

The Use of Artificial Intelligence in the Technological University Environment: A Bibliometric Analysis Using VOSviewer

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Abstract. *In today's rapidly advancing technological environment, higher education institutions are increasingly integrating generative artificial intelligence solutions to improve academic performance and streamline pedagogical processes. Students and faculty can operate more efficiently using large linguistic models for personalized learning and assessment, which fundamentally reshapes academic integrity and educational experience. This paper aims to present a retrospective analysis of publications on generative artificial intelligence used in the context of higher education and academic assessment. In this regard, a bibliometric study is conducted based on the analysis of 2,000 scientific papers published in the Web of Science Core Collection database between 2022 and 2025. Searches were conducted using specific keywords such as "generative AI", "ChatGPT", "higher education" and "academic integrity". The collected data were analyzed using Microsoft Excel and VOSviewer software to map the evolution of the field and collaboration networks. The data analyzed revealed the existence of several clusters of publications, authors, and organizations, revealing a significant increase in research, with a peak in 2025. This research also indicates six thematic clusters of keywords that suggest potential directions for future research, from technology adoption to ethical risks in specialized fields such as medical education. Through this bibliometric study, the authors provide valuable information for researchers and policymakers who want to investigate the digital transformation of universities and the strategic integration of large-scale linguistic models in academia.*

Keywords: ChatGPT, artificial intelligence, large language models, higher education, generative artificial intelligence, academic integrity, assessment, university.

Introduction

The rapid expansion of generative artificial intelligence is profoundly reshaping the academic landscape, highlighting the critical influence of technology on academic integrity, assessment methodologies, and overall institutional performance. In this transformative context, bibliometric research offers important insight into the accelerated evolution of this scientific field. This paper presents a systematic overview of trends and conceptual models regarding the impact of generative AI on the teaching-learning process and the organizational adaptation of universities.

The authors of this study analyzed a dataset of 2,000 publications to identify key keywords, prevailing trends, and strategic gaps for future scholarly research. In addition to summarizing the current literature, this study highlights the critical importance and immediate applicability of the topic in the context of the ongoing digital transformation of higher education.

Keywords like as "ChatGPT," "higher education," and "large language models" are examined in depth, along with key pillars such as "academic integrity" and "assessment." A detailed analysis of the evolution of publications in this field reveals a significant increase in recent

years, especially between 2022 and 2025, highlighting the growing interest in studying the impact of generative artificial intelligence on academic institutions, their students, and their faculty.

This study aims to provide researchers and technology experts with a solid foundation for understanding current and future changes in academic performance and integrity. Therefore, this research serves as a valuable reference to guide the further development of academic studies and institutional policies in this area.

Literature review

Artificial intelligence and generative intelligence have emerged as disruptive forces for academic research worldwide (Amofa, 2025; Rahim, 2025), with a focus on traditional digitization and the integration of complex linguistic models (Wang et al., 2026; Kirchner & Miake, 2025). According to Chen (2025) and Granata (2025), “This transition” is not due to technology; rather, it is a fundamental change in the way knowledge is produced, assessed, and disseminated within universities. According to Li et al. (2025), academic discourse has revealed a greater interest in researching the symbiotic relationships between human intelligence and artificial intelligence.

The public release of large-scale linguistic models contributed to the rapid increase in the number of publications between 2022 and 2025, indicating a real “gold rush” in academic research (Delen, 2024; Luo et al., 2025). Generative AI has now become an essential part of the higher education strategy, rather than a secondary tool (O'Dea et al., 2024). In this context, research focuses on topics such as technology adoption, ethical standards, and specialized application of these models in different academic fields (Koppl and Kakarougkas, 2024; Luo et al., 2025). Wang et al. ChatGPT serves as a major stimulus for academic attention and is the technical basis of modern educational research, which is dominated by large language models (Salih et al., 2024). These models can produce human-like code, text, and creative content and are known as advanced natural language processing systems (Xiaoyu, 2025; Tlili et al., 2025). Initial research focused on the basic architecture of systems such as GPT-4 or Gemini AI, but now there is more focus on their practical utility, especially in automating administrative tasks and complex research activities.

In addition, the “ChatGPT” phenomenon has created a distinct thematic cluster in bibliometric analyses. This cluster is frequently linked to concepts such as performance and evaluation (Zhu et al., 2025). These systems are based on machine learning and data processing, but their application in higher education is driven by the growing need for AI literacy. Increasingly, this competency is considered essential for both educators and students, as it helps to bridge the gap between effective pedagogical use and technical capability (Brünner et al., 2025; Xiaoyu, 2025).

The tension between the principles of academic integrity and the capability of generative artificial intelligence is among the most controversial topics in literature (Bittle, 2025). Most studies focus on the increased risk of plagiarism and the reduced importance of traditional essay-based assessments (Abdallah, 2025; Ardito, 2025). Researchers speak of two different approaches in this discussion: one that prioritizes detection and regulation, and the other is transformative, which encourages the creation of authentic assessment methods to integrate AI tools (Corbin, 2025).

At the same time, according to Luo et al. (2025), the shift towards more personalized learning environments is being accelerated by the implementation of generative artificial intelligence. Research focuses on AI systems in areas such as medical education to simulate patient interactions and provide feedback on diagnostic reasoning in real time, as Chan and Hu (2023) argue. Despite these advances, there is still a significant gap in the spread of research and policy development worldwide. Many areas, such as Eastern Europe and Romania, are still at the

beginning of creating local frameworks for AI governance in higher education, while the United States and China are leaders in publication production.

This uneven change indicates that, despite the technology being global, regulatory responses and institutional strategies remain strongly influenced by local and cultural circumstances (Nguyen et al., 2025).

Methodology

The general objective of conducting a systematic bibliometric analysis of the specialized literature on the use of generative artificial intelligence in higher education is the basis of the current methodology. The purpose of this analysis is to structure the current knowledge and identify future research directions. The research pursues the following specific objectives:

- OS1. Analysis of the time evolution of publications;
- OS2. Mapping scientific cooperation networks;
- OS3. Identifying thematic cores and new ideas;

The first objective (OS1) involves monitoring the trends and volume of scientific publications from 2022 to 2026 to understand the level of academic interest in this topic. The second objective (OS2) refers to identifying the most active authors, leading institutions and dominant countries, as well as assessing how these important actors collaborate. The third objective (OS3) uses co-occurrence and density maps to analyze keywords to determine how technology is applied in education.

A bibliometric analysis of articles indexed in the Web of Science (WoS) database was conducted. The analysis focused on the field of generative artificial intelligence in higher education and was conducted to support the objectives of bibliometric study. The study uses exclusively the WoS Main Collection, which includes the extended science citation index, the social science citation index, and the emerging sources citation index. The choice of this database is justified by the high standards of selection and consistency of articles, which are essential for building an effective bibliometric network.

The search formula was designed to include technological and educational aspects. In terms of the technological domain, terms such as “generative AI”, “ChatGPT”, “LLM”, “large language models”, “GPT-4”, and “Gemini AI” were used to query the title field (TI) to select materials with generative artificial intelligence as the focus, including recent articles.

The topic field (TS) query for education included words such as “higher education”, “university”, “academic integrity”, and “evaluation”, to limit the analysis to academia and exclude studies that are strictly technical or related to other fields. The time range that was analyzed was 2022–2026, with 2022 as the starting point and the period 2023–2025 covering the rapid growth of the specialized literature after the public appearance of ChatGPT-type models. Therefore, the search formula is: (TI= (“generative AI”), (TS= (“higher education”, “university”, “academic integrity” OR “evaluation”)) and (GPT-4” OR “Gemini AI”).

A total of 4,297 records were found after an initial search, and multiple filters were applied to ensure relevance and quality. Relevance assessment was performed in two stages. The first selection was based on title and abstract, followed by a full-text review if necessary. Strict inclusion and exclusion criteria were applied to ensure the rigor of the selection.

An article had to simultaneously meet several inclusion criteria to be included in the final set. First, the main theme of the paper had to be the use, impact, perception, or implementation of generative artificial intelligence models. Second, the context of the study had to be strictly focused on the academic environment, including students, teachers, researchers, and higher education

administration. In addition, the topic addressed had to examine specific and applied elements of education, such as teaching, learning, assessment, academic integrity, performance, and curriculum development. From a typological point of view, only original research articles and review articles that were published in English within the specified time frame were validated.

Instead, articles that met at least one exclusion criterion were removed from the dataset. Therefore, works on traditional artificial intelligence, such as predictive machine learning or signal processing, were removed so that LLMs would not focus on text and content creation. In addition, research was rejected when it was applied to different educational contexts, such as pre-university, early childhood, or corporate training. Attention was paid to articles that used a strictly technical or algorithmic approach specific to the field of computer science (proposals for new architecture, code optimizations, or training metrics) and did not directly examine pedagogical implications. At the same time, papers that only mentioned generative AI models and were not a primary research concern were removed. Also removed were formats that were not scientifically validated, such as letters, editorials, reviews, or conference abstracts, which may have inadvertently passed through the initial automated filters. Only articles and review articles in English were retained, excluding editorials, letters, corrections, and conference abstracts. Using a filtering and relevance checking process based on titles and abstracts, a final set of 2,000 articles was obtained, which served as the database for the bibliometric analysis. The articles were cleaned before being exported from WoS in a compatible bibliometric format and contained complete information, including authors, titles, sources, affiliations, keywords, and cited references. VOSviewer (version 1.6.20) was used to perform the analysis.

Results and discussions

Between 2022 and 2026, the total number of publications related to digital technology, performance and satisfaction evolved, according to Figure 1.

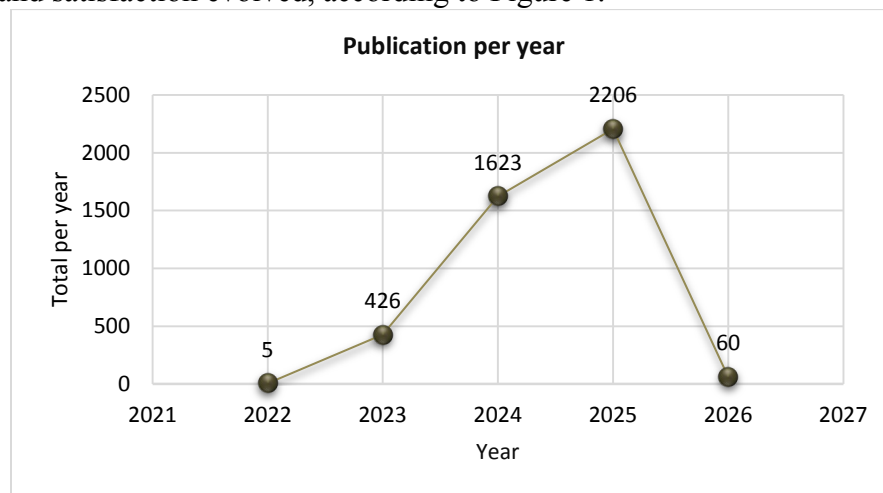


Figure 1. Publication per year

Source: Created by the authors based on results highlighted by VOSviewer in Microsoft Excel.

Starting with 2022, there will be an increasing trend in studies examining how digital technology affects organizational performance and satisfaction. The volume of publications in the field increased significantly in 2023, when it exceeded the threshold of 400 papers per year, which demonstrates evolution. In 2025, publication activity reaches a peak of 2,206 articles, much more than at the beginning of the period.

The analysis showed that there were 62 clusters with a total of 129 elements (authors). This structure, in which the number of clusters represents almost half of the total number of authors, indicates that research in this area is highly fragmented. Even though 170 links between authors and a total strength of 489 links were found, these are unevenly distributed in the network.

The central cluster, which is marked in green and shows a high density of interactions between authors Chu, Guangdi, Tang, Bufu, Gan, Wenyi and Luo, Peng, is the strongest collaboration group. This group is the core of the network and contributes significantly to the total link strength. Clusters colored in turquoise (e.g. Sallam, Ahmed B.) and blue (e.g. Zou, Di) show other active secondary networks.

There are 62 clusters for only 129 authors, which confirms that most researchers, such as Hwang, Gwo-Jen, Butte, Atul J. or Wang, Jing, work in small or individual groups, represented by gray nodes and not integrated into extensive collaborative networks. This distribution shows a scientific community that is still divided into research “islands”. A consolidation of the theoretical body and an increase in the practical relevance of studies in the field could be the result of stronger collaboration between authors and the integration of these clusters.

Out of a total of 2,720 organizations, only 97 meet the selection thresholds for the analyzed field, indicating a relatively low concentration of researchers (Figure 3). This is demonstrated by the affiliation of researchers to different organizations.

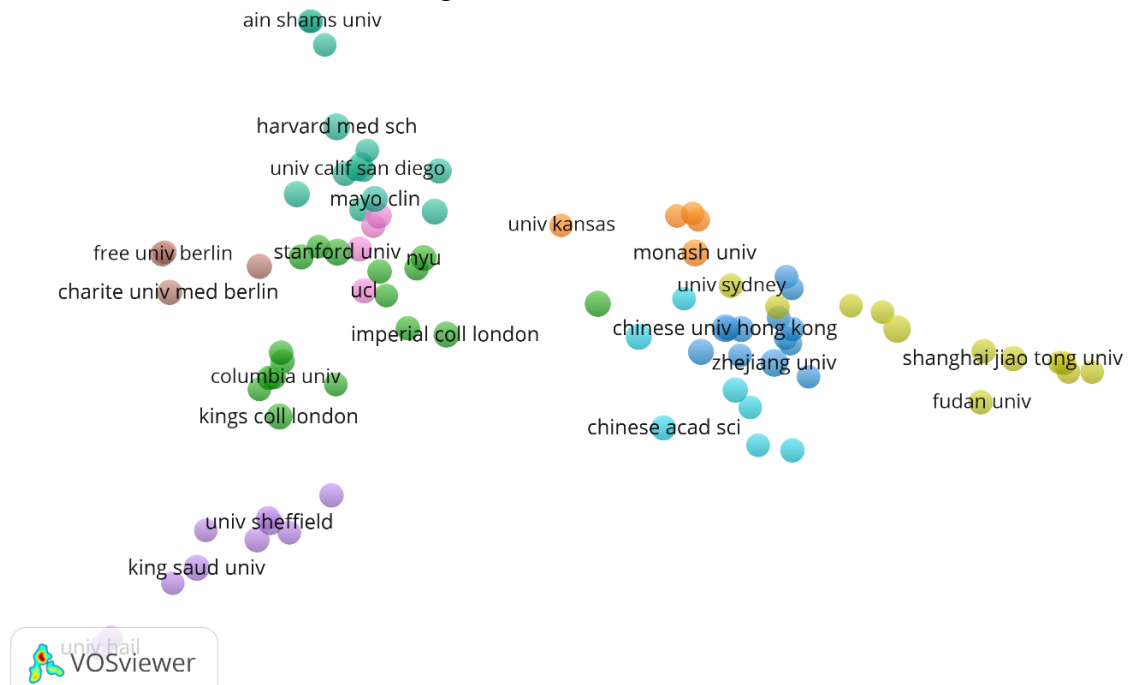


Figure 3. The affiliation of researchers to different organizations

Source: Authors' own research based on the results highlighted by VOSviewer.

The central nodes of the western cluster are Stanford University, Harvard Medical School, University College London (UCL), Imperial College London and King's College London, which are the most visible organizations in the research and collaboration network. At the same time, universities such as Shanghai Jiao Tong University, Fudan University, Chinese Academy of Sciences and Monash University are renowned in Asia and Australia for their own collaborative networks.

The collaboration networks are divided into distinct clusters, structured primarily along geographical lines. This can be seen when the Chinese group is separated from the American or European groups. This organization shows that there are strong collaboration centers in these regions, but a fully integrated global network of institutional cooperation has not yet emerged.

There are nine clusters that bring together the 72 identified countries, as well as the links between them in terms of research on the effects of artificial intelligence on higher education, as illustrated in Figure 4. The links between the nodes are very dense and complex, with 722 connections and a total strength of 1683. This shows the high level of interconnection and the numerous cooperative relationships between the countries, with a network that includes important countries such as the United States, the People's Republic of China and England.

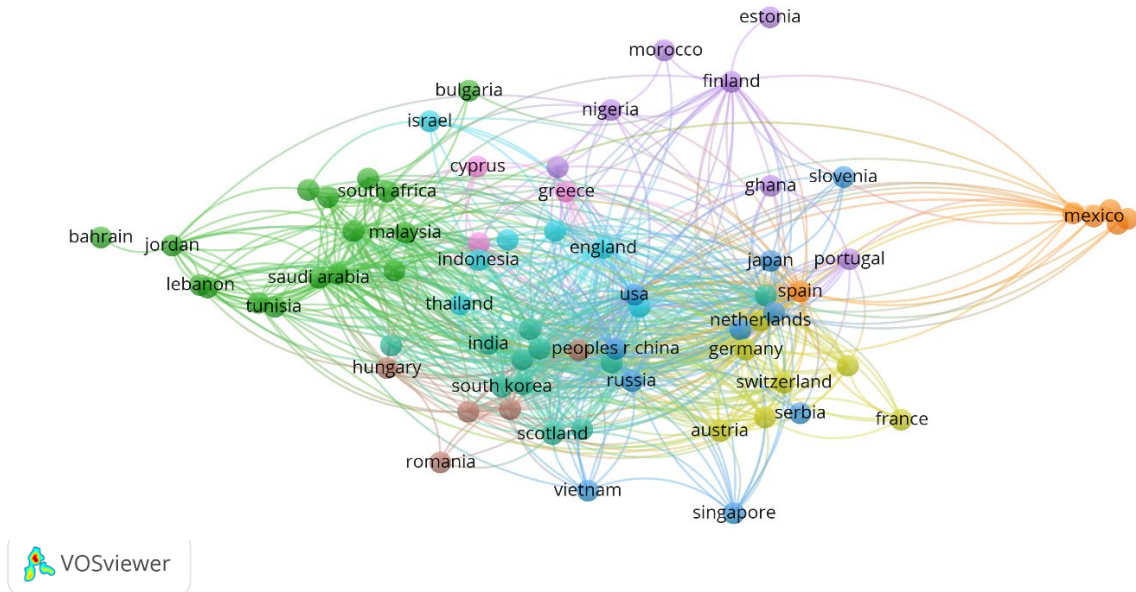


Figure 4. The most active countries in terms of the impact of artificial intelligence on higher education

Source: Authors' own research based on the results highlighted by VOSviewer.

The clustering highlights certain geographical and strategic configurations. For example, countries such as Jordan, Saudi Arabia and Tunisia dominate the green cluster, while Mexico occupies a peripheral but well-connected position in the orange cluster. Romania is located next to countries such as Scotland, South Korea and Hungary, which shows that there is a somewhat strong direction of collaboration in this global scientific community.

Table 2 presents the rankings of the top ten countries in terms of publication volume, citation impact and strength of international collaboration.

Table 2. Top 10 countries that have published articles on the impact of artificial intelligence in higher education

Rank	Country	Documents	Citations	Total link strength
1	USA	467	8713	315
2	China	363	6933	190
3	England	158	3848	228
4	Australia	115	3420	129

Rank	Country	Documents	Citations	Total link strength
5	Germany	95	847	128
6	Spain	91	1117	114
7	Saudi Arabia	91	1404	99
8	Canada	76	697	141
9	India	73	651	72
10	South Korea	68	406	51

Source: Authors' own research based on the results highlighted by VOSviewer.

The United States has the highest number of publications (467), followed by China (363) and England (158). England has 158 publications on this topic, followed by Germany (95) and Spain (91). The United States also has the highest number of citations (8,713), followed by the People's Republic of China (6,933) and England (3,848).

Only 11 papers have been published in this field in Romania, which received 54 citations and have a total link strength of 7. These papers highlight collaboration with other European and non-European countries (Figure 5).

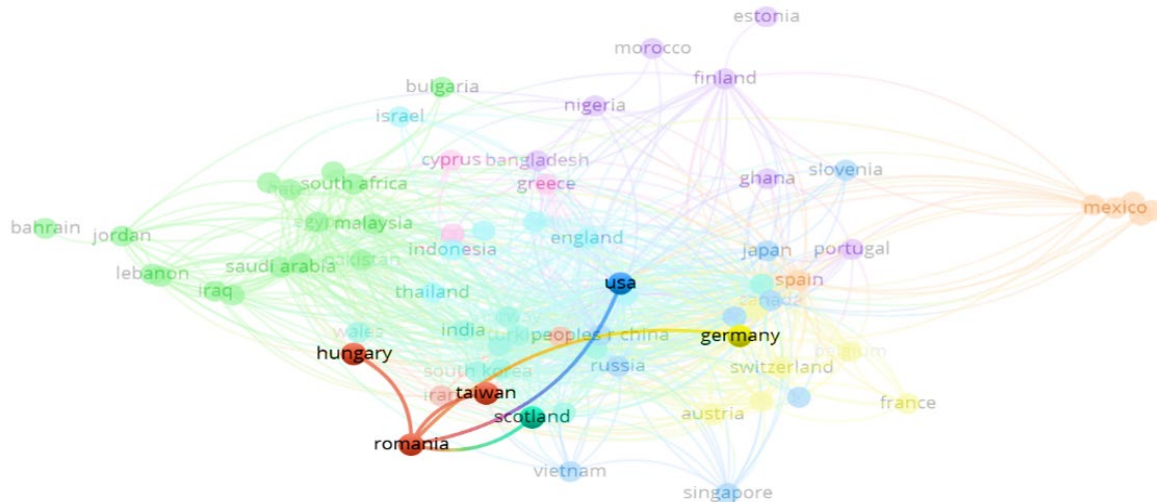


Figure 5. Romania's connections with other countries

Source: Authors' own research based on the results highlighted by VOSviewer.

There is significant untapped potential in researching the effects of artificial intelligence in higher education in Romania, as demonstrated by the limited number of papers published by Romanian authors. This offers researchers and institutions an opportunity to become more actively involved and to provide a more visible contribution to the development of the field. It is necessary for the state, universities and the private sector to support this potential through funding and policies that encourage research.

The most frequently used keywords were examined for the 2,000 articles in the selected sample. 4,606 distinct keywords were found, of which 3,681 appeared only once (79.92%). Author terms were identified that appeared at least five times in the Web of Science database during this analysis. Therefore, only 229 of the 4,606 keywords reached this threshold. Of these, the three most frequently used keywords are "ChatGPT" (33.30%), "Artificial Intelligence" (24.45%), and "Large Language Models" (19.70%), all of which are expected results given the domain analyzed (Table 3).

Table 3. Top 10 keywords used by the authors in at least 5 of the analyzed papers

Rank	Keyword	Occurrences	Total link strength
1	ChatGPT	663	3472
2	artificial intelligence	485	2796
3	Large language models	389	2005
4	higher education	384	2107
5	generative artificial intelligence	367	1820
6	AI	169	849
7	education	102	630
8	natural language processing	76	683
9	assessment	71	489
10	chatbots	55	557

Source: Authors' own research based on the results highlighted by VOSviewer.

This information indicates that many issues have recently emerged in higher education institutions regarding how generative artificial intelligence can be used to improve academic performance and the quality of teaching and learning. This trend highlights the need for clear organizational strategies to manage ethical risks and maximize the use of large language models in academia.

Figure 6 shows the map of the most used keywords, which are grouped into six thematic clusters. For each cluster, the keywords are “ChatGPT” (blue), “large language models” (red), “higher education” (yellow), “academic integrity” (green), “education” (orange), and “medical education” (purple).

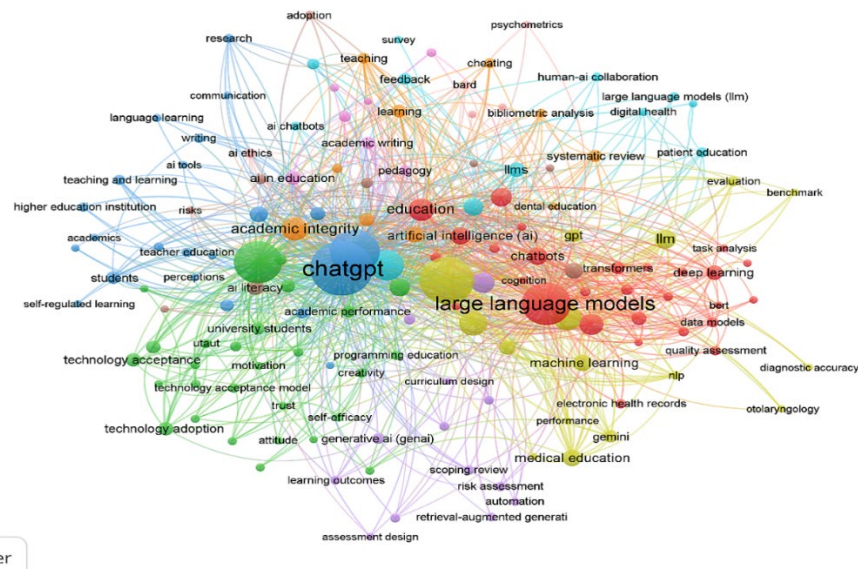


Figure 6. Visual map of thematic interconnections regarding generative AI in higher education

Source: Authors' own research based on the results highlighted by VOSviewer.

The blue cluster provides access to educational performance analysis, particularly through ChatGPT. The authors sought solutions to see how technology can improve student performance

and assessment processes in academia. The goal of the green cluster is to help people use technology. Keywords in this group (such as technology acceptance, adoption, and AI literacy) indicate that some studies have examined the factors that determine students' use of AI to improve their digital skills and motivation. The yellow cluster focuses on the higher education context, with an emphasis on writing and academic institutions, elements that suggest efficiency in terms of time spent on research tasks. In terms of the impact of technology in specialized fields, the purple cluster focuses more on medical education and the quality of assessment in this sector. The orange cluster focuses on education and pedagogy in general, studying how artificial intelligence can help develop personalized teaching solutions that increase student satisfaction. The red cluster focuses on technological foundations, such as large linguistic models (LLMs) and machine learning, and examines how they influence organizational data processing processes.

A keyword density map complements the analysis, helping to identify the most important areas of scientific interest in the sample. This representation uses color variations to emphasize the frequency and importance of terms, unlike a network map. To distinguish between emerging themes, which are on the periphery of current research, and “core” concepts, which dominate academic discourse, this perspective is necessary.

In Figure 7, the areas marked in bright yellow are the core resources of current research, and the areas marked in bright yellow indicate the maximum density around the term “ChatGPT”.

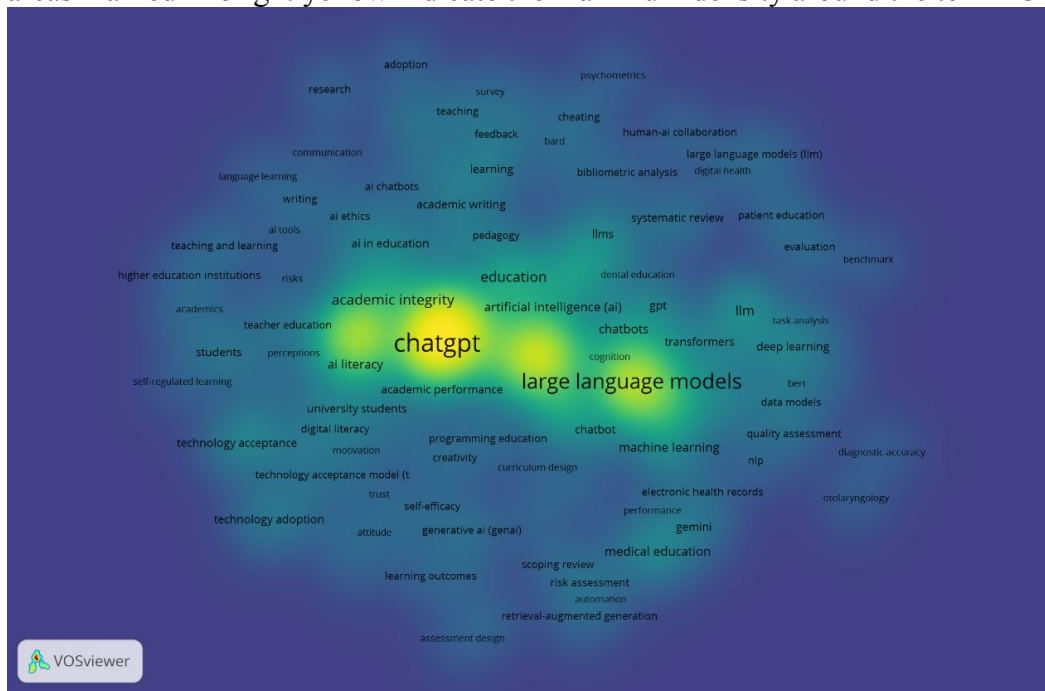


Figure 7. Density map of keywords in the literature on generative AI in higher education

Source: Authors' own research based on the results highlighted by VOSviewer.

The central area provides the largest amount of information on the use of artificial intelligence in universities, and the authors focused on the effects of this tool on academic performance and assessment. The areas densely covered by the words “Artificial Intelligence” and “Higher Education” emphasize that the focus of the research lies in the context of the digital transformation of educational institutions.

The green and blue shaded areas emphasize issues such as machine learning, AI ethics, and academic integrity. Keywords in these areas indicate that a significant portion of the literature reviewed examines the technical underpinnings and threats of language models, seeking ways to control how they are used in academia. Similarly, the observed density of terms in medical education and pedagogy indicates a shift in interest in personalized teaching and learning methods.

Conclusion

Finally, the findings of this bibliometric analysis demonstrate that the use of generative artificial intelligence in higher education is changing rapidly and profoundly. The results successfully address the specific objectives of the study. The analysis finds a rapid increase in academic interest, characterized by a rapid change in research priorities, in relation to the evolution of literature over time (SO1). In terms of mapping scientific collaboration networks (SO2), the data highlights the interconnected nature of the important authors and institutions that fuel this international discourse.

Keyword analysis also places ChatGPT at the center of recent academic discussions, addressing the identification of thematic cores and emerging concepts (SO3). In the dataset analyzed, this was the most frequently mentioned term, with the strongest network connections. Thematic mapping also shows a significant shift in literature: research has moved from purely technical studies to applied pedagogical concerns, focusing on how these tools influence teaching methodologies, student assessment, and academic integrity.

In the end, these findings show that the current barriers to adoption are not just technological, but rather ethical and cultural. This points to a larger shift in academia: interest in technology has transformed into a planned and regulated effort to learn long-term.

Acknowledgements

During the preparation of this work, the authors utilized ChatGPT 4 for translation assistance and to improve readability and language clarity. Following the use of this tool, the authors carefully reviewed and revised the manuscript to ensure scientific accuracy and assumed full responsibility for the final content of the publication.

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