the student is deficient in and providing him/her with customized content and feedback.

In addition to personalized learning experiences for students, AI also significantly reduces the administrative burden on teachers. AI-supported automated assessment systems allow teachers more time on lesson planning by providing fast and objective evaluation of exams and assignments to spend (Yıldırım-Erbaşlı, et. al. 2025). In addition, the automatic creation of course materials and their adaptation according to student performance contribute to making educational processes more efficient.

In the field of special education, artificial intelligence helps students with disabilities to adapt to educational processes more easily. AI-supported learning systems are customized according to individual needs and offer accessibility solutions for students with visual, hearing or learning disabilities (Thurzo, 2025). For example, educational tools that work with voice commands or artificial intelligence applications that provide real-time subtitles support equal opportunities in education by enabling individuals with disabilities to participate more actively in the educational process.

In addition, AI-supported educational technologies increase students' motivation and make the learning process more interesting. AI systems supported by gamification techniques can make the learning process more interactive by offering tasks, points and rewards that encourage students to learn (Stasolla & Passaro, 2025). Especially in STEM (Science, Technology, Engineering and Mathematics) fields, AI-based simulations and virtual laboratories can help students understand abstract concepts more easily and benefit from hands-on learning opportunities.

Finally, AI-based education systems analyze student data and provide valuable insights into learning processes. Educational administrators and teachers can use these insights to improve their teaching methods and offer solutions that are better suited to students' needs (Goldston, 2025). Thanks to big data analytics, success rates in education can be increased, students' academic progress can be better tracked, and education policies can be shaped in a more informed way.

Considering all these advantages, it is predicted that the role of artificial intelligence agents in education is gradually increasing and will carry educational processes even further in the future. However, in order to implement these technologies effectively, ethical rules need to be determined, teachers need to be trained to use artificial intelligence tools, and necessary measures need to be taken regarding data security.

Challenges and Ethical Issues

While the proliferation of artificial intelligence technologies in education offers many advantages to students and teachers, it also brings with it various ethical and technical challenges. These challenges include data privacy and security, teacher and student acceptance of AI systems, algorithmic bias, and fairness in education. In order for AI to be used effectively and fairly in educational processes, these issues need to be addressed and

solutions developed.

With the use of AI-based educational tools, processes such as collecting, analyzing and storing student data raise important questions about data privacy. AI-supported learning systems offer personalized recommendations by continuously monitoring students' performances and behaviors. However, there are risks that the large amounts of data collected in this process may be misused, exposed to unauthorized access or shared for commercial purposes (Goldston, 2025). Legal regulations such as the European Union's General Data Protection Regulation (GDPR) and the Family Educational Rights and Privacy Act (FERPA) in the United States include policies to protect student data. However, more stringent regulations are needed to fully implement such legal frameworks on a global level and to ensure that AI systems operate within ethical boundaries.

Another important issue is how teachers and students react to and adopt AI-supported education systems. Many teachers, accustomed to traditional teaching methods, are concerned about the role of AI in education. Teachers are uncertain about how AI will affect the pedagogical process in classrooms and how it will change their roles (Jahankhani, et. al. 2023). Teachers in particular are concerned that too much involvement of AI in decision-making in teaching processes will reduce the human touch in education. Similarly, students may have different attitudes towards interacting with AI systems. While students who are familiar with technology can easily adopt these systems, some students may have difficulty adapting to these innovations due to the digital divide. Therefore, it is of great importance that AI-supported education systems are designed by considering the needs of teachers and students and provide user-friendly interfaces.

How artificial intelligence systems ensure equality and fairness in education is also a critical topic of debate. The widespread use of artificial intelligence models in education algorithmic in some casesmay bring problems of. Artificial intelligence systems can learn the biases in the datasets they are developed for and reflect these biases in the educational process. For example, bias an artificial intelligence model trained on students from a certain region may not make fair decisions for students from different socioeconomic backgrounds (Popenici & Kerr, 2017). In order to prevent algorithmic bias, artificial intelligence systems should be trained with more comprehensive and diverse data sets, subjected to regular auditing processes, and operated in line with the principles of transparency.

To overcome all these ethical and technical challenges, AI-enabled education policies

need to be established in an open and transparent framework. Training programs to increase AI literacy for teachers, students and educational administrators should be organized and data privacy policies should be strengthened. In addition, the role of AI systems in pedagogical processes should be positioned as a complement to teachers and care should be taken to preserve a human-centered understanding of education. Artificial intelligence in education can only become a truly sustainable and inclusive innovation when it is developed in line with ethical principles and with the human factor in mind.

Future Perspectives and Recommendations

As the use of AI in education becomes more widespread in the future, comprehensive policies and strategies are needed to implement this technology in an effective, ethical, and sustainable manner. The integration of AI into educational processes should be supported not only by developments technological but also by pedagogical, ethical, and managerial approaches. Therefore, it is critical to establish AI-supported education policies, adapt teachers and students to these systems, set data security standards, and develop student-centered AI systems.

First, educational institutions need to develop guidelines that promote the ethical use of AI. The use of AI-based systems in education should not only be based on technical infrastructure, but also on specific ethical standards and guidelines. While regulations such as the European Union's General Data Protection Regulation (GDPR) and the Family Educational Rights and Privacy Act (FERPA) in the States United are important steps in protecting student data, more comprehensive and education-focused regulations are needed for the use of artificial intelligence in education on a scale global(Goldston, 2025). Shaping education policies within framework this will prevent, and the misuse of student data create a secure digital education environment.

However, special training programs need to be created for teachers to use AI-based systems effectively. The integration of artificial intelligence into educational processes should not be limited to the use of these technologies as a tool, but teachers should also be trained on how to strengthen their strategies teaching with systemsAI-based. Research has shown that when are able to use teachers AI-supported tools effectively, a significant increase in student achievement is observed (Li et al., 2025). However, for these systems to be adopted by teachers, educators need to increase their awareness of technology and develop their skillsdigital pedagogical.

As become more widespread AI-based education systems in the future, more advanced encryption techniques and data protection mechanisms should be implemented for the security of student data. Artificial intelligence systems optimize learning processes by analyzing copious amounts of student data, but there are various risks to the security of this data. Supporting artificial intelligence systems used in education with strong data encryption algorithms and anonymization methods to protect personal information will ensure the protection of student privacy (Jahankhani, et. Al. 2023). In addition, educational institutions should be transparent in their processes data collection and provide students with clear information about how their data is processed, which will increase trust in AI.

artificial in the process of future development intelligence systems, it is of immense importance to design these technologies with approacha student-centered. While offer many AI-based educational platforms today generalized solutions, it is necessary to develop systems that focus more on student needs and adapt to individual learning styles. Adaptive learning technologies can provide customized content by considering students' individual learning speeds, interests, and academic levels (Yıldırım-Erbaşlı, et. Al. 2025). As such systems become more widespread in the future, it will be possible for each student to have a learning experience at pace their own and in accordance with their needs.

In conclusion, the successful implementation of AI in education requires comprehensive policy reforms, teacher training, data security measures and, a focus on student-centered system designs. In this process, it is of immense importance that educational administrators, policy makers and technology developers work in collaboration to make AI-supported education systems more secure, ethical, and effective. Although it is predicted that artificial intelligence will play a more active role in education in the future, designing these technologies with approach a human-centered will ensure the protection of quality and fairness in education.

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