ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION. A LITERATURE REVIEW

https://doi.org/10.47743/jopafl-2023-30-09

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Abstract: *During the last decade, and especially since the launch of ChatGPT in late 2022, artificial intelligence has become a very hot topic for both professors and universities, raising concerns and challenges, as well as a wave of controversies. Using the methodology of bibliometric studies and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses protocol, the purpose of the investigation is to analyse the scientific production in the field of artificial intelligence's applications in higher education. The paper is an overview of the main discussions and trends reflected in articles published between 1989 and November 2023 and indexed in the Web of Science Core Collection.*
Keywords*: Higher Education; Artificial Intelligence; systematic literature review; bibliometric study.*

This Article was presented as a paper at the 15th edition of the Annual International Conference Globalization and Higher Education in Economics and Business Administration (GEBA 2023), which was held at the Alexandru Ioan Cuza University, Faculty of Economics and Business Administration in Iasi, Romania from the 19-21 October 2023.

Introduction

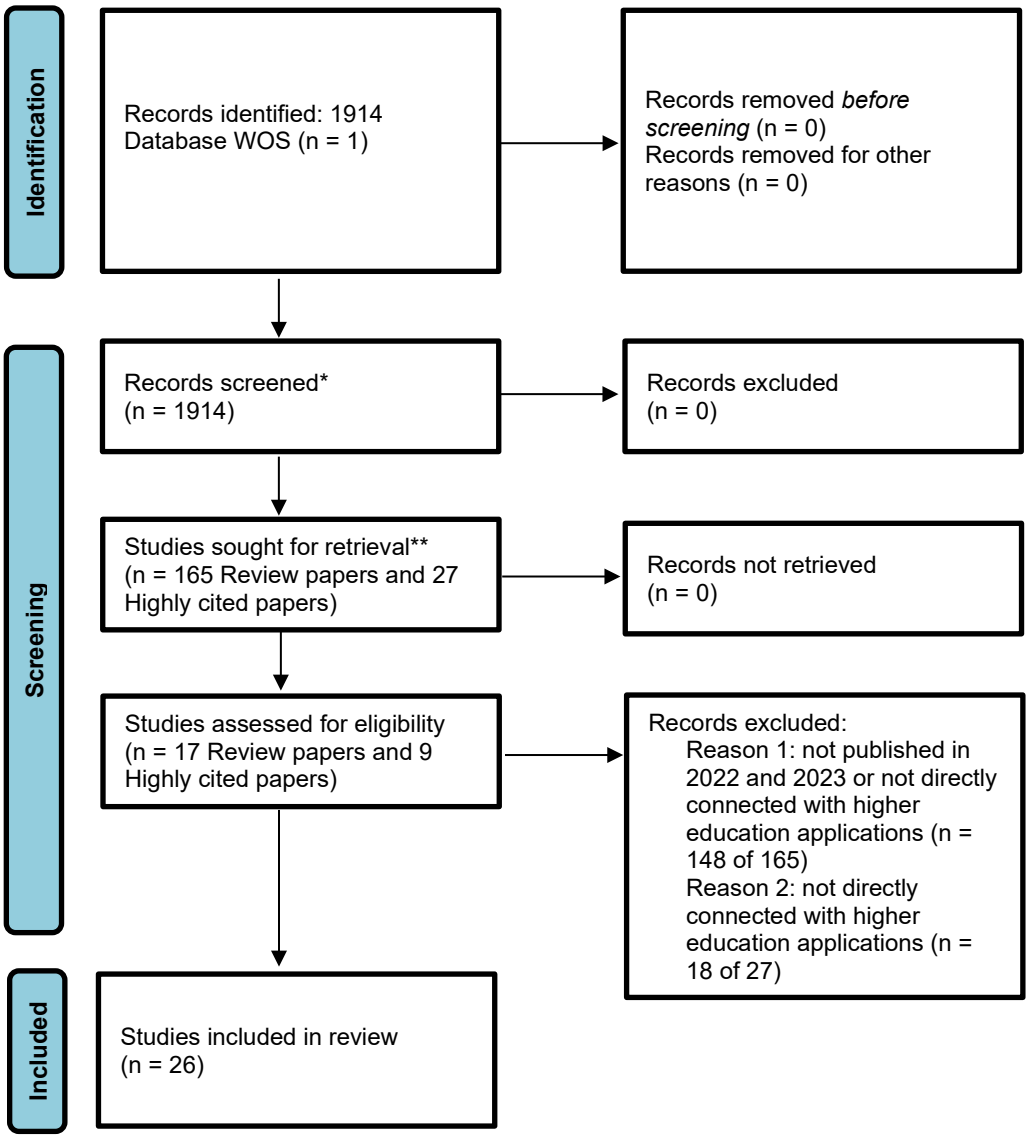
The use of artificial intelligence (AI) in education has been a topic for investigation since the early 1970s. However, concerns and challenges about the application of artificial intelligence in higher education (HE) reignite especially in late 2022, following the launch of ChatGPT. This paper provides general insights and details on current trends in the field and future directions of investigation. The structure of the review paper is organized as follows: Section 2 provides an overview of the methodology and tools used; Section 3 includes a comprehensive discussion of the contributions and findings of selected articles, and Section 4 contains the concluding remarks.

Methodology and data

This paper uses the bibliometric analysis approach. Pritchard (1969), was the first to use quantitative methods to measure and analyse different aspects of research articles; later,

the term "bibliometrics" was widely adopted and the approach was used for in-depth analysis different subject fields. Nowadays, the investigation of bibliographic material from a quantitative perspective is very convenient to provide a general overview of research in a specific field, identify trends, the most influential papers, authors or journals. Furthermore, bibliometric research can help to advance a field of study in novel and meaningful ways (Donthu et al., 2021) and represents an essential component of the research evaluation methodology, particularly in science and applied science (Ellegaard & Wallin, 2015).

We follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021) for selecting the relevant articles from the Web of Science Core Collection (WOS), *the most relevant database in social sciences.* The query concentrated on papers indexed between 1989 and 24th of November 2023, using as keywords: "artificial intelligence" and "higher education". The selection process of the articles is shown in Figure 1.



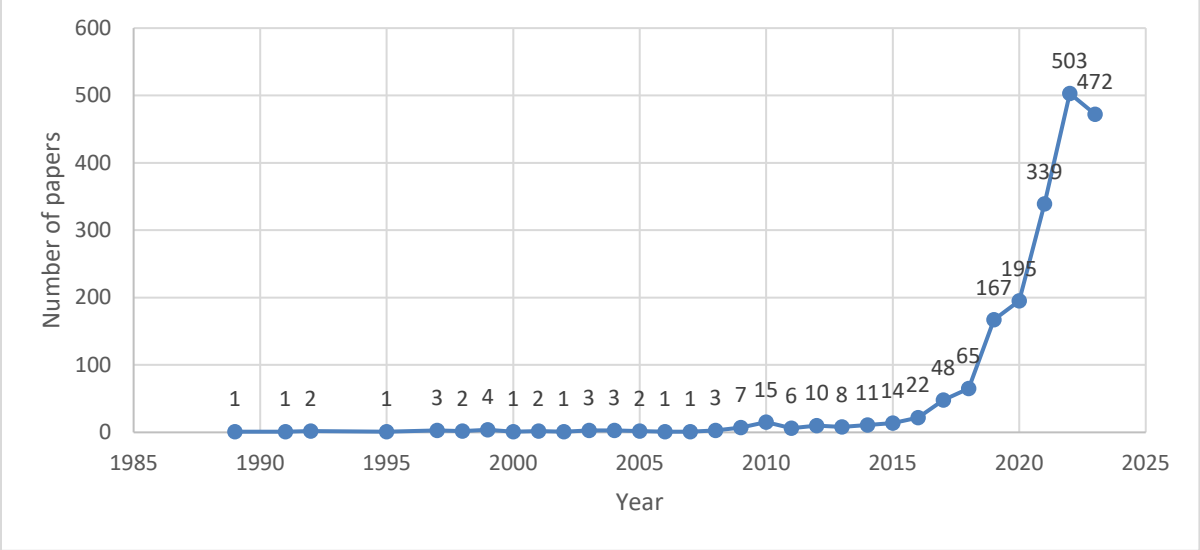
* Stage 1: For VOSviewer use
** Stage 2: Review papers and Highly cited papers
Source: Adapted from Page et al. (2021)

Figure 1. PRISMA flow chart of article identification and screening

The initial research query using the WOS database (https://www.webofscience.com/) and the above-mentioned keywords returned 1,914 results, spanning to 1989.

At this early stage, before refining the search, several interesting facts need to be highlighted about the query in Web of Science. As one could expect, in a detailed structure of the results (refined by *Document Types*), the majority of the indexed materials are *article journals*: 1284 of the total documents (including 165 *Review Articles*), while the others have been structured as follows: 147 *Early Access*, 27 *Editorial Materials* and 3 *Retracted Publications*), 420 *Proceeding Papers*, 21 *Book Chapters*, 9 *Book Reviews*, 2 *Books*, 2 *Meeting minutes*, 1 *Letter*, and 1 *Meeting Abstract*. Among the indexed papers, 27 *Highly Cited Papers* and 5 *Hot Papers* have been highlighted. Moreover, the Open Access publications have surpassed subscription-only publications: the majority of the documents (1,027 of the resources, or roughly 54% of the total), were made available Open Access, indicating that the research landscape is rapidly shifting, as academic journals and books move from Subscription to Open Access publishing - a trend that major publishers have been following for the past few years.

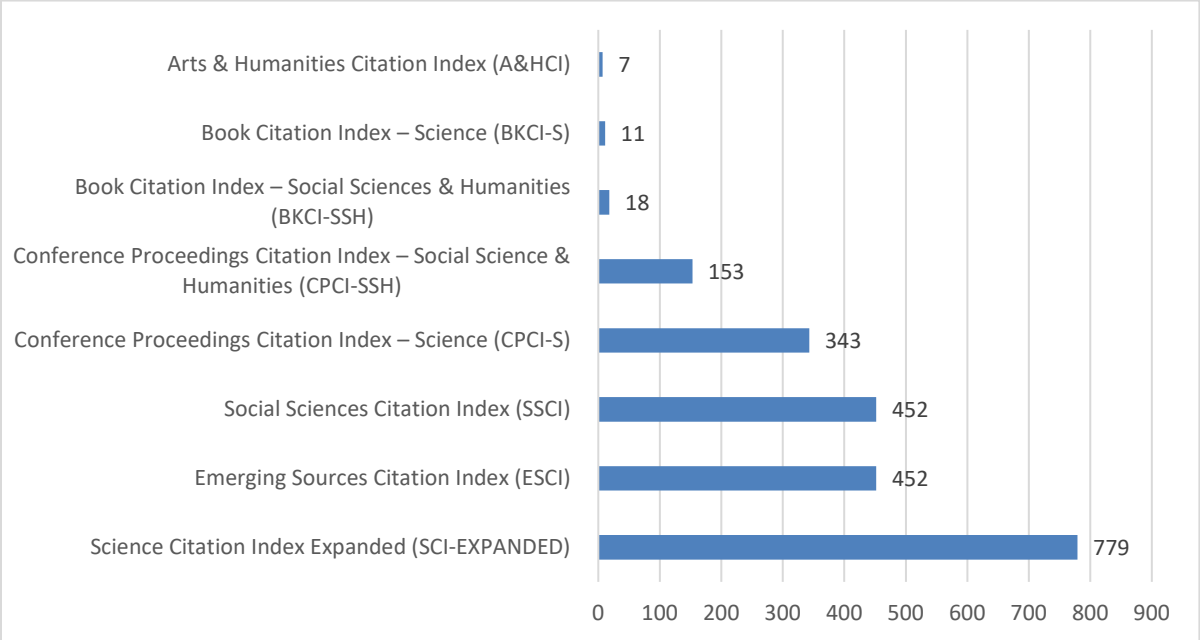
A more detailed analysis shows that the number of papers in the field has increased significantly over the years, but especially since 2020. In total, 1509 papers were published starting with 2020, representing 78.84% of the materials; if we include 2019 as well, the percentage increases to 87.56%. In fact, all the papers published between 1989 and 2019 count less than the number of materials published only in 2022. We also need to take into consideration that our analysis stops in late November 2023 and by the end of the year more resources will have been published and indexed.



Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 2. Number of papers published annually from 1989 to 2023 in journals indexed in Web of Science

In terms of *Web of Science Categories*, around 24% of the total (464 of 1914) belonged to *Education Educational Research,* where can be added the 132 papers included in *Education Scientific Disciplines*, reaching 31.13%. Apparently, the second field was *Computer Science Artificial Intelligence* (with a total of 205 items), at close range with *Computer Science Information Systems* (202) and *Computer Science Interdisciplinary Applications* (186), followed by *Engineering Electrical Electronic* (155), *Computer Science Theory Methods* (135), *Engineering Multidisciplinary* (127) and *Telecommunications* (122). However, all these fields interconnected include 1132 papers, i.e., 59.14%, taking the largest share of the total. The *Economics and Business* fields account only for 6.82% of the indexed papers (133 papers), distributed as follows: 49 in the field of *Management*, 40 in *Business* field, 23 in *Economics* category, 11 in *Ergonomics*, while *Business Finance* counts only 10 papers.
As expected, in terms of indexing, most of the papers belonged to the *Science Citation Index Expanded*, as shown in Figure 3; another interesting fact is that the newest category created by Clarivate Analytics a few years ago, the *Emerging Sources Citation Index*, included the same number of papers as the *Social Science Citation Index*.

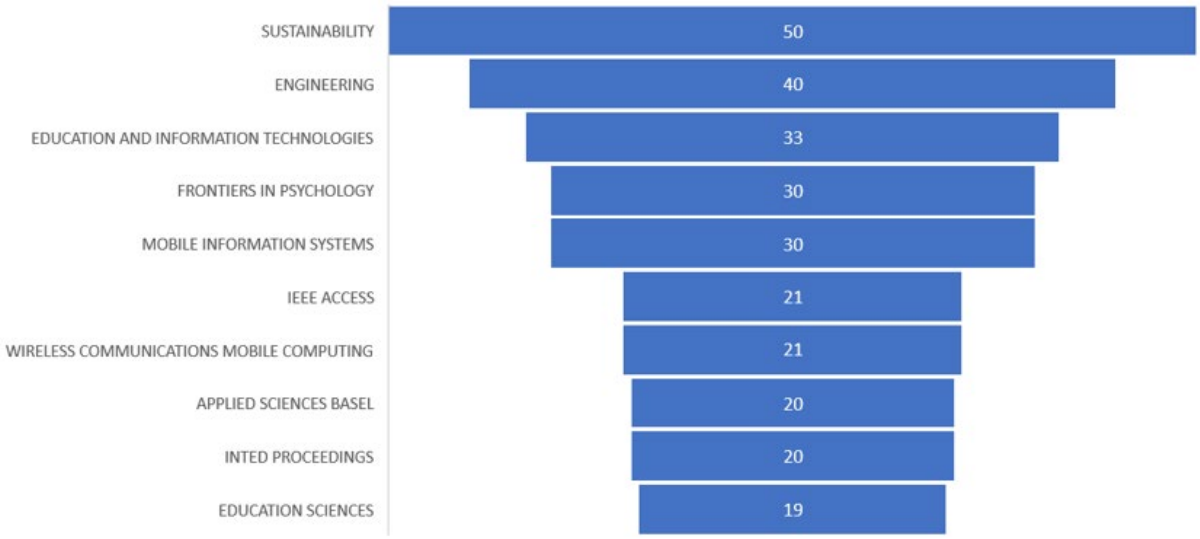


Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 3. Web of Science Indexes – repartition of indexed papers

In terms of *language of publication*, it results once again that the lingua franca for research and investigation is English, with the largest majority (97.23%, with 1861 papers), followed by Spanish (23) and Russian (12), as well as a few in Chinese (7), Turkish (4), German (3), Portuguese (2), Arabic (1) and Bulgarian (1 item). Most of the authors are from China (468), the USA is the second ranked with 333, followed by England, with 130 authors, Spain with 106, while Germany closes the Top 5 ranked countries, with only 85 authors. When the results of the query are refined by *Affiliations*, the top 5 universities are the University of London, with 36 papers, Harvard University with 27 articles, the

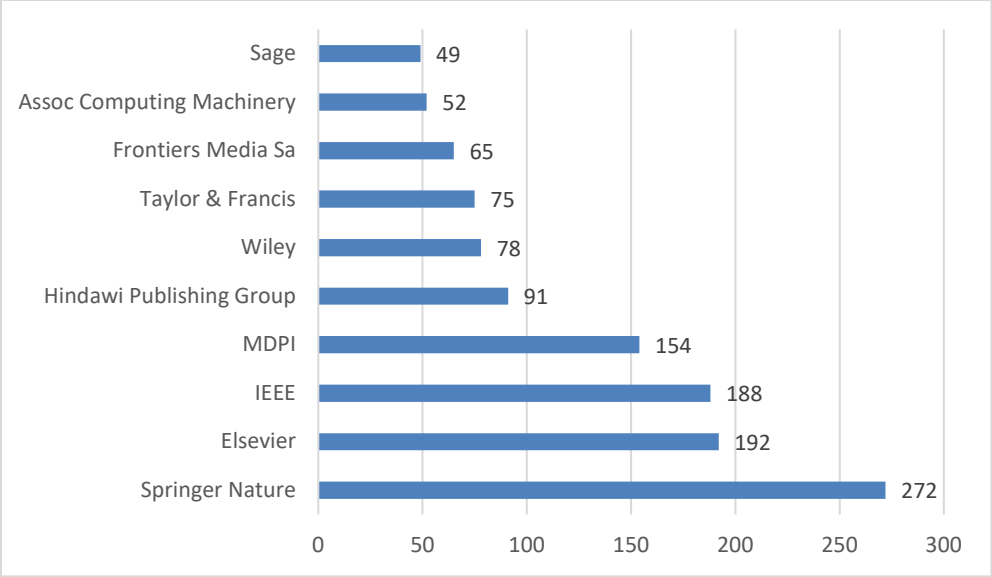
University of California System with 24, Tecnológico De Monterrey counts 21 items, while 20 are signed by authors affiliated to the University College London. The Top 10 journals, when the sample is refined by *Publication Titles* account for more than 10% of the total number of papers published in the field, while when expanding to Top 20 journals, they account for almost 23% of the papers. *Sustainability*, an MDPI multidisciplinary open-access journal, ranks the first, with 50 papers published over the years.



Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 4. Publication titles with highest numbers of papers in the field of artificial intelligence, in connection with higher education

An investigation in this field could not be completed without the publishers. The publishers' marketplace is becoming increasingly competitive. While most small independent publishers are struggling to survive, the market is dominated by major publishers, representing nowadays an oligopoly (Nishikawa-Pacher, 2022), where the top five publishers in terms of journals, with 12,248 journals, account for 43.64% of the total number of journals (28.060) published by the top 100 largest academic publishers, ranked by number of journals. In the digital era, top commercial publishers have achieved a significant rise in the share of scientific literature they published (Larivière et al., 2015).



Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 5. Top 10 Publishers in the field

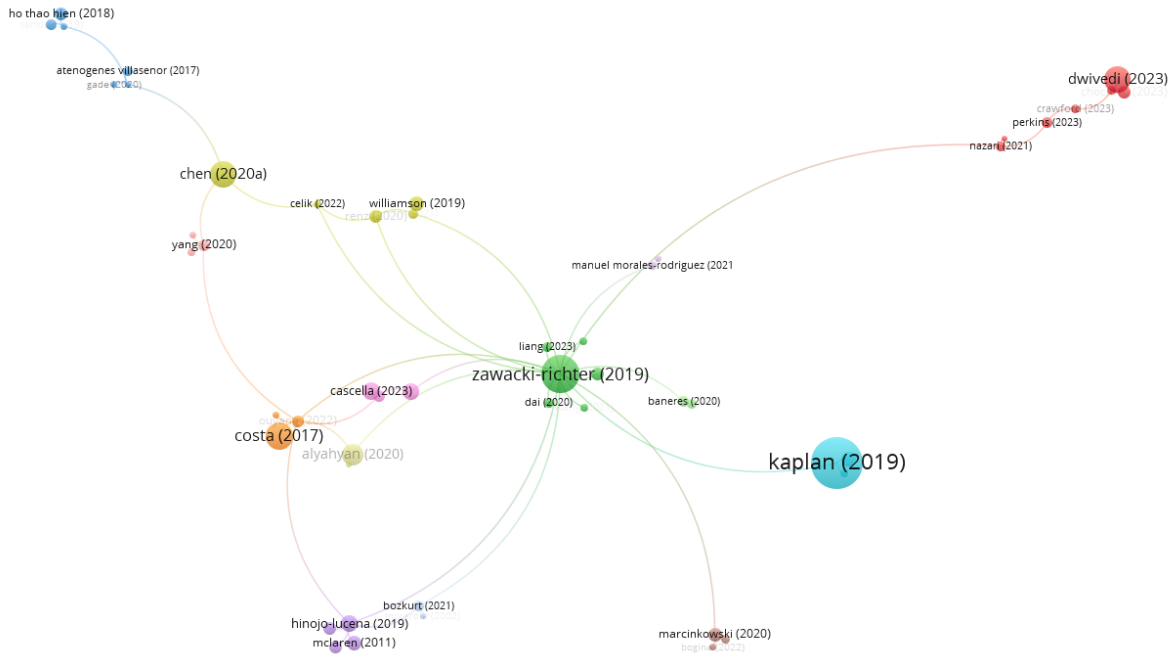
The ranking of the publishers does not show significant surprises, most of the papers are published by the publishers with the highest visibility in the world today. While Hindawi Publishing group appears in the top 10 in the 5th position and Wiley on the 6th, separately, ranked in the 12th position is Wiley Hindawi1 with 38 papers. As a result, including Hindawi in the Wiley group, would rank Wiley in 4th position.

Discussions

Bibliometric analysis with VOSviewer

In order to deepen the bibliometric analysis of our sample, we used VOSviewer software, version 1.6.20 (van Eck & Waltman, 2010). Starting from the entire sample of 1914 papers, in order to graphically highlight the citation network, we selected the papers with at least 10 citations, which resulted in a sample comprised of 319 items, among which the largest number of connected articles is 51.

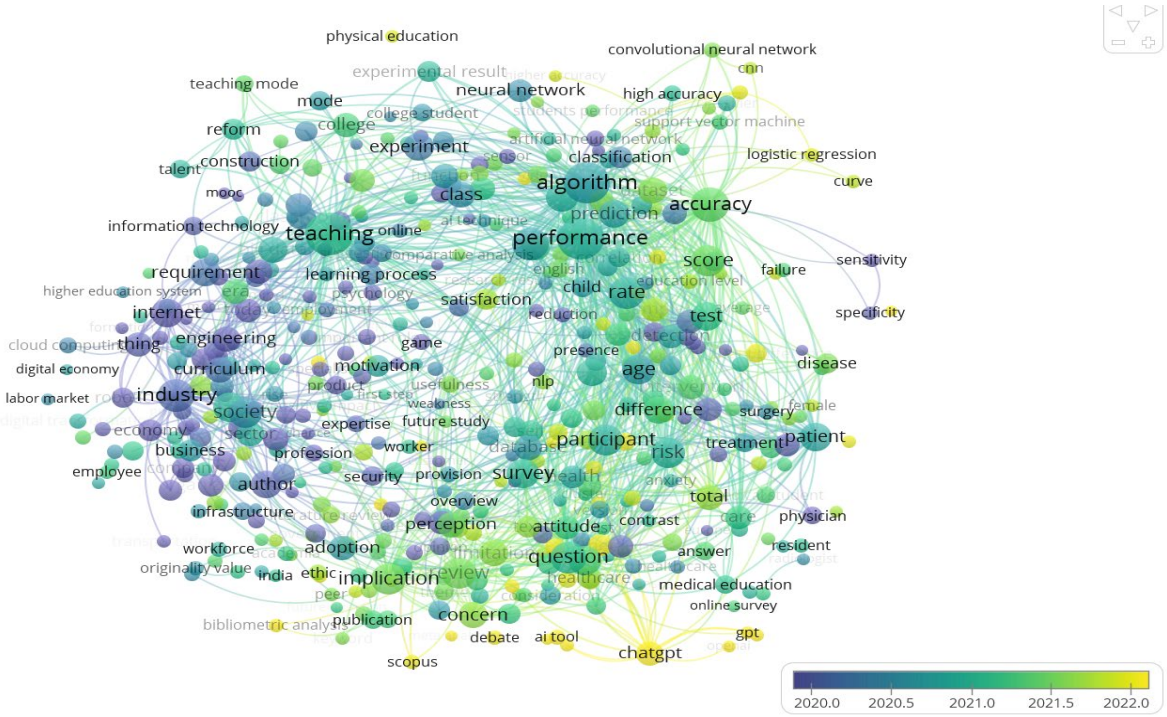
[1] Wiley and Hindawi collaborated on an Open Access publishing partnership since 2017 and in January 2021, John Wiley & Sons acquired Hindawi Limited.



Source: Web of Science Core Collection, using VOSViewer

Figure 8. Network visualization of the largest set of connected items - Citation network

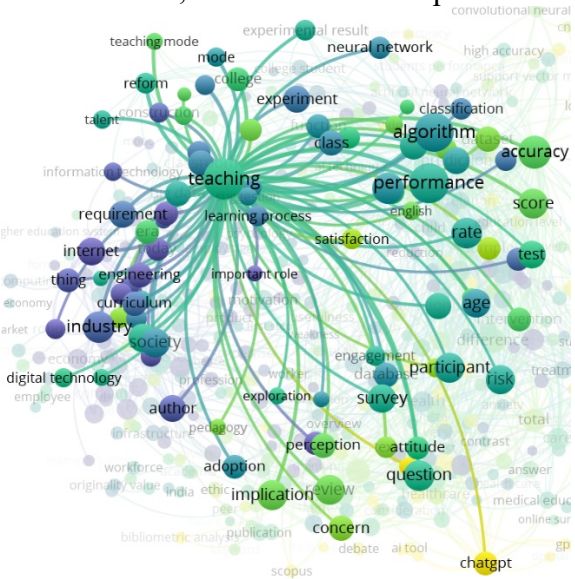
The visualisation available in Figure 8 suggestively places two research papers (Kaplan & Haenlein, 2019, with 619 citations in WOS, and Zawacki-Richter et al., 2019, with 473 citations in WOS), in central positions. A map generated in VOSviewer based on text data, using the title and the abstract fields for the entire sample of 1914 available items, resulted in a term co-occurrence map, with colours indicating the year of publication and the size (the importance, i.e. number of occurrences of the words, the minimum being set to 15) is available in Figure 9.

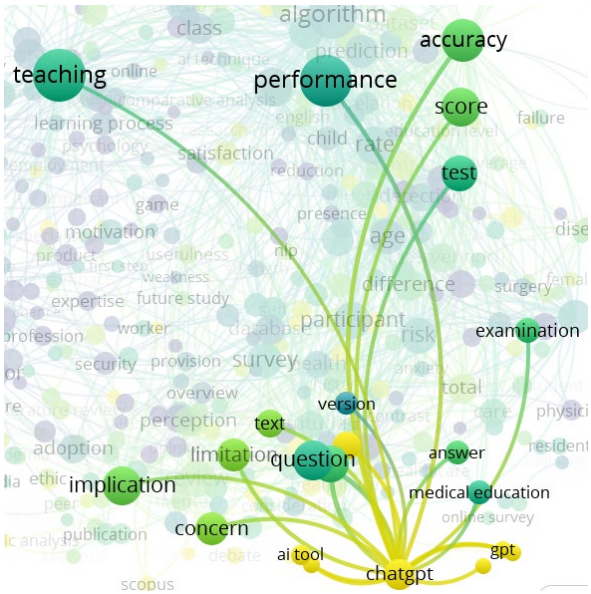


Source: Web of Science Core Collection, using VOSViewer

Figure 9. Keywords grouped by clusters - Co-occurrence map

The concentration in Figure 9 suggests that teaching was a common topic of investigation in papers published in 2020 and 2021, in connection with performance, class and algorithm.





Source: Web of Science Core Collection, using VOSViewer

Figure 10. Evolution of keywords over time - Co-occurrence map with main connections

Figure 10 takes a closer look at the two main themes identified, and shows that teaching was the main topic, with its connections, while in 2022-2023 ChatGPT and AI tools increased significantly in terms of occurrence as keywords. The use of AI in higher education has brought a paradigm shift in the idea that learning is delivered and experienced. In order to explore the advancements, challenges, and opportunities associated with the integration of AI in higher education we will discuss the main points.

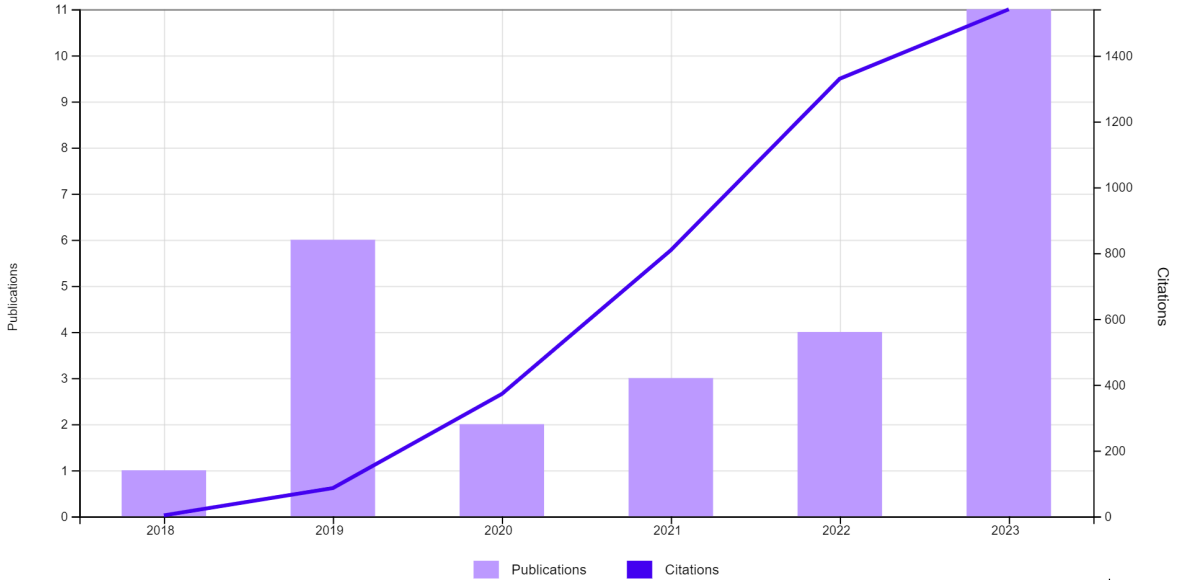
The integration of artificial intelligence in HE brings forth intriguing insights into the dynamics of student-machine interactions (Hu et al., 2023). Although the study did not reveal statistically significant differences in academic performance between the groups exposed to an Intelligent Tutoring Robot and traditional human instruction, the higher average performance in the latter group prompts us to critically examine the current efficacy of AI in significantly enhancing academic outcomes.

Likewise, the functionality of ChatGPT has limitations in handling scenarios that require application and interpretation. This demands a deeper consideration of ChatGPT's role in HE contexts, focusing on the need for further research and improvements to delineate its strengths and weaknesses. When considering the ethical dimension of AI integration in academic writing, the caution and transparency are fundamental, with concerns about the authenticity and credibility of academic works. The ethical considerations around the use of AI tools need a well-balanced approach, where the efficiency of those tools is leveraged beside the integrity of scholarly output. Furthermore, Farrokhnia et al. (2023) reveal the importance of a holistic evaluation of AI's impact on educational processes. For that reason, HE institutions must navigate these complexities, taking advantage of AI's strengths while mitigating its weaknesses and addressing potential threats. However, in this sense, it is important a broader institutional responsibility. The exploration of opportunities and challenges associated with AI in HE highlights the importance of robust policies and procedures to ensure ethical and responsible use, particularly in preventing academic dishonesty.

From an interdisciplinary perspective, we need to focus on the interconnections of AI with different academic disciplines. This may promote a better collaboration of experts from diverse fields and highlights the need for a deeper understanding of the implications of AI on knowledge, transparency, and ethics. The feedback from computer science, marketing, information systems, and education amongst others, underscores the collaborative effort required to use AI in HE. However, it is necessary that HE institutions seek to capitalise on AI's potential, without forgetting the imperative for a more critical reflection on the challenges, risks, and the study of different theoretical pedagogical perspectives.
Finally, as institutions embark on this transformative journey, a synthesis of interdisciplinary perspectives, ethical guidelines, and strategic policies emerges as the cornerstone for maximizing the benefits of AI while addressing potential risks. The ongoing dialogue and research in this domain will undoubtedly shape the future path of AI in HE.

An investigation of the Highly cited papers in the field of Artificial Intelligence in Higher Education

This is one of the most interesting categories, because the 27 papers included in the *Highly cited papers* category in WOS were cited in total 4148 times (4138 without self-citations) in the last 5 years.



Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 6. Highly cited papers: the yearly evolution of number of papers and citations

However, some of these papers deal with medical research topics (Clinical Medicine) or Engineering and are not directly connected with our main research, AI in HE, so we manually selected them and finally investigated the 9 papers below. These papers together were cited 1449 times in the Web of Science Core Collection, while the first two, (Zawacki-Richter et al., 2019 with 619 and (Kaplan & Haenlein, 2019) with 346, represent almost 67% of the citations for the sample of 9 papers selected, and over 23% of the citations for the entire category of 27 Highly cited papers sample.

Hu et al. (2023) used Robotic Process Automation on a sample of 123 students as a control group in order to relate the interactions between the Intelligent Tutoring Robot, students, and experimental groups to describe the synergy between students and teachers. They found a slight difference between the control and the experimental groups with a view to the educational achievements. As the integration of technology has become a priority for most of us in recent years, Fergus et al. (2023) investigated the functionality of Chat Generative Pre-Trained Transformer (ChatGPT) in answering to chemistry evaluation inquiries which needed further analysis to determine its possible influence on learning. They used two modules, focused on chemistry in the first and the second year of a pharmaceutical science programme and they reached the conclusion that ChatGPT generated answers to questions that concentrated on knowledge and comprehension, using verbs such as "describe" and "discuss". They discovered that ChatGPT offered limited results for questions concentrated on the application of knowledge and interpretation with non-text information. In addition, ChatGPT was not classified as a high-risk instrument able to facilitate cheating, but rather a possible catalyst for educational discussions about academic integrity.

In their turn, Dergaa et al. (2023) examine the potential advantages and disadvantages of ChatGPT and other Natural Language Processing (NLP) technologies in research and academic publishing, highlighting the ethical aspects raised by their use, considering the potential effects on the academic work's legitimacy and authenticity. They found out that ChatGPT, as well as other NLP technologies, have the ability to increase the effectiveness of academic writing and research, however worries regarding the consequences on the authenticity and credibility of the academic work were also raised, highlighting the role of critical thinking and human intelligence in research.

Farrokhnia et al. (2023) used SWOT analysis to query ChatGPT's advantages and disadvantages, as well as its potential benefits and risks for education. They emphasized the ability to produce plausible, personalized, and real-time responses. According to their findings, ChatGPT can facilitate access to information, can ease personalized learning, and reduce teaching overload. Among shortcomings, they mentioned the failure to fully understand the context, possibly endangering academic integrity and facilitating plagiarism.

In their paper, Ouyang et al. (2022), by the help of a systematic review, offered a summary of empirical researches focusing on the use of AI in online HE. More precisely, they investigate the roles that AI plays in empirical researches, the algorithms employed, and the results obtained. There have been identified 434 articles (published between 2011-2020) for screening, using WOS, Scopus, ACM, IEEE, Taylor&Francis, Wiley, and Ebscohost, and only 32 papers being selected for the final investigation. The findings were as follows: traditional AI technologies are frequently used, but more sophisticated approaches (such as genetic algorithms or deep learning) are increasing; prediction of learning status and user satisfaction, resource recommendation, automatic assessment, as well as enhancement of learning experience became common ground, aiming to improve students' engagement in online classes and finally, their overall academic performance.

Cotton et al. (2023) scrutinized the possible dangers and benefits of using ChatGPT in higher education. The article tackled the challenges in identifying and discouraging unethical behaviour, suggesting policies that academia could use to enforce the accountable use of such tools.

Dwivedi et al. (2023) highlight the opinions of 43 experts in different domains, like computer science, marketing, IT, education, policy, hospitality and tourism, management, publishing, and nursing. While acknowledging ChatGPT's potential to increase productivity, the experts shed light on some drawbacks, including privacy and security concerns. The experts' opinions diverge if ChatGPT's use must be restricted or regulated.
Chen et al. (2020) focus on how artificial intelligence is applied and impacts teaching, learning, and administration. Using a qualitative approach and extensive literature review, they conclude that AI has been widely incorporated into education, especially by educational institutions, evolving from computers to web-based and online education systems and eventually to chatbots and humanoid robots performing teaching tasks.
Zawacki-Richter et al. (2019) conduct a systematic review to offer a complete picture of AI's use in HE. 146 papers were included in the final overview, out of 2656 papers published between 2007 and 2018. Most of the studies belong to Computer Science as well as to the STEM area and used a quantitative approach. The four areas of artificial intelligence applications in education identified were *profiling and prediction*; *assessment and evaluation*; *adaptive systems and personalisation*; and *intelligent tutoring systems*. The findings highlighted the nearly complete absence of investigation on challenges and threats, and the need for a more in-depth focus on ethical and pedagogical characteristics of AI use in HE.
Kaplan & Haenlein (2019) analysed how AI differs from associated notions, like the Internet of Things (IoT) or big data, and suggested that AI should be seen more nuancedly, either by concentrating on various AI system types (i.e. analytical AI, human-inspired AI, and humanized AI) or by seeing them by the help of the evolutionary stages (narrow, general, and artificial super intelligence). Using case studies involving colleges, businesses, and governments, they showed the possible risks of AI. In addition, they presented the Three C Model of Confidence, Change, and Consistency, a framework that can assist stakeholders in considering the repercussions of AI within the educational framework.

A review of review papers about artificial intelligence and higher education

Among the 165 articles marked as review papers in the WOS database, we first selected the ones published in the last couple of years, 2022 and 2023, in order to be able to extract the latest trends in the field; we excluded ESCI papers, and focused only on SSCI and SCIE indexed papers.
The structure of the papers is shown in Figure 7.

Source: Web of Science Core Collection, https://www.webofscience.com/

Figure 7. Web of Science categories for review papers published in 2022 and 2023

Later, we manually selected the papers, among them being papers mainly connected with industry, medicine, etc. and we obtained 17 review papers directly related to our scope, the applications of AI in HE, and the key findings are synthesised in Table 1.

Table 1. A summary of Review papers investigated

Paper	Sample	Methodology	Findings
Currie, (2023)	273 papers published between 2022 and 2023, from Medline	Literature review	- It is difficult to forecast ChatGPT's future effects; - It is possible to use inadequately large language models like ChatGPT to produce convincing text based on false material. With proper handling, it may turn out to be a useful instrument for professors; - A major concern is the use of ChatGPT in creating low-quality articles targeting predatory journals, fuelling them with questionable or flawed papers in an increased number.
Salas-Pilco & Yang, (2022)	383 articles July 2016 to June 2021 Web of Science, IEEE, Xplorer, Scielo, and CAPES Portal	Systematic literature review	- The paper outlines the findings regarding the implementation of AI technologies in HE in the context of Latin America; - The key AI applications in education identified are: predictive modelling; intelligent analytics; assistive technology; automatic content analysis; and image analytics; - AI applications are useful in identifying students with drop-out risk.

Paper	Sample	Methodology	Findings
Wu & Yu, (2023)	24 randomized studies	Meta-analysis Stata software (version 14)	The paper examines how AI chatbots influence students' learning results, and shows a significant outcome, greater for HE students in comparison with schoolchildren enrolled in elementary or secondary education.
Deng & Yu, (2023)	Web of Science, Wiley Online Library, Springer Link, Taylor & Francis Online, ScienceDirect (Elsevier), Google Scholar	VOSviewer, PRISMA	- The findings showed that chatbots had a significant positive effect on the learning results, irrespective of chatbot roles, length of intervention, or learning content; - Learning achievement was positively and significantly improved by the usage of chatbot technology, as well as the engagement in learning, the retention of information, and the explicit reasoning; - Chatbots did not considerably increase critical thinking, learning engagement, or motivation.
Bearman et al. (2023)	29 articles 1980-2020 Scimago, JCR and Google Scholar	- Linguistically based approach - critical literature review	- The authors found unclear definitions and a lack of explicit reference to AI as a research object; - Two Discourses were identified and discussed: the one of imperative change, which describes how AI is perceived, and the second one of altering authority, concentrating on how AI is positioned - the teacher is not anymore in the centre of the process and the authority is distributed across stakeholders, including staff and students.
Garlinska et al., (2023)	- 208 documents - Scopus, Web of Science, websites, selected government and European Union Documents	PRISMA	- Technologies improved significantly the learning process; students benefit from a more immersive experience generated by the online content; - The lack of face-to-face interaction specific to distance learning, caused women to feel more exhausted; - Online learning satisfaction is influenced by self-perception.
Polin et al., (2023)	2017-2022 236 articles	- Systematic literature review; - Meta-Analysis PRISMA	- The results provide an overview of smart campus conceptualization and offer guidance for future investigation regarding smart campuses.
Alotaibi & Alshehri, (2023)	55 articles Scopus, Web of Science	PRISMA VOSviewer systematic literature reviews Meta-Analysis	- The findings emphasize the imperative need to integrate AI into higher education institutions in order to improve the quality in education and address learning challenges.
Almufarreh & Arshad, (2023)	565 articles 2015-2022 Web of Science, Scopus, Science Direct,	VOSviewer	- Emerging technologies enhance educational experience, particularly concerning fast feedback, collaboration, and student-teacher engagement;

Paper	Sample	Methodology	Findings
	IEEE Xplore, MDPI, Google Scholar and internet resources		- Education institutions are supposed to develop governance bodies and mechanisms to integrate the emerging technologies into the teaching process; - The use of new technologies in education can assist and facilitate updating outdated teaching materials.
Chu et al., (2022)	50 articles 1996-2020 Web of Science	based learning model	- The most frequent application domain was engineering; - The AI was used especially for profiling and prediction of learning status; - The investigation topics mainly included learning behaviour, accuracy, sensitivity and precision, cognition and affect.
Essa et al., (2023)	2015-2022 IEEE, Springer, Science Direct (Elsevier) and ACM	Systematic literature review	- The results contain an investigation of the most recent advancements in this rapidly developing field, with regards to the uses of machine learning techniques in order to create better e-learning environments, capable to identify automatically participants' learning styles to facilitate learning; - The results that more empirical research should be done in the area of deep learning algorithms, connected with the learning styles, in order to increase their adaptability.
Yenduri et al., (2023)	145 articles Google Scholar, arXiv, Springer, Nature, Wiley, Elsevier, Taylor and Francis, MDPI, and IEEE	Systematic literature review	- Artificial Intelligence, Extended Reality (XR), IoT, Human-Computer Interaction (HCI), digital twins, and the metaverse are new technologies that can offer inclusive education for students with learning difficulties.
Ansari et al., (2023)	69 articles	Systematic literature review PRISMA	-The results show that ChatGPT can assist teachers, students, and researchers with a variety of activities. Although the particular needs differ, the main goal is the same: for academics, it means seeking personal advantages or easing the academic burden, using it for personal and professional learning, while students utilize it as personal tutors for learning objectives. - Though, a large body of research brought up issues connected with the accuracy, reliability, academic integrity, and even detrimental consequences on cognitive, as well as social development.
Grimalt-Álvaro & Usart, (2023)	2006-2021 518 articles	Systematic literature review PRISMA	- Sentiment Analysis as a research area is expanding, however still the majority or articles adopt a technical perspective,

Paper	Sample	Methodology	Findings
			while are published mainly in journals pertaining to the digital technologies field.
Fang et al., (2023)	2018-2022 27 articles Web of Science, Scopus, ACM digital library, ERIC (Education Resources Information Centre), ProQuest, IEEE Xplore	Systematic literature review	- The results reveal a growing interest in using AI technologies; - In terms of research methodology, most papers employ quantitative approaches, however, mix-methods are frequently employed as well, while the least used methods are the qualitative ones; - The majority of studies utilized planning-based models, followed by research using machine learning models; - According to the majority of research, using AI technology to augment human storytellers improved kids' motivation, creativity, presentation, sketching, and knowledge acquisition abilities as well as their interpersonal and story-related skills. They also enhanced the creativity, writing abilities, engagement, and sense of fulfilment of adults and university students; - Educators or teachers should evaluate integrating AI-based story-writing into course learning (like English, or STEM) in order to help participants develop their writing skills, problem-solving skills, and AI literacy; - Schools should implement AI-based story-writing courses or activities to offer students the chance to practice their writing skills, creativity, and AI comprehension; - Policymakers should design policies to encourage AI-supported story writing in school education.
Rangel-de Lázaro & Duart, (2023)	107 articles Scopus, Web of Science and EBSCO	Systematic literature review Meta-Analysis PRISMA	- The study provides a comprehensive overview of how extended reality and artificial intelligence have been implemented and impacted the online HE during the COVID-19 pandemic; - The investigation reveals the increasing attention to leveraging extended reality and AI to enhance learner's experience, to support a more collaborative, and self-paced experience, and improve online education's accessibility and effectiveness.
Shahzad et al., (2023)	50 articles 2000-2022 Summon, LISA, LISTA, Scopus, Web of	Systematic literature review Meta-Analysis PRISMA	- Psychological Ownership (PO) has a key position in personal knowledge and information management (PKIM);

Paper	Sample	Methodology	Findings
	Science, EBSCO Host, Google Scholar, Pro Quest, Emerald, Wiley Inter Science, Taylor & Francis, and Wiley Inter-Science Databases		- PO encourages individuals to better organize knowledge and information to provide peak performance. PO is a noteworthy instrument that could be used to encourage creative contributions from their staff; - Empirical research demonstrated a strong positive correlation between IT self-efficacy and PKIM for lifelong learning; - The use of social media instruments, the implementation of new technologies, professional development, AI, and teamwork are popular strategies both for implementing PKIM activities successfully as well as for producing innovative outcomes in academia.

Source: Compiled by the authors.

The investigation of review papers allowed to briefly synthetise the main themes of research as well as concerns about the use of AI in HE nowadays.

Conclusions

The exploration of artificial intelligence in higher education, as examined through the diverse lenses of the discussed studies, underscores the intricate relationship between technological innovation and the evolving landscape of academia. As we draw insights from the nuanced investigations into student-machine interactions, the capabilities, and limitations of AI-driven tools, ethical considerations, and the broader implications for the educational ecosystem, it becomes evident that the integration of AI is a multifaceted endeavour that requires careful consideration and strategic planning.

The implementation of AI in HE unravels a complex set of opportunities, challenges, and ethical considerations. The studies analysed shed light on the multifaceted impact of AI, from refining subject-specific interactions to reshaping pedagogical landscapes. While AI exhibits notable strengths in knowledge-based domains, its nuanced limitations underline the indispensability of maintaining the delicate balance between technological integration and traditional pedagogical approaches.

For instance, ethical considerations in preserving academic integrity, emerge as one of the most important assets. Indeed, the design of educational policies is necessary and these policies must analyse the situation from a strategic synthesis of interdisciplinary insights and ethical frameworks, as it becomes imperative for utilizing AI to its fullest, while preserving HE's core principles.

Future research in the realm of AI in HE should explore the evolving dynamics of human-AI collaboration, delving into more nuanced analyses of student-machine interactions, as well as the perceptions of students about the use of AI in HE, and this information will allow for a better design of the future educational policies.

References

1. Almufarreh, A., & Arshad, M. (2023). Promising Emerging Technologies for Teaching and Learning: Recent Developments and Future Challenges. *Sustainability, 15*(8), 6917 https://doi.org/10.3390/su15086917
2. Alotaibi, N. S., & Alshehri, A. H. (2023). Prospers and Obstacles in Using Artificial Intelligence in Saudi Arabia Higher Education Institutions - The Potential of AI-Based Learning Outcomes. *Sustainability, 15*(13), 10723. https://doi.org/10.3390/su151310723
3. Ansari, A. N., Ahmad, S., & Bhutta, S. M. (2023). Mapping the global evidence around the use of ChatGPT in higher education: A systematic scoping review. *Education and Information Technologies,* 1–41. https://doi.org/10.1007/s10639-023-12223-4
4. Bearman, M., Ryan, J., & Ajjawi, R. (2023). Discourses of artificial intelligence in higher education: a critical literature review. *Higher Education 86*(2), 369–385. https://doi.org/10.1007/s10734-022-00937-2
5. Chen, L. J., Chen, P. P., & Lin, Z. J. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, *8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510
6. Chu, H.-C., Hwang, G.-H., Tu, Y.-F., & Yang, K.-H. (2022). Roles and research trends of artificial intelligence in higher education: A systematic review of the top 50 most-cited articles. *Australasian Journal of Educational Technology, 38*(3), 22–42.
7. Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International, 61*(2), 228–239. https://doi.org/10.1080/14703297.2023.2190148
8. Currie, G. M. (2023). Academic integrity and artificial intelligence: is ChatGPT hype, hero or heresy? *Seminars in Nuclear Medicine, 53*(5), 719–730. https://doi.org/10.1053/j.semnuclmed.2023.04.008
9. Deng, X., & Yu, Z. (2023). A Meta-Analysis and Systematic Review of the Effect of Chatbot Technology Use in Sustainable Education. *Sustainability, 15*(4), 2940. https://doi.org/10.3390/su15042940
10. Dergaa, I., Chamari, K., Zmijewski, P., & Saad, H. B. (2023). From human writing to artificial intelligence generated text: Examining the prospects and potential threats of ChatGPT in academic writing. *Biology of Sport*, *40*(2), 615–622. https://doi.org/10.5114/biolsport.2023.125623
11. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285–296. https://doi.org/https://doi.org/10.1016/j.jbusres.2021.04.070
12. Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., … Wright, R. (2023). So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *71,* 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642
13. Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*, *105*(3), 1809–1831. https://doi.org/10.1007/s11192-015-1645-z
14. Essa, S. G., Celik, T., & Human-Hendricks, N. E. (2023). Personalized Adaptive Learning Technologies Based on Machine Learning Techniques to Identify Learning Styles: A Systematic Literature Review. *IEEE Access*, *11*, 48392–48409. https://doi.org/10.1109/ACCESS.2023.3276439
15. Fang, X., Ng, D. T. K., Leung, J. K. L., & Chu, S. K. W. (2023). A systematic review of artificial intelligence technologies used for story writing. *Education and Information Technologies*, *28*(11), 14361–14397. https://doi.org/10.1007/s10639-023-11741-5
16. Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International,* 1-15. https://doi.org/10.1080/14703297.2023.2195846
17. Fergus, S., Botha, M., & Ostovar, M. (2023). Evaluating Academic Answers Generated Using ChatGPT. *Journal of Chemical Education*, *100*(4), 1672–1675. https://doi.org/10.1021/acs.jchemed.3c00087
18. Garlinska, M., Osial, M., Proniewska, K., & Pregowska, A. (2023). The Influence of Emerging Technologies on Distance Education. *Electronics, 12*(7), 1550. https://doi.org/10.3390/electronics12071550

19. Grimalt-Álvaro, C., & Usart, M. (2023). Sentiment analysis for formative assessment in higher education: a systematic literature review. *Journal of Computing in Higher Education,* 1–36. https://doi.org/10.1007/s12528-023-09370-5
20. Hu, Y. H., Fu, J. S., & Yeh, H. C. (2023). Developing an early-warning system through robotic process automation: Are intelligent tutoring robots as effective as human teachers? *Interactive Learning Environments,* 1–14. https://doi.org/10.1080/10494820.2022.2160467
21. Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, *62*(1), 15–25. https://doi.org/10.1016/j.bushor.2018.08.004
22. Larivière, V., Haustein, S., & Mongeon, P. (2015). The Oligopoly of Academic Publishers in the Digital Era. *PLOS ONE*, *10*(6), e0127502-. https://doi.org/10.1371/journal.pone.0127502
23. Nishikawa-Pacher, A. (2022). Who are the 100 largest scientific publishers by journal count? A webscraping approach. *Journal of Documentation*, *78*(7), 450–463. https://doi.org/10.1108/JD-04-2022-0083
24. Ouyang, F., Zheng, L. Y., & Jiao, P. C. (2022). Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020. *Education and Information Technologies*, *27*(6), 7893–7925. https://doi.org/10.1007/s10639-022-10925-9
25. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71
26. Polin, K., Yigitcanlar, T., Limb, M., & Washington, T. (2023). The Making of Smart Campus: A Review and Conceptual Framework. *Buildings, 13*(4), 891. https://doi.org/10.3390/buildings13040891
27. Pritchard, J. (1969). Statistical-Bibliography or Bibliometrics? *Journal of Documentation*, *25*(4), 348–349. https://cir.nii.ac.jp/crid/1574231874928746752.bib?lang=en
28. Rangel-de Lázaro, G., & Duart, J. M. (2023). You Can Handle, You Can Teach It: Systematic Review on the Use of Extended Reality and Artificial Intelligence Technologies for Online Higher Education. *Sustainability, 15*(4), 3507. https://doi.org/10.3390/su15043507
29. Salas-Pilco, S. Z., & Yang, Y. (2022). Artificial intelligence applications in Latin American higher education: a systematic review. *International Journal of Educational Technology in Higher Education, 19*(1), 21. https://doi.org/10.1186/s41239-022-00326-w
30. Shahzad, K., Javed, Y., Khan, S. A., Iqbal, A., Hussain, I., & Jaweed, M. V. (2023). Relationship between IT Self-Efficacy and Personal Knowledge and Information Management for Sustainable Lifelong Learning and Organizational Performance: A Systematic Review from 2000 to 2022. *Sustainability, 15*(1), 5. https://doi.org/10.3390/su15010005
31. van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3
32. Wu, R., & Yu, Z. (2023). Do AI chatbots improve students learning outcomes? Evidence from a meta-analysis. *British Journal of Educational Technology*, *55*(1), 10–33. https://doi.org/https://doi.org/10.1111/bjet.13334
33. Yenduri, G., Kaluri, R., Rajput, D. S., Lakshmanna, K., Gadekallu, T. R., Mahmud, M., & Brown, D. J. (2023). From Assistive Technologies to Metaverse - Technologies in Inclusive Higher Education for Students with Specific Learning Difficulties: A Review. *IEEE Access*, *11*, 64907–64927. https://doi.org/10.1109/ACCESS.2023.3289496
34. Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education - where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 1–27. https://doi.org/10.1186/s41239-019-0171-0