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The Dual Edge of Generative AI in E-Learning: Supporting Decision-Making Under Uncertainty While Confronting Ethical Challenges in Higher Education

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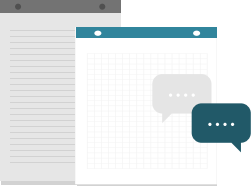
Abstract: This study examines how recent research explores the impact of generative artificial intelligence on higher education, focusing on its role in decision-making under uncertainty and ethical challenges. A bibliometric analysis was conducted on 641 publications indexed in Scopus (2023-2024) to classify research trends, identify prolific authors, leading institutions, and the most relevant academic sources. The findings indicate a sharp rise in research activity during 2024, with most studies (75%) addressing artificial intelligence-based decision-making in e-learning. Geographically, China leads scientific production, followed by the United States and India. The analysis reveals that most studies highlight the potential of generative artificial intelligence to optimize administrative processes and enhance personalized learning, while also identifying critical concerns, including ethical risks, data privacy issues, and disparities in access to artificial intelligence-driven tools. Additionally, a substantial portion of research on ethical challenges emphasises the necessity of institutional policies to mitigate risks related to academic integrity and algorithmic biases. Despite the rapid expansion of research in this area, significant gaps remain, particularly in regulatory frameworks and teacher training programs for generative artificial intelligence adoption. This study underscores the necessity of well-defined ethical guidelines, tailored professional development for educators, and equitable infrastructure investment. By systematically mapping trends and research gaps, this study provides a foundation for ethical governance and AI-enhanced educational decision-making. Future research should refine regulatory frameworks, promote equitable AI adoption, and assess generative artificial intelligence's long-term cognitive and social impacts in learning environments.

Keywords: AI governance frameworks, bibliometric analysis, collaborative learning technologies, educational decision-making tools, ethical dimensions of generative AI, personalised e-learning innovations.

Introduction

Generative Artificial Intelligence (GenAI) is reshaping higher education, offering unprecedented opportunities while raising complex ethical dilemmas. Its rapid evolution, accelerated by the launch of OpenAI's ChatGPT in November 2022 and the emergence of advanced language models from various technology firms, has significantly transformed education and other domains.

This technological shift has introduced a dual reality in academic routines. On the one hand, these technologies are readily available, offering immense potential to streamline administrative tasks, personalize learning experiences, and enhance engagement in digital education (Alqahtani & Wafula, 2025). On the other hand, their rapid and widespread adoption has sparked intense debates on academic integrity, data privacy, and the ethical implications of AI-driven decision-making in higher education.



Thus, the ongoing scholarly discourse on GenAI's impact reflects this dual nature. For instance, Gruenhagen et al. (2024) examine how students increasingly turn to GenAI tools to assist with coursework, prompting institutions to reconsider traditional evaluation methods. Sevnarayan and Potter (2024) emphasise that while GenAI fosters student-centred learning in online education, it raises concerns about authenticity and knowledge retention. Similarly, Murdan and Halkhoree (2024) discuss the tension between AI-driven efficiency and the deepening digital divide. Ethical concerns have also gained traction in academic discourse, with researchers such as Gallent-Torres et al. (2023) and Nartey (2024) calling for urgent regulatory frameworks to ensure responsible AI implementation.

Despite the growing body of literature on GenAI in education, significant gaps remain in understanding its dual impact, both as a decision-making aid under conditions of uncertainty and as a source of ethical and regulatory challenges. After more than two years of integrating GenAI into educational practices, research has primarily examined these aspects in isolation, rather than as interconnected factors shaping its adoption in higher education. To address this gap, the present study conducts a bibliometric review of Scopus-indexed research, a method well-suited for identifying trends, tracing the evolution of academic discourse, and highlighting underexplored areas. By systematically mapping these developments, this study informs ongoing debates on GenAI governance in education. It provides a foundation for future interdisciplinary research on ethical frameworks and decision-making in AI-enhanced learning environments.

Research Problem

The rapid adoption of GenAI in higher education presents a dual challenge: while it enhances decision-making in e-learning and streamlines academic processes, it also raises ethical concerns related to data privacy, misinformation, and academic integrity. As outlined in the Introduction, the launch of advanced language models prompted diverse institutional responses, ranging from outright bans to structured integration, reflecting the uncertainty surrounding their long-term implications.

Despite increasing research efforts, studies often examine GenAI's benefits and risks in isolation, failing to address their interconnected impact on institutional policies and pedagogical frameworks. UNESCO's *Guidance for Generative AI in Education and Research* (Holmes & Miao, 2023) underscores the need for ethical governance, yet concrete strategies for responsible AI adoption remain underdeveloped.

Research Focus

Multiple studies, such as those by Al Husaeni et al. (2024), Nee et al. (2023), and Okonkwo & Ade-Ibijola (2021), suggest that between 2016 and 2023, there has been a significant increase in research on the use of chatbots in education, particularly in higher education. This growth is closely linked to advancements in GenAI, as modern chatbots rely on language models to



generate human-like responses, making them a key example of AI-driven tools in education. These studies highlight that chatbots can enhance learning and provide multiple benefits, as "chatbots can improve skills and motivate students by supporting learning and teaching activities" (Nee et al., 2023, p. 517). However, significant challenges associated with their implementation have also been identified, as "chatbot technology in education faces some significant challenges, including ethical, insufficient evaluation, user attitude, programming, and data integration issues" (Okonkwo & Ade-Ibijola, 2021, p. 7). Additionally, it has been noted that "interactions with chatbots can lose important human aspects, such as empathy and appreciation of the social context" (Al Husaeni et al., 2024, p. 11).

While many studies focus on specific GenAI applications in education, a notable deficit in research connects AI-driven decision-making with the ethical dilemmas it raises. This study seeks to bridge that gap by analysing GenAI's dual role in higher education—both as a tool for optimizing learning and decision-making under uncertainty and as a source of ethical and regulatory challenges.

Research Aim and Research Questions

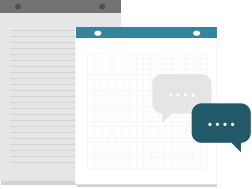
The primary question guiding this study is: What patterns and trends can be identified in recent bibliometric data on using GenAI in higher education, based on publications indexed in Scopus?

This study aims to analyse how the research community approaches the dual impact of GenAI in e-learning within higher education, focusing on bibliometric trends and key topics such as decision-making under uncertainty, ethical challenges, and emerging technologies. This research seeks to uncover the structure, dynamics, and gaps in the literature on using GenAI through bibliometric analysis.

Literature Review

The emergence of GenAI is transforming how students and educators interact with technology (Batista et al., 2024). From advanced chatbots like *ChatGPT* to predictive analytics systems, these tools are no longer experimental; they are now integral to e-learning, enabling personalised learning, automating tasks, and expanding access to information (Bhullar et al., 2024; Liu et al., 2024; Zhou et al., 2024). More significantly, they influence decision-making processes in education, helping institutions refine teaching strategies and optimize administrative functions.

The theoretical foundation for these advancements can be traced to Herbert A. Simon's (1955) concept of "bounded rationality", which suggests that individuals make decisions with limited cognitive resources, often relying on heuristics. This principle is particularly relevant in e-learning, where GenAI must process incomplete or uncertain data to create personalised learning pathways (Kazanidis & Pellas, 2024). Similarly, has influenced AI-driven decision-making models,



demonstrating how simple but effective rules can enhance learning without compromising accuracy (Adjekum et al., 2024; Lin et al., 2024). While these theories provide a valuable framework for understanding GenAI's role in decision-making, there is still limited discussion on how AI-driven heuristics shape students' cognitive development, specifically, whether they foster deeper critical thinking or promote overly simplified learning approaches. The literature lacks a comprehensive framework to assess the trade-offs between AI-driven efficiency and the depth of knowledge acquisition, an issue this study aims to highlight.

Beyond automation, GenAI is increasingly acting as a decision-making partner, allowing educators and institutions to develop adaptive learning environments. However, its integration into education has been inconsistent, with institutions adopting varying strategies. Some universities have incorporated GenAI as a fundamental component of digital learning, while others remain cautious due to concerns over algorithmic transparency, data security, and ethical risks (Bikanga Ada, 2024; Spennemann et al., 2024).

These critical aspects are often overshadowed by the rapid adoption of GenAI technologies, leaving underrepresentation in research related to their regulation and ethical use (Alqahtani & Wafula, 2025). In this context, we examine how GenAI shapes educational practices across four key dimensions, detailed in the following subsections.

Generative Artificial Intelligence Transforming Education

GenAI technologies have enabled significant advancements in learning personalisation and student interaction with educational content. These tools generate texts, summaries, and automated assessments and facilitate the design of personalised learning pathways based on individual student needs (Liu et al., 2024; Peláez-Sánchez et al., 2024). For instance, tools like *GepetoAI* have demonstrated their ability to analyse educational data and provide tailored recommendations, enhancing student performance and satisfaction in online courses (Becerra et al., 2024).

Furthermore, studies such as those by Hamerman et al. (2025) highlight that positive perceptions of these technologies are linked to their ability to enhance collaborative learning and improve access to resources. Despite these advantages, existing literature primarily focuses on technological capabilities rather than evaluating their long-term impact on student engagement and independent learning skills. While GenAI offers students immediate access to structured information, whether such reliance enhances deep learning or fosters superficial knowledge retention is unclear. Does AI-driven personalisation adapt to students' cognitive needs, or does it oversimplify learning by minimising the effort required to engage with complex concepts?

Concerns persist regarding over-reliance on these technologies and the potential weakening of critical skills, such as analytical thinking and creativity (Shahzad et al., 2024). The literature underscores the importance of developing digital competencies to ensure a



responsible and effective use of GenAI in educational settings (Asamoah et al., 2024; Chee et al., 2024). No clear framework exists to distinguish between meaningful AI-assisted learning and mere automation.

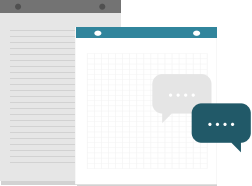
Decision-Making Tools in E-Learning

Integrating GenAI tools in decision-making processes within e-learning has facilitated the optimisation of complex tasks such as assessment, student progress tracking, and forecasting future needs (Ghosh et al., 2024). For instance, systems like *Q-Module-Bot*, specifically designed to answer student queries, have proven effective in personalising the educational experience and reducing teachers' administrative workload (Allen et al., 2024).

From a theoretical perspective, Simon's (1983) research on organisational structuring and decision-making gains renewed relevance with the design of these tools, which aim to provide data-driven recommendations based on large-scale data analysis (Suryanarayana et al., 2024). This approach has been widely supported by recent studies emphasising the value of predictive models and machine-learning-based recommendations in improving academic outcomes (Khlaif et al., 2024; Romero-Rodríguez et al., 2023; Strzelecki et al., 2024). Despite these advantages, little is known about how these tools balance efficiency with human teaching intuition. These tools optimise workflows but rely on historical data, which may reinforce biases instead of encouraging new teaching methods. It is also unclear how much educators trust and follow AI-driven recommendations. Do these tools support decision-making, or do they risk limiting human agency in education? We can only observe gaps in the literature regarding how these technologies can be effectively and ethically integrated into educational environments (Qadhi et al., 2024). Without established guidelines, institutions risk inconsistent AI adoption, leading to unequal learning experiences and unresolved ethical concerns (Camacho-Zuñiga et al., 2024; Nartey, 2024).

Ethical Challenges in Higher Education

The controversy surrounding the responsible use of GenAI in education has become an urgent and widely debated topic. While institutions have begun implementing policies to address AI-assisted plagiarism, data privacy risks, and algorithmic biases (Arowosegbe et al., 2024; Kumar et al., 2024; Roe et al., 2024), these measures remain inconsistent across universities. So far, the ethical debate has primarily centered on academic misconduct, often overlooking broader concerns, such as the long-term impact of AI on students' cognitive autonomy and critical thinking skills (Chan, 2024; Rasu et al., 2023). The absence of unified ethical frameworks means that universities often react to AI-related issues rather than proactively shaping responsible AI policies. Clear regulatory standards are essential to prevent fragmented AI adoption, which could otherwise deepen inequalities in educational access and compromise fairness in student assessment (Bhullar et al., 2024; Chaka, 2023; Holdcroft, 2024).



Emerging Technologies in Digital Learning

The advancement of cutting-edge technologies has profoundly transformed the landscape of e-learning. Digital twin systems and intelligent chatbots are revolutionising teaching models, enabling more immersive and personalised learning experiences (Ilieva et al., 2023; Soto et al., 2024). These technologies not only foster adaptability and learning efficiency but also redefine the role of educators as facilitators of collaborative and dynamic learning environments (Wang et al., 2024). However, their adoption remains uneven, with institutions facing problems such as faculty resistance, inadequate training, and accessibility barriers (Adjekum et al., 2024). To fully harness their potential, future research must move beyond implementation and examine the pedagogical implications of integrating these technologies into diverse learning contexts, ensuring that they enhance academic performance and independent thinking (Katsamakas et al., 2024).

Materials and Methods

This study employs Scopus as the primary database for gathering detailed bibliographic data. The analysis covers 2023 and 2024, as the launch of *ChatGPT* in November 2022 marked a turning point in using GenAI tools in education. This event also accelerated the development of new language models as a competitive response, reflecting a profound transformation in e-learning dynamics.

To conduct the bibliometric analysis, carefully selected key terms were used to capture relevant and specific research within the field of GenAI in e-learning. These terms, detailed in Table 1, were chosen to ensure both precision and broad coverage in search queries, enabling the identification of relevant studies. The initial keyword set was derived from a preliminary literature review, incorporating core terms related to GenAI, decision-making, and ethical challenges in higher education. These terms were refined through validation and iterative testing within Scopus to assess relevance, recall, and precision. To further enhance search accuracy, the selected keywords included compound terms such as "AI-powered" and "AI-driven", which are widely used in scientific literature, strengthening the precision of retrieved results. Additionally, the selection emphasised the connection between GenAI and its ethical, pedagogical, and academic implications in higher education, ensuring a comprehensive and up-to-date dataset for analysis. As shown in Table 1, Boolean operators (AND, OR) were also applied to construct search queries, ensuring that retrieved publications were contextually relevant. The final search queries included multi-level combinations of key terms, ensuring that the bibliometric analysis captured the full spectrum of research related to AI in decision-making and ethics, while filtering out irrelevant GenAI publications outside the educational context.



Table 1

Classification of Keywords for Bibliometric Analysis

Category	Key terms
Generative Artificial Intelligence	"Generative AI in Higher Education and Ethical Implications" OR "Generative AI and Academic Integrity"
Decision-Making Tools in E-Learning	"AI-Driven Tools" OR "AI-Powered Tools" OR "Artificial Intelligence" AND "Decision-Making" OR "E-Learning" AND "Higher Education" OR "University" OR "Tertiary Education"
Ethical Challenges in Higher Education	"Ethical Challenges" AND "AI Learning" OR "Plagiarism" AND "Generative AI" AND "Higher Education" OR "University"
Emerging Technologies in Digital Learning	"Generative AI" AND "Student Learning" OR "E-Learning" AND "Higher Education"

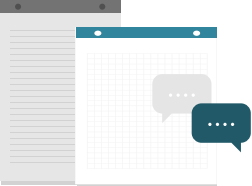
Source: Author's development.

The bibliometric analysis was structured into several carefully planned stages to ensure a rigorous and systematic approach. These stages included identifying relevant publications, classifying documents by type, and analyzing research productivity, which allowed for identifying the most influential authors in the field. Additionally, an examination of high-impact academic journals was conducted, alongside a geographical analysis that highlighted the leading countries and educational institutions contributing to the scientific literature. Table 2 presents a detailed summary of these key stages, providing a comprehensive overview of the methodological framework applied in this bibliometric study. This methodological approach, which integrates both quantitative and content analysis, facilitates a holistic understanding of the dual role of GenAI in e-learning.

Table 2

Stages of the Bibliometric Analysis

Stage of Analysis	Description
Identification of Publications	The search was conducted in Scopus using refined keywords within the "Article Title, Abstract, and Keywords" fields (inclusion/exclusion criteria were incorporated).
Geographical Analysis	Examination of countries contributing to scientific production in the field.
Leading Institution	Identification of the institutions with the highest productivity in terms of research publications.



Author Productivity Analysis	Determination of the most prolific authors in the field of study.
Journals and Conference Proceedings	Determination of journals or conferences with the highest number of relevant publications.
Document Classification	Categorizing documents by type, including research articles, reviews, and conference papers, for systematic analysis.

Source: Author's development.

Sample and Participants

The study sample comprised documents from the Scopus database, selected according to predefined inclusion criteria. The analysis was restricted to publications from 2023 to 2024, ensuring the relevance of the collected materials. Six hundred forty-one documents aligned with the study's focus on GenAI in higher education were identified and analysed.

Instruments and Procedures

Scopus was selected as the primary database for this bibliometric study due to its high academic standards and indexing of peer-reviewed literature. In the bibliometric analysis, filters were applied to refine the search results, including publication years, document type (articles, reviews, conference papers), subject areas (Social Sciences, Computer Science), and language (English and Spanish). A structured approach was used to develop and refine the search strategy, ensuring a balance between sensitivity (capturing all relevant studies) and specificity (eliminating irrelevant ones).

To ensure methodological rigour, a multi-level filtering process was applied. The aim was to obtain only relevant results containing high-quality academic contributions. The focus was solely on peer-reviewed articles, review studies, and conference papers published between 2023 and 2024 (the reason for selecting this timeframe is explained in the previous sections of this study). The filtering process was restricted to publications explicitly focused on GenAI in higher education. Studies dealing exclusively with the technical development of AI models without an educational or ethical context were excluded, as were studies on AI applications outside education, such as in business or finance. Opinion articles without empirical validation were also manually removed.

The filtering process was conducted systematically. Automated filtering was performed first, and search queries were repeated across different sessions to verify the consistency of results. Duplicates and irrelevant results that did not meet the predefined search parameters were removed. Two independent reviewers screened titles and abstracts to ensure alignment with the study's objectives. Differences in the screening process between the two reviewers were resolved through discussion and final adjudication by a third reviewer. A full-text review was also applied



to borderline cases to ensure methodological consistency. This multi-level approach ensured that the final bibliometric dataset included only methodologically sound and highly relevant publications.

Data Analysis

Once the documents were selected, a qualitative analysis focused on thematic patterns derived from keywords, titles, and abstracts. Additionally, a descriptive frequency analysis of the sample and its classification groups was carried out, indicating the total number of publications, distribution by year, document type, and geographical location and identifying the most productive authors and influential journals.

Results

The bibliometric analysis provided a comprehensive overview of scientific production related to the dual role of GenAI in e-learning, focusing on its support for decision-making under uncertainty and the ethical challenges in higher education. The most relevant findings are presented below, structured according to six key analytical categories: Publications, Geographical Distribution, Leading Institutions, Prolific Authors, Influential Journals and Conference Proceedings, and Document Classification.

1. Publications

The analysis identified 641 publications indexed in Scopus between 2023 and 2024. As shown in Table 3, the distribution of publications was organized according to keyword categories. The most predominant category was *Decision-Making Tools in E-Learning*, with 482 publications (75%), reflecting the high academic interest in AI-based decision support systems. The *Generative Artificial Intelligence* category accounted for 58 publications (9%), while *Ethical Challenges in Higher Education* and *Emerging Technologies in Digital Learning* recorded 54 (8%) and 47 (7%) publications, respectively.

The intense focus on *Decision-Making Tools in the E-Learning* category in GenAI research reflects their practical benefits in automating assessments, tracking student progress, and improving institutional efficiency. Their appeal lies in measurable outcomes, making them a priority for academia. While these tools reduce educators' workload and provide real-time insights into student performance, their dominance raises concerns. Do they enhance learning or prioritise efficiency at the expense of human judgment? Their reliance on historical data may also reinforce biases, making them less adaptable to diverse learning environments.

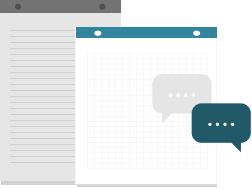


Table 3

Distribution of Research Publications Across Key Categories (2023–2024)

Keyword Category	Number of Publications
Generative Artificial Intelligence	58
Decision-Making Tools in E-Learning	482
Ethical Challenges in Higher Education	54
Emerging Technologies in Digital Learning	47

Note. The keyword Categories is derived from Table 1, where the specific keywords used for each category are detailed.

Source: Author’s development.

2. Geographical Distribution

Previous studies, such as Nee et al. (2023), highlight that the United States leads chatbot education research. However, the geographical analysis in this study identifies China as the top contributor to GenAI research in education. China accounts for 90 publications in the *Decision-Making Tools in E-Learning* category and 11 additional publications across other research categories.

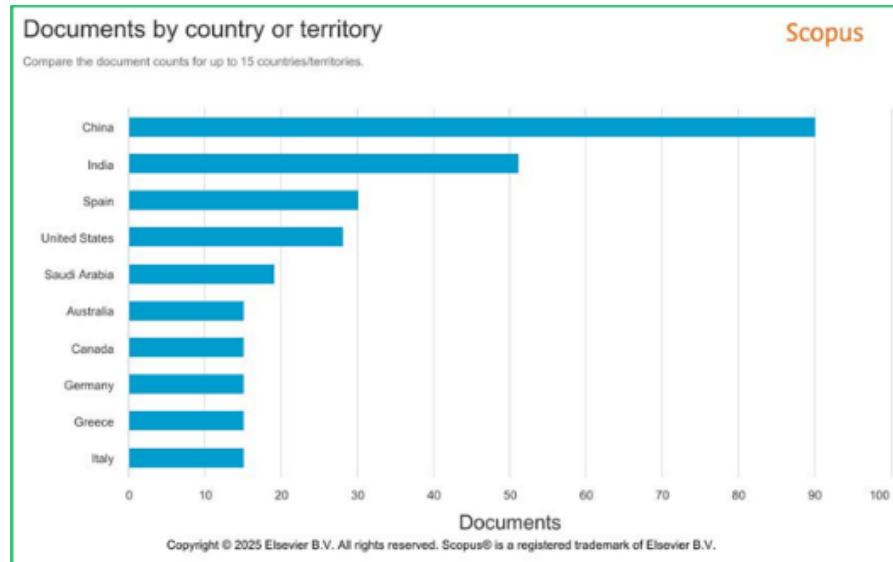
Following China, the United States (61 publications) and India (57 publications) are the next major contributors, reflecting their substantial investment in AI for education. European nations, however, are underrepresented in the dataset, with Spain (30), the UK (17), and other European countries contributing fewer studies. Europe lags, likely due to stricter AI regulations, slower adoption rates, and fragmented research efforts. This imbalance indicates that AI policy and funding strategies significantly influence research output and the speed of implementation in higher education.

While Mexico and Saudi Arabia also show notable research activity, the overall dominance of China, the US, and India suggests that policy support, technological infrastructure, and research funding play a crucial role in shaping GenAI research output.



Figure 1

Geographical Distribution of Publications in the Decision-Making Tools in the E-Learning Category



Source: Scopus (2025) <https://www.scopus.com/term/analyzer.uri>

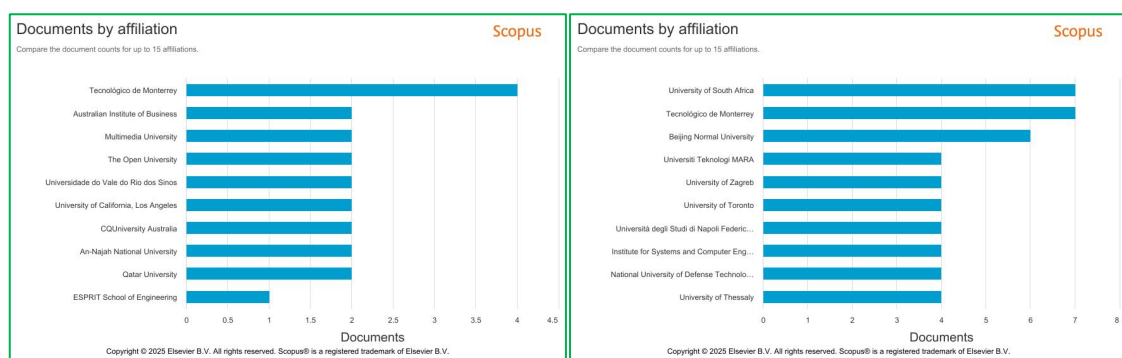
3. Leading Institutions

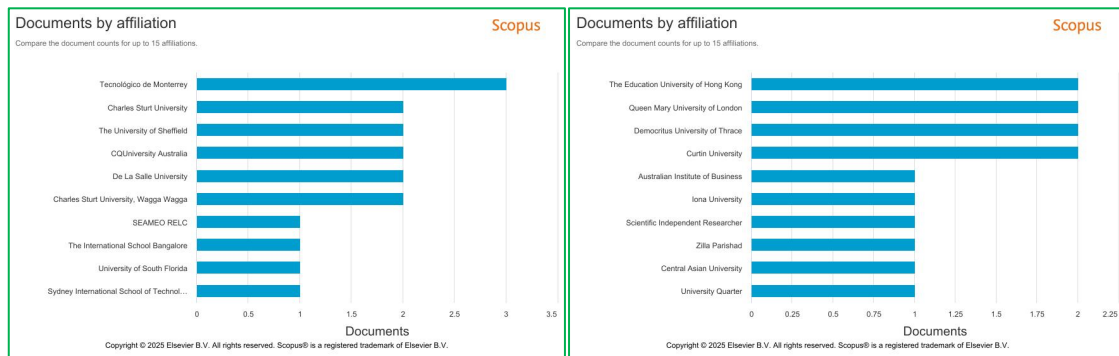
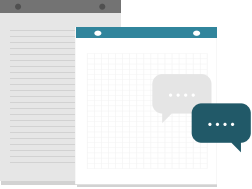
The study identifies *Tecnológico de Monterrey* and the *University of South Africa* as the most prolific institutions, with multiple publications on GenAI in education. Other prominent contributors include *Beijing Normal University*, *The Open University*, and *Charles Sturt University*, reflecting this research field's interdisciplinary and international nature.

Figure 2 visually compares publication volume by institutional affiliation, highlighting the institutions with the most significant impact on research into GenAI.

Figure 2

Institutional Contributions Across Four Key Research Categories





Source: Scopus (2025) <https://www.scopus.com/term/analyzer.uri>

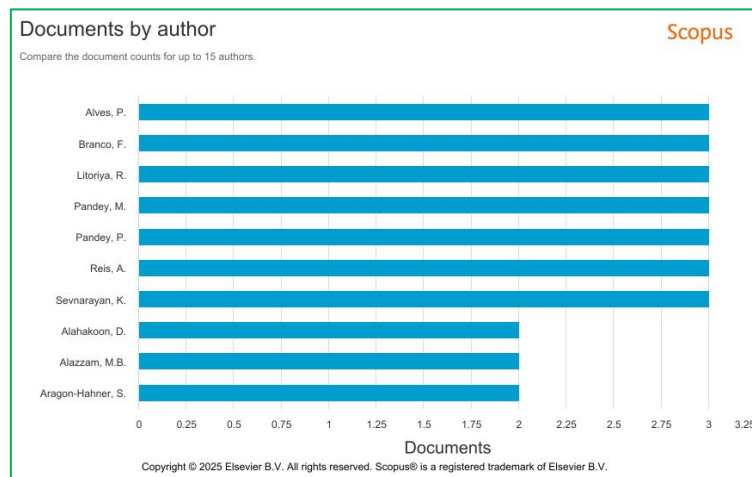
4. Most Prolific Authors

The bibliometric analysis reveals that authorship in GenAI research in education is highly distributed, with only a small number of authors contributing more than one or two publications. When consolidating data across the four analysed categories, it becomes evident that some researchers have published a maximum of three articles within the period. Unlike other fields where a few prolific scholars drive research agendas, GenAI in education appears to evolve through a scattered network of contributors. This fragmented authorship suggests that the field lacks a clear research leadership, which could slow the development of standardised methodologies and theoretical frameworks. Without concentrated contributions from leading experts, research on GenAI in education may continue to be exploratory rather than structured, with limited cross-institutional collaboration.

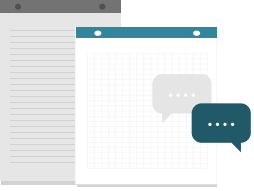
Figure 3 presents a sample from the *Decision-Making Tools in E-Learning* category, highlighting the authors who have published up to three articles during this period.

Figure 3

Most Prolific Authors on Decision-Making Tools in the E-Learning Category



Source: Scopus (2025) <https://www.scopus.com/term/analyzer.uri>



5. Influential Journals and Conference Proceedings

Research on GenAI in higher education is concentrated in diverse academic sources, with a strong presence in conferences and technical journals that serve as key dissemination forums. As shown in Table 4, the leading publication venues in this field are *Lecture Notes in Networks and Systems* (33 publications) and the *ACM International Conference Proceeding Series* (20 publications), underscoring their fundamental role in disseminating knowledge on GenAI in education.

CEUR Workshop Proceedings and *Lecture Notes in Computer Science* have been pivotal platforms, further solidifying their relevance in documenting advancements in GenAI applications within educational settings. The *IEEE Global Engineering Education Conference (Educon)* also stands out as a high-impact event in discussions on GenAI integration in learning environments, suggesting that these technologies are being widely debated at international conferences.

Regarding indexed journal dissemination, sources such as *Communications in Computer and Information Science* and *Applied Mathematics and Nonlinear Sciences* have played a crucial role in GenAI's theoretical and applied exploration in digital education and technological innovation research.

Table 4

Key Journals and Conference Proceedings Across Four Research Categories

Source	Number of Publications
Lecture Notes in Networks and Systems	33
ACM International Conference Proceeding Series	20
CEUR Workshop Proceedings	13
Lecture Notes in Computer Science Including Subseries	12
IEEE Global Engineering Education Conference (Educon)	11
Communications in Computer and Information Science	10
Applied Mathematics and Nonlinear Sciences	9



Computers and Education Artificial Intelligence	8
IEEE Access	8
International Conference on Computer-Supported Education (CSEDU) Proceedings	7
Sustainability (Switzerland) (Journal)	7
Applied Sciences (Switzerland)	6
Electronic Journal of e-Learning	5

Note. The table includes only the most influential publication sources in GenAI in higher education, with at least five publications from the analyzed period.

Source: Author's development based on Scopus (2025) <https://www.scopus.com/term/analyzer.uri>

6. Document Classification

The analysis reveals that research on GenAI in higher education is primarily disseminated through *journal articles* and *conference papers*, with a smaller proportion of *review papers* and *book chapters*. Significant variations exist in the distribution of these document types depending on the research category.

In the *Generative Artificial Intelligence* category, *journal articles* account for 84.5% of publications, establishing themselves as the primary dissemination channel. These are followed by *review papers* (8.6%) and *conference papers* (6.9%).

The trend for the Decision-Making Tools in the E-Learning category differs: *conference papers* constitute 51.7% of the total, surpassing *journal articles* (45.2%), while *review papers* account for only 3.1%.

In the *Ethical Challenges in Higher Education* category, *journal articles* dominate with 81.5%, followed by *conference papers* (14.8%), whereas *review papers* and *book chapters* each hold a marginal representation of 3.7%.

Finally, *journal articles* comprise 59.6% of the publications in the Emerging Technologies in Digital Learning category, with a substantial share of *conference papers* (38.3%), while *review papers* make up only 2.1%.

Figure 4 summarizes the distribution of document types across the four analysed categories, providing a clear overview of how scientific production on GenAI was disseminated during 2023–2024.

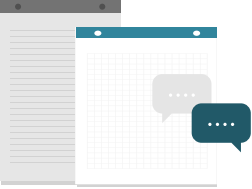
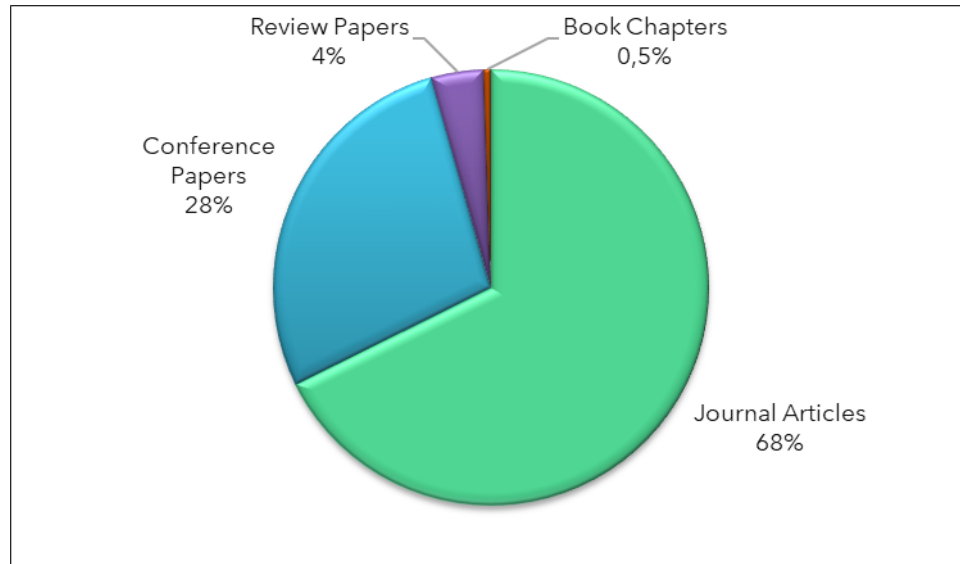


Figure 4

Distribution of Document Types Across Four Research Categories



Source: Author's development based on Scopus (2025) <https://www.scopus.com/term/analyzer.uri>

To highlight unexpected findings, the dominance of *conference papers* in the *Decision-Making Tools* category suggests that research in these areas is still in a developmental stage, where findings are often presented in conference settings before being formalized into journal articles. Additionally, the relatively low proportion of review papers across all categories (ranging from 2.1% to 8.6%) indicates a lack of consolidated meta-analyses and systematic reviews, suggesting that GenAI in education is still an evolving and fragmented research area. This finding highlights the need for more comprehensive literature syntheses to build a cohesive knowledge base and guide future research directions.

Discussion

The temporal analysis reveals a notable surge in GenAI research in e-learning, with publications increasing from 233 in 2023 to 408 in 2024. This sharp rise underscores its growing prominence as a key research area in higher education. A significant factor behind this expansion is the release of *ChatGPT* in November 2022, which has significantly influenced scholarly discourse across multiple disciplines. Keyword analysis supports this trend, with 168 articles explicitly referencing *ChatGPT*, reflecting its profound impact on education. However, while enthusiasm for GenAI is evident, its long-term educational implications remain underexplored, requiring further empirical investigation.

The geographical distribution of research highlights significant disparities in AI adoption across educational systems. While China and the United States dominate publication output, European contributions are comparatively lower, suggesting regional policy and funding



differences. The lack of leading scholars producing multiple high-impact studies suggests that GenAI research in education remains fragmented, with no unified theoretical or methodological direction.

The nature of academic dissemination further reinforces this developmental stage. Conference proceedings suggest that much of the research remains exploratory, with scholars actively debating best practices rather than establishing standardised frameworks. The fragmentation of GenAI research across multiple publication venues presents a challenge in consolidating knowledge. It also signals an opportunity to expand its presence in high-impact journals, fostering more structured discourse. Research dissemination patterns also vary across GenAI's thematic categories. *Decision-Making Tools in E-Learning* and *Emerging Technologies in Digital Learning* remain heavily conference-driven, reflecting their evolving nature and rapid technological shifts. Conversely, *Ethical Challenges in Higher Education* appear more established, with research concentrated in peer-reviewed journals rather than conference papers, suggesting greater conceptual stability in discussions of AI ethics compared to its practical applications.

This study set out to analyse the dual impact of GenAI in higher education, both as a decision-making aid under uncertainty and a source of ethical and regulatory challenges. The results confirm this duality, as most research (75%) prioritises *AI-driven decision-making*, highlighting its role in optimizing educational efficiency. However, significant challenges remain, particularly in ethics, accessibility, and regulatory inconsistencies, limiting GenAI's practical implementation in education. Risks associated with data privacy, algorithmic biases, and AI misuse in assessments remain unresolved (Roe et al., 2024; Arowosegbe et al., 2024). Additionally, accessibility barriers hinder equitable adoption, as Bhullar et al. (2024) highlighted, emphasising the urgent need for inclusive policy frameworks.

Among the four primary research categories, *Decision-Making Tools in E-Learning* stands out with 482 publications, reflecting strong global interest in leveraging GenAI for data-driven decision-making. These tools, informed by Simon's (1983) "bounded rationality" theory, enhance institutional decision-making and predictive analytics, optimizing academic performance tracking and administrative efficiency. Meanwhile, *Emerging AI-Driven Technologies*, such as digital twins and intelligent chatbots, are reshaping conventional teaching models by fostering immersive and interactive learning environments (Ilieva et al., 2023; Wang et al., 2024). However, the persistent challenges discussed throughout this article hinder widespread adoption.

Conclusions and Implications

The findings on GenAI's dual role in higher education confirm that while GenAI enhances personalised learning, institutional decision-making, and efficiency, its unresolved ethical concerns, accessibility barriers, and risks of over-reliance must be addressed to secure responsible adoption. This study contributes to the ongoing discourse on GenAI integration in education by providing empirical evidence on GenAI's impact. It underscores the urgent need



for a balanced approach that leverages GenAI's benefits while implementing ethical safeguards, robust governance models, and equitable access strategies. Without these elements, GenAI's potential could be overshadowed by systemic inequities and governance gaps.

Institutions should prioritise clear regulatory guidelines and comprehensive faculty training to ensure responsible GenAI adoption. Additionally, strategic investments in digital infrastructure are essential to bridge access disparities, ensuring that GenAI's benefits reach diverse student populations. Future research should continue examining the long-term implications of GenAI, focusing on optimizing its use and anticipating and mitigating its risks, paving the way for its ethical and inclusive integration in higher education.

Limitations of the study

While this study provides valuable insights, the bibliometric methodology presents inherent limitations. First, relying exclusively on Scopus-indexed publications may exclude relevant research from other databases, potentially narrowing the scope of analysis. Also, by focusing on publications from 2023 and 2024, this study captures recent trends but may overlook foundational research or ongoing developments that have yet to be published. Additionally, bibliometric studies focus on publication trends rather than evaluating the real-world effectiveness of AI-driven educational tools.

Suggestions for Future Research

There should be a focus on how GenAI influences learning, cognitive development, and educational equity over time. Understanding the effectiveness of ethical frameworks and teacher training programs will ensure responsible GenAI adoption. Developing inclusive, bias-free GenAI systems and studying regional differences in AI integration can help address existing disparities. Stronger collaboration between educators, ethicists, and AI specialists will be essential to shaping sustainable policies.

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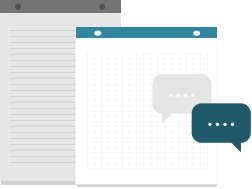
None.

Conflict of Interest

None.

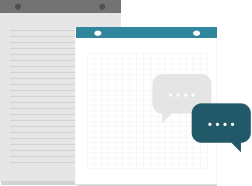
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References

- Adjekum, D., Waller, Z., & Keller, J. (2024). An evaluation of artificial intelligence chatbots' ethical use, attitudes towards technology, behavioral factors and student learning outcomes in collegiate aviation programs. *Collegiate Aviation Review International*, 42(2), 84-118. <https://doi.org/10.22488/okstate.24.100239>
- Al Husaeni, D. F., Haristiani, N., Wahyudin, W., & Rasim, R. (2024). Chatbot artificial intelligence as educational tools in science and engineering education: A literature review and bibliometric mapping analysis with its advantages and disadvantages. *ASEAN Journal of Science and Engineering*, 4(1), 93-118. <https://doi.org/10.17509/ajse.v4i1.67429>
- Allen, M., Naeem, U., & Gill, S. S. (2024). Q-module-bot: A generative AI-based question and answer bot for module teaching support. *IEEE Transactions on Education*, 67(5), 793-802. <https://doi.org/10.1109/TE.2024.3435427>
- Alqahtani, N., & Wafula, Z. (2025). Artificial intelligence integration: Pedagogical strategies and policies at leading universities. *Innovative Higher Education*, 50(2), 665-684. <https://doi.org/10.1007/s10755-024-09749-x>
- Arowosegbe, A., Alqahtani, J. S., & Oyelade, T. (2024). Perception of generative AI use in UK higher education. *Frontiers in Education*, 9, Article 1463208. <https://doi.org/10.3389/feduc.2024.1463208>
- Asamoah, P., Zokpe, D., Boateng, R., Marfo, J. S., Boateng, S. L., Asamoah, D., Muntaka, A. S., & Manso, J. F. (2024). Domain knowledge, ethical acumen, and query capabilities (DEQ): A framework for generative AI use in education and knowledge work. *Cogent Education*, 11(1), Article 2439651. <https://doi.org/10.1080/2331186X.2024.2439651>
- Batista, J., Mesquita, A., & Carnaz, G. (2024). Generative AI and higher education: Trends, challenges, and future directions from a systematic literature review. *Information*, 15(11), Article 676. <https://doi.org/10.3390/info15110676>
- Becerra, Á., Mohseni, Z., Sanz, J., & Cobos, R. (2024). A generative AI-based personalized guidance tool for enhancing the feedback to MOOC learners. In *2024 IEEE Global Engineering Education Conference (EDUCON)* (pp. 1-8). IEEE. <https://doi.org/10.1109/EDUCON60312.2024.10578809>
- Bhullar, P. S., Joshi, M., & Chugh, R. (2024). ChatGPT in higher education—A literature synthesis and future research agenda. *Education and Information Technologies*, 29(16), 21501-21522. <https://doi.org/10.1007/s10639-024-12723-x>



- Bikanga Ada, M. (2024). It helps with crap lecturers and their low effort: Investigating computer science students' perceptions of using ChatGPT for learning. *Education Sciences*, 14(10), Article 1106. <https://doi.org/10.3390/educsci14101106>
- Camacho-Zuñiga, C., Rodea-Sánchez, M. A., López, O. O., & Zavala, G. (2024). Generative AI guidelines by/for engineering undergradu 2024 *IEEE Global Engineering Education Conference (EDUCON)*, 1-8. IEEE. <https://doi.org/10.1109/EDUCON60312.2024.10578870>
- Chaka, C. (2023). Detecting AI content in responses generated by ChatGPT, YouChat, and Chatsonic: The case of five AI content detection tools. *Journal of Applied Learning & Teaching*, 6(2), 94-104. <https://doi.org/10.37074/jalt.2023.6.2.12>
- Chan, C. K. Y. (2025). Students' perceptions of 'AI-giarism': Investigating changes in understandings of academic misconduct. *Education and Information Technologies*, 30(6), 8087-8108. <https://doi.org/10.1007/s10639-024-13151-7>
- Chee, H., Ahn, S., & Lee, J. (2024). A competency framework for AI literacy: Variations by different learner groups and an implied learning pathway. *British Journal of Educational Technology*, Article13556. <https://doi.org/10.1111/bjet.13556>
- Gallent Torres, C., Zapata González, A., & Ortego Hernando, J. L. (2023). El impacto de la inteligencia artificial generativa en educación superior: Una mirada desde la ética y la integridad académica. *RELIEVE - Revista Electrónica de Investigación y Evaluación Educativa*, 29(2), Article M5. <https://doi.org/10.30827/relieve.v29i2.29134>
- Ghosh, D., Tiwari, R. K., & Gundalwar, P. R. (2024). In *Enhancing education 4.0 with artificial intelligence. 2024 5th International Conference on Recent Trends in Computer Science and Technology (ICRTCST)* (pp. 558-563). IEEE. <https://doi.org/10.1109/ICRTCST61793.2024.10578478>
- Gruenhagen, J. H., Sinclair, P. M., Carroll, J.-A., Baker, P. R. A., Wilson, A., & Demant, D. (2024). The rapid rise of generative AI and its implications for academic integrity: Students' perceptions and use of chatbots for assistance with assessments. *Computers and Education: Artificial Intelligence*, 7, Article 100273. <https://doi.org/10.1016/j.caeai.2024.100273>
- Hamerman, E. J., Aggarwal, A., & Martins, C. (2025). An investigation of generative AI in the classroom and its implications for university policy. *Quality Assurance in Education*, 33(2), 253-266. <https://doi.org/10.1108/QAE-08-2024-0149>
- Holdcroft, C. (2024). Can generative AI improve the standardisation of student feedback across a business school faculty? In L. Uden & D. Liberona (Eds.), *Learning Technology for Education Challenges* (Vol. 2082, pp. 364-376). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-61678-5_26



- Holmes, W., & Miao, F. (2023). *Guidance for generative AI in education and research*. UNESCO Publishing. <https://doi.org/10.54675/EWZM9535>
- Ilieva, G., Yankova, T., Klisarova-Belcheva, S., Dimitrov, A., Bratkov, M., & Angelov, D. (2023). Effects of generative chatbots in higher education. *Information*, 14(9), Article 492. <https://doi.org/10.3390/info14090492>
- Katsamakas, E., Pavlov, O. V., & Saklad, R. (2024). Artificial intelligence and the transformation of higher education institutions: A systems approach. *Sustainability*, 16(14), Article 6118. <https://doi.org/10.3390/su16146118>
- Kazanidis, I., & Pellas, N. (2024). Harnessing generative artificial intelligence for digital literacy innovation: A comparative study between early childhood education and computer science undergraduates. *AI*, 5(3), 1427–1445. <https://doi.org/10.3390/ai5030068>
- Khlaif, Z. N., Ayyoub, A., Hamamra, B., Bensalem, E., Mitwally, M. A. A., Ayyoub, A., Hattab, M. K., & Shadid, F. (2024). University teachers' views on the adoption and integration of generative AI tools for student assessment in higher education. *Education Sciences*, 14(10), Article 1090. <https://doi.org/10.3390/educsci14101090>
- Kumar, S., Rao, P., Singhanian, S., Verma, S., & Kheterpal, M. (2024). Will artificial intelligence drive the advancements in higher education? A tri-phased exploration. *Technological Forecasting and Social Change*, 201, Article 123258. <https://doi.org/10.1016/j.techfore.2024.123258>
- Lin, L., Zhou, D., Wang, J., & Wang, Y. (2024). A systematic review of big data driven education evaluation. *Sage Open*, 14(2), Article 21582440241242180. <https://doi.org/10.1177/21582440241242180>
- Liu, Y., Park, J., & McMinn, S. (2024). Using generative artificial intelligence/ChatGPT for academic communication: Students' perspectives. *International Journal of Applied Linguistics*, 34(4), 1437–1461. <https://doi.org/10.1111/ijal.12574>
- Murdan, A. P., & Halkhoree, R. (2024). Integration of artificial intelligence for educational excellence and innovation in higher education institutions. *2024 1st International Conference on Smart Energy Systems and Artificial Intelligence (SESAL)* (pp. 1–6). IEEE. <https://doi.org/10.1109/SESAL61023.2024.10599402>
- Nartey, E. K. (2024). Guiding principles of generative AI for employability and learning in UK universities. *Cogent Education*, 11(1), Article 2357898. <https://doi.org/10.1080/2331186X.2024.2357898>
- Nee, C. K., Abdul Rahman, M. H., Yahaya, N., Ibrahim, N. H., Abdul Razak, R., & Sugino, C. (2023). Exploring the trend and potential distribution of chatbot in education: A systematic review.



- International Journal of Information and Education Technology*, 13(3), 516-525.
<https://doi.org/10.18178/ijiet.2023.13.3.1834>
- Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, 2, Article 100033.
<https://doi.org/10.1016/j.caeai.2021.100033>
- Peláez-Sánchez, I. C., Velarde-Camaqui, D., & Glasserman-Morales, L. D. (2024). The impact of large language models on higher education: Exploring the connection between AI and Education 4.0. *Frontiers in Education*, 9, Article 1392091.
<https://doi.org/10.3389/feduc.2024.1392091>
- Qadhi, S. M., Alduais, A., Chaaban, Y., & Khraisheh, M. (2024). Generative AI, research ethics, and higher education research: Insights from a scientometric analysis. *Information*, 15(6), Article 325. <https://doi.org/10.3390/info15060325>
- Rasu, T., Nair, S., Kalendra, D., Robin, M., Santini, F. de O., Ladeira, W. J., Sun, M., Day, I., Rather, R. A., & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning & Teaching*, 6(1), 41-56.
<https://doi.org/10.37074/jalt.2023.6.1.29>
- Roe, J., O'Sullivan, D., Arumynathan, P., & Kappen, B. (2024). Paraphrase or plagiarism? Exploring EAP students' use of source material in a transnational university context. *Journal of Applied Learning & Teaching*, 7(2), 232-245. <https://doi.org/10.37074/jalt.2024.7.2.11>
- Romero-Rodríguez, J.-M., Ramírez-Montoya, M.-S., Buenestado-Fernández, M., & Lara-Lara, F. (2023). Use of ChatGPT at university as a tool for complex thinking: Students' perceived usefulness. *Journal of New Approaches in Educational Research*, 12(2), 323-339.
<https://doi.org/10.7821/naer.2023.7.1458>
- Sevnarayan, K., & Potter, M.-A. (2024). Generative artificial intelligence in distance education: Transformations, challenges, and impact on academic integrity and student voice. *Journal of Applied Learning & Teaching*, 7(1), 104-114. <https://doi.org/10.37074/jalt.2024.7.1.41>
- Shahzad, M. F., Xu, S., & Zahid, H. (2025). Exploring the impact of generative AI-based technologies on learning performance through self-efficacy, fairness & ethics, creativity, and trust in higher education. *Education and Information Technologies*, 30(3), 3691-3716.
<https://doi.org/10.1007/s10639-024-12949-9>
- Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69(1), 99-118. <https://doi.org/10.2307/1884852>
- Simon, H. A. (1983). *Reason in human affairs*. Stanford University Press.



- Soto, D., Higashida, M., Shirai, S., Ueda, M., & Uranishi, Y. (2024). Enhancing learning dynamics: Integrating interactive learning environments and ChatGPT for computer networking lessons. *Procedia Computer Science*, 246, 3595-3604. <https://doi.org/10.1016/j.procs.2024.09.198>
- Spennemann, D. H. R., Biles, J., Brown, L., Ireland, M. F., Longmore, L., Singh, C. L., Wallis, A., & Ward, C. (2024). ChatGPT giving advice on how to cheat in university assignments: How workable are its suggestions? *Interactive Technology and Smart Education*, 21(4), 690-707. <https://doi.org/10.1108/ITSE-10-2023-0195>
- Strzelecki, A., Cicha, K., Rizun, M., & Rutecka, P. (2024). Acceptance and use of ChatGPT in the academic community. *Education and Information Technologies*, 29(17), 22943-22968. <https://doi.org/10.1007/s10639-024-12765-1>
- Suryanarayana, K. S., Kandi, V. S. P., Pavani, G., Rao, A. S., Rout, S., & Siva Rama Krishna, T. (2024). Artificial intelligence enhanced digital learning for the sustainability of education management system. *The Journal of High Technology Management Research*, 35(2), Article 100495. <https://doi.org/10.1016/j.hitech.2024.100495>
- Wang, Y., Irwin, D., Towey, D., & Xie, J. (2024). Creativity using generative AI vs. physical prioritiz: A case study of architecture workshops in a SfHEI. *2024 IEEE 48th Annual Computers, Software, and Applications Conference (COMPSAC)* (pp. 1520-1521). IEEE. <https://doi.org/10.1109/COMPSAC61105.2024.00218>
- Zhou, X., Teng, D., & Al-Samarraie, H. (2024). The mediating role of generative AI self-regulation on students' critical thinking and problem-solving. *Education Sciences*, 14(12), Article 1302. <https://doi.org/10.3390/educsci14121302>