MBAR 661: Academic Research Project (ONS-WINTER25-08)

Assessing the Impact of Artificial Intelligence in Higher Education: A Systematic Review

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Table of Contents

Abstract

Generative AI has undergone a profound transformation, emerging as a disruptive force comparable in scale to the advent of the internet. It has reshaped learning environments and educational processes, influencing both students' experiences and instructional approaches.

In this context of rapid change, the present systematic review investigates the role of AI in higher education, using the principles of Education 4.0 as a guiding framework for analysis. The study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology and is based on an evaluation of 243 peer-reviewed articles published between 2017 and 2025. It addresses three main objectives: to review existing literature, to examine the opportunities and challenges related to AI adoption, and to identify gaps that warrant further research.

A co-occurrence analysis, supported by data-driven techniques such as Latent Dirichlet Allocation (LDA), BERTopic, and K-Means clustering, shows a growing academic interest in the topic, especially after 2024. The most prominent themes include ethical governance, the personalization of learning, and the development of faculty competencies. These concerns reflect broader priorities related to fairness, transparency, and inclusive educational practices.

By contrast, areas such as statistical analysis and institutional applications have received limited attention and remain underexplored. This exploratory review contributes to a clearer understanding of the evolving role of AI in education and proposes future directions for both research and practical implementation in higher education contexts.

Introduction

In recent years, global interest has turned toward the rapid development of artificial intelligence (AI) systems capable of generating text and images in response to user prompts. These advancements are reshaping how individuals work, communicate, process information, and learn, raising important questions about their potential benefits and drawbacks.

In the education sector, AI was valued at approximately $2.5 billion in 2022. Forecasts suggest this figure will grow to $6 billion by 2025 and reach $88.2 billion by 2032, representing a compound annual growth rate of 43.3% between 2023 and 2032. Alongside this growth, studies show that 54% of students use generative AI tools for school assignments, while 44% report regular interaction with such technologies. Among educators, 60% have already incorporated AI into their lesson planning, with AI-powered educational games emerging as a commonly used resource (AIPRM, 2024).

In the context of higher education, a Global AI Student Survey conducted by the Digital Education Council (2024) collected responses from 3,839 students in 16 countries to assess attitudes toward AI in postsecondary settings. The findings reveal that 86% of students utilize AI in their studies, with 54% engaging with these tools on a weekly basis. Common uses include research support, academic writing assistance, and data interpretation. A significant number of students expressed a desire for universities to integrate AI into academic programs and offer guidance on its responsible use.

In Canada, research by KPMG (2024) shows that 59% of students have adopted generative AI tools for coursework, an increase of 13% from the previous year. While 75%

believe AI has enhanced the quality of their work, 67% are concerned that their reliance on such tools may reduce their ability to retain information. Additionally, 63% worry about possible academic consequences, and 65% consider the use of generative AI to be comparable to academic dishonesty. These findings emphasize the importance of institutional strategies that promote critical thinking and uphold academic integrity while adapting to technological shifts.

Generative AI represents a significant turning point in the evolution of education, comparable in impact to the introduction of the internet. Due to the speed of these developments, educational leaders are now challenged to understand the technology, acquire relevant skills, and reshape teaching models to harness new opportunities. These opportunities include increased administrative efficiency, faster access to financial insights, enhanced research capabilities, personalized instruction, and broader support for diversity, equity, and inclusion. However, these advantages must be weighed against concerns regarding ethics, governance, and legal implications (Deloitte Insights, 2024).

Scholarly research over the past five years reflects a mixed outlook on AI's role in higher education. While some studies report modest benefits, others highlight considerable limitations (Nadim & Di Fuccio, 2024). Evidence suggests that the presence of AI in classrooms alone does not guarantee better learning outcomes. In some cases, overreliance on automated tools may hinder student motivation, reduce engagement, and compromise critical thinking (Krullaars et al., 2023). Concerns have also been raised about algorithmic bias, which can reinforce inequality in admissions and assessments, as well as surveillance systems that may infringe upon student privacy (Baker & Hawn, 2021).

Faculty roles are also being redefined, with discussions surrounding potential deskilling, changing labor expectations, and increased automation in academic workflows (Fügener et al., 2021). For students, high levels of automation can negatively affect motivation and the sense of ownership over learning outcomes. The literature further highlights issues related to academic honesty. When students submit AI-generated work, they may disengage from the learning process and fail to develop essential academic skills. Educators have expressed concerns that easy access to writing tools encourages academic dishonesty and discourages original thought (Cotton et al., 2023). Without safeguards, AI could also exacerbate existing educational disparities. To address these risks, scholars have called for transparency in algorithm design, stakeholder involvement in system development, and routine audits of AI systems used in education (Baker & Hawn, 2021; Al-Zahrani, 2024).

Implementing AI in higher education is not solely a technical challenge; it is also an ethical and social responsibility. Institutions must consider faculty resistance, uncertainty about appropriate use, and the need to align AI tools with pedagogical goals. Critical areas for attention include data privacy, intellectual property, system reliability, and policy compliance. Without careful planning and user-focused implementation, AI adoption may lead to confusion, increased cognitive burden, or institutional resistance (Deloitte Insights, 2024).

In response to these issues, this systematic review investigates the current academic literature on AI in higher education. The analysis focuses on three core areas: learning outcomes, ethical considerations, and the broader transformation of academic systems. This research builds upon established frameworks concerning technological adoption and educational ethics, especially regarding fairness, transparency, and accountability. Additionally, this review

identifies a key research gap: while there is substantial literature on ethics, institutional practices, and faculty experiences, relatively few studies focus on administrative applications or student perspectives. By addressing these underrepresented themes, this study contributes to a more comprehensive and balanced understanding of the challenges and opportunities associated with AI integration in higher education.

Contextual framework

To contextualize the topic, UNESCO (2021a, p. 4) states that "Advances in AI-powered solutions carry enormous potential for social good and the achievement of the Sustainable Development Goals." Realizing this potential, however, requires robust ethical oversight, global policy coordination, and meaningful collaboration with educators and researchers worldwide.

The use of AI in education remains a major concern for both educators and policymakers, as its implementation must be grounded in the fundamental values of equity and inclusion. The potential benefits of AI in education will only be realized if its integration is carefully planned to reinforce human-centered pedagogical methods while respecting ethical norms and standards.

AI technologies should serve as tools that empower educators, enhance learning management systems, and support more effective and personalized learning pathways for students. A major global challenge lies in preparing learners and citizens to navigate life and work alongside AI responsibly. Higher education institutions must play a central role in this process by equipping both students and faculty with foundational AI competencies, including knowledge of how data is collected and processed, and how to protect personal information (UNESCO, 2021a).

UNESCO has taken a leading role in this global conversation, engaging with stakeholders from multiple disciplines and sectors. Adopting a humanistic and ethics-based approach, UNESCO emphasizes that AI systems must be designed and governed by people, with the aim of enhancing human capacity while safeguarding core values such as fairness, transparency, accountability, and equity. Ethical considerations include tracking the societal impacts of AI and

ensuring these technologies do not reinforce biases or deepen inequalities. Other essential dimensions include data ownership, privacy protection, and the development of regulatory frameworks that ensure AI is used responsibly within educational settings.

Since 2019, UNESCO has actively supported its member states in responding to these challenges by organizing awareness-raising initiatives and publishing guidance materials. The first event, "Mobile Learning Week," explored the intersection between sustainable development and AI. That same year, the "International Conference on Artificial Intelligence and Education" was held in Beijing, resulting in the Beijing Consensus—a foundational document that provides recommendations for leveraging AI to achieve Sustainable Development Goal 4 (SDG 4) on inclusive and equitable quality education by 2030.

This document outlines several key actions, including the promotion of research initiatives to encourage interdisciplinary studies on the impact of AI on teaching practices and learning outcomes, and the implementation of pilot programs in schools to identify best practices for AI use in the classroom. Additionally, UNESCO calls for the monitoring of AI strategies and tools to evaluate their effects on teaching and learning, and for policies that address disparities in access to AI technologies, particularly in the least developed countries or regions affected by conflict.

In 2021, UNESCO published “AI and Education: Guidance for Policy-Makers,” a roadmap for implementing the Beijing Consensus. This document provides governments with a framework for designing education policies that promote ethical, inclusive, and sustainable AI use. That same year, UNESCO also released the “Recommendation on the Ethics of Artificial Intelligence”, the world’s first globally agreed framework for guiding the ethical development

and application of AI. This recommendation emphasizes principles such as respect for human rights, diversity, and environmental sustainability. It serves as a foundation for national policies that promote responsible AI development (UNESCO, 2021b).

UNESCO (2019) also proposed several models for implementing AI in educational settings. These include policies that align AI applications with educational objectives under SDG 4; systems for improving education management information systems through enhanced data collection and analysis; and strategies for teacher empowerment, which involve preparing educators for AI-rich environments and redefining professional competencies. Additionally, the AI for Learning Assessment model promotes the use of adaptive technologies and data-informed assessments to evaluate student learning. UNESCO also advocates for the expansion of lifelong learning through the use of AI platforms that offer accessible, flexible, and individualized educational experiences. Finally, UNESCO highlights the importance of establishing regulatory frameworks that ensure ethical data use, protect privacy, and guarantee fairness in algorithmic decision-making.

In 2023, UNESCO published the document “Recommendation on the Ethics of Artificial Intelligence,” which further elaborates on policy areas such as ethical impact assessments, data governance, and education strategies. It encourages the development of AI ethics curricula and supports interdisciplinary research that incorporates ethics, law, cultural studies, and other fields to promote comprehensive understanding and accountability. The recommendation also emphasizes the importance of inclusive and adaptive governance through collaboration among diverse stakeholders (UNESCO, 2023a).

Later that year, UNESCO released a report titled “Foundation Models such as ChatGPT through the Prism of the UNESCO Recommendation on the Ethics of Artificial Intelligence.” This document explores the ethical challenges associated with advanced AI models, including their use in education. It calls attention to risks such as environmental impact, bias, and the potential for reduced critical thinking, especially when these technologies are introduced without adequate oversight. The report underscores the need for greater transparency, ethical literacy, and critical engagement from both developers and users. It urges the development of public awareness strategies and emphasizes that stakeholders must be involved in ethical impact assessments at every stage of the AI design and implementation process (UNESCO, 2023b).

All of these actions reflect UNESCO’s sustained commitment to promoting the ethical and equitable integration of AI into education. The organization's work highlights the importance of supporting dynamic, human-centred learning environments while ensuring that ethical standards, policy frameworks, and best practices are firmly in place to guide the responsible use of AI technologies.

Conceptual Framework

This section establishes the theoretical foundation for the study by clarifying key concepts, models, and relationships that inform the research focus. It explains how the integration of artificial intelligence (AI) in higher education aligns with the broader paradigm of Education 4.0 and how this connection responds to the evolving demands of the global economy and society. By mapping the interaction between technological innovation, pedagogical transformation, and the development of essential competencies, the framework provides a coherent lens through which the study's objectives are analyzed.

The framework is organized around several interconnected pillars:

- AI in Higher Education: Examines how AI technologies enable personalized learning, automate administrative functions, and apply data analytics to improve educational outcomes.
- Education 4.0 Principles: Describes the shift from traditional, industrial-era models to flexible, student-centered approaches that emphasize lifelong learning, adaptability, and both technical and socio-emotional competencies.
- Core Competencies for the Future Workforce: Identifies the digital, cognitive, and interpersonal skills required to succeed in an AI-enhanced world, drawing on frameworks from the OECD and the World Economic Forum.
- Pedagogical Innovation and Technological Integration: Explores new teaching strategies, digital tools, and learning environments that support adaptive, personalized, and collaborative education.

- Equity and Access: Addresses the challenges posed by the digital divide and underscores the importance of digital literacy for both educators and students to ensure equitable participation.

In this context, the inclusion of AI in higher education represents a transformative development aligned with Education 4.0. AI systems can simulate cognitive functions, supporting individualized instruction, administrative streamlining, and data-informed decision-making (Mittal, 2023; Slimi, 2023). These capabilities not only enhance student engagement but also enable the design of tailored learning pathways, contributing to improved academic outcomes.

As globalization and technological advancement continue to reshape labor markets, traditional education models have become increasingly disconnected from current workforce demands. The Fourth Industrial Revolution requires new skills, including digital literacy, emotional intelligence, adaptability, and collaboration. Education 4.0 offers a strategic response, proposing reforms in both curriculum content and instructional delivery to cultivate these human-centric values (World Economic Forum, 2020).

This framework promotes a vision of education that is lifelong, personalized, and globally oriented. It supports innovative pedagogy, problem-based learning, and the use of digital tools to foster creativity, critical thinking, and global citizenship. It calls for the collaboration of schools, governments, and industries in equipping learners to become adaptable and socially responsible contributors to future societies (World Economic Forum, 2020).

A notable contribution from the World Economic Forum is the AI Governance Alliance Briefing Paper Series, which emphasizes the ethical design and application of AI. It promotes global collaboration among stakeholders to ensure inclusive, transparent, and socially beneficial

AI adoption (World Economic Forum, 2024). Similarly, the Future of Jobs Reports highlight the urgent need for educational institutions to integrate digital competencies and emerging technologies into formal curricula.

The OECD also forecasts significant shifts in the skill landscape by 2030, driven primarily by the integration of AI across various sectors. Alongside technical knowledge, workers will need advanced cognitive abilities, such as complex problem-solving, creativity, and critical thinking, and socio-emotional competencies like empathy and effective communication (OECD, 2020; OECD, 2022; McKinsey & Company, 2021). Adaptability is especially crucial as individuals respond to the rapid changes driven by automation. While AI is expected to eliminate some repetitive tasks, it will also generate new opportunities that require human oversight and creativity. The OECD outlines three core areas of competence that will be shaped by AI by 2030, as shown below.

Table 1

Core Competencies for Working with AI

Skill Area	***Description and Relevance in the AI Context***
Digital and Technical Skills	Advanced abilities in programming, data analysis, and AI literacy will be essential for engaging with AI systems. Foundational digital skills will remain necessary across all sectors (OECD, 2022; 2025a).
Higher-Order Cognitive Skills	Competencies such as critical thinking, complex problem-solving, and analytical reasoning are vital for interpreting AI outputs and solving novel problems (OECD, 2022; 2025).

Skill Area	*Description and Relevance in the AI Context*
Social and Emotional Skills	Interpersonal abilities, including empathy, adaptability, and collaboration, will support inclusive and ethical human-AI interaction (OECD, 2022; 2025b).

Note. Own elaboration.

To thrive in an AI-enhanced environment, learners must also develop general AI literacy, the ability to understand, interpret, and interact with various forms of AI, including general, narrow, and generative models. Proficiency with tools such as Chatgpt (OpenAI) and Gemini (Google) is increasingly recognized as essential (OECD, 2025a, p. 5). Accordingly, education and workforce development programs must be realigned to foster these competencies. Achieving this vision demands that higher education institutions adopt an Education 4.0 approach, characterized by using modern technologies, updated infrastructure, and innovative pedagogical methods that align with the shifting requirements of a digital society. Below in Table 2 are the most important aspects:

Table 2

Core Components of Education 4.0.

Components	***Description***
Competencies	Development of both transversal (soft) skills, such as critical thinking, communication, and creativity, and disciplinary (technical) skills aligned with professional tasks.
Learning Methods	Incorporation of active, problem-based, challenge-based, and gamified learning, including blended and flipped classroom formats.

Components	***Description***
Information and Communication Technologies (ICTs)	Application of technologies like AI, cloud computing, IoT, and immersive environments to support instruction.
Infrastructure	Creates innovative physical and virtual environments tailored to students' needs, such as collaborative spaces equipped with cutting-edge tools like augmented reality and holograms.

Note: Own elaboration with information from Miranda et al. (2021).

Education 4.0 also incorporates alternative pedagogies such as Heutagogy (self-directed learning), Peeragogy (peer-based collaboration), and Cybergogy (ICT-based, context-flexible education) (Miranda et al., 2021). Additional pedagogical strategies include experiential, embodied, computational, and playful learning models (WEF, 2020). Technological integration is further supported by platforms like Blackboard, Brightspace, Moodle, and immersive tools such as educational robotics and mixed-reality simulations.

A key component of this transformation is adaptive learning, which tailors' content and pace to the learner's real-time performance and preferences (Waters, 2014; Wang, 2012). This approach addresses diverse learning needs and promotes deeper engagement. Closely related is personalized learning, which seeks to align content with students' abilities and interests (Duckett, 2009; Jenkins & Keefe, 2002; Baer et al., 2013). These models promote autonomy and improve learning outcomes by connecting institutional and external resources.

In parallel, student-centered learning encourages active participation, critical thinking, and learner autonomy, moving away from teacher-centered paradigms (Chen et al., 2015). Educational automation supports this shift by streamlining administrative and instructional processes, such as grading and scheduling, thus freeing educators to focus on pedagogy (Fitria, 2021). Nevertheless, these innovations also raise concerns regarding digital inequality, which may deepen existing educational gaps if not properly addressed (Chen & Kidd, 2007; Clark, 2003).

Faculty adoption of technology is essential to this ecosystem. The Technology Acceptance Model (TAM) identifies perceived usefulness and ease of use as key predictors of adoption (Pérez-Ovando et al., 2005). Strong institutional support and faculty development programs can improve these perceptions. In this context, digital literacy becomes a fundamental skill for both students and teachers, encompassing the ability to engage effectively with digital technologies in academic environments (Ng, 2014). Promoting digital literacy is crucial to ensuring equitable access to the benefits of AI, adaptive learning, and educational automation.

Ultimately, integrating AI, personalized learning, student-centered strategies, and automation within the Education 4.0 model offers the potential for more inclusive, efficient, and future-ready educational experiences. However, realizing this vision requires more than simply adopting new technologies. Institutions must foster adaptable learning environments that prioritize critical thinking, emotional intelligence, and digital fluency. They must also address barriers such as the digital divide and support faculty through targeted strategies like TAM-informed training programs.

This framework supports the present study by providing a comprehensive foundation for understanding the transformative potential of AI in higher education. It highlights the necessity of aligning educational practices with the requirements of the Fourth Industrial Revolution and defines the competencies and pedagogical innovations needed to prepare students for future labor markets and civic life. It also emphasizes the importance of equity and digital literacy as prerequisites for sustainable innovation. By outlining the relationships among these elements, the framework ensures that subsequent sections of the study are grounded in theory, connected to global trends, and positioned to evaluate the effectiveness and inclusiveness of AI integration in higher education.

Methodology

The literature review aimed to examine the impact of artificial intelligence (AI) on institutional practices, learning outcomes, faculty teaching, academic management, and ethical considerations in the context of higher education. The objectives of the review were:

1. To systematically review and analyze existing research on the impact of AI in higher education.
2. To assess the opportunities and challenges associated with AI integration in learning environments.
3. To identify gaps in the current body of knowledge and suggest directions for future research.

To conduct the review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was applied, following the guidelines outlined by Page et al. (2021). The review process involved several phases: research design, data collection, synthesis, analysis, visualization, and interpretation. These steps were followed to ensure a rigorous, transparent, and replicable review process.

During the research design stage, a set of keywords and Boolean strings was developed to capture the relevant literature. These are summarized in Table 3.

Table 3

Boolean strings used for literature review.

Category	*Target Group*	*Boolean String*
Learning Outcomes	Students, Faculty	("artificial intelligence" OR "AI" OR "generative AI") AND ("higher education") AND ("learning outcomes") AND (students OR faculty)
Ethics	All groups	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (ethics OR academic integrity) AND (students OR faculty OR administrators).
Institutional Practices	Administrators	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (institutional practices) AND (administrators).
Faculty Teaching	Faculty	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (faculty teaching OR pedagogy) AND (faculty OR professors).
Statistics	Administrators, Faculty	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (statistics) AND (administrators OR faculty).
Students	Students	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (students OR student learning).
Administration	Administrators	(artificial intelligence OR "AI" OR generative AI) AND (higher education) AND (administration OR university leadership) AND (impact).

Note. Own elaboration.

Data Collection and Source Selection

The data collection phase focused on secondary sources published between 2017 and 2025. References were drawn from a diverse array of academic journals, scientific publishers, international organizations, expert consultancies, and statistical databases. The main types of sources include:

- Academic Journals and Scientific Publishers: Such as Springer, Elsevier, SAGE Publishing, MDPI, Nature Portfolio (Springer Nature), Wiley, Taylor & Francis (Routledge), IGI Global, ERIC, and EBSCO.
- Preprint Repositories and Open Access Platforms: Including arXiv.org and ResearchGate, which provided early-stage research and author-shared content.
- Organizations and Advisory Bodies: Such as Deloitte Insights, KPMG Canada, AACSB International, EDUCAUSE, and the Digital Education Council.
- Industry Blogs and Expert Portals: Including Aquarius AI Blog, Artsmart AI Blog, and Bright Eye VC.
- Statistical Databases: Primarily Statista, for numerical and industry-related data.

In total, 421 sources were identified, encompassing peer-reviewed journal articles, institutional reports, expert commentaries, and survey data. Together, these sources provide a comprehensive and up-to-date view of the integration of AI in higher education. To ensure methodological rigor, priority was given to empirical studies, conceptual articles, and systematic reviews. These were selected based on relevance, clarity of research objectives, methodological soundness, and their contribution to academic and practical knowledge.

A formal scoring tool or bias assessment instrument was not uniformly applied, as the aim of this review was exploratory and integrative, rather than evaluative or effectiveness focused.

Inclusion of Non-Peer-Reviewed Materials

Reports and materials from credible non-academic sources, such as UNESCO, KPMG, Deloitte, and EDUCAUSE, were included due to their authority, relevance to educational policy, and insight into administrative and institutional perspectives. These sources were selected using targeted searches and snowball sampling techniques. Although not peer-reviewed, they were issued by recognized international bodies with expertise in education and technology and were therefore deemed credible and informative. Their role in the analysis is complementary, offering context and practical viewpoints to support or contrast with findings from academic literature.

To maintain transparency, non-academic sources are clearly cited and discussed separately where appropriate. Their inclusion enhances the scope of the review while preserving analytical depth, as their insights are used to supplement, not replace, empirical findings.

Exclusion Criteria and Screening Process

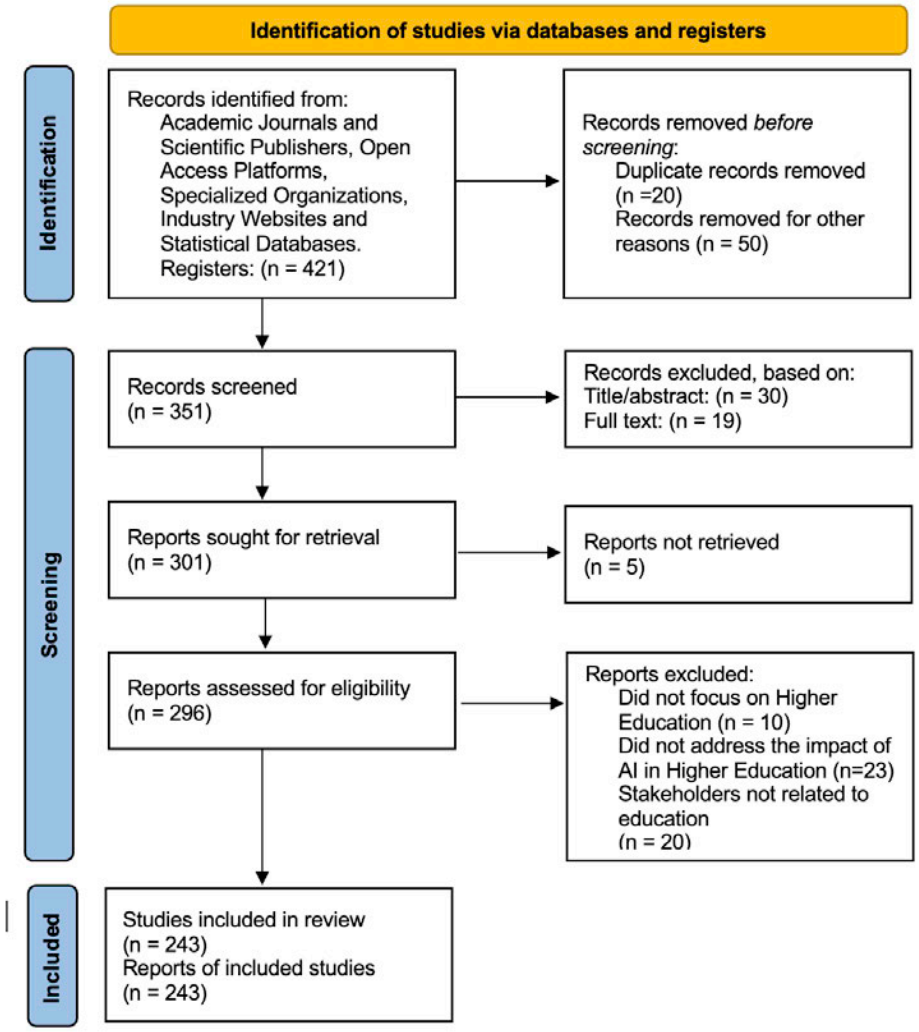
Papers were excluded if they met any of the following criteria: Originated from conference proceedings, were not written in English, or were not peer-reviewed or directly relevant to the impact of AI in higher education.

The initial exclusion stage removed 70 records, comprising 20 duplicates and 50 sources that did not meet the inclusion criteria. During the screening phase, an additional 30 records were excluded due to inconsistencies between the titles, abstracts, and the research focus. After full-text review, nine more articles were discarded. Further exclusions included: 10 records not focused on higher education; 23 records not addressing the impact of AI in educational contexts;

a small number of sources where the relevant stakeholder groups were unrelated to higher education. More details are explained below in Figure 1.

Figure 1

PRISMA Flowchart for study selection



Note. The figure was generated by the author using the PRISMA platform (Haddaway et al., 2022) for design.

After the data cleaning process, a total of 243 records were retained for analysis. During the data synthesis phase, a matrix was developed to organize the information systematically. This

matrix included identification details for each article, classification based on the relevance of its content, alignment with the study's objectives and categories, and a summary of its main findings.

For the analysis phase, qualitative content classification was performed using Python in Google Colab. The articles were categorized according to key thematic areas identified in this study: learning outcomes, institutional practices, faculty teaching, academic management, and ethical issues related to AI implementation in higher education.

To explore connections between research themes, a co-occurrence analysis was also conducted. This analysis applied data processing techniques grounded in principles of Grounded Theory, implemented through Python scripts. By combining structured synthesis with thematic analysis and co-occurrence mapping, the research approach enabled the identification of meaningful patterns and relationships within the literature. These insights contributed significantly to understanding how AI is being applied and discussed in the context of higher education.

Analytical Techniques and Outcomes

To generate the insights presented in this study, a set of analytical techniques was applied to a dataset of 243 document summaries focused on the role of artificial intelligence (AI) in higher education. Each method was selected to provide a unique analytical perspective, enriching the overall depth and breadth of the findings.

Latent Dirichlet Allocation (LDA) Topic Modeling was used as a probabilistic technique to identify key themes in the dataset (Murel & Kavlakoglu, 2025). This method was

implemented using the Gensim library. It was selected for its capacity to detect prominent topics in large collections of unstructured text without the need for predefined categories. The document summaries were preprocessed by cleaning the text, removing stopwords, and converting the data into a bag-of-words format. Several models were tested using different values of *K* (between 2 and 10), and the final model was chosen based on the highest coherence score. A four-topic model offered the most interpretable structure.

LDA identified the following key topics:

- **Academic Integrity and Ethics**: This theme includes issues such as plagiarism, academic honesty, and ethical considerations in AI adoption within education.
- **Student Learning Outcomes**: Focused on terms like learning, performance, and engagement, this topic explored how AI tools influence student success.
- **Institutional Adoption and Policy Development**: This topic encompasses institutional strategies for integrating AI, including policy formulation and long-term planning.
- **Teaching Practices and Faculty Perspectives**: Emphasized how educators perceive and adopt AI in teaching, including needs for training and support.

To expand on these findings, **BERTopic** was also applied. This advanced topic modeling technique leverages transformer-based embeddings to capture the semantic context of the documents (Grootendorst, 2022). BERTopic was chosen for its ability to detect nuanced and emergent themes not easily captured by traditional models. After text preprocessing, the model generated document embeddings and grouped them into topic clusters, allowing for a more detailed analysis.

BERTopic identified five key topics:

- **Academic Integrity and AI Ethics**: Overlapping with the LDA output, this topic centered on the responsible use of AI and institutional policy development.
- **Student Learning and Academic Outcomes**: Explored AI's impact on performance, engagement, and personalized learning.
- **Faculty Engagement and Technology Adoption**: Focused on faculty attitudes, levels of adoption, and challenges in integrating AI into teaching.
- **Institutional Policy and Strategy**: Highlighted broader institutional efforts to integrate AI into governance and operational planning.
- **Generative AI Tools and Writing Support**: A new theme that emphasized the growing use of tools like ChatGPT for writing assistance, indicating emerging research on generative AI in academic contexts.

In addition to LDA and BERTopic, **K-Means Clustering** was employed to validate and triangulate the findings. This technique groups documents based on the similarity of their textual features, offering an unsupervised approach to thematic classification (Sharma, 2025). After converting the text data into numerical vectors, several cluster configurations were tested. The model that yielded the most coherent distribution produced three dominant clusters:

- **AI Ethics and Governance**: Included documents centered on ethical dilemmas, regulatory frameworks, and oversight mechanisms.
- **AI Integration in Educational Systems**: Comprised documents addressing institutional strategies, educational policies, and administrative implementation.

- **AI in Teaching and Student Learning**: Focused on how AI enhances learning outcomes and transforms instructional practices.

Together, these analytical techniques provided a comprehensive view of the key trends and research areas in the application of AI in higher education. The triangulation of findings across different models helped strengthen the reliability of the thematic structure, offering a well-rounded foundation for interpreting the role of AI in shaping future academic environments.

Co-occurrence Analysis of Themes

To deepen the understanding of how research themes are interrelated, a co-occurrence analysis was conducted using grounded theory techniques, implemented through Python-based data processing. Since many studies addressed more than one topic, this method was essential for identifying which themes appeared together most frequently. Recognizing these patterns offers meaningful insights into the structural connections between research areas and facilitates the identification of broader conceptual groupings, such as the recurring overlap observed between ethics and institutional practices.

A co-occurrence matrix was generated by tallying the number of documents associated with each pair of themes. Each cell in the matrix reflected the frequency with which two themes co-occurred within the reviewed literature. This approach enabled the identification of strong thematic associations as well as areas with weaker linkages. As a result, distinct clusters of closely related topics were revealed, helping to map the overall thematic landscape of the

literature. These findings support the formulation of future conceptual frameworks that are grounded in the actual structure of the research field.

The results of this analysis emphasize the centrality and interconnection of several dominant themes in the literature on AI in higher education. In particular, ethics, institutional practices, learning outcomes, and faculty teaching emerged as prominent and closely linked areas. In contrast, themes such as statistics, administration, and student perspectives appeared less frequently, suggesting that they are either emerging or underexplored domains within the current research corpus.

The combination of co-occurrence analysis with data-driven techniques, such as Latent Dirichlet Allocation (LDA), BERTopic, and K-Means clustering, enabled a more comprehensive examination of the literature. These tools not only highlighted dominant research themes but also helped surface more nuanced or emerging areas of study, including the growing use of generative AI tools.

In summary, the systematic exploration of the literature reveals a thematic landscape in which ethical governance, institutional policy, and faculty engagement are central pillars. These areas are supported by their frequent co-occurrence and thematic prominence. Meanwhile, the limited attention given to topics such as administrative strategies and statistical analysis reveals potential avenues for future inquiry. Addressing these gaps can expand the scope of academic understanding and enhance the practical, responsible, and inclusive implementation of AI technologies within educational settings.

Findings & Discussion

This section presents the results of the systematic literature review and discusses their relevance to the present study. The objective is to offer a clear and critical overview of the key themes identified in the existing research, using both quantitative categorization and qualitative interpretation. These findings provide insights into current trends, recurring concerns, and potential directions for future research on artificial intelligence (AI) in higher education.

Based on a predefined set of keywords and selection criteria, a total of 421 open-access academic articles and reports were initially identified. After applying the exclusion criteria, 243 documents were retained for analysis. These were categorized according to thematic areas relevant to the scope of this study, as detailed in Table 4.

Table 4

Content Categorization

Category	***Number of articles***
Learning outcomes	n = 50
Ethics	n = 57
Institutional practices	n = 62
Faculty teaching	n = 43
Students perspective	n = 7
Administration perspective	n = 10

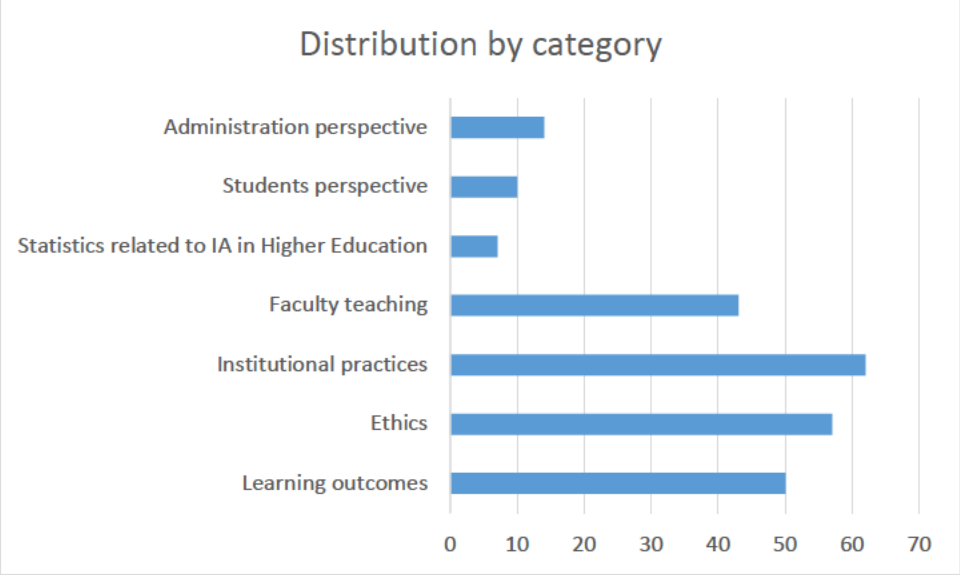
Source: Own elaboration.

The discrepancy between the number of articles presented in Table 2 (n = 229) and those analyzed here (n = 243) is due to thematic overlap. While Table 2 applies a primary classification system, this section accounts for articles that were relevant to more than one theme. This multi-categorization approach reflects the complexity and interconnectedness of the literature and is further explained in the methodology section.

Among the thematic areas, institutional practices (25.5%) emerged as the most frequently discussed, followed by ethics (23.5%) and learning outcomes (20.6%). In contrast, themes such as administrative perspective and student perspective were less frequently addressed. These proportions are visually summarized in Figure 2.

Figure 2

Overview of topics per category



Note. Own elaboration.

To deepen the analysis, a matrix was developed to record article identifiers, category assignments, research objectives, and key contributions. Table 5 highlights selected articles that were particularly influential in shaping the thematic understanding of this study.

Table 5

Analysis of relevant articles per category

Category	***Authors***	***Main ideas***
Institutional practices	Agathursamy (2024); Al-Zahrani and Alasmari (2024); Camilleri (2024); Chan (2023); Ahmed, et al. (2025).	These studies examine how institutional strategies affect academic practices, stressing the importance of clear policy development, staff training, and responsible implementation for long-term success.
Ethics	Fowler (2023); Kallunki et al. (2024); Lee et al. (2024); Lim et al. (2023); McGehee (2024).	These works address transparency, fairness, and academic integrity, emphasizing the need for ethical training and inclusive policies to mitigate risks of inequality.
Learning outcomes	Askew et al. (2024); Atchley et al. (2024); Bond et al. (2024); Cavazos et al. (2024): Davis and Kumar (2024).	These studies highlight how AI can personalize instruction and enhance skill development, while also noting limitations such as lack of robust evidence for improved outcomes and uncertainty around long-term effects.
Faculty teaching	Aljemely (2024); Chan and Tsi (2023); Chiu et al.	The focus is on faculty challenges, including reluctance to adopt AI due to concerns about

Category	*Authors*	*Main ideas*
	(2023); Gallent-Torres at al. (2023), Gibson (2024).	autonomy, changing roles, and a lack of tailored training or support.

Note. Own elaboration.

While many of the reviewed studies emphasize the benefits of AI in academic environments, several also offer cautionary perspectives. For instance, McGehee (2024) and Lee et al. (2024) express concerns about data governance and algorithmic transparency, which could affect student trust. Bond et al. (2024) and Askew et al. (2024) question the assumption that AI-driven tools automatically improve learning outcomes, especially when these technologies are not aligned with pedagogical goals. Similarly, Chiu et al. (2023) and Gibson (2024) report hesitancy among educators who view AI as a potential threat to the human elements of teaching, such as interaction and mentorship.

Taken together, the findings suggest a field in transition. While progress is evident, particularly in areas like policy design and ethics, there remain inconsistencies in how innovations are implemented across institutions. These complexities suggest that educational leaders should adopt a balanced approach: one that supports innovation and experimentation, but also considers ethical risks, equity challenges, and the diverse needs of students and faculty alike.

Trend Topics

To understand how academic interest in artificial intelligence (AI) in higher education has evolved, a trend analysis was conducted. This included a review of annual publication volumes and an assessment of the most frequently discussed research themes.

Table 6

Yearly Production Related to AI in Higher Education

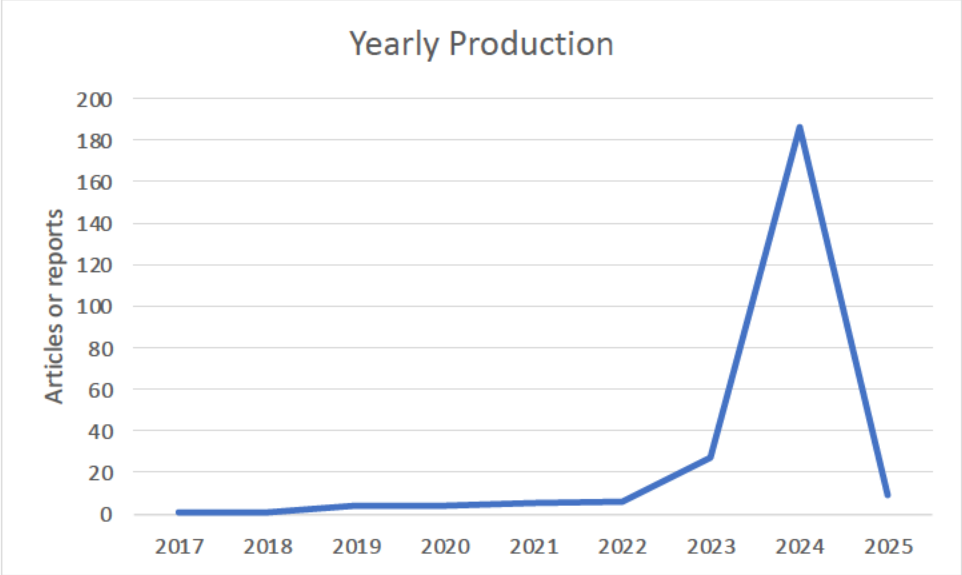
Year	***Number of articles***
2025	9
2024	76
2023	27
2022	3
2021	4
2020	4
2019	4
2018	1
2017	1

Note. Own elaboration.

Although 2025 shows a temporary decline in output, this is due to data being collected during the first quarter. Given the significant increase in publications in 2024, it is likely that research activity will continue to rise throughout the current year.

Figure 3

Annual Scientific Production



Note. Own elaboration.

In addition to production data, a trend topic analysis was performed to identify which themes were most prevalent and how their relevance has changed over time. The following methods were used:

- **Frequency of Mention**: Themes were ranked based on how often they appeared across the dataset. Topics such as *Institutional Practices* and *Ethics* emerged as the most frequently discussed.
- **Co-occurrence Analysis**: This method examined how often themes appeared together, revealing strong conceptual links. For example, *Ethics* frequently co-occurred with *Institutional Practices*, indicating their interdependence in the literature.
- **Topic Modeling**: Using LDA, BERTopic, and K-Means clustering, the study identified robust topic clusters across various analytical approaches.

- **Emerging Themes**: Topics like *Generative AI Tools* gained recognition despite lower frequency, due to their novelty and increasing academic attention.
- **Expert Interpretation**: Both quantitative outputs and qualitative judgment were used to prioritize themes with relevance to current and future challenges in higher education.

The full code and visualization notebooks used in this study are available on GitHub (Farhadian, 2025). Overall, the ranking of trend topic priorities was a combination of quantitative data analysis and qualitative judgment, ensuring that the most significant and emerging themes were highlighted. Table 7 presents a ranked list of key areas, with lower numbers indicating higher priority. This prioritization shows the critical necessity for ethical governance and regulation of AI, the enhancement of personalized learning experiences, and the development of faculty competencies in AI literacy. The analysis also underscores the importance of student well-being, institutional decision-making, and addressing broader challenges, such as the technology gap and workforce development in the context of AI. These results provide significant insight into the areas demanding prompt action and those requiring long-term strategic planning.

Table 7

Trend Topics Analysis

AI Integration Topics	***Priority Level***
AI Governance & Ethical Regulations	1
AI in Personalized Learning & Student Success	2
Faculty Training & AI Literacy	3
AI in Student Well-being & Mental Health	4

AI Integration Topics	*Priority Level*
AI for Institutional Decision-Making	5
Addressing the Digital Divide in AI Adoption	6
Future of AI in Faculty & Workforce Development	7

Note. Own elaboration using Python in Google Colab.

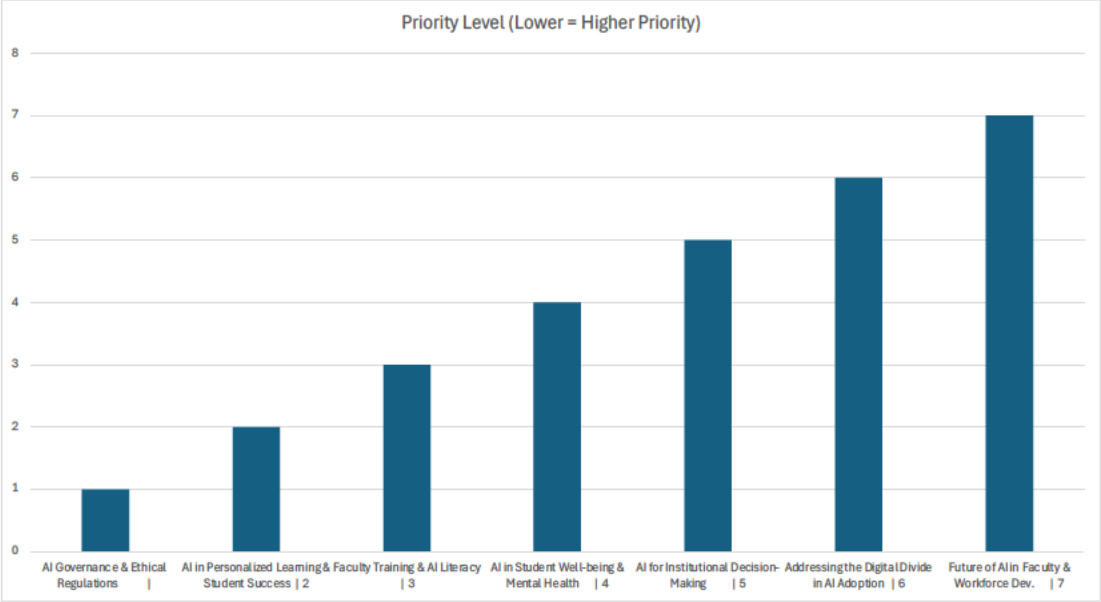
This table organizes key AI integration topics according to their priority level, with lower numbers indicating higher urgency, explained in more detail below in Figure 4.

- **Highest Priority (1)**: *AI Governance & Ethical Regulations* are the top priority, emphasizing the immediate need to establish ethical guidelines and regulatory mechanisms to manage AI's rapid growth in higher education.
- **Second Priority (2)**: *AI in Personalized Learning & Student Success* stresses the critical role AI can play in enhancing learning experiences and improving student outcomes.
- **Third Priority (3)**: *Faculty Training & AI Literacy* points to the necessity of preparing faculty members to effectively integrate AI into teaching and academic life.
- **Mid Priorities (4 and 5)**: Topics like *AI in Student Well-being and Mental Health,* and *AI for Institutional Decision-Making* remain important, focusing on support services and strategic uses of AI.
- **Lower Priorities (6 and 7)**: Although *Addressing the Digital Divide in AI Adoption* (Priority 6) and *Future of AI in Faculty and Workforce Development* (Priority 7) are ranked lower, they remain essential. These areas focus on guaranteeing fair access to AI technologies in diverse student populations and preparing faculty and future workers to adapt to evolving AI-driven environments.

These results highlight an evolving set of priorities. Governance and ethics emerged as the top concern, emphasizing the need for clear regulations and ethical practices. Enhancing student learning and preparing faculty to engage with AI technologies also ranked highly. Meanwhile, systemic challenges such as the digital divide and long-term workforce preparation, though less urgent, are gaining attention.

Figure 4

Key AI integration topics

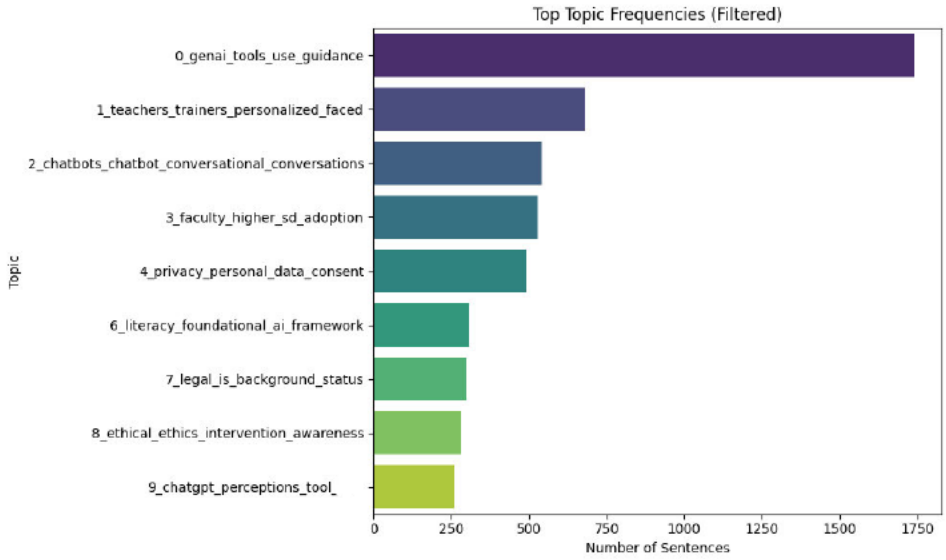


Note. Own elaboration.

As it is shown, ethical governance, personalization in learning, and faculty readiness are seen as the top priorities, while broader systemic issues like the digital divide and future workforce impacts, though important, are less pressing at this stage. On the other hand, the following chart illustrates the distribution of topics' thematic frequencies identified through coding with Python of the literature on generative AI in education.

Figure 5

Top 10 Topic Frequencies

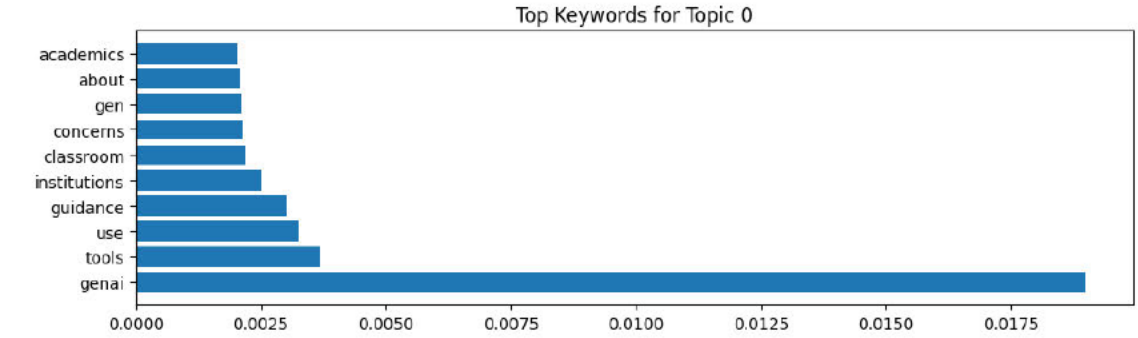


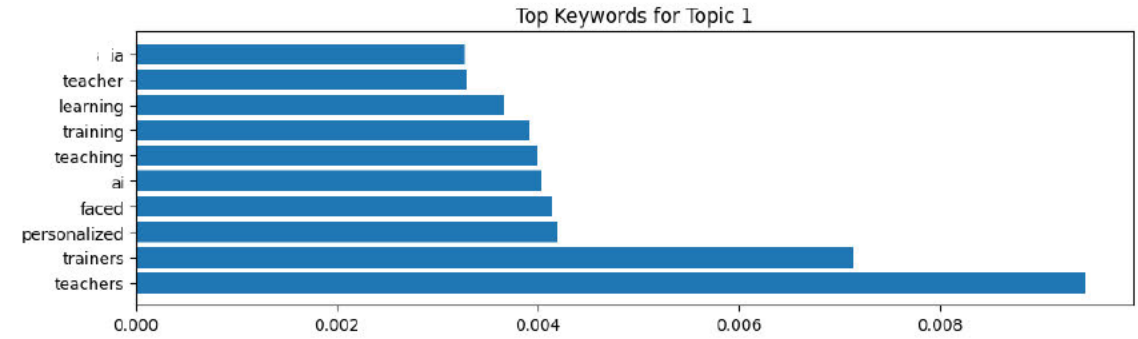
Note. Generated by the authors using Python.

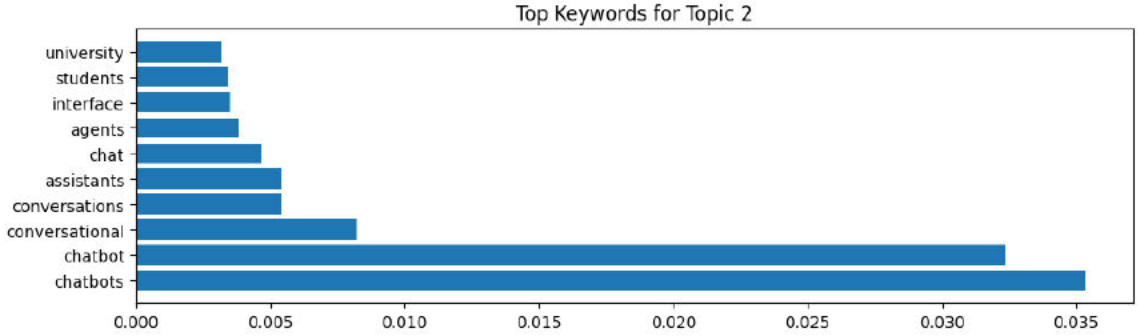
The chart shows that Topic 0 ("genai_tools_use_guidance") appeared most frequently, reflecting an intense focus on practical implementation. Other themes, including teacher support, chatbot integration, institutional adoption, and privacy, were moderately frequent, while legal frameworks and ethical interventions appeared less often, indicating niche or emerging interest. These patterns guide the selection of topics for deeper axial coding and highlight the need to explore underrepresented themes. The top keywords per topic include GenAi, Teachers, Chatbots, Faculty and privacy, as is shown below.

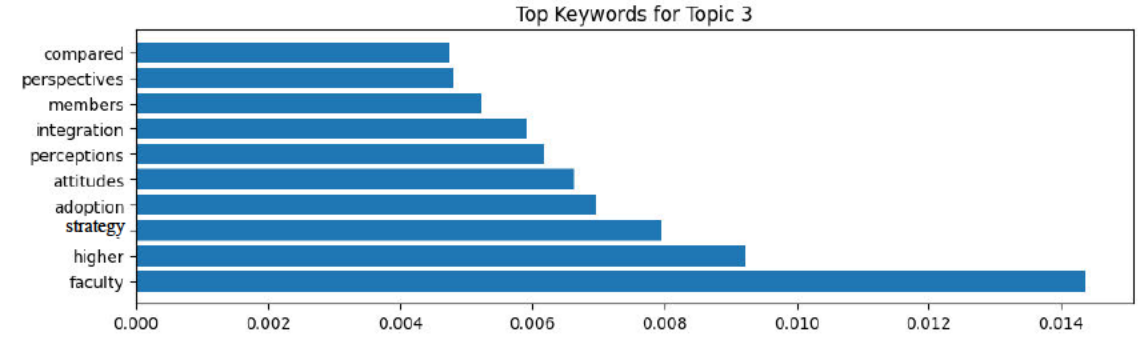
Figure 6

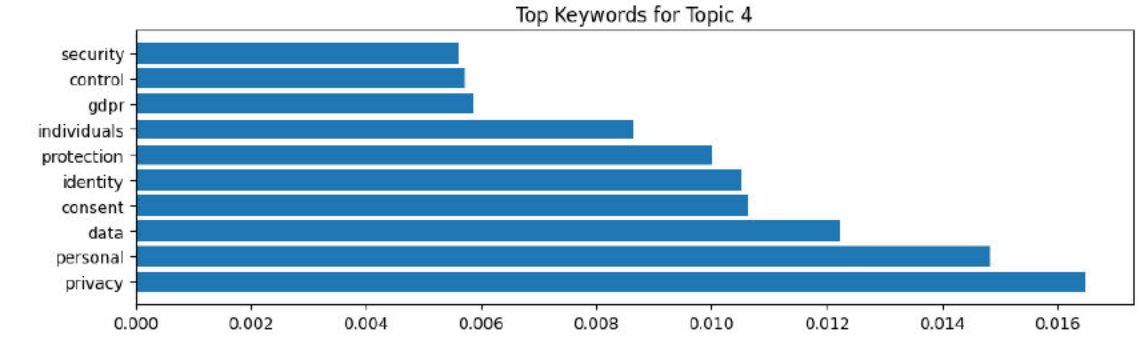
Top keywords per topic


Top Keywords for Topic 0
academics
about
gen
concerns
classroom
institutions
guidance
use
tools
genai
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175


Top Keywords for Topic 1
teacher
learning
training
teaching
ai
faced
personalized
trainers
teachers
0.000
0.002
0.004
0.006
0.008


Top Keywords for Topic 2
university
students
interface
agents
chat
assistants
conversations
conversational
chatbot
chatbots
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035


Top Keywords for Topic 3
compared
perspectives
members
integration
perceptions
attitudes
adoption
strategy
higher
faculty
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014

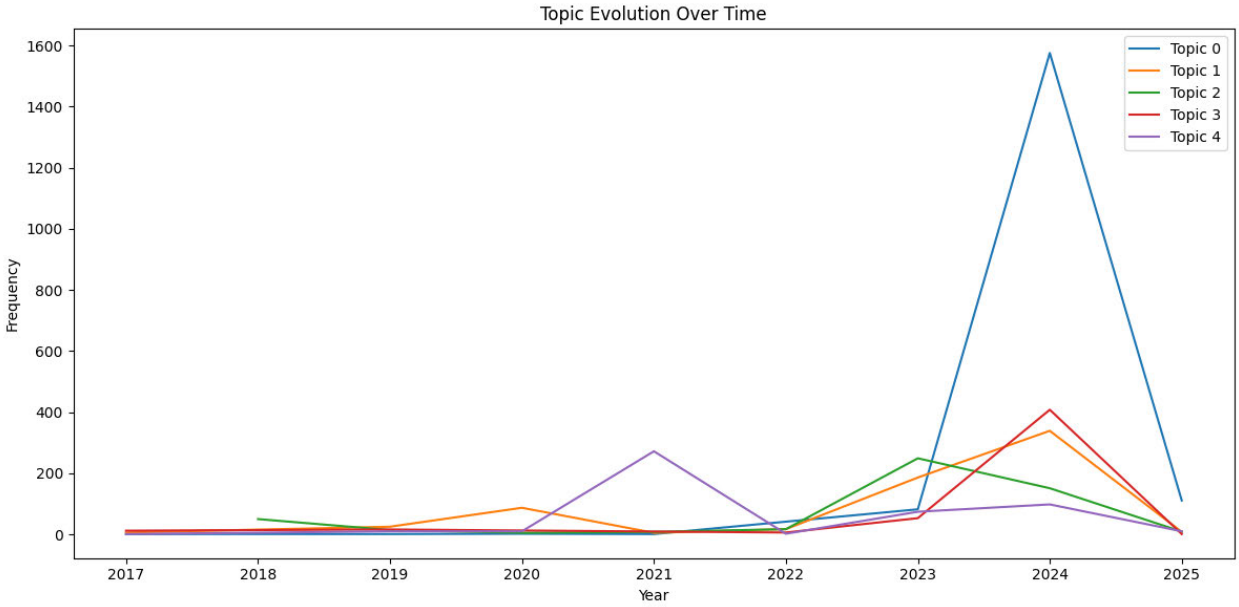

Top Keywords for Topic 4
security
control
gdpr
individuals
protection
identity
consent
data
personal
privacy
0.000
0.002
0.004
0.006
0.008
0.010
0.012
0.014
0.016

Note. Generated by the authors using Python.

An analysis of topic evolution over time confirmed that Topic 0 has consistently dominated recent literature. As shown in the next graph, its prevalence is markedly higher than that of the other topics.

Figure 7

Topic evolution over time



Note. Generated by the authors using Python.

Topic 0 represents widespread interest in how generative AI tools are used in academic environments. Related keywords—*tools*, *use*, *guidance*, *institutions*, *classroom*—indicate practical concerns, especially around usage frameworks and user training. In contrast, Topics 1–4 explore issues such as:

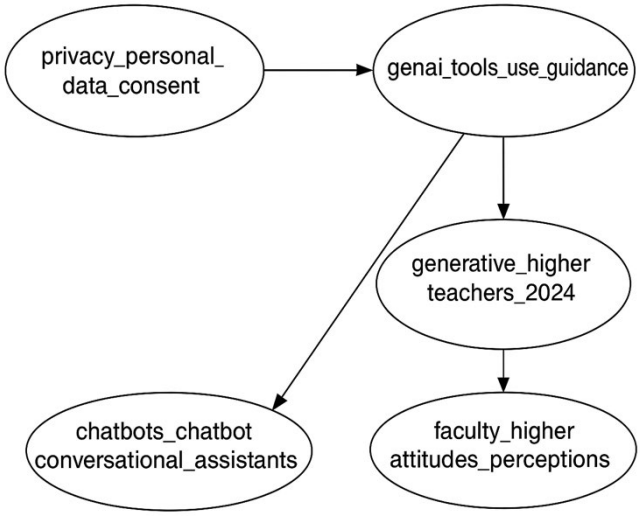
- Privacy and data consent
- Conversational AI and chatbots

- Faculty roles in AI-enhanced education
- Perceptions of AI among teachers

Together, these findings capture the broader ecosystem of generative AI in education, connecting technological innovation with pedagogical, institutional, and ethical dynamics.

Figure 8

Ecosystem of GenAI in education



Note. Generated by the authors using Chatgpt.

Interpretation and Implications

This trend analysis reveals both opportunities and challenges in the evolving academic landscape. There is clear momentum toward innovation, but gaps remain between theoretical interest and practical readiness. Although institutional policies and ethics are well represented, other areas, such as student experience and administrative strategy, are less frequently addressed.

This suggests that the integration of AI in education is not just a technical matter but also a cultural and organizational one.

For institutions to succeed, they should align infrastructure, leadership, and communication across departments, offer training and support for educators, and develop inclusive policies that involve all stakeholders, especially students. Ethical governance, personalized learning, and faculty development emerged as central priorities. Ethical frameworks are more than regulatory tools, they help build trust.

Meanwhile, personalization tools must align with clear pedagogical goals to be effective. Additionally, less-discussed areas such as mental health, data privacy, and the digital divide are gaining prominence. These must be addressed proactively to avoid worsening inequality or neglecting the human dimensions of technology adoption.

The literature also revealed thematic overlap, for example, ethics often intersects with institutional strategy, and faculty development is closely linked to student outcomes. These interconnections point to the need for integrated planning. In sum, the review highlights both the potential and complexity of AI integration in higher education. While awareness of the transformative potential of new technologies is growing, responsible implementation remains a major challenge.

To benefit fully from AI-driven innovation, higher education institutions must go beyond adoption and commit to creating ethical, inclusive, and pedagogically sound environments. Short-term measures such as training and policy reform should be paired with long-term strategies aimed at sustainability, digital inclusion, and academic integrity.

Conclusion

This literature review on artificial intelligence (AI) highlights the multifaceted nature of its integration into higher education, revealing both significant opportunities and critical challenges. The most prominent themes identified, Institutional Practices, Ethics, and Learning Outcomes, underscore a growing scholarly focus on the practical application of AI, ethical implications, and its influence on educational effectiveness.

The sharp rise in academic publications, peaking in 2024, reflects a heightened interest in understanding AI's transformative role in education. This trend suggests a continued expansion of research, fueled by the evolving demands AI places on institutions, educators, and students.

The thematic priorities identified in the literature emphasize the urgent need for ethical governance, personalized learning enhancement, faculty development in AI literacy, and attention to student well-being. These findings provide insight into areas requiring both immediate intervention and long-term strategic planning. While AI offers the potential to improve academic efficiency and support personalized learning, it simultaneously raises concerns around academic integrity, algorithmic bias, and equitable access.

To address these challenges, institutions must establish comprehensive ethical governance and training structures to guide AI implementation and minimize associated risks. The emphasis on Institutional Practices highlights the importance of aligning AI strategies with institutional missions and values, fostering a culture of trust and inclusion. These priorities align closely with UNESCO's recommendations on the ethical and human-centered use of AI in education, particularly the need to balance innovation with safeguards against bias, exclusion, and privacy loss.

The review also reflects the principles of Education 4.0, which envisions a learner-centered, flexible, and technology-driven educational paradigm. AI can play a vital role in supporting personalized learning trajectories, adaptive assessments, and the development of competencies such as creativity, critical thinking, digital literacy, and ethical reasoning, skills essential for navigating an AI-enabled future. However, fully realizing the promise of Education 4.0 requires closing the digital divide and ensuring equitable access to these opportunities for all learners.

Additionally, the findings can be contextualized using the Technology Acceptance Model (TAM), which highlights the importance of perceived usefulness and ease of use in technology adoption. For AI to be embraced by faculty and students, institutions must provide not only effective tools but also training, support, and user-centred design that reduce barriers to engagement. Addressing ethical and transparency concerns is equally vital to building the trust necessary for widespread acceptance.

Crucially, the risks identified, such as algorithmic bias, erosion of academic integrity, and marginalization of underrepresented groups, demand immediate and coordinated responses. These include inclusive policy development, transparent system design, interdisciplinary collaboration, and professional development initiatives that embed ethics and social responsibility throughout the AI adoption process.

Ultimately, the successful integration of AI in higher education depends on a balanced, forward-thinking strategy, one that meets today's pedagogical and ethical challenges while proactively addressing future shifts in workforce needs and educational equity. By embracing this dual approach, institutions can leverage AI as a catalyst for innovation and inclusivity, rather than a force that reinforces existing disparities. At this pivotal juncture, both academic and

institutional leadership must move beyond aspirational rhetoric and engage in deliberate, inclusive, and critically informed action to shape the responsible future of AI in education.

One limitation of this review is the methodological constraint inherent in AI-based topic modelling. While techniques such as clustering and multiple correspondence analysis (MCA) provide valuable insights into patterns within large textual datasets, their outputs are sensitive to parameters like the number of clusters or the dimensionality reduction techniques employed. Moreover, tools such as Sentence-BERT and UMAP may reduce complex qualitative data into overly simplified categories, potentially obscuring context or perpetuating embedded biases. As such, these results should be interpreted with caution and viewed as exploratory. To address this, human validation of topic coherence was incorporated, and findings were analyzed in conjunction with theoretical frameworks. Nonetheless, future research should consider triangulating these results with qualitative coding or focus group analysis to enhance interpretive depth and reliability.

Recommendations for Future Research

Despite growing interest in the use of AI in education, important questions remain unanswered. Future studies should focus on understanding how AI can be integrated into academic environments in ways that are both effective and ethically sound. In particular, more research is needed to explore the relationships between ethical oversight, personalized learning experiences, and faculty preparedness. Investigating how AI can support learning while staying aligned with core academic values will contribute to more thoughtful and sustainable implementation practices.

Several promising directions for future research include:

- Evaluating Ethical Frameworks in Practice: Examine how existing institutional guidelines, such as those inspired by UNESCO's recommendations, are being applied in real educational contexts. Research should assess their effectiveness in protecting academic integrity and supporting inclusive innovation.
- Assessing AI Literacy Initiatives: Study how embedding AI-related skills (e.g., ethical reasoning, data literacy, critical thinking) into various academic programs affects student preparedness, engagement, and learning outcomes across disciplines.
- Exploring Governance and Collaboration Models: Investigate inclusive and participatory governance models that involve key stakeholders (educators, students, policymakers, and industry) in AI decision-making. Future studies should explore how such models contribute to transparency and human-centred AI development.
- Examining Equity in Access and Use: Analyze the impact of AI tools on students from diverse socioeconomic backgrounds. Research should aim to identify best practices for reducing digital divides and ensuring equal access to AI-enhanced education.
- Studying Faculty Development Needs: Further investigation is required into the types of professional development that most effectively prepare educators to integrate AI into their teaching. This includes research on training content, delivery methods, and long-term impacts on teaching practices.
- Refining Technology Acceptance Models (TAM): Extend current TAM-based studies by focusing on how design features, user support, and perceived trustworthiness influence educators’ and students’ willingness to adopt AI tools in higher education.

- Investigating Underexplored Stakeholder Perspectives: Future research should include longitudinal and qualitative studies on how students, administrators, and faculty perceive AI's role in education, as well as the broader societal and institutional impacts of AI adoption.

By addressing these research gaps, scholars can help build a deeper understanding of AI's role in education and support the development of responsible, equitable, and context-aware strategies for its use in higher education.

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Statement Acknowledging Academic Integrity

I affirm that the work presented in this paper is my own and that I have complied with all academic integrity guidelines. I have properly cited all sources used to support my ideas and arguments.

To support grammar accuracy, I used Grammarly (2025) as a writing tool. Additionally, I used ChatGPT (OpenAI, 2025) to assist with brainstorming and improving clarity in phrasing. However, all final content was reviewed, edited, and written by me. I did not submit any AI-generated text as original work without proper acknowledgment or citation.

I understand the ethical implications of using AI tools in academic work and have used them in a responsible and transparent way, strictly for support, not as a replacement for my own academic effort.

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