XGlobal Integration of Artificial Intelligence in Higher Education Sector: A Bibliometric Analysis

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Abstract: In modern perspective, the phenomenon of artificial intelligence (AI) has witnessed considerable advancements, extending its influence across various sectors, with higher education emerging as one of the most significant areas of impact. Researchers who have found the revolutionary potential and essential contributions of AI in boosting educational practices and approaches have extensively emphasized this trend. (George & Wooden, 2023; George & Paul, 2020). The higher education domain is progressively acknowledging AI as a key factor for competitive edge (Hannan & Liu, 2021). This paper aims to examine the existing research on AI implications in the higher education segment. Grounded on the theory of technology diffusion (Rogers, 2003), our research systematically examines the scientific field, identifying emerging research topics. Using SCOPUS as a database for peer-reviewed article selection (publication period 2011–2024) and bibliometric analysis, we provide an insight into the varied geographic spread of research within the realm of AI in education. Our findings shed light on the evolution of models for the adoption of AI technologies in higher education, revealing six main areas of research in the field: (1) teaching and involving students in the educational process using generative AI, (2) using chatbots to improve the educational process, (3) improving the literacy of teachers and students in the field of AI, (4) AI and blockchain in educational practices (5) development of regulations for the use of AI and (6) improving operational processes at universities. This article explains current influences on research prospects in the context of higher education. By offering an understanding of the challenges and opportunities presented by AI, this paper encourages educators to investigate possible uses of AI in the context of higher education.

Keywords: Artificial Intelligence, Resistance to Change; Digital Technologies; Digitalization; Leadership; Leadership in Higher Education.

1. Introduction

The emergence of the ChatGPT served as a catalyst for a global technological breakthrough in almost all sectors of the economy and lead to the exponential increase in the interest of scientific community in implementing AI, especially in higher education sector (George & Wooden, 2023; Kroshilin, 2022). The latest phase in the digital transformation of higher education is AI. Although when introduced, its full extent and impact have not yet been comprehended (Solís et al., 2023). Representing an important watershed of pedagogical methodologies for higher education, AI has been grafted into the body of higher education. A cutting-edge technology moving ahead speedily, AI capability can be used in learning processes all sorts of exciting ways (Zaman, 2023). From the increasing output of academic words published during 2019-2023 it can be clearly observed that higher education is now obsessed with AI.

As field of AI in higher education matures, understanding its evolving landscape becomes vital. Researchers in this dynamic discipline continually seek fresh insights to enrich the knowledge base and unveil new research directions that stimulate debates on pivotal topics (Crompton & Song, 2021). Systematic reviews of the existing research in AI implementation within higher educational contexts are needed to recognize key contributions and to construct well-founded arguments about the field's progression (Zawacki-Richter et al., 2019). Literature reviews play a critical role in mapping the intellectual terrain for further scholarly exploration (Anand et al., 2021a), offering valuable insights into prominent authors, institutions, countries, and the predominant themes and works shaping this field (Anand et al., 2021a). However, a review employing bibliometric analysis to unravel the intellectual foundations and emerging trends in this area of AI diffusion in higher education has not yet been extensively undertaken, indicating a gap in scholarly inquiry (Zawacki-Richter et al., 2019).

Previous studies tended to be narrowed to specific aspects of AI and did not present a complete picture of the development of the field. For example, the work of Takahashi and colleagues (2024) in a bibliometric review of the diffusion of innovations demonstrates this shortcoming by not specifically focusing on AI in work. Simultaneously, several studies emphasize the need for a detailed analysis of the role of AI in higher education (Zaman, 2023).

While there have been attempts to review the diffusion of AI technologies in educational settings, these efforts often need scope and clarity. For example, some scholars have focused on specific aspects of AI in education, such as its impact on learning outcomes or its integration in curriculum design, without offering a broad overview

of the field's evolution (Zawacki-Richter et al., 2019). This study aims to overcome these limitations by employing systematic bibliometric methods to explore and systematize the existing literature on AI technology diffusion in higher education.

2. Background and Research Questions

Bibliometric techniques, combined with science mapping software, offer a robust approach to categorize, conceptualize, and reveal trends in literature, surpassing the capabilities of traditional review methods such as narrative or structured reviews (Anand et al., 2021a; Anand et al., 2021b,). This study adopts relational techniques (Benckendorff and Zehrer, 2013), to analyse qualitative, quantitative, and structural growth in this research field (Anand et al., 2021a). These techniques also help identify theoretical foundations (Zupic and Cater, 2015) and emerging trends (Walsh and Renaud, 2017).

Thus, the current study seeks to fill this gap by systematizing and analysing existing publications on AI in higher education through bibliometric data analysis (Anand et al., 2021a; Walsh & Renaud, 2017). This research applies both evaluative and relational bibliometric methods to analyse the global landscape of AI in higher education, identify influential authors, most cited papers, and identify emerging research trends.

Within this objective, the following research question was identified:

RQ: What are the emerging research topics and trends in the diffusion of AI technologies in higher education?

3. Methodology

Our study of AI in higher education relies on a systematic literature review conducted according to the five-step methodology proposed by (Anand et al., 2021a; Tranfield et al., 2003). To ensure the reliability of the results, this methodology was aligned with the Preferred reporting items for systematic reviews and meta-analyses (PRISMA) program to ensure academic transparency and reliability (Moher et al., 2009). Scopus was chosen as the database, with a focus on current and relevant publications in the field of AI and education, excluding irrelevant papers and other types of papers to maintain a rigorous methodological discipline. The collected data was analyzed and presented visually using VOSviewer.

Step 1. Firstly, our research process encompassed several steps, such as constructing SCOPUS search strings, and choosing the appropriate databases, among other tasks, all in line with the established guideline of Anand et al., 2021a.

3.1 Database Selection for the Search

To conduct this comprehensive literature review, the Scopus database was utilized for article selection and bibliometric analysis. This database provides access to a vast repository of research articles, making it a suitable resource for a review of AI in higher education.

3.2 Identification of Relevant Keywords and Subject Areas, Followed by the Construction of Precise Search Strings

Consequently, we executed a search in title and abstract to retrieve publications from this database for more in-depth analysis (Table 1). A term search in topic and abstract employing various combinations was conducted on the Scopus database to retrieve publications. We established specific inclusion criteria for selecting these publications, focusing on the subject codes related to business and economics. The data was collected in January 2024, and considering the regular updates to the Scopus database, it's expected that the figures might vary in future searches. We limited our inclusion to journal articles, deliberately excluding editorials, conference papers, and book chapters. This decision was based on the methodological rigor these articles hold in the scientific community, following guidelines by Anand et al, 2021a and Thyer, 2008. Later, the data was processed via MS Excel to remove duplicates and form a sample. This resulted in a total sample of 2652 articles related to AI in higher education.

Step 2: Secondly, to analyze the trends in the literature based on the 2652 publications we obtained, we employed bibliometric methods. These methods are commonly used in conjunction with science mapping tools and techniques to visualize the structure of a discipline (Anand et al., 2021a; Walsh and Renaud, 2017; Zupic & Cater, 2015) and to analyze clusters (Anand et al., 2021a; Walsh and Renaud, 2017). In our paper, we utilized Van Eck and Waltman's (2010) VOS Viewer software for mapping bibliography and citation trends, which are

represented through clusters, tables, and maps, as shown by Anand et al (2021a) and Walsh and Renaud (2017). Over the last decade (2013-2024), VOS Viewer has been increasingly adopted and applied in various literature reviews published in top-ranked journals, as evidenced by Kirby (2023).

Step 3: Relational techniques, as described by Anand et al. (2021a) and Benckendorff and Zehrer (2013), provide a more nuanced understanding of the connections and relationships within the field. These techniques involve analyzing the links between different academic works, authors, and themes, enabling a deeper exploration of the intellectual structure and network dynamics characterizing AI technology diffusion in higher education. The bibliographic coupling was performed, and 6 clusters were identified.

Step 4: Following Anand et al. (2021a) guideline, we embarked on a qualitative descriptive coding of the abstracts of these publications. Based on the content of abstracts, 102 out of 2652 publications were selected. The content of 102 abstracts from selected articles was analyzed in accordance with the parameters of Anand et al., (2021a). As emphasized by Salager-Meyer (1990, p. 367), abstracts are crucial for consolidating research ideas and fully grasping the arguments of the original articles. This process involved two researchers independently examining the abstracts and compiling notes, followed by a verification process for consistency by one other author.

Step 5: Fifth, synthesis was performed. In the line with the methodology of our study on AI technology diffusion in higher education, we conducted systematic reviews with a focus on synthesis, following the framework established by Anand et al. (2021a). The synthesis approach is a systematic method for amalgamating, integrating, and synthesizing diverse literature, offering a cohesive narrative and summary of the field (Schick-Makaroff et al., 2016). This approach is particularly useful in handling the multifaceted nature of AI technology diffusion in higher education.

4. Findings

RQ. What are the emerging research topics and trends in the diffusion of AI technologies in higher education?

Based on the bibliographic coupling in the research, six primary clusters were identified (Figure 1)

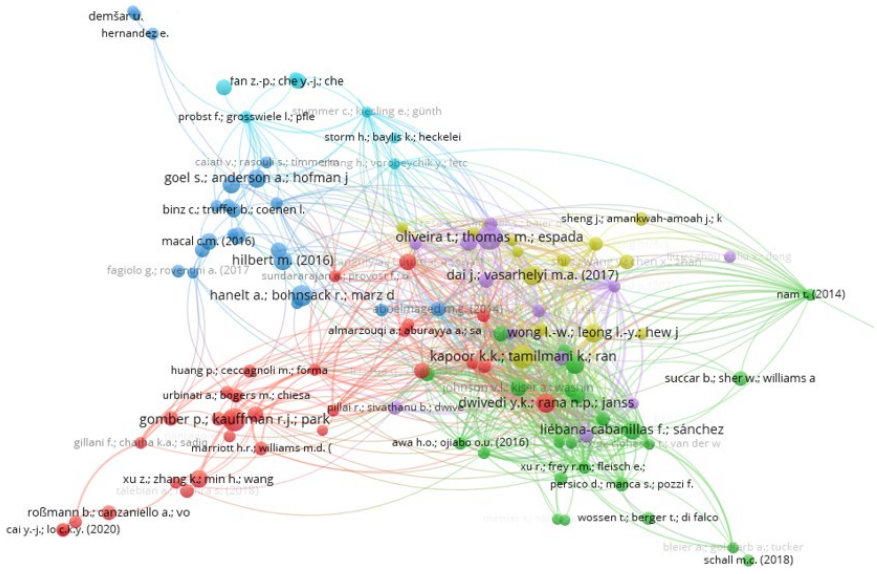

Figure 1: Bibliographic coupling (made in VOSviewer)

The first cluster (red) "*teaching and involving students in the educational process using generative AI*" (n=26) uncovers the application of generative AI in educational environments, not merely to improve student involvement in education, but also to promote individualized learning experiences and enable research tools. This cluster contains a seminal work by Dwivedi et al., 2019 "Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. Information systems frontiers" which serves as a conceptual framework for many studies observing AI implementations in educational context. Another seminal work Gomber et al., 2018 "On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services" serves in articles as a framework to interpret AI innovation

implementation within educational context. The second cluster (green) *"using chatbots to improve the educational process"* (n=24) describes how the development of chatbots proceeds to improve the educational processes. The cluster is characterized by the representative capacity of chatbots, as a key tool for achieving guided learning. The third cluster (blue) "*improving the literacy of teachers and students in the field of AI*" (n=23) is focused on the expansion of AI literacy among educators and students. From this perspective, this cluster stresses the urgency of familiarizing teachers and learners with the principles of efficient utilization of AI devices in their educational environments. Fourth cluster (yellow) "*AI and blockchain in educational practices*" (n=12) analyzes the merger of AI and blockchain technology in universities. It specifically focuses on the use of AI for analysis of educational data, which is securely stored on blockchain platforms. Fifth cluster (purple) "*development of regulations for the use of AI*" (n=11) highlights the development of guidelines for an ethical and efficient approach to AI in education. The studies in this cluster focus on the call for a regulatory structure and deployment necessitate an ethical and comprehensive, regulatory framework, policy and responsible AI guideline's structure. Sixth cluster (light blue) "*improving operational processes at universities*" (n=6) is centered around optimizing operational processes in universities through developing guidelines for the use of AI .

5. Discussion

A deeper look into the first cluster demonstrates that AI is adept at improving student participation in interactive problem-solving exercises and the shift of AI from aiding teacher instruction to that of active learner management (Chan & Lee, 2023; Dehouche & Dehouche, 2023). AI provides a personalized educational solution that adjusts learning methods to cater to the needs of individual students, thereby fostering a more personalized learning environment (Cox et al., 2021; Chrisinger; 2019; Kumar, 2019). This cluster also focus on AI capabilities to ease research in educational processes (Kitamura, 2023; van Dis et al., 2023). Despite the advantages presented in the first cluster there still are controversial thoughts within AI research discourse. Resent research states that although AI can help higher education to significantly evolve, the models are biased and need development (Ouyang et al., 2022; Roshanaei, 2024). All in all, the findings reveal much promise and difficulty in implementing generative AI into educational practice which aligns with the findings of Farrokhnia et al. (2023).

In the second cluster, studies by Hwang & Chang (2023) and Lin's et al (2022) state that chatbots are effective in guiding students through data-driven and practice-based learning to develop discipline, learning perseverance and activate participation. Some articles within the cluster highlight that AI chatbots are enhancing students' collaborative learning and information exchange thus effectively supporting the assessment of peers and interactive learning (Bauer E. et al. 2023, Cachero et al., 2023; Darvishi et al., 2022, Chang et al., 2022). Other articles within the cluster focus on AI chatbots as assistants in scheduling and managing time or preparing for exams (Arruda et al., 2019, Fuchs, 2023; Frommert et al., 2018). Even though some scholars state that chatbots with, for example, FAQs and short answers can provide many improvements for teaching students and providing content to teachers (Cunningham-Nelson et al., 2019; Ismail & Ade-Ibijola, 2018) some sholars actively oppose the use of chatbots due to their inaccuracy and inability to be creative in response (Kooli, 2023; Toader et al., 2019).

Third cluster discusses the literacy of teachers and students in the field of AI. Some articles like Mizumoto & Eguchi (2023) and Crompton & Burke (2023) feature examples of how AI helps automate the process of checking students' papers, making it less biased and, at the same time, less time-consuming. Apart from simplifying certain personnel-related activities, this tool helps teachers concentrate more on applied aspects of their work than on organizational. Furthermore, the cluster discusses the application of AI as an enabler of synchronous studying in the form of group assignments or problem-solving tasks (Han et al., 2023). Although the positive aspects presented in the cluster, some studies in the existing research field raise concerns about teacher's trust in AI systems and the impact they can have on educational communities, suggesting that future work should explore not only the possibilities of using AI, but also the perception and understanding of these methods by students (e.g. Pishtari et al., 2023).

The fourth cluster uncovers the possible co-use of blockchain and AI. Blockchain is used to securely store educational records and student achievements, and AI can analyze this data to personalize curricula and teaching methods (Aliane & Salim, 2023). Such technologies have demonstrated effectiveness in managing student data and preventing fraudulent decryptions in higher education. However, there are several difficulties in implementing these technologies, including due to data privacy issues and a shortage of technical staff. (Aliane & Salim, 2023).

The fifth cluster indicates a strong need within educational systems to guide policy development and ensure responsible AI usage. Some studies such as Nguyen et al., 2023 and Dieterle et al., 2024 indicate the need for a normative framework that will regulate the deployment and use of AI in addition to preventing its misuse, but also innovation. There is also a concern about the vision of ethics the two parties between the educators and learners should have when it comes to operating and using AI. For example, Flores-Vivar & García-Peñalvo, 2024 focused on promoting a culture that maintains ethics in the use of AI. This signifies a call for a collaborative approach to responsible implementation and use of AI in education.

The last cluster states that AI can be used to help management in universities. For example, AI can be used to generate standardized templates for administrative communications, which can mitigate the bottlenecks created by the lack of standardized forms of communication between administrators (Parycek et al., 2023). However, there is a resistance towards AI among employees within universities which can have a different background for each case (Muñoz & Chimbo, 2023).

6. Conclusions

In this bibliometric analysis of the global integration of artificial intelligence (AI) in higher education, we provided a set of emerging research topics and trends in the diffusion of AI technologies in higher education. By synthesizing 102 papers, six clusters were found to be the main landscapes in this area: generative AI in education, chatbots for teaching and learning, AI literacy, AI and blockchain, ethical usage of AI and AI for administrative processes optimalization.

The research illustrates AI's potential to improve teaching and learning practices. The impact this might have includes encouraging student involvement, facilitating personalized instruction and automating administrative processes. In the education field, generative AI could offer the answer. While these are hugely complex systems which might exhibit bias or other vulnerability, it remains feasible when individuals concern themselves with their own educational direction (Chan & Lee, 2023; Dehouche & Dehouche, 2023; Cox et al., 2019). Chatbots are another promising app; they can improve student interaction with teachers and provide guided learning modes (Hwang & Chang, 2021). But their effectiveness depends very much on exact use, and this underscores the need for careful applications (Arruda et al., 2019). The research also indicates that educators require a greater understanding of AI (Mizumoto & Eguchi, 2023). With integration of AI and block-chain technology, educational data can be stably stored and then analyzed. However, adoption is obstructed by privacy anxieties as well as technical blockages (Aliane & Salim, 2023). The ethical problems arising from use of AI in education is a crucial issue. There is a general demand for comprehensive regulatory frameworks and codes of practice to be created, with consensus on balance innovation with responsible use (Nguyen et al., 2023; Flores-Vivar & García-Peñalvo, 2024). Finally, for universities and other higher education institutions AI presents potential, although this is contested because of potential technological bias or mistrust of automation (Muñoz & Chimbo, 2023).

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