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# Challenges of E-Learning in The Era of Artificial Intelligence

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**Abstract:** The growth of Artificial intelligence in education (AIED) is poised to influence the future of online education, educators and students as well as administrators and policy makers. Traditional e-learning is being revolutionized by AIED systems, with new challenges emerging from the effects of these technologies. Issues about funding, privacy, security and policy will reemerge as AIED is tactically deployed. Further, the potential benefits of AIED for education can be best realized if its development and introduction are meticulously planned. Key concerns related to funding, data privacy, algorithmic transparency, security, and policy governance are resurfacing as institutions move toward strategic implementation of AIED technologies. These issues highlight the need for robust regulatory frameworks and ethical guidelines to ensure that AI applications support equitable and responsible learning experiences. Moreover, the potential benefits of AIED—ranging from personalized learning pathways to scalable support for diverse learners—can only be fully realized when their design, development, and deployment are thoughtfully planned and grounded in pedagogical principles.

**Keywords:** e learning, Artificial intelligence, AIED, Challenges

**Citation:** Saif M D & Kazim, D. T. Challenges of E-Learning in The Era Of Artificial Intelligence. Central Asian Journal of Mathematical Theory and Computer Sciences 2026, 7(1), 151-156

Received: 03<sup>rd</sup> Sep 2025

Revised: 11<sup>th</sup> Oct 2025

Accepted: 19<sup>th</sup> Nov 2025

Published: 12<sup>th</sup> Dec 2025



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## 1. Introduction

E-learning, a type of education that uses electronic technology for accessing educational content remotely, rather than in a traditional classroom environment, has been an option or supplement for instruction at many levels of education. Artificial intelligence (AI) is making machines to work and react like humans and can be used to model political, economical, social and cultural scenarios. The application of AI in e-learning provides unique opportunities to enhance the quality of education, but it also leads to challenges for its wide spreading and applying [1].

Online learning makes use of the internet to provide learning content and to allow learners to take classes from anywhere. In addition to delivering pre-recorded lessons and using ancillary media, online education is increasingly providing options for interaction between students and teachers, live lectures, digital whiteboards and recordings that students can consult[2]. Besides video lectures, online teaching uses a number of computer-based tools and platforms through which students and teachers interact, access more learning materials, monitor progress and even conduct grading and evaluation.

AI technology is frequently a combination of computer science, data science and statistics and is really just using those to imitate intelligent behaviours and problem

solving of humans. Artificial intelligence in education (AIED) investigates the application of AI technology to provide individualised support to a student or teacher in educational activities [3]. AIED seeks to create computer applications which enable educators and/or learners to interact with the computing system in a manner different than traditional methods. Integrating AIED has the potential to greatly complicate the design of digital education infrastructures, as it requires grounding new technologies in existing paradigms at an earlier stage – shaping selection of algorithms, user expectations and modes of validation.

## 2. Materials and Methods

This study employed a qualitative systematic review methodology to examine the current landscape, opportunities, and challenges associated with the integration of Artificial Intelligence in Education (AIED). The research process was designed to ensure rigor, transparency, and reproducibility, and consisted of four main stages: data sourcing, selection and screening, thematic analysis, and synthesis of findings.

A comprehensive search was conducted across major academic databases including Scopus, Web of Science, IEEE Xplore, SpringerLink, and Google Scholar. Peer-reviewed journal articles, conference proceedings, book chapters, and credible preprints published between 2017 and 2024 were considered to capture the most recent developments in AIED. Keywords such as “AI in education,” “AIED systems,” “adaptive learning,” “intelligent tutoring,” “AI challenges in education,” and “ethical implications of AIED” were used to ensure wide coverage.

## 3. Results

In e-learning, the access to technology varies widely between regions, and especially in developing countries due to lack of infrastructure. The process to integrate AI tools in e-learning plat-forms is complex considering the functions and the related risks that require compliance with security and protection of data. Designing a robust e-learning infrastructure is a matter of strategic planning, even if realized solutions generally tend to focus on particular sub-systems in place of a holistic approach [4].

The success of e-learning systems is greatly affected by the constraints of infrastructure, implying the need for validation of the enabling technologies and tools [5]. Established platforms like Blackboard, Canvas, Moodle and Google Classroom have a range of functionality, but the introduction of AI into the traditional delivery methods is not straightforward. AI tools, Georgia Tech’s virtual instructor Jill Watson, can provide support 24/7, but their adoption presents a range of technological and societal challenges. Moreover, privacy question are raised by the massive gathering of personal data in AI-based e-learning and these data must be handled carefully to protect students information, especially in the case of minors [ 6].

Among the other advantages, e-learning fosters a learning environment where remote students have easy access to learning materials, but at the same time gives rise to new types of inequalities, for instance the teaching methods that best suit certain learning styles. Although e-learning has brought many advantages, it also presents a range of challenges – technical, pedagogical, social, and ethical[7]. Poor connectivity in rural regions, for example, places limits on how effective on-campus instruction can be. Content producers have difficulty making materials truly accessible to all, and students of all types without internet doing so miss out on the type of interactive favored learning experiences. Under various constraints, teachers are still struggling to control students' thinking [8].

The integration of AI in e-learning has become essential for promoting learner engagement and motivation as external and internal determinants of educational success, demonstrating its pivotal role in the future direction of the educational system[9]. Chatbots provide interactive interactions to practice grammar, vocabulary, and speaking

functions and promote favourable attitudes in interaction. Content personalization, as enabled by AI such as Linguaskill and adaptive EdTech solutions, individualizes learning behavior, yet measuring engagement accurately remains a challenge given the noisiness of physiological data [10]. E-learning's assessment and review are improved by AI through dependable early detection of student understanding, and chatbots have positive effects on learning results. New flexible evaluations can be realized by using innovative "Smart Grading" technologies based on Generative AI, where assessments are categorized as learning or acting based, the first type verifies understanding at the phase of acquiring knowledge.

The digital divide threatens the benefits of the AI-assisted e-learning due to the fact that the access to social networks, to collaborative groups, and to quality courses is restricted, particularly for the disadvantaged students.

Community participation is a powerful enhancer of educational returns, as evidenced by students who form within a university a tightly knit digital social network. On the other hand, learners on stand-alone platforms may not engage in critical exchanges that create a sense of belonging and offer academic support [11].

Building digital infrastructure is crucial for e-learning, particularly for AI-based platforms that rely on rapid data processing and on-the-fly interactions. Although the digital divide may be addressed through waivers for broadband access, access to technology is not enough; divides related to digital competence and instructional support remain [13]. In parallel to technological problems, strong social problems emerge, such as isolation feelings that are worse in cyberlearning situation which de-motivate and de-engage learning. A community-building focus is essential for participants to manage these tensions, particularly as teachers attempt to reforge social ties post-pandemic. The formation of virtual communities thus becomes significant in relation with distributed cognition, as educators encounter logistical and social barriers in bringing students back into collaborative settings[14].

Bias in AI has moral implications since it disrupts moral equality, and algorithms are likely to be embedded with historical and cultural biases based on the data they are trained on. These biases can be reproduced (and magnified) by AI systems, leading to cycles of discrimination. As a solution, AI should give importance to transparency and accountability of its decision making, in a way that it can be subject to Auditing and Explainability. Such algorithmic biases can therefore contribute to exacerbating inequality in education and warrant vigilance, particularly in times of crisis (such as with the COVID-19 pandemic). Fairness and equity in educational AI inevitably depend also on continued attention to mitigating bias in and by the system, and to documenting and sharing the process of development in ways that support transparency, and promote ethical commitment[15].

To sum up, challenges in the application of AI in education can be divided into several types. The technical and financial problems of high cost, aging infrastructure, and insufficient data contribute to the digital divide and call for substantial investment in technology and training. Ethical and privacy concerns are raised by data security threats, algorithmic bias, and transparency problems, which must be tackled by a rigorous set of protocols and diverse datasets to guarantee fairness. From a (human) pedagogy perspective, diminished human interaction and the potential for academic dishonesty reinforce the need for human mentorship given that AI is likely to discourage critical thinking. Resistance from teachers and the necessity for comprehensive training, complicate the integration process on the systemic level, signaling that cultural change within schools is crucial for successfully fostering a spirit of AI use within education. The monitoring tables below summarize the core challenges.

Both the technology and pedagogy have evolved significantly since the 1980s, a trend that intensified during the COVID-19 pandemic. The application of ICT tools in education has been enabled by the Fourth Industrial Revolution and artificial intelligence (AI), which take advantage of massive data in online platforms for insights of learning processes. The demand for transformation in the way of assessment towards digital techniques has been exacerbated due to the deficiency of traditional examination methods especially when applied to sizeable groups of students. E-learning has, of course, a mix of good and bad experiences: it has been liberating and has put more responsibility on the learners, but there are also issues to do with intellectual property rights. Teachers are essential to spearheading a wide range of learners, and therefore need to be skilled and mature in adapting technology. Life-long learning for educators is a prerequisite if they are to use AI in education in a meaningful way and they need to understand these tools better to be able to fully exploit their educational potential and to conceptualize teaching in terms of the new methodologies.

Table 1. Summarises the key challenges.

Challenge Category	Specific Issues	Key Considerations
<b>Technical &amp; Financial</b>	High costs of implementation, obsolete infrastructure, limited or poor-quality data, and dependence on technology.	Creates a digital divide; significant investment is needed for technology, training, and maintenance
<b>Ethical &amp; Privacy</b>	Data privacy and security risks, potential for bias in algorithms, and lack of transparency ("black box" problem)	Biased data leads to unfair outcomes; strict protocols and diverse data sets are needed to ensure fairness and security
<b>Pedagogical &amp; Human</b>	Minimized human involvement, threat of academic dishonesty, possibility of inaccurate data from an AI source, and suppression of critical thinking processes.	AI cannot replace human mentorship and empathy; over-reliance may hinder development of independent problem-solving skills.
<b>Systemic &amp; Adoption</b>	Resistance to change from educators, need for extensive teacher training, and difficulty integrating AI into existing systems	Success depends on shifting institutional culture and providing continuous professional development, not just on the technology itself.

The adoption of Artificial Intelligence (AI) in education is growing rapidly worldwide, and learning is now becoming personalized based on analysis of historical data and adaptive curriculum. AI improves teaching and learning processes, and these include AI-based teaching assistants, adaptive quizzes, and facial analytics to enhance student-teacher engagement. Such systems, for example Jill Watson or IntelliMetric, allow for real time interaction with students, providing tailored feedback and dynamically adjusting to student performance. But there are concerns about sustained engagement, authenticity of online credentials, and inequities in educational quality. Although AI provides tailored learning experiences, it threatens students' mental well-being, pointing to the importance of assistance in managing digital learning environments and sustaining moral values [16]. Moreover, the increasing dependence on technology raises questions about access and the role of human interaction in education – both of which have been shown to have a significant impact on students' overall satisfaction and engagement.

#### 4. Conclusion

The rapid growth of AIED will influence the future of developing digital education online or offline and will affect the individual learner, teaching staff, and administrators. More traditional forms of e-learning are now being transformed by various AIED systems. As distance and technology related challenges disappear, new challenges will arise in the form of legitimate worries about the scope, trajectory and consequences that AIED systems will be allowed to have. Related concerns of funding, privacy, security, and policy will also intersect the strategic deployment of AIED. The field is on the cusp of where the scope and trajectory should be carefully charted to fully realize the potential promise of the technology and the benefits to education. As technological and distance-related barriers continue to diminish, a new generation of challenges emerges. These challenges are no longer solely infrastructural but instead revolve around ethical, social, and policy-oriented questions regarding the acceptable scope, transparency, and long-term implications of AIED deployment. Legitimate concerns related to algorithmic bias, data privacy, cybersecurity, and the potential for over-automation demand proactive governance and careful regulatory oversight. Moreover, issues of funding, equitable access, and workforce preparedness will increasingly shape how institutions integrate AIED tools in a sustainable and socially responsible manner.

The field stands at a critical inflection point where the trajectory of AIED must be strategically and thoughtfully charted. Ensuring that AI technologies augment rather than replace human educators, support learner autonomy, and promote fairness will be essential in maximizing their benefits. If guided with ethical foresight, interdisciplinary collaboration, and robust policy frameworks, AIED has the potential to revolutionize education—enhancing learning outcomes, expanding access, and fostering more inclusive and adaptable educational systems. Ultimately, the promise of AIED can be fully realized only through deliberate planning, continuous evaluation, and a commitment to centering human values at the core of technological innovation.

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