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ORIGINAL ARTICLE

Applications, Challenges, and Tools of Artificial Intelligence (AI) in Education

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EXTENDED ABSTRACT

Interdiction:

The emergence of technology has fundamentally transformed pedagogical methods and learning processes. In the current era, characterized by an explosion of information and rapid computational advancement, Artificial Intelligence (AI) stands as a paramount technological achievement that is redefining the boundaries of education. By integrating capabilities for processing massive datasets, machine learning, and intelligent analysis, AI has become a powerful adjunct for educators, learners, and educational policymakers. This technology not only automates traditional administrative processes but also optimizes the learning experience, introducing flexibility through intelligent solutions such as personalized learning pathways, adaptive response systems, and sophisticated analysis of academic performance. Consequently, familiarity with AI is becoming indispensable for both teachers and students, necessitating an understanding of its utility and effectiveness, as well as a critical awareness of its associated challenges, to enable its informed and judicious application. The purpose of this study is to

provide educators with a comprehensive overview of the applications of artificial intelligence in education and learning through a systematic review of the relevant literature. This review will encompass the diverse uses, inherent challenges, and available tools of AI within educational contexts.

Methods:

This qualitative study employed a systematic review approach. The research population comprised 62 articles and books pertaining to the application of artificial intelligence in education and learning. From this population, a purposive sample of 40 articles and books was selected based on their relevance to the research questions. In the initial step, a comprehensive search was conducted within reputable scientific databases (including Semantic Scholar, Science Direct, and Google Scholar) and relevant resources available through IGI Global, covering the period from 2021 to 2025. The search utilized keywords related to artificial intelligence, such as "applications of artificial intelligence in education and learning" and "artificial intelligence tools in education and learning," to identify and collect all pertinent articles and texts. Following the selection and in-depth review of the identified research, the data were synthesized using thematic analysis. To ensure the reliability of the findings, an inter-coder agreement method was employed.

Findings:

The analysis of studies on the applications of artificial intelligence in education and learning yielded 17 main themes and 53 sub-themes. Regarding the challenges posed by AI in this domain, 7 main themes and 26 sub-themes were identified. Furthermore, in the area of AI tools, 45 distinct AI applications were identified and subsequently categorized into six functional groups. The findings indicate that key applications of AI in education and learning include: personalized teaching and learning; serving as a teacher assistant; generating educational content; guiding and directing learners; facilitating the comprehension of complex scientific concepts; developing intelligent tutoring systems; analyzing, evaluating, and monitoring learner performance; streamlining the teaching process; creating engaging and interactive learning environments; enhancing language learning skills; developing simulated learning environments; improving overall teaching and learning quality; fostering higher-order thinking skills; developing AI literacy; promoting interaction and communication skills; translating texts; and facilitating information retrieval and question-answering through chatbots.

The principal challenges associated with AI in education and learning were found to be ethical and security concerns, infrastructural deficits, issues of accessibility, legal and policy ambiguities, socio-cultural barriers, and pedagogical challenges. The identified AI tools were categorized into six groups: content generation tools; assessment and feedback tools; research assistants; classroom management and personalized learning tools; chatbots and intelligent assistants; and teaching assistants. Notably, a review of the Study fetch platform revealed that it offers 27 features of significant practical utility for teachers and 12 useful features for students.

Conclusions:

In conclusion, while a diverse array of AI tools is available for educational purposes and has demonstrably yielded positive effects on learning, their adoption by teachers and students must

be predicated on a thorough understanding and careful pedagogical planning. Inappropriate or uncritical use of AI risks not only ineffectiveness but also the introduction of fundamental challenges to the teaching and learning process. The value of AI in education is realized in concert with human intelligence. Educators should therefore employ these tools with sufficient knowledge, while students should use them under the supervision and guidance of their teachers to achieve higher-order learning objectives. Teachers must be cognizant of the extensive capabilities of AI; they should familiarize themselves with these functionalities and strategically design assignments that emphasize and cultivate human intelligence, while also thoughtfully managing students' use of AI for completing academic work. Accordingly, future research is encouraged to investigate optimal practices for the use of AI by both teachers and students, with the aim of developing effective and practical implementation models.

Data Availability Statement

Data available on request from the authors.

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Ethical considerations

Not applicable.

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Conflict of interest

The authors declare no conflict of interest.

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