**Review Article**

# Application of Artificial Intelligence in Higher Education: A Systematic Review

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## Abstract

Artificial intelligence (AI) is an advanced technology that enhances communication pathways across various industries, including education. Current state-of-the-art AI technologies offer significant benefits such as improved efficiency, personalized learning, inclusive learning, adaptive learning, smarter content, and enhanced effectiveness in educational administration. This study employed a qualitative research approach and systematically reviewed the literature to explore the impact of AI on higher education. To ensure a thorough and rigorous analysis, the review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria and searched databases such as Scopus, Web of Science, and IEEE Xplore. The findings indicate that AI positively influences higher education by enhancing instructional methods and administrative processes. Instructors can perform their activities more effectively, ensuring the reliability and quality of their teaching. While the integration of AI in education promotes learning effectiveness, it also addresses potential adverse effects, thereby improving the overall quality of learning. This study contributes to the academic field by providing empirical evidence of AI's benefits in higher education and offering practical recommendations for its implementation.

***Keywords***: Artificial Intelligence, Higher Education, Learning Effectiveness, PRISMA

## 1. Introduction

Technologies have the potential to transform the life style in all aspects. The integration of technology like artificial intelligence in higher education indeed has the potential to revolutionize various aspects of academic and administrative processes. Artificial Intelligence (AI) has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and ultimately accelerate the progress towards SDG 4 (UNESCO, 2021). AI is

increasingly being integrated into current higher education systems to enhance the learning experience for both instructors and students and improve the effectiveness of teaching methods (Crompton & Burke, 2023). Some common applications of AI in education include: personalized learning, adaptive learning, visual assistants, grading and assessment, data analysis and many more (Tan et al., 2022; Chen et al., 2020). Researcher (Gašević et al., 2023) explores into the impact of AI in education on both learners and instructors. It discusses how AI technologies, such as ChatGPT, have sparked public interest and influenced teaching and learning practices.

The review highlights the importance of empowering learners for the age of AI through innovative educational approaches. For instructors, the review emphasizes the need for understanding and trust in AI systems, as well as the development of new theories of learning to enhance teaching effectiveness. It also addresses challenges and opportunities in using AI for assessment, designing AI-driven systems, and incorporating AI applications in classrooms to improve educational outcomes for both learners and instructors. This integration aims to improve the quality of education, increase efficiency, and provide personalized learning experiences for higher education students (Zawacki-Richter et al., 2019). Therefore, by leveraging AI technology, educational institutions can streamline operations, improve decision-making processes, personalize learning experiences, and enhance overall efficiency.

### 1.1. Artificial Intelligence in Higher Education

Artificial intelligence, the technology that makes it possible for machines to mimic human intelligence to perform tasks that typically require humans, such as learning, reasoning, problem solving, and decision-making, has significant implications for higher education. AI is an expansive field that combines machine learning, algorithm development, and natural language processing, with significant implications for education. Its applications in education have produced prominent advancements in educational tools. These applications encompass personalized learning platforms that enhance students' educational experiences, automated assessment systems that aid teachers and facial recognition systems that provide insights into learners' behaviors. The growing interest in AI within higher education has motivated researchers to explore its utilization in educational contexts. Numerous scholars have conducted subject-specific studies, including (Zawacki-Richter et al., 2019; Tan et al., 2022; Han et al., 2023; Agrawal et al., 2021; Butler et al., 2018; Fu, 2019;

Chen et al., 2020), which offer valuable insights into the significance of AI and its broader application in higher education.

In their comprehensive systematic review, (Ouyang et al., 2022) focused on the integration of AI in online higher education. They extensively examined literature published from 2011 to 2020. The research findings highlighted key functionalities of AI applications in online higher education, such as performance prediction, resource recommendation, automated assessment, and the enhancement of learning experiences. Another study conducted by (Zawacki-Richter et al., 2019) explored the existing research literature on the implementation of artificial intelligence in higher education, with a specific emphasis on educators' perspectives and involvement in adopting and integrating AI technologies. This review analyzed studies investigating how educators engage with AI tools, their perceptions of AI in teaching and learning, the challenges they face, and the support needed to effectively incorporate AI into their teaching practices.

Similarly, the web-based and online education, as enumerated in different studies, has transitioned from simply availing materials online or on the web for students to simply download, study, and do assignments to just pass, to include intelligent and adaptive web-based systems that learn instructor and learner behavior to adjust accordingly, to enrich the educational experience, (Chassignol et al., 2018; Dong, 2022; Peredo et al., 2011). Incorporating Artificial Intelligence technologies in educational industry to enhance learning outcomes, improve administrative processes, and provide personalized experiences for students and faculty members. The industry constantly changing and adapting to new technologies and their educational needs (Li & Wang, 2020). If we consider the technological advancements and educational developments, it emphasizes the importance of implementing AI in education to enhance the overall performance of the learning platform and helps in creating opportunities for more effective and inclusive learning environments.

Several research works have highlighted the different modern advancements in Personalized Learning (Slimi, 2023; Fahd et al., 2021). With the help of AI, teachers may tailor recommendations and feedback to each student's unique learning needs and learning styles by analyzing their learning patterns. This demonstrates how AI can help achieve educational goals like increased student engagement (Xu & Ouyang, 2021; Zawacki-Richter et al., 2019). Through interactive material, adaptive learning platforms, and virtual tutoring systems, AI-powered tools

can improve student engagement. Additionally, AI has a great deal of potential to improve administrative activities (Zawacki-Richter et al., 2019). AI reduces costs and improves operational efficiency by streamlining administrative duties including scheduling, student support services, and admissions procedures. AI also has a role in predicting student success. In order to increase retention rates and academic success, AI algorithms can forecast student performance, identify at-risk individuals, and offer early interventions.

Moreover, by offering Enhanced Research Capabilities, AI is essential in raising academic achievement. Researchers may examine massive datasets, find trends, and speed up scientific discovery across a range of disciplines with the help of AI tools (Chen et al., 2020; Crompton & Burke, 2023). The use of AI in higher education not only improves student engagement and personalized learning but also expedites administrative work, forecasts student performance, and strengthens research capacities, all of which contribute to a future in education that is more effective and efficient.

### 1.2. Questions/Objectives

In this study, examining the implementation and relationship between AI tools and academic performance is essential to education because it makes it possible to determine how well these tools enhance teaching and learning processes. Thus, building on earlier systematic reviews that looked at the integration of AI in educational contexts, the objective of this study is to thoroughly review the research findings in the area of AI applications such as:

- What and How AI-enabled applications are being used by Higher education?
- What are the challenges and limitations of integrating AI tools in higher education settings?

## 2. Methods

This systematic review on the applications of AI in higher education adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, as recommended by Page et al. (2021), for item selection. To ensure the quality and consistency of reporting, a four-phase flow diagram was employed in this systematic review. PRISMA was selected due to its widespread endorsement and adoption as a guideline for systematic reviews in the field of AI applications in higher education (Page et al., 2021). This section provides an overview of the search strategy, selection criteria (including explanations for inclusion and

exclusion), and outlines the methodology for data coding specifically related to the application of AI in higher education.

### 2.1. Data sources and Search Strategy

To conduct a systematic review of the literature on the application of artificial intelligence (AI) in education, this study adheres to the guidelines outlined in the PRISMA statement. The PRISMA principles, as advocated by Page et al. (2021), are employed to address the three key research questions and to establish a structured framework for conducting a comprehensive systematic literature review. Given the nature of the study and the objective to evaluate the implementation of AI in education, a qualitative research design is adopted, incorporating qualitative content and thematic analysis methodologies. This design is deemed suitable for exploring the diverse approaches and impacts of AI in educational settings.

For the literature search, reputable academic databases such as IEEE Xplore, PubMed, Scopus, and Web of Science are utilized due to their credibility and extensive coverage of education research. A set of keywords including "artificial intelligence", "higher education", "AI in education", "AI-based education", "collaborative learning", "personalized learning", "machine learning", "AI-enhanced learning", "AI in ethical issues", "machine learning for student success", and "student learning" are employed to identify relevant articles that focus on the application of AI in educational contexts. This particular approach ensures a thorough examination of the existing literature on applications of AI in higher education, providing valuable insights into the various strategies and outcomes associated with the integration of AI technologies in educational settings.

### 2.2. Selection Inclusion and Exclusion Criteria

The inclusion and exclusion criteria played a crucial role in the selection process to identify the most relevant and significant studies for this review. To ensure the timeliness and relevance of the literature, the publication year was restricted to the past 7 years, specifically from January 2016 to February 2024. This timeframe was chosen to capture the latest advancements and developments in the field of artificial intelligence in education.

**Table 1: Inclusion and exclusion criteria**

| | Inclusion Criteria | Exclusion Criteria |
|---|---|---|
| **Publication year** | Paper published after 2016 | Paper published before 2016 |
| **Source** | Peer-reviewed journal papers | Non-peer-reviewed journal papers, editorials, books, Conference proceedings and review articles. Other languages |
| **Language** | English Language | Non-education |
| **Context** | Higher education | Non-academic, non-Scopus or Web of Science indexed articles |
| **Source type** | Academic and Scopus or web of science indexed databases | Application of AI in another sectors (e.g. health…) |
| **Topic** | Application of AI in higher education | |

In the subsequent phase, emphasis was placed on utilizing reputable academic databases for the literature search. Specifically, the focus was on databases such as IEEE Xplore, Scopus, and Web of Science.

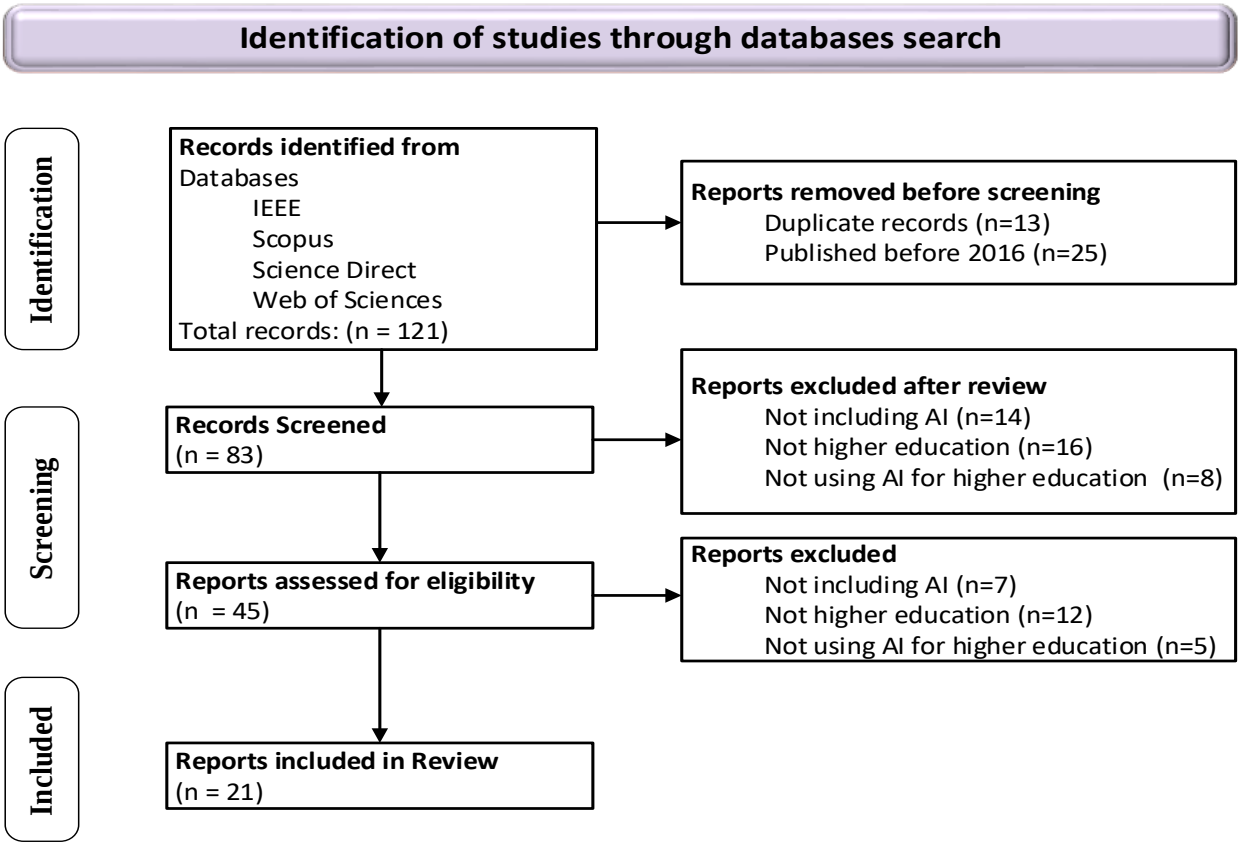


**Figure 1. PRISM flow chart of article identification and Screening**

By leveraging these databases known for their quality assurance and comprehensive coverage of scholarly works, the study aimed to access a wide array of high-quality research articles related to

the application of artificial intelligence in education. This meticulous approach to database selection was intended to enhance the rigor and robustness of the literature review process, ensuring that the studies included would contribute significantly to the overall analysis and findings of the study.

In the initial phase of the study, a comprehensive search was conducted, resulting in a total of 121 articles published after 2016. After excluding 25 articles published before 2016 and eliminating 13 duplicates, the initial sample size was refined to 83 articles for further evaluation. The titles and abstracts of these articles were then carefully reviewed during the screening process, leading to the exclusion of articles that were not relevant to AI, higher education, or the use of AI in higher education.

After the initial screening, 45 articles met the initial criteria and proceeded to the next stage of assessment. A more detailed examination against the inclusion criteria was carried out, which resulted in only 21 articles fully meeting the specified criteria for inclusion in the study. Therefore, the final selection of articles reviewed in this study comprised 21 articles that met the established criteria. To provide a visual representation of the search process and selection criteria, a PRISMA flowchart (Figure 1) was created to illustrate the progression from the initial identification of articles to the final selection of the 21 articles included in the review.

### 2.3. Applications

An outline of the objective of this study involves assessing the application of AI in higher education. The study intends to evaluate how AI has been implemented in education, specifically focusing on instruction, learning, and administration tasks. As observed by Igbokwe (2023), Willis (2024), and Sharma et al., the utilization of AI in education presents a significant opportunity for a revolutionary transformation of different aspects of the educational landscape. By exploring the uses of AI applications, we can partially uncover the ways in which AI is applied and its impact on education. This section examines and explains, based on the findings from the analyzed articles, the actual implementation and effects of AI on instructional, learning, and administrative tasks. Furthermore, it delves into ethical considerations associated with the implementation of AI in education.

#### *2.3.1. Key Applications of AI*

AI plays an important role in revolutionizing teaching learning and administrative processes in higher education. These technologies enable personalized learning experiences like AI-powered platforms, adaptive instructions – to provide learning materials, instructions, and feedback for students, and an automated and real time assessments, can improved student outcomes.

It also supports data analytics for data driven decisions regarding to academic program development; simplifies administrative tasks through AI-enabled systems such as student services, financial processes, and generally it improves operational efficiency; and also it enhances research and innovation by enabling researchers to use AI tools and platforms to analyze complex datasets, to develop predictive models, and automate experiments which leading to new inventions. Moreover, AI-powered chatbots and virtual assistants facilitate student support services. Generally, AI applications enable higher educational institutions to deliver high-quality education, raise innovation, and prepare students for success in a digital world that is changing rapidly.

#### *2.3.2. Instructional, Learning, and Ethical Considerations*

Instructional, learning, and administrative considerations are key aspects when examining the use of AI applications in higher education. The analysis of various articles highlights the rapid adoption and utilization of AI in different forms by instructors for instructional purposes and as pedagogical tools. The implementation of AI has significantly improved the effectiveness, efficiency, and quality of instructional work, as evidenced by the reviewed and analyzed publications (Chen et al., 2020; Zawacki-Richter et al., 2019; Crompton & Burke, 2023).

Efficiency and quality, within this context, is measured by the delivery of the relevant content in line with the curriculum and in line with the learner specific needs and capabilities, while effectiveness is assessed by the implied uptake and retention or the achievement of learning by the students or the learners. Considering these operational definitions and description of efficiency, quality, and effectiveness, the findings of the study therefore indicate AI has fostered the realization of quality, effectiveness, and efficiency in instruction or teaching (Tan et al., 2022; Xu & Ouyang, 2021).

The implementation of AI applications can have a significant impact on instructional quality. The analysis of relevant studies identified several important themes in which AI has affected the work of instructors. One prominent theme is the use of technology, particularly AI, to foster academic

integrity. Tools such as plagiarism checkers and proctoring systems, including platforms like Grammarly, and turnitin, have been highlighted as effective means to ensure academic integrity. Another theme is the leveraging of AI for instructional purposes, which has shown substantial benefits for enhancing instructional quality (Sutton, 2019; Gasparyan et al., 2017; Foltýnek et al., 2019; Sabeeh & Khaled, 2021). This includes the integration of humanoid robots with dialogue and conversational capabilities, creating engaging interactions with learners due to their improved capabilities and human-like appearances.

In addition to instructional benefits, AI applications have also had a notable impact on administrative tasks in higher education. AI technology has been employed to streamline administrative processes, such as student enrollment, registration, and course management. Automated systems powered by AI algorithms can efficiently handle administrative tasks, reducing manual workload and improving accuracy (Igbokwe, 2023; Chen et al., 2020). Moreover, AI-enabled analytics and data processing tools have revolutionized decision-making processes in higher education administration. AI algorithms can analyze large volumes of data to identify patterns, trends, and insights that inform strategic planning, resource allocation, and student support services.

These findings from these studies emphasize that AI applications have facilitated improvements in instructional quality and administrative efficiency in higher education. By leveraging AI technology, institutions can enhance both teaching and administrative processes, ultimately leading to a more effective and streamlined educational experience for students and educators alike.

## 3. Results and Discussions

AI technologies encompass a range of tools and applications, including machine learning algorithms, natural language processing, and predictive analytics. In higher education, AI is being used to personalize learning experiences, provide real-time feedback, and support data-driven decision-making. This systematic literature review includes 21 studies based on application of AI in higher education. The analysis guided by the research questions provides some insights into the application of AI.

*Research Question 1: What and How AI-enabled applications are being used by Higher education?*

AI-enabled applications are revolutionizing higher education by offering innovative solutions to enhance teaching, learning, and administrative processes. One prominent use of AI in higher education is personalized learning, where algorithms analyze student data to provide tailored educational experiences (Tan et al., 2022). Adaptive learning platforms, virtual teaching assistants, personalized learning, Intelligent Tutoring Systems, and smart content recommendation systems are examples of AI applications that provide to individual student needs and preferences. Additionally, predictive analytics tools are being utilized to identify students at risk of academic underperformance, enabling timely interventions to improve student outcomes. Virtual reality simulations, automated grading systems, and smart campus management solutions are other AI applications transforming the higher education landscape.

Our findings show most of the studies indicate that AI has been widely adopted and utilized in education, particularly by educational institutions in various forms. Initially manifesting as computer and related technologies, AI has evolved into web-based and online intelligent education systems. Furthermore, the study notes the integration of embedded computer systems, humanoid robots, and web-based chatbots into educational settings to perform instructional tasks independently or in collaboration with instructors. By leveraging these AI platforms, instructors have empowered themselves and enhance their administrative functions, such as reviewing and grading students' assignments more efficiently. Additionally, AI's machine learning capabilities have facilitated the customization and personalization of curriculum and content to align with students' needs. This personalized approach has resulted in increased student engagement, retention, and overall improvement in the quality of learning experiences (Gašević et al., 2023).

The integration of AI applications in higher education involves a diverse range of users such as learners, educators, administrators, researchers, parents, and the like; each with specific roles and responsibilities in leveraging AI tools to enhance teaching, learning, and administrative functions in educational institutions. Collaboration among these stakeholders is essential to maximize the benefits of AI technologies and address any challenges or ethical considerations that may arise. Therefore, the integration of AI technologies in education has the potential to transform traditional educational practices, leading to more effective and efficient teaching and learning outcomes.

*Research Question 2: What are the challenges and limitations of integrating AI tools in higher education settings?*

The integration of AI in decision-making processes within higher education institutions raises important ethical considerations. One key ethical implication is the potential for bias in AI algorithms, which can lead to discriminatory outcomes in areas such as admissions, grading, and student support services. Transparency and accountability are crucial ethical principles that must be upheld when using AI in decision-making, ensuring that the rationale behind AI-generated decisions is clear and justifiable. Moreover, concerns about student privacy, consent, and the impact of automation on the roles of educators in decision-making processes highlight the need for ethical guidelines and frameworks to govern the responsible use of AI in higher education. Institutions must prioritize ethical considerations to safeguard against potential harms and ensure that AI technologies are deployed in a manner that upholds fairness, equity, and integrity in educational decision-making processes.

Despite the potential benefits of AI in higher education, there are several challenges and limitations that institutions need to address. One major challenge is the issue of data privacy and security, as AI systems rely on vast amounts of student data that must be protected from breaches and misuse. Another challenge is the need for faculty training to effectively integrate AI tools into teaching practices and curriculum development. Resistance to change from traditional teaching methods, high initial costs of implementation, and concerns about the reliability and bias of AI algorithms are additional challenges that institutions face when adopting AI technologies (Gašević et al., 2023). Moreover, the lack of interoperability between different AI systems and the difficulty of ensuring the ethical use of AI tools present further obstacles to successful implementation in higher education settings.

Another key finding of this study is, trustworthiness and reliability of AI technologies will remain an open challenge. (Marcus & Davis, 2019) challenges the notion of quickly achieving human-level intelligence in AI. They highlight the limitations of current AI systems, emphasizing the need to bridge the gap between closed systems and real-world complexities. The authors propose focusing on common sense and deep understanding in AI. Their insights are valuable for higher education, encouraging responsible AI deployment and inspiring institutions to enhance AI programs with a realistic understanding of capabilities and ethical considerations.

Moreover, the integration of AI in the education sector presents both opportunities and challenges. While AI has the potential to enhance teaching and learning experiences, there are specific

considerations that need to be addressed (Luckin et al., 2022). Encouraging active participation and recognizing the interconnectedness of education systems are crucial elements in successful AI applications. This study emphasizes that, to effectively integrate AI in education, it is recommended to develop tailored AI training programs for educators and foster collaboration between AI researchers and educators. Ethical considerations should be prioritized, and investments in research and development for AI in education should be made. Ongoing professional development should be provided to educators, fostering a culture of experimentation and evaluation with AI technologies. Engaging policymakers and stakeholders are crucial in shaping AI policies and guidelines for education. By following these recommendations, the education sector can harness the potential of AI while ensuring responsible and effective integration.

## 4. Conclusion, recommendations, and future work

Based on the results and discussions presented above, it is proofed that AI technologies have the potential to revolutionize higher education by improving teaching, learning, and administrative processes. As of a personalized education, increased student engagement, and administrative effectiveness, the integration of AI applications with the existing system such as personalized learning platforms, analytical tools, and as the whole smart campus management systems has demonstrated encouraging results. However, the integration of AI in higher education also presents challenges and ethical considerations that need to be addressed.

The potential for bias in AI algorithms, data privacy and security concerns, faculty training, interoperability issues, and the need for ethical guidelines are among the challenges that institutions must navigate. Trustworthiness and reliability of AI technologies remain open challenges, highlighting the importance of realistic expectations and responsible deployment.

To effectively integrate AI in education, the researcher of this study recommends the following actions:

- Develop tailored AI training programs for educators: Institutions should provide professional development opportunities to educators to enhance their understanding and skills in utilizing AI tools effectively in teaching practices and curriculum development.

- Create collaboration between AI researchers and educators: Encouraging partnerships and collaboration between AI researchers and educators can facilitate the development and implementation of AI solutions that address specific educational needs and challenges.
- Prioritize ethical considerations: Institutions must establish clear ethical guidelines and frameworks to ensure the responsible use of AI in decision-making processes. Transparency, fairness, equity, and integrity should be upheld, addressing concerns such as bias, privacy, consent, and the impact of automation on the roles of educators.
- Invest in research and development for AI in education: Continued investment in research and development is necessary to advance AI technologies specifically tailored for educational contexts. This includes addressing the limitations of current AI systems and focusing on areas such as common sense and deep understanding.
- Foster a culture of experimentation and evaluation: Institutions should promote a culture that encourages educators to experiment with AI technologies and evaluate their effectiveness. Ongoing professional development should support educators in adopting and adapting AI tools to their teaching practices.

In addition to these recommendations, future work in the field should focus on leveraging novel pedagogical approaches such as adaptive learning environments and intelligent tutoring systems, as well as exploring the development of lifelong learning platforms, cutting-edge research initiatives, and the integration of AI-assisted curriculum design and assessment tools. By incorporating these advancements, educators can pave the way for a more personalized, inclusive, and effective learning experience for learners of all ages.

**Disclosure of Conflicts of Interest**

This paper is free of conflict of interest.

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