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Enhancing Student Engagement Through Artificial Intelligence (AI): Understanding the Basics, Opportunities, and Challenges

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Abstract

The proliferation of artificial intelligence (AI) technologies and chatbots has the potential to significantly reshape higher education. It is now imperative for stakeholders in this sector to grasp the fundamental aspects of AI technologies and understand their implications. This paper not only introduces basic AI concepts but also explains their specific applications and relevance in the higher education context. Moreover, it outlines the prospects of using AI technologies and chatbots to boost student engagement, presenting a synthesis of the opportunities available. Concurrently, we discuss the concerns and challenges associated with integrating AI into higher education settings. Several articles included in this special issue explore these opportunities and challenges from diverse viewpoints and within various contexts, across countries such as Australia, the United Kingdom, Vietnam, Cyprus, and GCC nations. Finally, we propose several avenues for future research aimed at enhancing student engagement through AI, charting a path forward for empirical evidence and practical application of AI and chatbots in enhancing student engagement.

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Introduction

The invasion of digital technology into higher education, spanning several decades, has been met with both enthusiasm and skepticism, characterised by challenges such as user resistance, lack of necessary skills, policy complications, and ethical and privacy concerns (Essien et al., 2024; Nguyen, Gardner, et al., 2020). Despite these hurdles, the disruptive potential of emerging technologies like Artificial Intelligence (AI) is undeniable (Crawford, Cowling, & Allen, 2023; Kelly et al., 2023; Lodge et al., 2023), offering new horizons for learning and teaching practices. While these technologies offer great promise, educators and institutions will need to overcome significant obstacles for successful implementation (Crawford, Cowling, & Allen, 2023; Perkins, 2023). This requires strategies that bridge skill gaps, carefully consider ethical implications, and ensure alignment with existing policies (Nguyen et al., 2023). The recent advancements in AI, particularly with generative AI, emphasise the transformative impact on higher education, raising critical questions about the future of learning and teaching with AI technologies.

The recognition of AI technology's potential in higher education predates the public introduction of generative AI models such as ChatGPT by OpenAI, highlighting the evolving landscape of educational technology and its implications for learning and teaching. Nguyen et al. (2020) highlighted the capacity of AI to unveil critical indicators previously overlooked by stakeholders at various levels of the educational hierarchy, suggesting a transformative role for AI in shaping strategic decisions and educational outcomes. Furthermore, the comprehensive review by Zawacki-Richter et al. (2019) emphasised AI's potential in facilitating adaptive learning systems, personalisation, and intelligent tutoring systems, underscoring the technology's capability to cater to diverse learning needs and styles. These advancements demonstrate the potential for a revolutionary change in education, creating learner-centred environments that could significantly boost student engagement. However, the deployment of AI in educational contexts also introduces ethical concerns, including data privacy, bias in AI algorithms, and the implications of AI-mediated interactions on the student learning experience (Essien et al., 2024). These issues require a thoughtful and considered strategy for incorporating AI technologies in higher education, ensuring that their advantages are achieved while mitigating potential risks and prioritizing ethical practices and student welfare (Holmes et al., 2021; Nguyen et al., 2023).

This editorial introduction, as well as the entirety of the Journal of University Teaching & Learning Practice (JUTLP) special issue titled “Enhancing Student Engagement using Artificial Intelligence (AI) and chatbots like ChatGPT” aims to provide university stakeholders with a comprehensive overview and multifaceted perspectives on both the opportunities and challenges presented by AI technology in elevating student engagement within higher education. This initiative seeks to discuss the transformative potential of AI in creating more personalised, adaptive, and engaging learning experiences, while also addressing the ethical, practical, and pedagogical challenges that accompany the integration of such advanced technologies into educational settings. Through a series of articles and studies, the special issue intends to spark a rich dialogue among educators, policymakers, technologists, and scholars, encouraging a collaborative exploration of how AI can be leveraged to foster a more engaging and effective educational environment. By

showcasing diverse viewpoints and cutting-edge research, the special issue aspires to inform and inspire stakeholders across the spectrum of higher education to navigate the complexities of AI adoption and to harness its full potential for enhancing student engagement.

Alongside summarising the contributions of this special issue, this introductory article provides a basic understanding of AI in higher education. It explores its potential to enhance student engagement and addresses the accompanying concerns and challenges. Additionally, the article proposes several research directions for AI in higher education and calls for further investigation into this evolving field. By outlining key areas for future research, the introduction encourages academics and practitioners to explore how AI can be effectively integrated to improve educational outcomes while navigating the complexities of its adoption in academic environments.

Understanding Artificial Intelligence (AI) in Higher Education

There has been considerable discourse surrounding the application of AI in education, encompassing areas such as machine learning and generative AI. Beyond well-known tools like ChatGPT or Gemini, these AI concepts have broader implications and applications in educational contexts. Understanding these concepts is crucial for leveraging AI to address specific educational needs and challenges, thereby enhancing both teaching effectiveness and student learning outcomes.

AI, Machine Learning (ML), and Deep Learning (DL)

Artificial Intelligence (AI), Machine Learning, and Deep Learning represent interconnected concepts of computational technology, each with its distinct characteristics and applications in various fields, including education. At the broadest level, AI encompasses the development of machines capable of performing tasks that would typically require human intelligence. This includes a wide array of functionalities such as understanding natural language, recognising patterns, and making decisions, achieved through various approaches like rule-based systems, expert systems, and more advanced methods such as machine learning and deep learning. In the educational sphere, AI systems can significantly enhance learning and teaching processes (Järvelä et al., 2023). They might include intelligent tutoring systems (ITS), adaptive learning systems, or personalised learning platforms, which can customize instruction, provide timely feedback to learners, and aid in developing adaptive learning resources tailored to individual student needs.

Machine learning, a subset of AI, focuses on enabling machines to learn from data, make predictions, classify information, and identify patterns without being explicitly programmed for each task. Within the context of education, machine learning can be harnessed for learning analytics to analyse vast amounts of student data, offering personalised instruction recommendations, identifying trends in student behaviour, and forecasting academic performance. For instance, Gray and Perkins (2019) demonstrated that by applying machine learning techniques to early learning engagement data, it is feasible to identify students at risk of failing as early as the fourth week of the Fall semester. Moreover, machine learning algorithms can dynamically adjust the learning environment in real-time, providing each student with a customised learning trajectory that optimally supports their progress and engagement (Ninaus et al., 2019; Raj & Renumol, 2022).

Deep learning, which falls under the broader umbrella of machine learning, involves the use of artificial neural networks with multiple layers - deep neural networks (DNNs). These networks are inspired by the human brain's structure and functionality and are adept at processing and making sense of large datasets, including complex and unstructured data like images, video, and audio. The application of deep learning in education is particularly promising for analysing learners' cognitive and emotional processes, with studies by Nguyen et al. (2022) and Tzirakis et al. (2017) highlighting its potential. For example, multimodal deep learning approaches have been explored for predicting intricate learning activities, such as those involved in shared regulation during collaborative learning scenarios. These technological advancements in AI, machine learning, and deep learning open new horizons for personalised and adaptive learning experiences in education, offering the potential to deeply understand and enhance the learning process based on individual learner data and interactions.

Generative AI (GenAI) and (Multimodal-) Large Language Models (M-LLMs)

Generative AI (GenAI) and (Multimodal-)Large Language Models (M-LLMs) represent significant advancements in the field of artificial intelligence, offering profound implications for learning and teaching. These technologies have the potential to revolutionise educational practices by providing innovative tools for content creation, personalised learning, and interactive engagement. Generative AI encompasses algorithms designed to produce new content such as text, images, audio, and video that mimic human-generated work. In educational environments, this type of AI can be used to create personalised learning resources, model real-life situations for hands-on learning, and develop detailed simulations or models for scientific investigation. This technology allows educators to offer varied, engaging, and customised learning experiences. For instance, generative AI can formulate mathematical or physics practice questions, construct historical recreations, or develop language exercises that adjust to a student's level of proficiency.

LLMs, such as GPT (Generative Pre-trained Transformer), are a subset of GenAI focused on understanding, generating, and translating human language. These models can comprehend and produce text in ways that are contextually relevant and syntactically coherent, making them particularly useful for a variety of educational applications. LLMs can support personalised learning by offering tutoring or feedback on written assignments, generating practice essay prompts, and facilitating language learning through conversation simulations. Additionally, LLMs can assist in the creation of instructional content, summarise academic texts, and even help in drafting research papers or educational resources, thereby reducing the workload on educators and enabling more focused and effective teaching strategies (Dwivedi et al., 2023; Nguyen et al., 2024).

A recent study by Nguyen et al. (2024) has demonstrated the patterns of collaboration between humans and AI in AI-assisted academic writing. This research provides insights into how AI tools utilising LLMs are being integrated into the writing process, highlighting the ways in which these technologies complement human skills to enhance productivity, creativity, and efficiency in academic writing tasks. Multimodal Large Language Models (MLLMs) represent an advanced evolution in the sphere of educational technologies, extending the capabilities of traditional Large Language Models (LLMs) by integrating multiple forms of input and output, including text, images, audio, and video. This integration enables MLLMs to understand and generate content across

various modalities, offering innovative avenues for learning and teaching that cater to diverse learning preferences and needs. MLLMs have the potential to transform educational content delivery by making it more interactive and engaging. For example, an MLLM can analyse a scientific text and generate corresponding visual aids, such as diagrams or animations, to help students better understand complex concepts. This multimodal approach caters to visual learners and can aid in the retention of information by providing multiple reference points for understanding material.

Furthermore, recent advancements in learning analytics have highlighted the potential of MLLMs to support research in the learning process (Whitehead et al., 2024). These tools enable the detailed analysis of educational data, helping researchers identify patterns and trends that inform more effective teaching strategies and learning interventions. By leveraging MLLMs, educators can gain deeper insights into student behaviours, engagement levels, and learning outcomes. This allows for the creation of targeted interventions that cater to specific learning requirements. This method not only increases the accuracy of educational research but also enhances the quality of the learning experiences provided.

Opportunities in Enhancing Student Engagement through AI in Higher Education

The incorporation of AI technology in higher education to enhance student engagement offers immersive opportunities but also presents several challenges that need to be addressed. These challenges are crucial not only for improving learning experiences but also for mitigating issues stemming from technology advancement such as an over-reliance on GenAI.

Interactive Teaching Aids

Decades of research into Intelligent Tutoring Systems (ITS) have established that these systems employ to provide immediate, personalised feedback and support to learners, akin to one-on-one tutoring. These systems can assess student submissions, identify errors, and provide targeted feedback to help students improve (Mousavinasab et al., 2021; Tchounikine et al., 2010). By offering support that is tailored to the student's current level of understanding, ITS can enhance student engagement and lead to learning outcomes (VanLehn, 2011).

However, despite their potential, Intelligent Tutoring Systems (ITS) have not seen widespread adoption in formal educational settings across many countries. This limited uptake could be attributed to several challenges, including issues related to technological accessibility, the digital divide, and pedagogical integration (Nguyen, 2022; Nguyen, Hong, et al., 2020; Strobl et al., 2019). Technological accessibility concerns arise from the substantial resources required to implement and maintain ITS, which can be a barrier in under-resourced educational environments. The digital divide further exacerbates this issue, as disparities in access to technology limit the availability of ITS to all students. Additionally, integrating ITS effectively into existing pedagogical frameworks poses another significant challenge, as educators must align these advanced systems with traditional teaching methods and curricular goals. These factors collectively hinder the broader adoption of ITS in formal education.

Recently, the widespread availability of GenAI, coupled with its advanced capabilities and ease of access and adoption, has introduced new affordances to teaching and learning (Enriquez et al., 2023; Nguyen et al., 2024). This accessibility allows for broader integration into various educational settings, supporting a more dynamic and responsive learning environment. These technological advancements enable educators and students to engage with content in innovative ways that were previously unattainable.

GenAI can serve as dynamic teaching assistants, offering educators a range of tools to enhance their teaching methods. Teachers can use GenAI to create diverse educational materials that incorporate text, visuals, and audio, making lessons more dynamic and engaging. Moreover, GenAI can assist in evaluating students' work by examining written assignments, presentations, and spoken responses, providing comprehensive feedback that covers both the textual and auditory elements of the content. Thus, generative AI is transforming the educational field, making it more interactive and adaptable to the needs of today's learners.

Personalised Learning Experience and Accessibility

While personalised learning has been acknowledged as an effective method that customises educational experiences to meet the specific needs of individual learners (Xie et al., 2019; Zheng et al., 2021), the significant resources needed to put this model into practice make it challenging to adopt on a large scale (Nguyen, Gardner, et al., 2020). The advent of technology and new learning platforms, such as Massive Open Online Courses (MOOCs), has advanced the concept of personalised learning by providing scalable educational resources (Fan et al., 2023). However, these resources are often static and do not truly cater to the unique needs of each learner.

Numerous studies have explored the development of personalised learning, resulting in various prototypes that aim to enhance its feasibility and effectiveness (Denny et al., 2015; Hsieh et al., 2012). Yet, similar to ITS, these personalised learning systems have not been broadly integrated into mainstream educational settings. The key challenge remains the static nature of the resources, which fails to dynamically adapt to the evolving needs of individual learners.

The recent availability of GenAI technologies has further propelled the personalised learning experience by facilitating real-time interactions with each learner. This capability of GenAI to provide instantaneous feedback and tailor learning materials according to individual student needs represents a transformative step towards true personalised learning. Moreover, GenAI enhances educational accessibility and convenience, allowing students to interact with learning materials anytime and anywhere. This flexibility is particularly beneficial for learners who need to balance educational pursuits with other commitments or those who prefer studying outside conventional classroom settings. By generating personalised content, assessments, and feedback dynamically, GenAI supports a variety of learning styles and schedules, thereby increasing engagement and making education more responsive to the diverse needs and lifestyles of students. This round-the-clock availability of tailored educational resources through GenAI not only makes learning more accessible but also substantially enriches the overall learning experience.

Furthermore, AI technologies, such as natural language processing and speech recognition, can make learning materials more accessible to students with disabilities (Nguyen et al., 2018). For

instance, AI-powered tools can automatically generate captions for lecture videos or provide real-time language translation, removing barriers to access and engagement for a broader spectrum of students.

However, much more work is needed to realize a fully personalised learning experience where an AI system can comprehensively understand a learner's profile, accurately establish their learning model, and adapt the content to best fit their individual needs. This involves not only technological advancements but also a deeper integration of educational theories and practices to ensure that AI-driven personalization enhances learning outcomes without compromising educational equity or integrity.

Concerns and Challenges of Implementing AI in Higher Education

The integration of AI, particularly Generative AI, into education brings substantial benefits but also raises significant ethical issues and challenges to academic integrity that need to be thoughtfully examined and managed (Crawford, Cowling, & Allen, 2023; Holmes et al., 2021; Nguyen et al., 2023). One of the foremost ethical concerns involves data privacy. The use of AI in education often requires the collection and analysis of large amounts of personal data from students, including learning patterns, performance metrics, and potentially sensitive information. This raises questions about who has access to this data, how it is used, and how the privacy of individuals is protected. Institutional leadership plays a crucial role in ensuring the ethical deployment and management of ChatGPT by establishing standards and practices that prioritize transparency, accountability, and the protection of user data (Crawford, Cowling, & Allen, 2023).

Another significant ethical issue is the potential for bias in AI algorithms (Baker & Hawn, 2021). These systems can inadvertently perpetuate existing biases present in their training data, leading to unfair treatment of certain student groups. This can affect assessments, recommendations, and the personalization of learning experiences, potentially disadvantaging students based on race, gender, or socioeconomic status.

Moreover, the integration of AI technologies in educational settings also poses challenges to academic integrity (Kasneci et al., 2023; Kishore et al., 2023; Nguyen et al., 2024). As students increasingly rely on AI-generated content, there is a risk that it could facilitate academic dishonesty, making it difficult to ascertain whether work submitted is truly indicative of a student's own understanding and effort. This reliance on AI tools also raises concerns about students' development of critical thinking and problem-solving skills, as the ease of access to information might deter deeper engagement with learning materials.

Addressing these issues requires a thoughtful approach that includes setting clear policies on the ethical use of AI, ensuring transparency in AI operations, and educating students and educators about the implications of using such technology (Nguyen et al., 2023). It also necessitates ongoing monitoring and evaluation to ensure that AI tools are used in ways that uphold academic standards and promote a fair and equitable learning environment. Ensuring that these tools are developed and implemented with an awareness of these ethical concerns and academic challenges is crucial for harnessing the potential of AI in education while safeguarding the values of the educational community.

Future Research Directions

This special issue titled “Enhancing Student Engagement using Artificial Intelligence (AI) and chatbots like ChatGPT” consists of a commentary and seven articles that examine the integration of AI technology in various educational settings, including higher education and language learning, across countries such as Australia, the United Kingdom, Vietnam, Cyprus, and GCC nations. This issue provides detailed insights into the adoption of AI tools and their impact on enhancing educational processes and student engagement. Each contribution explores both the potential benefits and the challenges associated with the implementation of AI technologies in educational environments. The articles collectively contribute to a broader understanding of how AI can influence educational practices and learner outcomes globally, presenting evidence-based evaluations and recommendations.

As we continue to explore the intersection of AI and education, several promising avenues for future research emerge, particularly in enhancing student engagement via AI technologies. One of the key areas of interest is the development of adaptive learning systems that can more deeply personalise the learning experience. This involves not just adjusting the difficulty of tasks based on student performance but also integrating multimodal data, including emotional and behavioural cues, to adapt the learning environment more holistically to individual student needs (Järvelä et al., 2023).

Another vital research direction is the exploration of ethical AI use in education (Nguyen et al., 2023). This includes addressing concerns related to data privacy, algorithmic bias, and the digital divide (Kishore et al., 2023). It is essential to develop guidelines and frameworks that ensure the equitable use of AI across diverse educational contexts (e.g., public and private schools, rural and urban schools) and populations (e.g., students with disabilities). Research could focus on creating transparent AI systems where the decision-making processes are clear to all stakeholders, thereby fostering trust and broader acceptance.

Moreover, stepping beyond individual learning, the integration of AI into collaborative learning environments presents an exciting area for investigation. AI could play a crucial role in facilitating group interactions, supporting peer learning, and even mediating discussions, potentially transforming how group learning is conducted both in physical and virtual classrooms.

Investigating the long-term impacts of artificial intelligence on learning outcomes and student engagement is a crucial area of study that requires a sustained and methodical approach. Longitudinal studies, in particular, are essential as they can track the effects of AI integration over extended periods, providing a richer, more nuanced understanding of how continuous interaction with AI technologies influences students' educational journeys. These studies could examine a variety of factors, including academic performance, cognitive development, and emotional and social engagement, to determine how AI tools affect these areas over time.

Furthermore, longitudinal research could help identify the specific characteristics of AI tools that are most effective in enhancing learning and engagement. For example, studies could compare the impacts of AI systems that provide personalised learning paths versus those that offer more generic support. This would not only help in understanding the potential of AI in education but also in refining AI tools to better meet the needs of learners. Such research could also explore

whether AI technologies contribute to closing achievement gaps between different groups of students or if they inadvertently perpetuate or exacerbate existing disparities. This would involve analysing the accessibility of AI technologies among students from diverse socio-economic, racial, and geographical backgrounds and evaluating the equity of AI-driven educational opportunities.

In conclusion, as we stand on the brink of a potential new era in education shaped by the pervasive influence of AI technologies, this special issue, with its diverse contributions, offers critical views from various perspectives on the role of AI in higher education. These contributions lay a solid foundation for exploring effective strategies to enhance student engagement through AI in this sector. It is our hope that this issue not only provides essential insights into the phenomenon but also stimulates fresh ideas and perspectives. Furthermore, it aims to serve as a guidepost for future necessary research in the field, encouraging continued exploration and understanding of how AI can most effectively benefit higher education environments.

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