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A Bibliometric Analysis of Artificial Intelligence Research in Higher Education: Growth, Trends, and Collaborations

Yükseköğretimde Yapay Zekâ Araştırmalarının Bibliyometrik Analizi: Büyüme, Trendler ve İşbirlikleri

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Abstract

Objective: This research aims to reveal the development of scientific output in the field of artificial intelligence in higher education, its thematic trends, influential publications, and international collaboration networks. The study aims to contribute to future research and policy-making processes by mapping the intellectual structure of the field.

Method: The research was conducted using a bibliometric analysis design. Data were obtained from 196 articles scanned in the Scopus database and meeting the specified criteria. VOSviewer (v1.6.20) software was used for data analysis. Publication trends, co-authorship, citations, keyword association, and international collaboration networks were analyzed. To increase validity and reliability, pre-specified inclusion and exclusion criteria were applied, the analysis process was reported in detail, and cross-validation was performed among researchers.

Results: The findings show that artificial intelligence research in higher education has increased rapidly, especially since 2022, and that publications constitute approximately two-thirds of the total studies in 2024. Forty-five percent of the studies fall within the social sciences, followed by computer science and engineering. Thematic analysis identified ethics, ChatGPT, generative AI, learning, teaching, and educational technologies as the most frequently co-occurring concepts. Collaboration analyses revealed that the United States, Australia, and the United Kingdom hold leading positions in international research networks.

Conclusion and Recommendations: The research shows that AI studies in higher education have an interdisciplinary structure and that technological developments are addressed together with pedagogical, ethical, and managerial dimensions. The findings reveal that AI is not only a technological innovation but also that publications from 2024 alone account for approximately two-thirds of the dataset. Future research should incorporate comparative bibliometric studies across multiple databases and expand qualitative and mixed-methods research into the long-term pedagogical and cognitive effects of AI.

Keywords: Bibliometric Analysis, Educational Technology, Pedagogical Issues, Artificial Intelligence, Higher Education

Özet

Amaç: Bu araştırma, yükseköğretimde yapay zekâ alanındaki bilimsel çıktıların gelişimini, tematik eğilimlerini, etkili yayınlarını ve uluslararası işbirliği ağlarını ortaya çıkarmayı amaçlamaktadır. Çalışma, alanın entelektüel yapısını haritalandırarak gelecekteki araştırma ve politika oluşturma süreçlerine katkıda bulunmayı hedeflemektedir.

Yöntem: Araştırma, bibliyometrik analiz deseninde yürütülmüştür. Veriler, Scopus veri tabanında taranan ve belirlenen ölçütleri karşılayan 196 makaleden elde edilmiştir. Veri toplama sürecinde PRISMA ilkeleri izlenmiş, analizlerde VOSviewer (v1.6.20) yazılımı kullanılmıştır. Yayın eğilimleri, ortak yazarlık, atıf, anahtar kelime eş oluşumu ve ülkeler arası iş birliği ağları analiz edilmiştir. Geçerlik ve güvenirliği artırmak amacıyla açık veri seçim ölçütleri uygulanmış, analiz süreci ayrıntılı biçimde raporlanmış ve araştırmacılar arasında çapraz doğrulama gerçekleştirilmiştir.

Bulgular: Bulgular, yükseköğretimde yapay zekâ araştırmalarının özellikle 2022 yılından sonra hızla arttığını ve 2024 yılında yayınların toplam çalışmaların yaklaşık üçte ikisini oluşturduğunu göstermektedir. Araştırmaların %45'i sosyal bilimler alanında yoğunlaşırken, bilgisayar bilimleri ve mühendislik diğer öne çıkan alanlar olmuştur. Tematik analizde etik, ChatGPT, üretken yapay zekâ, öğrenme, öğretme ve eğitim teknolojileri en sık birlikte kullanılan kavramlar olarak belirlenmiştir. İş birliği analizleri ise Amerika Birleşik Devletleri, Avustralya ve Birleşik Krallık'ın uluslararası araştırma ağlarında lider konumda olduğunu ortaya koymuştur.

Sonuç ve Öneriler: Araştırma, yükseköğretimde yapay zekâ çalışmalarının disiplinlerarası bir yapıya sahip olduğunu ve teknolojik gelişmelerin pedagojik, etik ve yönetsel boyutlarla birlikte ele alındığını göstermektedir. Bulgular, yapay zekânın yalnızca teknolojik bir yenilik değil, aynı zamanda yükseköğretimde dönüşümü şekillendiren stratejik bir unsur olduğunu ortaya koymaktadır. Gelecekte farklı veri tabanlarını kapsayan karşılaştırmalı bibliyometrik çalışmaların yürütülmesi, ayrıca yapay zekânın uzun dönemli pedagojik ve bilişsel etkilerini inceleyen nitel ve karma yöntem araştırmalarının artırılması önerilmektedir.

Anahtar Kelimeler: Bibliyometrik Analiz, Eğitim Teknolojisi, Pedagojik Konular, Yapay Zeka, Yükseköğretim

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Artificial intelligence (AI) has begun to create a broad impact that extends from policies to entire education systems. In the context of higher education, AI is not only perceived as a technological innovation but also as a strategic element of institutional transformation. The UNESCO report AI and Education: Guidance for Policy-Makers (Miao et al., 2021) emphasizes the importance of AI in expanding access to knowledge, supporting personalized learning, and strengthening research capacity. Similarly, the European Commission's Horizon Europe program prioritizes AI as a critical field of research and innovation for higher education institutions and provides substantial funding opportunities (European Commission, 2021).

Countries around the world are actively developing strategies and initiatives to integrate AI into higher education. For example, China has expanded undergraduate and graduate programs in AI and established research centers to support AI integration, exemplified by Peking University's Intelligent Teaching Platform, which enhances personalized learning and supports faculty decision-making in curriculum design (Tlili et al., 2025; Wang & Li, 2020). India, under its National Education Policy 2020, has developed AI-focused course content and established centers to promote AI education (Nayak & Singh, 2022). In the United States, the National Science Foundation (NSF) has launched the AI Research Institutes Program to accelerate AI research and education at universities (NSF, 2023). Collectively, these initiatives demonstrate that AI is increasingly recognized as a fundamental driver of competitiveness and innovation in higher education globally.

Recent academic studies further extend this perspective. Jin et al. (2025), in a study covering 40 universities across six regions, examined the adoption of generative AI through the lens of the Diffusion of Innovations theory, revealing how institutional policies are adapted and implemented. Humble (2025) conducted a document analysis of AI policies at Swedish universities, identifying key themes and patterns, and developed a dynamic alignment model for higher education AI policy (DAMHEAP), which highlights strategic, pedagogical, ethical and legal, operational, and adaptive alignments. Likewise, conducted a comparative study of how universities approach generative AI tools whether through adoption, prohibition, or cautious delay. Dotan et al. (2024), meanwhile, proposed a "points to consider" framework grounded in faculty perspectives. Taken together, these studies offer theoretical, comparative, and contextual insights into the institutional adoption of AI in higher education.

Against this international backdrop, Türkiye has also positioned AI as a strategic priority. The National Artificial Intelligence Strategy 2021-2025 outlines six strategic priorities: human capital development, research capacity, data and infrastructure, ethics and regulations, international cooperation, and socio-economic transformation. Within these areas, 24 objectives and 119 measures have been identified (Republic of Türkiye, 2021). As part of this strategy, higher education institutions are expected to strengthen AI research, establish interdisciplinary centers, and align their academic programs with national priorities.

Such substantial support for AI research by national strategies encourages and fuels researchers' interest in AI studies in education. Understanding the trends and impact of AI-themed scientific production, which is still in its infancy but rapidly increasing across disciplines, is therefore important.

Conceptual Framework

Artificial Intelligence in Higher Education and Bibliometric Analyses

In the last decade, artificial intelligence (AI) has been used for a range of purposes, including improving student achievement, supporting teaching processes, streamlining administration, and personalizing learning. Studies have shown that the use of AI algorithms improves student learning outcomes and increases their motivation (Manciaracina, 2022). It has been stated that AI in higher education can improve the quality of education, provide practical learning and teaching methods, and enhance assessments to better prepare students for their careers (Slimi & Carballido, 2023). AI algorithms are also used to predict student success rates and identify at-risk students. AI-supported prediction models provide high accuracy in predicting students' course success, thus creating opportunities for early intervention (Okubo et al., 2017). Studies exploring students' and educators' perceptions of AI-based chatbots in higher education have revealed a positive attitude toward these chatbots and their potential to enhance educational experiences, but have also highlighted concerns about trust, privacy, and reliability of information in their wider acceptance (Saihi et al., 2024).

When the use of AI in higher education is grounded in theory, theoretical approaches such as learning analytics, digital pedagogical transformation models, and ethical theories are prominent. Learning analytics is one of the paradigms that underpins the pedagogical integration of AI in higher education. This approach aims to generate meaningful insights from student data (e.g., interaction history, performance indicators, cognitive processes) and transform this information into personalized learning paths, targeted interventions, and decision-support systems using AI-powered systems (Siemens & Long, 2011). In the literature, large language model-based tools such as ChatGPT have been examined in the context of the opportunities and risks created by learning analytics (Yan et al., 2024). has been proposed to support the responsible, fair, and transparent use of AI in learning analytics tools (Tirado et al., 2024). *Digital pedagogical transformation models* define strategic, technological, and pedagogical innovation processes that restructure learning environments in higher education; within this framework, models such as Gilly Salmon's 5-Stage Model enable instructional designers to systematically design blended and online learning experiences (Ruzmetova, 2018; Salmon, 2011). The integration of Artificial Intelligence into these transformation paradigms reinforces digital pedagogical transformation by enabling personalization, real-time feedback, and adaptive content delivery. For example, Qian et al. (2025) developed the Smart Education Optimization Model (SEOM), which uses random forest and graph neural network techniques to optimize learning paths. Additionally, studies examining the impact of AI-supported pedagogical innovations on behavioral intention and usage level indicate that the adoption of AI-based tools can be a driving force of pedagogical transformation in the production of satisfying digital learning environments (Bayaga, 2025). While models of digital pedagogical transformation describe the strategic, technological, and pedagogical innovation processes that are reshaping learning environments in higher education, *ethical theories* theoretically solidify the moral aspects of this transformation. *Deontological ethics*, in particular, advocates for evaluating actions based on fundamental principles (e.g., justice, privacy, honesty) rather than their consequences; in this context, it mandates that the use of AI in education respect students' autonomy and academic rights (Floridi & Taddeo, 2016; Porayska-Pomsta et al., 2023). On the other hand, a *utilitarian* approach supports the legitimacy of AI applications related to digital pedagogical transformation based on outcomes, based on the potential of these technologies to maximize educational efficiency, accessibility, and overall well-being (Yan & Liu, 2024). These ethical references show that in the digital era, administrations must build pedagogical structures not only technologically but also on ethical foundations.

Governments and international organizations are implementing strategies to integrate AI into higher education, prioritizing ethical frameworks, centers of excellence, and inclusive practices (Lopez-Chila et al., 2024; Sahar & Munawaroh, 2025; UNESCO, 2023). Curricula are being revised to foster competencies such as critical digital literacy, algorithmic thinking, and ethical awareness, while universities increasingly adopt adaptive learning systems, AI-powered assessment tools, and open educational resources to enhance pedagogical outcomes and equitable access to knowledge (Delen, 2024). As a result, universities are transforming from mere course providers into knowledge-generating institutions that establish ethical standards, promote interdisciplinary collaboration, and broaden access in the AI era (Serpil & Kesim, 2024). A recent UNESCO survey indicates that nearly two-thirds of higher education institutions are developing guidance on AI use, reflecting a global trend toward formalizing AI integration in academic settings (UNESCO, 2025).

The increasing importance of AI in higher education indicates that research in this area is growing rapidly. In recent years, a significant increase has been observed in the number of studies focusing on the integration of AI into educational processes and its pedagogical implications (Batubara et al., 2024). In addition, more in-depth research is needed on the long-term effects, ethical dimensions, and pedagogical implications of AI in higher education. It is important for future studies to examine the role of AI in education more comprehensively and its effects on student achievement, teaching methods and educational policies (Jones & Sefton-Green, 2021). Analyses on the pedagogical applications of AI have identified gaps and potential issues in research in this area (Hinojo-Lucena et al., 2019). It can be said that these analyses contribute to filling gaps in the literature by attracting the attention of academics.

One of these analyses, bibliometric reviews, can process significantly more studies published over a longer period with less investment of time and resources, while providing a comprehensive picture of the development and status of a field (Hernández-Torrano & Ibrayeva, 2020). Bibliometric analyses guide researchers, allowing the identification of new research areas and the promotion of scientific production in these areas. Thus, increased academic production allows for more comprehensive bibliometric analyses to be conducted and enables a more in-depth examination of the literature. This relationship reveals the cyclical nature of academic knowledge: Bibliometric analyses evaluate existing literature, and the results of this evaluation form the basis of future research. Therefore, there is a reciprocal relationship between the increase in research in a field such as artificial intelligence research in higher education and bibliometric analyses.

As an approach to mapping a research field, bibliometric analysis is "a set of quantitative methods used to measure, monitor, and analyze print-based academic literature" (Roemer & Borchardt, 2015, p. 28). Bibliometric analysis uses bibliographic information encoded in academic databases (ERIC, PsycINFO, Scopus, Web of Science, etc.) to examine trends in publication and citation data, the contribution of authors, institutions, and countries to the development of the field and their scientific collaboration networks, and the distribution of publications across journals and disciplines (Andres, 2009). Although several bibliometric studies exist (Appana et al., 2025; Batubara et al., 2024; Hinojo-Lucena et al., 2019; Sahar & Munawaroh, 2025; Valdiviezo Sir, 2024), those focusing specifically on higher education remain limited.. Therefore, a research gap exists regarding the status of this rapidly expanding research and knowledge base. This study is expected to provide a clear understanding of conceptual issues related to AI research by presenting the current state of the art and will guide future research by identifying trends in the field.

This study, consistent with the anticipated results of the bibliometric assessment, will contribute to the field of higher education and artificial intelligence in various ways. The research will provide fundamental insights into current developments in the field, revealing the performance dimension of AI use in higher education through publication trends, leading authors, countries, and highly cited studies; and its intellectual structure through key concepts, topics, citation and co-authorship networks, and bibliographic links. Furthermore, the findings will enable the integration of new contributions with the existing literature and contribute to the shaping of future research agendas. By highlighting critical gaps in current research, the study will highlight the importance of AI in higher education and offer managerial and practical recommendations for students, universities, and policymakers.

In this context, the research aims to reveal the general view of artificial intelligence research in the field of higher education using the bibliometric method. The research questions for this purpose are as follows:

1. What are the growth trend and subject areas of AI research in higher education?
2. Which journals, articles, and authors are most influential in the AI literature?
3. What are the dominant themes in the AI literature?
4. What are the patterns of research collaboration in the AI literature?

Methodology

Research Design

A bibliometric analysis design was used in this research. Bibliometric analyses are studies that reveal the amount of scientific production in a specific field, its geographic distribution, networks among researchers, collaboration patterns, and citation impact. This method offers a broader perspective for examining the dynamics of a scientific field by revealing information such as knowledge accumulation patterns, historical development of themes, and frequently used keywords (Zupic & Cater, 2015). This design overlaps epistemologically with the quantitative research approach based on the positivist paradigm because it relies on objective, measurable, and repeatable data (Al & Tonta, 2004; Pritchard, 1969). Bibliometric analyses offer advantages such as working with big data, objectivity, scientific performance analysis, and science mapping (Yılmaz, 2019). However, this design also includes disadvantages such as a lack of contextual depth, citation bias, and interdisciplinary differences (Bornmann & Daniel, 2005). Bibliometrics, on the other hand, is preferred for revealing scientific trends and structural relationships with large data sets. Systematic reviews and meta-synthesis, on the other hand, offer contextual depth but operate with a more limited sample size (Yılmaz, 2021). The reason for choosing this design is to explain the general trend and landscape of artificial intelligence research in higher education without covering the content in great depth.

Search Criteria, Source Identification, and Analysis

On February 28, 2025, researchers searched the Scopus database for studies containing the following keyword phrases in the "Article title, Abstract, Keywords" fields: "artificial intelligence in higher education," "artificial intelligence in higher education," and "generative artificial intelligence in higher education." No date restriction was applied. Instead of selecting keywords individually, these keyword phrases were searched in their entirety within quotation marks to protect the study from irrelevant research caused by the misleading effect of keywords and to create a consistent structure. The inclusion and exclusion criteria for research material in the "Article title, Abstract, Keywords" fields in the Scopus database are shown below.

Inclusion criteria:

- "all-subject areas"
- Being in the "all-time" timeframe
- Including the phrases "artificial intelligence in higher education," and "generative artificial intelligence in higher education"
- Published journal articles, including bibliometric articles

Exclusion criteria:

- Articles in press
- Books, book chapters, conference proceedings, or editorial notes
- Records in which the terms appear only separately rather than as the complete search phrase

Scopus was selected as the sole data source for this bibliometric analysis due to its extensive multidisciplinary coverage, structured metadata, and compatibility with bibliometric tools. Scopus indexes a broad spectrum of academic outputs, which makes it well suited to research topics such as *artificial intelligence in higher education*, which span multiple disciplines including education, computer science, and the social sciences (Elsevier, 2024; Mongeon & Paul-Hus, 2016). Its independent Content Selection and Advisory Board (CSAB) ensures quality control and consistency in indexed material, which enhances the reproducibility of search results (Falagas et al., 2008).

From a methodological perspective, Scopus provides richer coverage than the Web of Science (WoS) in certain fields, particularly the social sciences and education, thereby reducing the risk of underrepresentation of relevant literature (Mongeon & Paul-Hus, 2016). While WoS is highly selective, its narrower coverage could have limited the dataset in this interdisciplinary research. Other potential sources, such as Google Scholar, lack consistent metadata quality, formal curation, and export formats suitable for advanced bibliometric network analysis, leading to risks of duplication, non-academic content inclusion, and data noise (Halevi et al., 2017). Similarly, ERIC, TR Dizin, and YÖK Thesis Center, while valuable for domain-specific or national studies, would have narrowed the scope to regional or format-specific publications, contradicting the objective of constructing an international and interdisciplinary literature map.

Although relying on a single database introduces potential limitations in terms of language, geographical, and disciplinary bias (Archambault et al., 2009), Scopus was deemed the most methodologically appropriate choice for balancing data diversity, representativeness, and bibliometric analysis compatibility. These limitations are acknowledged, and future research could integrate WoS, ERIC, or national databases to triangulate findings and address publication bias more comprehensively.

Researchers adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al., 2009), which specify the steps to be reported for document identification when conducting systematic reviews (Fig. 1). It was decided to include bibliometric research articles in the analysis because they are considered important for the interest in AI research and provide valuable data by mapping the knowledge generated in a scientific field.

The search strategy used complete keyword phrases in quotation marks-such as "*artificial intelligence in higher education*" and "*generative artificial intelligence in higher education*"-within the *Article title*, *Abstract*, *Keywords* fields, without restricting the time frame. This phrase-based approach was adopted to mitigate the misleading effect of disaggregated keywords, which can capture irrelevant records, thereby improving the precision of the dataset (Zupic & Čater, 2015). This search yielded 382 records, and the data extraction process began. During the data extraction process, 186 records were excluded, including books, book chapters, proceedings, editorials and articles in press. This left 196 published articles in the dataset. The abstracts of the remaining articles were meticulously reviewed by the researchers. Abstract screening identified no irrelevant records, which we attribute to the use of exact-phrase searching. The resulting 196 records were exported in CSV format. No data rows with missing information were identified in the exported file. Data from 196 articles were analyzed using VOSviewer version 1.6.20, which fully supports existing Scopus export structures. The VOSviewer program used for data analysis in this study is a widely used tool for analyzing and visualizing citation and collaboration networks in scientific literature (Van Eck & Waltman, 2010).

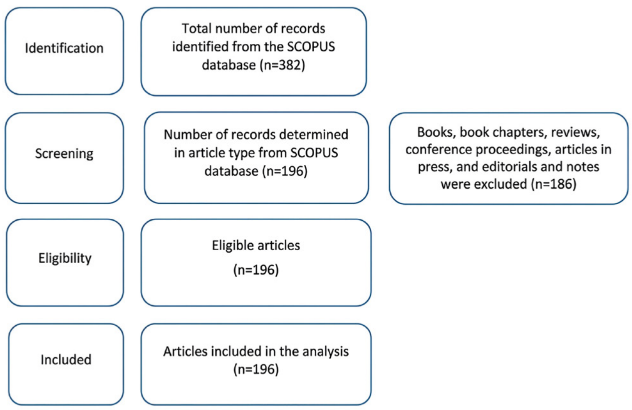
The algorithms used in the software include a clustering algorithm, weighted network analysis, and distance-based visualization. VOSviewer uses a modularity-based clustering algorithm (Waltman et al., 2010). This algorithm groups elements within the network based on their similarity, thus highlighting research themes or interdisciplinary areas. Clustering sensitivity can be set by default, and the depth of analysis can be adjusted if necessary (Van Eck & Waltman, 2017). The default settings were used in this study. In weighted network analysis, connections such as citation counts or joint publications are weighted; this allows each connection to be evaluated according to its strength (Van Eck & Waltman, 2010). The minimum number of connections in the study was set to one.

In distance-based visualization, VOSviewer places data on a two-dimensional map based on the similarity or strength of connections between data. It displays the degree of distance, similarity, or collaboration between objects (Van Eck & Waltman, 2010). The placement algorithm uses a combination of multidimensional scaling and force-balanced methods by default.

The primary metrics used in data analysis in this study include degree centrality and betweenness centrality. Degree centrality helps identify central actors in the network by indicating the number of direct connections a node has, while betweenness centrality is used to determine the nodes' positions as bridges in the network's information flow. These metrics were chosen to understand the structural dynamics of the network and to identify key actors in the research area. Furthermore, network structures were considered with the number of connections, allowing for the analysis of quantitative information such as the frequency of collaboration or the number of citations.

In this study, the bibliometric analysis conducted with VOSviewer was structured to clarify not only the workflow but also the specific algorithms applied at each stage. First, during the data import and preprocessing stage, VOSviewer's built-in parsing algorithm was used to normalize author names and unify keyword variants using a thesaurus file; fractional counting was applied for weighting. In the network construction stage, different similarity measures and counting methods were selected depending on the network type. For co-authorship and co-citation networks, association strength normalization was applied to calculate the similarity between items, as this metric reduces the bias caused by large-scale authors or documents and provides more stable link weights. For keyword co-occurrence analysis, full counting was used to retain the complete semantic structure of the field. Cluster identification was performed using VOSviewer's modularity-based clustering algorithm, derived from the smart local moving (SLM) optimization technique. This algorithm iteratively maximizes modularity by moving nodes between communities, thereby producing coherent and statistically meaningful thematic clusters. In the visualization stage, the study employed the VOS (Visualization of Similarities) mapping algorithm, which is based on a weighted multidimensional scaling (MDS) approach. This algorithm minimizes the weighted sum of squared distances between items, ensuring that strongly related items appear closer on the two-dimensional map while preserving the global network structure. Compared to force-directed layout algorithms, VOS mapping produces more stable and reproducible bibliometric maps, which was the main reason for its selection. Detailing these algorithms is intended to support replication and extension of the analysis.

Figure 1
PRISMA Flowchart Showing the Steps of Identifying and Screening Artificial Intelligence Research in Higher Education (Moher et al., 2009)



Validity and Reliability

Various strategies were implemented to ensure validity and reliability in the bibliometric analysis design used in this study. First, a comprehensive and interdisciplinary database such as Scopus was chosen to ensure data accuracy and consistency (Elsevier, 2024; Mongeon & Paul-Hus, 2016). Scopus is considered a reliable source for bibliometric studies due to its broad scope and up-to-dateness (Falagas et al., 2008). Furthermore, clear and rigorous inclusion and exclusion criteria were established during the data collection process, and systematic data selection was implemented (Moher et al., 2009). These criteria increased the representativeness of the sample and allowed for the exclusion of unnecessary or non-domain-specific data. During the data analysis phase, the use of scientific mapping and visualization software such as VOSviewer contributes to the objective and reproducible presentation of research results (Van Eck & Waltman, 2010). This allows cross-validation of different bibliometric indicators (citation, collaboration, word analysis) and increases the reliability of the findings.

In order to ensure reliability in the research, audit-trail/confirmability strategy was also used (Lincoln & Guba, 1985); the selection of the research material, the extraction of the data, their preparation for analysis, analysis algorithms and parameters were presented in detail. Finally, the involvement of multiple researchers in the analysis process and cross-checking the results reduced subjective influences in interpretations and increased reliability (Hallinger & Kovačević, 2019). Therefore, the results were reviewed by multiple researchers to increase the validity and reliability of the study.

On the other hand, the inherent limitations of bibliometric studies should also be considered; for example, a high number of citations may not always fully reflect the scientific quality or impact of a study (Bornmann & Daniel, 2005). In this context, bibliometric data has been used only to reveal general trends in the field, and it is recommended to provide a holistic perspective by supporting it with methods such as content analysis or qualitative research (Yılmaz, 2021).

Findings

Growth Trend and Study Areas of AI Research in Higher Education

Figure 2 presents the growth trend of artificial intelligence literature in higher education research by year. The first study in the dataset, which includes 196 studies, was published in 2018 (n=1). Growth was slow until 2022 (n = 8), accelerated in 2023 (n = 34), and peaked in 2024 (n = 131). Studies published in 2024 (n = 131) account for 66% of the dataset, indicating rapid expansion of the literature. The fact that the number of studies available even in February 2025, when the research data was downloaded, was greater than the total of 2022 (n=8), suggests that interest in AI research will continue in 2025.

Figure 2
Historical Growth of Higher Education AI Research

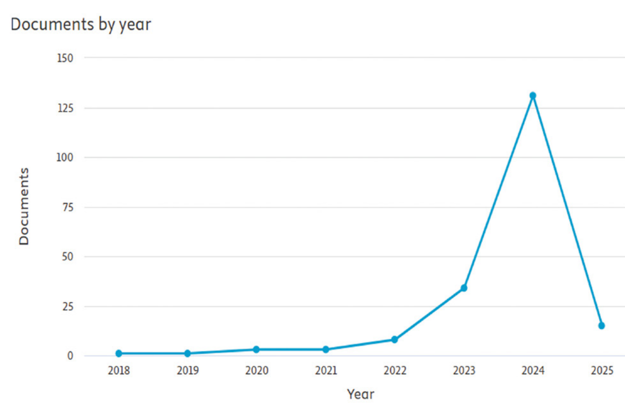
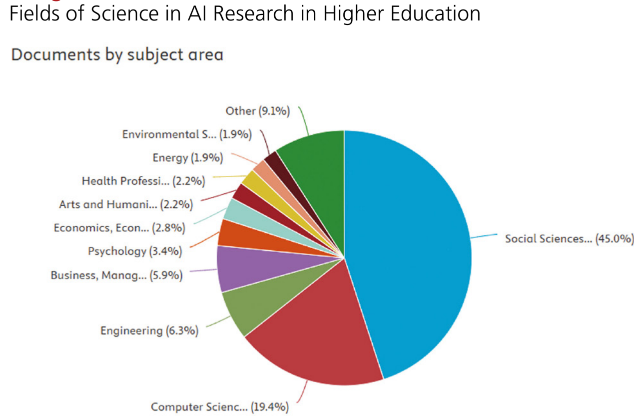


Figure 3
Fields of Science in AI Research in Higher Education

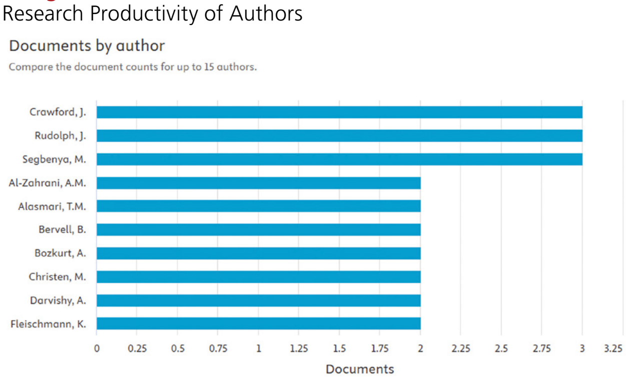


When examining the scientific fields where AI research in higher education is conducted, a very wide range is evident. The presence of research across 20 different fields illustrates the interdisciplinary nature of AI. While the majority of AI research is conducted in the social sciences, it is followed by computer science, engineering, business, management and accounting, psychology, economics, econometrics and finance, and health professions. Although AI might seem like a technical subject belonging primarily to computer science, the fact that research in the social sciences (45%) constitutes the largest portion indicates the weight given to AI's social dimensions (Fig. 3).

Influential Journals, Articles, and Authors

In practice, this analytical approach involves ranking authors by publication count to identify productive scholars, as well as ranking them by citation count to assess academic impact and growth patterns across different research areas (Kavitha et al., 2024). The selected parameters (type of analysis: citation; unit of analysis: document; minimum number of citations per document: 1) revealed that education and technology-focused journals are more prevalent among the journals containing the most cited articles on AI research in higher education. Only two higher education journals appear in the list. It is also noteworthy that the journals' focus topics cover a wide range, emphasizing the interdisciplinary nature of AI research in higher education. The most cited article was "Chatting and cheating: Ensuring academic integrity in the era of ChatGPT" by Cotton et al., published in Innovations in Education and Teaching International in 2024. The most cited authors are Cotton, D. E. R., Cotton, P. A., and Shipway, J. R., who are co-authors of the same article with 685 citations (Table 1). Although citation counts normally accumulate with time since publication, recent studies in the field of artificial intelligence are also highly cited. This situation is due to the very rapid progress of developments in the field of AI, and points to the speed at which knowledge in this field circulates and dates. Bibliometric studies are relatively more common among the most cited studies. This pattern likely reflects the intense interest in artificial intelligence literature and the need to follow current research on this subject.

Figure 4
Research Productivity of Authors

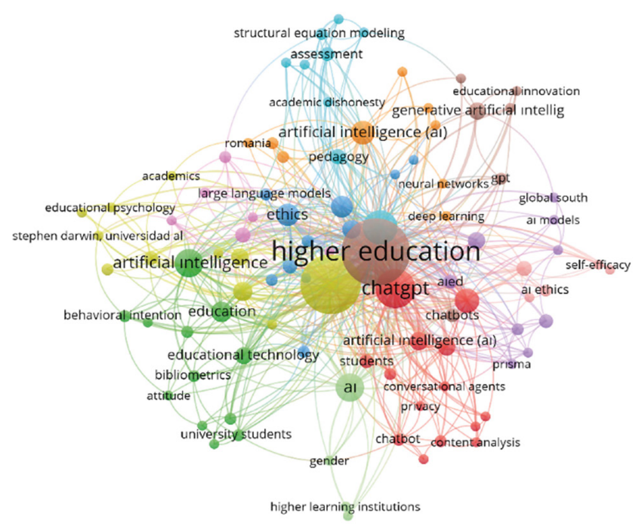


To uncover authors who have made an impact in higher education AI literature, the research productivity of the authors was examined (Fig. 4). In terms of research productivity, the top ten authors with the highest output are Crawford, Rudolph, and Segbenya with three articles each, followed by Al-Zahrani, Alasmari, Bervell, Bozkurt, Christen, Darvishy, and Fleischmann with two articles each.

Thematic Overview of AI Literature in Higher Education

A co-occurrence analysis of keywords was conducted to determine the thematic trend of artificial intelligence research in higher education (Fig. 5). Keyword analysis provides important insights that can be used to reveal the conceptual focal points of artificial intelligence in higher education. Furthermore, according to Hallinger and Kovacevic (2019), keyword co-occurrence analysis offers a more detailed picture of the composition of the knowledge base. Based on the selected parameters (type of analysis: concurrency; unit of analysis: additional keywords; counting methods: full count; minimum number of occurrences of a keyword: 2), 97 of 570 co-occurring keywords were identified. The most frequently occurring keywords in the articles were 'higher education' (n=109), 'artificial intelligence' (n=99), 'ChatGPT' (n=35), 'generative artificial intelligence' (n=26), and 'artificial intelligence' (n=17). Apart from the synonyms of higher education and artificial intelligence, the keywords frequently used together are listed as 'ethics' (n=11), 'education' (n=9), 'learning' (n=8), 'teaching' (n=6), 'educational technology' (n=6), 'technology' (n=5), and 'pedagogy' (n=5). The findings indicate that ethics, education, learning, teaching, and educational technology are frequently addressed together in AI research in higher education and are dominant in the thematic outlook of the field. This is consistent with the fact that 45% of AI research is in the social sciences.

Figure 5
Thematic View of AI Literature in Higher Education



Research Collaboration View of AI Literature in Higher Education

An analysis of co-authorships between authors and countries was conducted to reveal the collaborative power of artificial intelligence research in higher education. Among 348 authors whose articles received at least one citation, the strongest collaborations were formed by 17 authors. According to the selected parameters (type of analysis: co-authorship; unit of analysis: author; counting method: complete count; minimum number of documents per author: 1; minimum number of citations per author: 1), it was determined that these research collaborations were most established by Crawford (n=18) and Rudolph (n=17), who are located in the center of the network map. On the right side of the map, the collaboration cluster where Crawford is most active includes Cowling, Pani, and Allen. Examining the keywords of the researchers in these partnerships revealed that this cluster represents topics related to learning, leadership, and psychology in AI. The other cluster, led by Rudolph in the lower-left side of the map, consists of Ismail (M. F. M) and Popenici. These researchers investigate topics such as AI, student engagement, and chatbots in higher education (Fig. 6).

It is also considered valuable to identify countries that collaborate through co-authorship in AI research in the field of higher education. The top 60 countries with the most research collaborations that received at least one citation are the United States (n=13), Australia (n=13), and the United Kingdom (n=13) (Fig. 7).

Figure 6
Authors' Research Collaborations

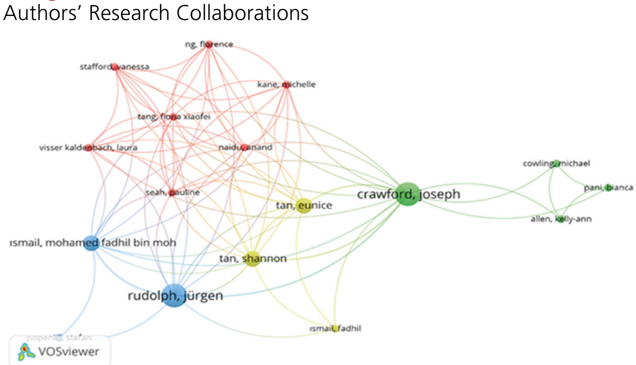
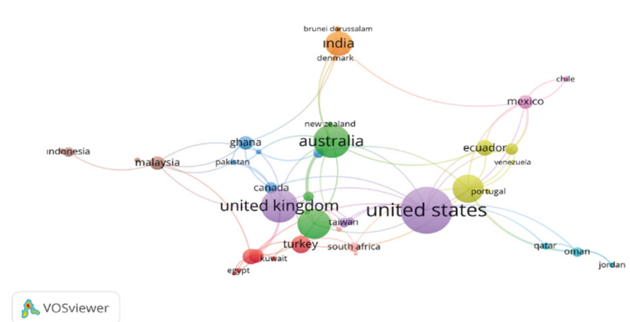


Figure 7
Research Collaborations of Countries



Discussion

This study, based on a bibliometric analysis of artificial intelligence (AI) research in higher education, shows that the field is growing rapidly after 2022. This growth is projected to continue through 2025. Similarly, the literature has noted this increase in recent years (Crompton & Burke, 2023). This is attributed to the increasing emphasis on personalized learning, adaptive teaching methodologies, and the integration of AI technologies into classrooms (Dogan et al., 2023) as well as the significant importance of AI, particularly in education (Ivanova & Holotescu 2024). This increase in artificial intelligence research in higher education can also be explained by rapid technological developments that have significantly expanded the applications of artificial intelligence in various academic and administrative fields (Sahar & Munawaroh, 2025). Many countries and institutions prioritize artificial intelligence research to develop data-driven decision-making tools for higher education institutions, as well as to increase academic productivity (Lin & Yu, 2024). Therefore, it seems that efforts to integrate artificial intelligence into pedagogy, academia and governance are effective in the growth of this research volume.

The study found that artificial intelligence (AI) studies in higher education encompass 20 different scientific fields, demonstrating an interdisciplinary character. The high proportion of studies in the social sciences, at 45%, demonstrates that AI is not only a technical innovation but also receives intensive attention for its social, ethical, and pedagogical dimensions. This finding aligns with studies emphasizing the increasing importance of the social and human dimensions of AI in education and learning environments (Akhmadieva et al., 2023; Al-Zahrani & Alasmari, 2024). The fact that computer science and engineering follow the social sciences demonstrates that the technical foundations of AI are also strongly present in research, and that the interaction between technical development and societal implications is mutually nourishing. Furthermore, studies in the fields of business, management, accounting, and psychology demonstrate that AI is not limited to educational performance or technical processes but also encompasses multidimensional outcomes such as decision-making, organizational transformation, and learning behaviors (Prieto-Gutiérrez et al., 2023). This distribution reveals that the social dimension of AI is strongly conceptualized in higher education, but technical aspects are not ignored. The dominance of social sciences suggests that societal questions such as ethics, privacy, and inequality are prominent in research, while technical issues such as algorithmic performance and data quality remain relatively limited. Therefore, interdisciplinary collaborations can contribute to the sustainable and responsible use of AI in higher education by integrating technical and social dimensions (Hajkowicz & Sanderson 2023).

AI research in higher education is concentrated in education and technology-focused journals, taking an interdisciplinary approach. This demonstrates that not only the technical but also the pedagogical and ethical aspects of AI are important. The recent and heavily-cited cited study by Cotton et al. (2024) on ChatGPT in the context of academic integrity demonstrates the centrality of ethical discussions in the literature. Similarly, examining the impact of ChatGPT on academic integrity, Evangelista (2025)highlights the increasingly important role of AI in education.While research indicates that AI has tremendous potential to enhance learning efficiency and academic performance, its successful implementation also requires addressing concerns about accuracy, cognitive disengagement, and ethical implications (Vieriu, 2025). In this context, the effectiveness of AI applications in higher education depends not only on technical capacity but also on pedagogical design, ethical guidance, and careful consideration of students' cognitive processes.

Thematic analysis findings clearly demonstrate the conceptual focus and evolutionary nature of AI research in higher education. The most frequently occurring keywords, "higher education" and "artificial intelligence," confirm the field's fundamental framework, while the prominence of current concepts such as "ChatGPT" and "generative artificial intelligence" demonstrates that the research agenda is rapidly being shaped by technological innovations. Furthermore, the extensive use of concepts such as "ethics," "learning," "teaching," "educational technology," and "pedagogy" demonstrates that the literature does not focus solely on technical aspects but also systematically addresses ethical, social, and pedagogical implications. Consistent with the fact that approximately 45% of studies in the field are located in the social sciences, the findings reveal that AI is not considered a purely instrumental technology in higher education but rather a multidimensional phenomenon associated with values, learning processes, and institutional transformation. This shows that the research agenda is concentrated on three main axes - technological developments, pedagogical processes, and ethical – social dimensions, and that the field will continue to evolve around this triple structure in the future. This underscores the importance of considering AI not only as a technical innovation but also in its social and pedagogical dimensions (UNESCO, 2025). The role of AI in educational processes has attracted global attention due to its potential to provide personalized learning opportunities and facilitate teaching processes (Manciaracina, 2022). However, the literature lacks sufficient empirical evidence regarding the long-term pedagogical impact of the high-interest in such technologies. In particular, tools that facilitate short-term instructional processes, as well as the potential negative impacts on long-term student independence, critical thinking, and evaluation, need to be systematically examined. Recent studies have begun to address these concerns. Shidiq (2023), testing creative writing development in AI-supported instruction, found that AI is effective in developing creative writing skills; However, teachers should manage the process in a controlled manner. For instance, Kosmyna et al. (2025) found that students using ChatGPT had the weakest neural connectivity across EEG bands, and performed poorly in cognitive functions such as executive control, memory, and creativity. Therefore, while AI tools offer immediate instructional benefits, their potential to undermine essential cognitive skills necessitates comprehensive research into their long-term effects.

The co-authorship analysis of AI research in higher education revealed two significant clusters of scholarly collaboration that not only map interpersonal and institutional networks but also shed light on the intellectual architecture of the field. The first cluster, centered around Crawford and his collaborators such as Cowling, Pani, and Allen, highlights a strong orientation toward the intersections of learning, leadership, and psychology in the integration of AI in higher education. This cluster reflects a strand of research that conceptualizes AI not merely as a technical innovation but as a catalyst for rethinking pedagogical practices and leadership frameworks in universities. Crawford et al. (2023) argue that AI-related transformations demand adaptive leadership, critical reflection on learning design, and institutional strategies that support ethical and sustainable use of technology. Their work resonates with Zawacki-Richter et al. (2019), who emphasize that the successful adoption of AI requires not only technological readiness but also the cultivation of faculty competencies and organizational cultures that align with ethical values such as justice, transparency, and academic integrity. By positioning leadership and psychological perspectives at the center of AI research, this cluster contributes to shaping an intellectual tradition that prioritizes human development, institutional responsibility, and systemic change. The second cluster, anchored by Rudolph is distinct in its thematic focus on the application of AI-driven tools, particularly chatbots, and their implications for student engagement and learning. Rudolph et al. (2023) highlight that chatbots have become a critical site of innovation, offering new opportunities for enhancing immediacy, personalization, and support in higher education contexts. Similarly, Popenici and Kerr (2017) underscore the disruptive potential of AI in reshaping how students interact with knowledge, raising both opportunities for engagement and concerns about the erosion of human-centered pedagogical values. Taken together, this cluster represents the "applied" dimension of AI research in higher education, foregrounding the design, deployment, and evaluation of AI systems for concrete educational purposes. The existence of these two clusters points to a bifurcation in the intellectual structure of the field. On the one hand, the Crawford-centered cluster reflects a socio-psychological and leadership-oriented paradigm that emphasizes the broader organizational and ethical implications of AI adoption. On the other hand, the Rudolph-centered cluster reflects a techno-pedagogical paradigm that concentrates on practical applications, student engagement, and tool-specific affordances. This duality mirrors what Liu et al. (2023) describe as the 'dual promise' of AI in education, where scholars are simultaneously tasked with advancing innovative practices and confronting the ethical, cultural, and institutional challenges that shape technology use in higher education. It also reflects broader debates in the literature concerning whether AI in education should primarily be understood as a tool for efficiency and innovation or as a transformative force with profound implications for equity, ethics, and institutional governance (Akgun & Greenhow, 2022; Williamson & Eynon, 2020). From an intellectual structure perspective, these clusters suggest that AI research in higher education is consolidating into two partially overlapping but distinct subfields. The leadership- and psychology-oriented subfield situates AI within discussions of human agency, organizational learning, and ethical responsibility, while the application-oriented subfield situates AI within debates on tool design, usability, and learning outcomes. Importantly, the interaction between these subfields indicates a dynamic research ecology in which practical experimentation with AI technologies informs, and is informed by, broader conceptual debates about the role of higher education in the age of intelligent machines. Such an ecology underscores the need for interdisciplinary collaboration that bridges technological expertise with social sciences perspectives, ensuring that AI's integration into higher education remains both innovative and human-centered.

The research results reveal that the United States, Australia, and the United Kingdom are leading research collaborations, and policy support in these countries strengthens their positions in the global research ecosystem. Similar findings are also found in the literature (Bergmann & Müller, 2023; Jones & Sefton-Green, 2021). Furthermore, the finding is consistent with Xie et al.'s (2024) study comparing the AI policies of different countries, demonstrating the importance of countries' AI policies in these collaborations. However, the concentration of collaboration networks primarily among developed countries also poses the risk of regional imbalances in knowledge production. This imbalance could be addressed by building AI research capacity in lower- and middle-income countries and by funding schemes that reward cross-regional co-authorship.

Conclusion

Research on artificial intelligence in higher education has expanded rapidly in recent years, reflecting the growing integration of AI technologies into teaching, learning, and institutional practices. The field demonstrates a strong interdisciplinary character, encompassing social sciences, computer science, engineering, business, and psychology. This indicates that AI is not only a technical innovation but also a phenomenon with profound social, ethical, and pedagogical implications. Thematic trends reveal that research focuses on three interrelated dimensions: technological development, pedagogical processes, and ethical and social considerations, highlighting a multidimensional understanding of AI in higher education. Analyses of scholarly collaborations reveal two dominant clusters shaping the intellectual structure of the field. One cluster emphasizes leadership, learning, and psychological perspectives, highlighting the ethical and organizational dimensions of AI integration. The other cluster focuses on applied AI, including educational technologies, chatbots, and student engagement, reflecting the practical implementation of AI in learning environments. The coexistence of these two trajectories highlights the importance of interdisciplinary collaboration in balancing technological innovation with social, ethical, and pedagogical concerns, thereby promoting the sustainable and human-centered adoption of AI. Despite the rapid growth and diversification of research, challenges remain. Regional disparities in research collaboration and limited empirical evidence regarding long-term cognitive and pedagogical effects of AI warrant attention. For practice and policy, higher education institutions should develop comprehensive strategies that integrate AI tools with pedagogical design, faculty development, and ethical guidelines, ensuring that technology enhances learning outcomes without compromising critical cognitive or social skills.

In practical terms, this study makes several contributions to the literature: it provides a detailed mapping of AI research in higher education, identifies influential authors and journals, highlights thematic priorities such as ethics and pedagogy, and emphasizes the interdisciplinary character of the field. These contributions can inform educators, policymakers, and researchers about the current landscape of AI research and guide strategic decisions for integrating AI in higher education. Overall, this study contributes to understanding the evolution, interdisciplinary nature, and intellectual structure of AI research in higher education, providing a foundation for future research, institutional strategies, and policy development.

At the same time, the study has certain limitations. As a bibliometric analysis, it primarily captures publication volume, citation patterns, and collaboration networks, but does not assess the qualitative impact of research, the effectiveness of AI applications in classrooms, or the long-term pedagogical consequences of AI use. Therefore, while it provides a valuable overview of trends and patterns, the findings should be complemented with qualitative, experimental, or mixed-method studies to gain a deeper understanding of AI's influence on teaching and learning.

References

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K- 12 settings. *AI and Ethics*, *2*(3), 431–440. https://doi.org/10.1007/s43681-021-00096-7

Akhmadieva, R. S., Udina, N. N., Kosheleva, Y. P., Zhdanov, S. P., Timofeeva, M. O., & Budkevich, R. L. (2023). Artificial intelligence in science education: A bibliometric review. *Contemporary Educational Technology*, *15*(4), ep460. https://doi.org/10.30935/cedtech/13587

Al, U., & Tonta, Y. (2004). Atıf analizi: Hacettepe Üniversitesi Kütüphanecilik Bölümü tezlerinde atıf yapılan kaynaklar. *Bilgi Dünyası*, *5*(1), 19–47. https://yunus.hacettepe.edu.tr/~tonta/yayinlar/tonta- al-bilgi-dunyasi.pdf

Al-Zahrani, A. M., & Alasmari, T. M. (2024). Exploring the impact of artificial intelligence on higher education: The dynamics of ethical, social, and educational implications. *Humanities and Social Sciences Communications*, *11*, 912. https://doi.org/10.1057/s41599-024-03432-4

Andrés, A. (2009). *Measuring academic research: How to undertake a bibliometric study*. Chandos Publishing..

Appana, S. M., Pasupuleti, R. S., Tulimelli, J., Dokku, Y., Chen, W.-K., & Nalluri, V. (2025). Future agenda on higher education policy using artificial intelligence tools: A review and bibliometric analysis. *Engineering Proceedings*, *98*(1), 12. https://doi.org/10.3390/engproc2025098012

Archambault, É., Campbell, D., Gingras, Y., & Larivière, V. (2009). Comparing bibliometric statistics obtained from the Web of Science and Scopus. *Journal of the American Society for Information Science and Technology*, *60*(7), 1320–1326. https://doi.org/10.1002/asi.21062

Batubara, H. S., Jalinus, N., Rizal, F., & Watrianthos, R. (2024). Mapping the frontier: A bibliometric analysis of AI in tertiary education. *International Journal of Learning, Teaching and Educational Research*, *23*(10), 62–81. https://doi.org/10.26803/ijlter.23.10.4

Bayaga, A. (2025). Leveraging AI-enhanced and emerging technologies for pedagogical innovations in higher education. *Education and Information Technologies*, *30*(1), 1045–1072. https://doi.org/10.1007/s10639-024-13122-y

Bergmann, K., & Müller, R. (2023). The role of artificial intelligence in European higher education policy: Ethical and strategic considerations. *European Journal of Education*, *58*(1), 102–115. https://doi.org/10.1111/ejed.12537

Bornmann, L., & Daniel, H. D. (2005). Does the h-index for ranking of scientists really work? *Scientometrics*, *65*(3), 391–392. https://doi.org/10.1007/s11192-005-0281-4

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2024). 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

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching and Learning Practice*, *20*(3), 1–19. https://search.informit.org/doi/10.3316/informit.T2024112000002891427961342

Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, *20*(1), 22. https://doi.org/10.1186/s41239-023-00392-8

Delen, I. (2024). Understanding the growth of artificial intelligence in educational research through bibliometric analysis. *Sustainability*, *16*(16), 6724. https://doi.org/10.3390/su16166724

Dogan, M. E., Goru Dogan, T., & Bozkurt, A. (2023). The use of artificial intelligence (AI) in online learning and distance education processes: A systematic review of empirical studies. *Applied Sciences*, *13*(5), 3056. https://doi.org/10.3390/app13053056

Dotan, R., Parker, M., & Radzilowicz, M. (2024). Responsible adoption of generative AI in higher education: Developing a “points to consider” approach based on faculty perspectives. *arXiv*. https://arxiv.org/abs/2406.01930

Elsevier. (2024). *Content policy and selection*. Retrieved August 12, 2025, from https://www.elsevier.com/solutions/scopus/how-scopus-works/content

Evangelista, E. D. L. (2025). Ensuring academic integrity in the age of ChatGPT: Rethinking exam design, assessment strategies, and ethical AI policies in higher education. *Contemporary Educational Technology*, *17*(1), ep559. https://doi.org/10.30935/cedtech/15775

European Commission. (2021). *Horizon Europe: Strategic plan 2021–2024*. Publications Office of the European Union. Retrieved September 29, 2025, from https://data.europa.eu/doi/10.2777/083753

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal*, *22*(2), 338–342. https://doi.org/10.1096/fj.07-9492LSF

Floridi, L., & Taddeo, M. (2016). What is data ethics?. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *374*(2083), 20160360. https://doi.org/10.1098/rsta.2016.0360

Hajkowicz, S., & Sanderson, C. (2023). Artificial intelligence adoption in the physical sciences, natural sciences, life sciences, social sciences and the arts and humanities: A bibliometric analysis of research publications from 1960–2021. *Technology in Society*, *74*. https://doi.org/10.1016/j.techsoc.2023.102260

Halevi, G., Moed, H., & Bar-Ilan, J. (2017). Suitability of Google Scholar as a source of scientific information and as a source of data for scientific evaluation–Review of the literature. *Journal of Informetrics*, *11*(3), 823–834. https://doi.org/10.1016/j.joi.2017.06.005

Hallinger, P., & Kovačević, J. (2019). A bibliometric review of research on educational administration: Science mapping the literature, 1960 to 2018. *Review of Educational Research*, *89*(3), 335–369. https://doi.org/10.3102/0034654319830380

Hernández-Torrano, D., & Ibrayeva, L. (2020). Creativity and education: A bibliometric mapping of the research literature (1975–2019). *Thinking Skills and Creativity*, 35, 100625. https://doi.org/10.1016/j.tsc.2019.100625

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature. *Education Sciences*, *9*(1), 51. https://doi.org/10.3390/educsci9010051

Humble, N. (2025). Higher education AI policies–A document analysis of university guidelines. *European Journal of Education*, *60*(3), 1–13. https://doi.org/10.1111/ejed.70214

Ivanova, M., Grosseck, G., & Holotescu, C. (2024). Unveiling insights: A bibliometric analysis of artificial intelligence in teaching. *Informatics*, *11*(1), 10. https://doi.org/10.3390/informatics11010010

Jin, Y., Yan, L., Echeverria, V., Gašević, D., & Martinez-Maldonado, R. (2025). Generative AI in higher education: A global perspective of institutional adoption policies and guidelines. Computers and Education: Artificial Intelligence, 8, 100348. https://doi.org/10.1016/j.caeai.2024.100348

Jones, M. L., & Sefton-Green, J. (2021). AI and higher education: A new research agenda for teaching and learning. *AI & Society*, *36*(3), 875–890. https://doi.org/10.1007/s00146-021-01206-3

Kavitha, K., Joshith, V. P., Rajeev, N. P., & Asha, S. (2024). Artificial intelligence in higher education: A bibliometric approach. *European Journal of Educational Research*, *13*(3), 1121–1137. https://doi.org/10.12973/eu-jer.13.3.1121

Kosmyna, N., Hauptmann, E., Yuan, Y. T., Situ, J., Liao, X. H., Beresnitzky, A. V., ... & Maes, P. (2025). Your brain on ChatGPT: Accumulation of cognitive debt when using an AI assistant for essay writing task. *arXiv preprint arXiv:2506.08872*, 4. https://doi.org/10.48550/arXiv.2506.08872

Lin, Y., & Yu, Z. (2024). A bibliometric analysis of artificial intelligence chatbots in educational contexts. *Interactive Technology and Smart Education*, *21*(2), 189–213. https://doi.org/10.1108/ITSE-12-2022-0165

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Liu, M., Ren, Y., Nyagoga, L. M., Stonier, F., Wu, Z., & Yu, L. (2023). Future of education in the era of generative artificial intelligence: Consensus among Chinese scholars on applications of ChatGPT in schools. *Future in Educational Research*, *1*(1), 72–101. https://doi.org/10.1002/fer3.10

Lopez-Chila, R., Llerena-Izquierdo, J., Sumba-Nacipucha, N., & Cueva-Estrada, J. (2024). Artificial intelligence in higher education: an analysis of existing bibliometrics. *Education Sciences*, *14*(1), 47. https://doi.org/10.3390/educsci14010047

Manciaracina, A. (2022). How to design learning using technology and users' needs?. In *Designing hybrid learning environments and processes: Interactive Communication Tools for Active Learning* (pp. 93–128). Springer International Publishing. https://doi.org/10.1007/978-3-030-95274-7_5

Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *AI and education: Guidance for policy-makers*. United Nations Educational, Scientific and Cultural Organization (UNESCO). Retrieved September 28, 2025, from https://unesdoc.unesco.org/ark:/48223/pf0000376709

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group, T. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, *151*(4), 264-269. https://doi.org/10.1016/j.ijsu.2010.02.007

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, *106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

National Science Foundation. (2023, July 29). *NSF announces $100 million investment in National Artificial Intelligence Research Institutes*. Retrieved September 29, 2025, from https://www.nsf.gov/news/nsf-announces-100-million-investment-national-artificial?utm

Nayak, R., & Singh, A. (2022). Artificial intelligence in Indian higher education: Policy implications and challenges. *International Journal of Educational Development*, 92, 102609. https://doi.org/10.1016/j.ijedudev.2022.102609

Okubo, F., Yamashita, T., Shimada, A., & Ogata, H. (2017). A neural network approach for students' performance prediction. Paper presented in *International Conference on Learning Analytics and Knowledge*. https://doi.org/10.1145/3027385.3029479

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1), 22. https://doi.org/10.1186/s41039-017-0062-8

Porayska-Pomsta, K., Holmes, W., & Nemorin, S. (2023). The ethics of AI in education. In *Handbook of artificial intelligence in education* (pp. 571–604). Edward Elgar Publishing. https://doi.org/10.4337/9781800375413.00038

Prieto-Gutiérrez, J. J., Segado-Boj, F., & Da Silva França, F., 2023. Artificial intelligence in social science: A study based on bibliometrics analysis. *Human Technology*, *19*(2), 149–162. https://doi.org/10.14254/1795-6889.2023.19-2.1.

Pritchard, A. (1969). Statistical bibliography or bibliometrics? *Journal of Documentation*, *25*(4), 348–349. https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1190144

Qian, L., Cao, W. & Chen, L. (2025). Influence of artificial intelligence on higher education reform and talent cultivation in the digital intelligence era. Scientific Reports, 15(1), 1–14. https://doi.org/10.1038/s41598-025-89392-4

Republic of Türkiye. (2021*). National Artificial Intelligence Strategy 2021–2025. Ministry of Industry and Technology & Digital Transformation Office of the Presidency of the Republic of Türkiye*. Retrieved September 29, 2025, from https://wp.oecd.ai/app/uploads/2021/12/Turkey_National_Artificial_Intelligence_Strategy_2021- 2025.pdf

Roemer, R. C., & Borchardt, R. (2015). *Meaningful metrics: A 21st century librarian's guide to bibliometrics, altmetrics, and research impact*. Amer Library Assn. https://aura.american.edu/ndownloader/files/41885916

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?. *Journal of Applied Learning and Teaching*, *6*(1). https://doi.org/10.37074/jalt.2023.6.1.9

Ruzmetova, M. (2018). Applying Gilly Salmon's five stage model for designing blended courses. *Dil ve Edebiyat Araştırmaları*, *17*(17), 271-290. https://doi.org/10.30767/diledeara.418085

Sahar, R., & Munawaroh, M. (2025). Artificial intelligence in higher education with bibliometric and content analysis for future research agenda. *Discover Sustainability*, *6*(1), 401. https://doi.org/10.1007/s43621-025-01086-z

Saihi, A., Ben-Daya, M., Hariga, M., & As' ad, R. (2024). A Structural equation modeling analysis of generative AI chatbots adoption among students and educators in higher education. *Computers and Education: Artificial Intelligence*, 7, 100274. https://doi.org/10.1016/j.caeai.2024.100274

Salmon, G. (2011). *E-moderating: The key to teaching and learning online* (3rd ed.). Routledge.

Serpil, H., & Kesim, E. (2024). Understanding the application of AI in higher education systems: Global perspectives from a local AI ecosystem. *Open Praxis*, *16*(4), 645–662. https://doi.org/10.55982/openpraxis.16.4.725

Shidiq, M. (2023, May). The use of artificial intelligence-based chatgpt and its challenges for the world of education; from the viewpoint of the development of creative writing skills. *In Proceeding of international conference on education, society and humanity* (Vol. 1, No. 1, pp. 353–357).

Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE Review*, *46*(5), 30-32. Retrieved August 11, 2025, from https://er.educause.edu/articles/2011/9/penetrating-the-fog-analytics-in-learning-and-education

Slimi, Z., & Carballido, B. V. (2023). Systematic review: AI's impact on higher education-learning, teaching, and career opportunities. *TEM Journal*, *12*(3), 1627. https://doi.org/10.18421/TEM123-44

Tirado, A. M., Mulholland, P., & Fernandez, M. (2024). *Towards an operational responsible AI framework for learning analytics in higher education*. Retrieved August 11, 2025, from https://doi.org/10.48550/arXiv.2410.05827

Tlili, A., Huang, R., & Chang, T.-W. (2025). Artificial intelligence in higher education in China: Policy, case study, and challenges. *Revue internationale d'éducation de Sèvres*, HS-4. https://doi.org/10.4000/146vq

UNESCO (2023). *Artificial intelligence and higher education: A global perspective*. UNESCO Publishing. Retrieved February 14, 2025, from https://unesdoc.unesco.org/ark:/48223/pf0000386670

UNESCO (2025). *The role of higher education in national artificial intelligence strategies: A comparative policy review*. Retrieved February 16, 2025, from https://www.iesalc.unesco.org/en/articles/role-higher-education-national-artificial-intelligence-strategies-comparative-policy-review.

Valdiviezo Sir, V. M., Baique Timaná, D. B., et al. (2024). The rising influence of AI in higher education: Trends and insights from a bibliometric analysis. *Journal of Educational and Social Research. 14*(5), 52. https://doi.org/10.36941/jesr-2024-0121

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

Van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*, *111*(2), 1053–1070. https://doi.org/10.1007/s11192-017-2300-7

Vieriu, A. M. (2025). The impact of artificial intelligence on students' learning processes and academic performance: *A systematic review*. *Education Sciences*, *15*(3), 343. https://doi.org/10.3390/educsci15030343

Waltman, L., Van Eck, N. J., & Noyons, E. C. M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics*, *4*(4), 629–635. https://doi.org/10.1016/j.joi.2010.07.002

Wang, H., & Li, J. (2020). Artificial intelligence education in China: Challenges and opportunities. *Educational Research Review*, 29, 100343. https://doi.org/10.1016/j.edurev.2020.100343

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology*, *45*(3), 223–235. https://doi.org/10.1080/17439884.2020.1798995

Xie, Q., Li, M., & Enkhtur, A. (2024). Exploring generative AI policies in higher education: A comparative perspective from China, Japan, Mongolia, and the USA. *arXiv preprint arXiv:2407.08986*. https://arxiv.org/abs/2407.08986

Yan, L., Martinez-Maldonado, R., & Gasevic, D. (2024, March). *Generative artificial intelligence in learning analytics: Contextualising opportunities and challenges through the learning analytics cycle*. In Proceedings of the 14th learning analytics and knowledge conference (pp. 101–111). https://doi.org/10.1145/3636555.3636856

Yan, Y., & Liu, H. (2024). Ethical framework for AI education based on large language models. *Education and Information Technologies*, *30*(8),10891–10909 (2025). https://doi.org/10.1007/s10639-024-13241-6

Yılmaz, K. (2021). Sosyal bilimlerde ve eğitim bilimlerinde sistematik derleme, meta değerlendirme ve bibliyometrik analizler. *Manas Sosyal Araştırmalar Dergisi*, *10*(2), 1457-1490. https://doi.org/10.33206/mjss.791537

Yılmaz, M. (2019). Bibliyometriye eleştirel bir bakış. *Türk Kütüphaneciliği*, *33*(1), 43-49. https://doi.org/10.24146/tkd.2019.47

Zawacki-Richter, O., Marín, 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

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629

Appendix: Table

Table 1
Most Cited Journal, Author and Article View

Serial number	Article name and year	Author name	Journal	Citation
1	Chatting and cheating: Ensuring academic integrity in the era of ChatGPT, 2024	Cotton, Debby R. E., Cotton, Peter A. Shipway, J. Reuben	Innovations in Education and Teaching International	685
2	Artificial intelligence in higher education: the state of the field, 2023	Crompton, H., Burke, D.	International Journal of Educational Technology in Higher Education	312
3	Adoption of artificial intelligence in higher education: a quantitative analysis using structural equation modelling, 2020	Chatterjee, S. & Bhattacharjee, K. K	Education and Information Technologies	271
4	Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature, 2019	Hinojo-Lucena, F.-J., Aznar-Díaz, I.i, Cáceres-Reche, M.-P., Romero-Rodríguez, J.-M.	Education Sciences	186
5	What ChatGPT means for universities: Perceptions of scholars and students, 2023	Firat, M.	Journal of Applied Learning and Teaching	170
6	Artificial intelligence and reflections from educational landscape: A review of AI studies in half a century, 2021	Bozkurt, A., Karadeniz, A., Baneres, D., Guerrero-Roldán, A.E., Rodríguez, M.E.	Sustainability (Switzerland)	130
7	Roles and research trends of artificial intelligence in higher education: A systematic review of the top 50 most-cited articles, 2022	Chu, H.-C., Hwang, G.-H., Tu, Y.-F., Yang, K.-H.	Australasian Journal of Educational Technology	76
8	A decolonial approach to AI in higher education teaching and learning: strategies for undoing the ethics of digital neocolonialism,2023	Zembylas, M., Yang, K.-H.	Learning, Media and Technology	51
9	The Impact of AI on Teaching and Learning in Higher Education Technology, 2022	Singh, S.V., Hiran, K.K.	Journal of Higher Education Theory and Practice	49
10	Implementing Artificial Intelligence in Higher Education: Pros and Cons from the Perspectives of Academics, 2023	Pisica, A.I, Edu, T., Zaharia, R.M., Zaharia, R.	Societies	47
11	University teachers' perceptions of responsibility and artificial intelligence in higher education-An experimental philosophical study	McGrath, C., Cerratto Pargman, T., Juth, N., Palmgren, P.J.	Computers and Education: Artificial Intelligence	45
12	Modern Artificial Intelligence Model Development for Undergraduate Student Performance Prediction: An Investigation on Engineering Mathematics Courses, 2020	Deo, R.C., Yaseen, Z.M., Al-Ansari, N., Langlands, T.A.M., Galligan, L.	IEEE Access	40
13	Challenges for higher education in the era of widespread access to Generative AI, 2023	Walczak, K., Cellary, W.	Economics and Business Review	38
14	Assessing student-perceived impact of using artificial intelligence tools: Construction of a synthetic index of application in higher education, 2023	Grájeda, A., Burgos, J., Córdova, P., Sanjinés, A.	Cogent Education	37
15	The optimistic future of Artificial Intelligence in higher education, 2023	Escotet, M.Á.	Prospects	36