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AI governance in higher education: A meta-analytic thematic review of current research trends, policy initiatives and knowledge gaps

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Abstract

Research background: Artificial Intelligence (AI) is rapidly transforming higher education, presenting both opportunities and challenges for institutions. AI improves education through personalized learning, adaptive assessments, virtual tutoring, and generative support. However, these advancements also bring challenges that require vigilant governance to uphold academic integrity and ethical standards.
Purpose of the article: Given the complexities and potential impacts of AI in higher education, this study aims to provide a thematic review by synthesizing the available literature to shed light on research trends, initiatives, and knowledge gaps in AI governance. The literature also explores the background of AI integration into higher education, focusing on its applications, benefits, challenges, and implications for students, educators, and institutions.
Methods: This study followed PRISMA guidelines and used the Scopus database for data collection. After rigorous screening, 142 papers were selected for the final review. The bibliometric analysis was conducted using the R Studio Bibliometrix package, which generates various indicators like publication trends, author collaborations, keyword co-occurrences, and citation patterns. This approach offers a different perspective on data representation and analysis compared to VOSviewer.
Findings & value added: The study highlights that AI governance in higher education involves establishing guidelines, data protection, and privacy policies. Institutions like Swansea University and government agencies like the European Commission and the US Department of Commerce are adopting ethical frameworks to guide AI development and reserving funds for AI governance research. The research concluded that governments worldwide had recognized the need for AI integration in academic research and higher education for sustainable growth and had implemented comprehensive regulations.

Introduction

AI has gained significant success since the mid-50s, with applications in various domains, including healthcare, finance, transportation, retail, education, agriculture, and robotics (Kumar, 2023). AI-powered diagnostic systems analyze medical images, predict disease progression, and provide personalized treatment plans (Li *et al.*, 2023). Robo-advisors and sentiment analysis help predict market trends, whereas Autonomous vehicles navigate and make real-time decisions, optimize traffic flow, and match drivers and passengers (Yüksel *et al.*, 2023). AI-powered chatbots assist customers, and Chatbots enhance shopping experiences. In agriculture, AI-based systems analyze sensor data, satellite imagery, and weather patterns to opti-

mize crop management, predict yields, and detect diseases. Drones and AI-powered robots can plant, water, and harvest crops, increasing efficiency and reducing labor requirements (Shang & You, 2019). In manufacturing, AI automates quality control processes, predicts equipment maintenance, optimizes logistics operations, and helps in customer segmentation, recommendation engines, and fraud detection. In retail, AI can target customers based on purchase history, recommend products, and detect fraudulent transactions. In the retail sector, AI is used to improve customer experience and streamline processes (Bertolini *et al.*, 2021).

Artificial Intelligence in Education, or AIEd, started with the advent of chatbots (Kooli, 2023) that either support self-regulated learning (Chang *et al.*, 2023), online video recommendation (Farhi *et al.*, 2022), improve computational thinking skills, programming self-efficacy (Yilmaz & Karaoglan Yilmaz, 2023), smart homework (Liu *et al.*, 2022) or online proctoring (Fawns & Schaepkens, 2022). The horizon further broadens through personalized learning, adaptive assessment, and virtual tutoring (Dai & Ke, 2022). These tools help students identify their strengths and weaknesses, provide customized resources, and offer personalized feedback and instruction (de Souza Zanirato Maia *et al.*, 2023). The following big things are AI-based assessment (Johri & Hingle, 2023) and learning analytics (Williams, 2023). Numerous research presents a quantitative, qualitative, non-experimental, projective, and predictive approach that transforms how we teach and learn, improves the quality of education, and supports student success (Chen, 2023). AI-powered language tools (AILTs) are another commonly used education technology tool students and faculty members perceive. These tools support academic writing and enhance students' communicative performance and personal language development (Santiago *et al.*, 2023; Ou *et al.*, 2024). With significant popularity in the healthcare sector, AI is recommended to integrate into medical education (Connolly *et al.*, 2023). It can be an instrument for learning support (Jha *et al.*, 2022), assessment (Karabacak *et al.*, 2023), curriculum review, and measuring attitude (Ahmad *et al.*, 2023a). However, challenges include a lack of faculty expertise and evidence supporting students' interests. Medical students and faculty recognize AI's potential and agree on the need for formal AI education, but with issues like data gathering, anonymity, privacy, consent, security, bias, transparency, responsibility, autonomy, and beneficence (Masters, 2023).

The latest Generative AI provides writing assistance (Lund *et al.*, 2023), paraphrasing, and education for students who need extra help or are learning from a distance (Naidu & Sevnarayan, 2023). Tools like ChatGPT (Essel *et al.*, 2024), Google Bard, and Gradescope (Rudolph *et al.*, 2023) help grade essays and provide student feedback based on their distinctive features. Much research has been done that justifies these large language models' attitude, perception, and acceptance theory (Almaraz-López *et al.*, 2023; Antony & Ramnath, 2023; Chan & Zhou, 2023). For better adoption, Generative AI (GenAI) has been studied by Generation Z students and Gen X and Y teachers, revealing its potential benefits, but also concerns about overreliance and ethical and pedagogical implications (Chan & Lee, 2023). Albayati (2024), Ellis and Slade (2023) examine ChatGPT's acceptance and user awareness levels, revealing that students believe AI will impact their professions and are willing to further their education in AI. The effectiveness of ChatGPT in generating accurate, clear, concise, and unbiased information to maintain academic integrity and scientific research (Tülübaş *et al.*, 2023; Su & Yang, 2023; Perkins, 2023), mainly one of the motivations behind the discussions on ethical AI and AI Governance.

In other educational streams, Alqahtani (2023) study on Qatari entrepreneurship education found AI positively impacts education, with machine vision having the highest impact. Bender (2023) explores the potential benefits of Gen-AI in screen media education, despite job concerns, suggesting it could improve employment opportunities and diversity and foster creative arts interest. Lee *et al.* (2022) presents an AI-applied system for Korean students, utilizing a Learner-Generated Context framework to enhance English language learning, highlighting its effectiveness and potential future research issues. Sumakul and Hamied (2023) reveals that over 25% of Indonesian EFL students experience apathy when using AI apps, attributed to factors such as intelligence, user interface, and lesson design, which are internal to AI. Ali *et al.* (2022) explores AI implementation in Pakistani university libraries, focusing on chief librarians' interviews. The findings by Sun and Hoelscher (2023) suggest AI could enhance services, but funding, time, and staff investment concerns persist.

These applications and benefits make AI an essential tool in education. Improving student engagement (Shi *et al.*, 2023), closing achievement gaps, personalizing learning (Rahiman & Kodikal, 2023), and enhancing access with quality and inclusivity aligns directly with SDG4 (Davenport & Mittal, 2022).

However, early research on AIEd was primarily focused on engineering aspects (Lesage *et al.*, 2024) and the impact of AI on education (Singh & Hiran, 2022). With the advent of Generative AI, research on AI governance is required to meet ethical and social challenges. Establishing laws, regulations, and ethical frameworks that guide the proper use of AI technology in educational contexts is called "AI governance" (Eaton, 2023). AI governance in higher education formally refers to the policies, regulations, and guidelines that govern the ethical and responsible use of artificial intelligence within educational institutions (Stone, 2023). It includes developing, implementing, and supervising AI technologies to ensure their proper use in teaching, learning, and research activities (Barrett & Pack, 2023). It may involve several vital aspects. Firstly, it establishes clear guidelines and standards for integrating AI technologies into the educational curriculum (Archer, 2023). Secondly, it creates mechanisms for faculty and researchers to ensure that the development and deployment of AI systems align with principles of transparency, accountability, and fairness (Mukasa *et al.*, 2023). Thirdly, establishing data protection and privacy policies to ensure the responsible handling of sensitive student (Rasul *et al.*, 2023). Finally, it includes implementing mechanisms to monitor and evaluate AI systems in education to address potential biases or ethical concerns (Doroudi, 2023; Alam *et al.*, 2023).

AI governance in higher education emerged in 2021 with several trends and considerations. These include the establishment of ethical guidelines, the addressing of algorithmic bias and fairness, the formation of collaborations and partnerships with stakeholders, the integration of AI governance into the curriculum, and concern about political prejudice and discrimination (Kumi-Yeboah *et al.*, 2023; Atenas *et al.*, 2023; Rozado, 2023). Though AI systems can make autonomous decisions that impact individuals' lives, AI governance establishes mechanisms for its accountability and liability. This enables institutions to stay updated with emerging ethical, legal, and social issues and adapt their policies and practices accordingly (McGrath *et al.*, 2023). Singapore's model AI governance framework (Liaw *et al.*, 2023), the Schwartz Reisman Institute for Technology and Society at the University of Toronto (Mcllwraith *et al.*, 2023), University of California system's moral principles (Mills, 2023), the University of Chicago's AI Governance Council, and the National Center for AI in Education's toolkit for developing AI governance policies (Erman & Furendal, 2022) are some classic examples. Institutions are adopting ethical frameworks to guide the devel-

opment and use of AI, requiring greater transparency and accountability from AI developers and users. Collaboration across institutions is essential, as no single institution can keep up with the latest developments in AI governance (Ratten & Jones, 2023).

This study aims to provide a systematic review by synthesizing the available literature to shed light on knowledge gaps and propose new research directions for using AI governance in higher education. This literature review also explores the background of AI's integration into higher education, focusing on its applications, benefits, challenges, and implications for students, educators, and institutions.

Rationale of AI governance adoption in higher education: Internationalism to ethical guidelines

AI in education

AI has been a significant part of education for decades, with early examples including the PLATO system in the 1960s (Friesen, 2020). In the 1980s, AI was used to develop intelligent tutoring systems (ITSs) (Rosenberg, 1987), adaptive testing in the 1990s, and virtual tutors in the 2000s (Wainer *et al.*, 2000). These programs provide personalized feedback and instruction to students, helping them overcome challenges or practice problems.

AIEd has evolved over several decades, integrating educational theory and technology. Research has explored intelligent tutoring systems, adaptive learning environments, and collaborative learning (Zawacki-Richter, 2023). In recent years, AI technologies have intensified synergies with educational practices, introducing innovative applications like chatbots, automated grading, and predictive analytics (e.g., Lai & Bower, 2019; Tamim *et al.*, 2011). However, researchers face challenges such as ethical use, system transparency, and navigating pedagogical implications of autonomous AI systems in educational settings Saghiri *et al.* (2022).

The review by Vecchiarini and Somià (2023) and Pellas (2023) explores the history of AI in higher education, tracing its roots to modern machine learning algorithms and examining intelligent tutoring, adaptive learning, and automated rating systems. China's government launched a strategic policy in 2019 to promote the integration of AI and the professional development of teachers (Chiu *et al.*, 2023). The US provides resources and

grants for AI-driven platforms (Boninger *et al.*, 2020; Williamson & Eynon, 2020), while the Jacobs Foundation has awarded CHF 2 million to Finland and Radboud University for these initiatives (Miao *et al.*, 2021; Kuhl *et al.*, 2019). The Organization for Economic Cooperation and Development recommends further research to translate findings into educational practice and use big data and learning analytics (Focacci & Perez, 2022). The Impact of AI-powered adaptive learning systems on student engagement and academic achievement is investigated in (Siemens & Baker, 2012). Adaptive learning aids increase student understanding and recall of complicated topics, resulting in better learning outcomes. AI in learning analytics evaluates data sets, providing information on student performance, behavior, and learning patterns, potentially improving educational interventions and student retention (Hagège, 2023; Drugova *et al.*, 2022; Salifu *et al.*, 2024). AI-driven virtual assistants in higher education improve the student experience and access to information and reduce response times, enhancing student satisfaction and support (Malik *et al.*, 2023; Qu & Kim, 2022). AI-based personalized learning pathways improve engagement, self-directed learning, and academic achievement by catering to individual needs and styles, according to (Jin *et al.*, 2023). AI-powered grading systems streamline the grading process, providing timely feedback and enhancing learning outcomes by reducing assessment time and effort while maintaining accuracy (Lachheb *et al.*, 2023; Nikolic *et al.*, 2023).

As AI becomes increasingly prominent in higher education, there is a rising need to address the issues and concerns related to its administration, ethics, and privacy (Liu *et al.*, 2023). AI governance at the university level can play the key role in addressing these issues and ensuring that using these technologies in the classroom aligns with ethical standards and protects human values as they become more ingrained in academic processes {Nam & Bai, 2023; Rahm & Rahm-Skågeby, 2023}. There is a requirement for effective data governance policies to protect sensitive information based on ethical considerations, including transparency, fairness, and accountability (Bin-Nashwan *et al.*, 2023).

Internationalism in AI governance in higher education emphasizes global cooperation and collaboration in developing policies, guidelines, and ethical frameworks for the responsible use of AI in countries and regions (Alhumaid *et al.*, 2023). The ethical implications of AI technologies affect students and educators worldwide. International cooperation in AI governance addresses collective efforts to address common ethical con-

cerns and foster a global culture of responsible AI use in higher education (Carvalho *et al.*, 2022). Although it is evident that institutions face challenges in navigating AI applications, international collaboration can develop harmonized standards, promoting trust and confidence in AI technologies (Chan, 2023; Chan & Hu, 2023). Therefore, during the past several years, there has been a proliferation of academic contributions and ideas on educational AI governance (Wang *et al.*, 2023; Crompton & Burke, 2023).

Government agencies such as the European Commission and the US Department of Commerce fund AI governance research, indicating government commitment to understanding AI risks and developing mitigation policies (Crompton & Burke, 2023). According to Shwedeh (2024), Saudi Arabia's educational institutions want digital transformation for Vision 2030, leveraging blockchain technology for increased verification, fraud prevention, and plagiarism detection (Chaudhry *et al.*, 2023). Shehzad and Charles (2023) intends to analyze U.A.E. contract cheating and offer a top-down strategy. Additionally, Martin-Núñez *et al.* (2023) show that the digital age and COVID-19 encourage digitalization in higher education. Saudi institutions must embrace data governance, internal audits, regulatory compliance, training, and evaluations for transformation to be successful. Alhumaid *et al.* 2023 investigates AI adoption in Gulf governmental institutions, emphasizing diffusion theory's favorable influence on business ease and technology export. Surveys were carried out among undergraduates at Oman institutions, and the findings have revealed that the suggested model had a favorable effect on the continuous desire to use it (Slimi & Villarejo Carballido, 2023). Habibi *et al.* (2023) and Gaber *et al.* (2023) also investigates the effects of university communication and technology acceptance models on student and faculty happiness, academic achievement, and effectiveness.

Watanabe (2023) states that AI has had major success since the mid-1950s, with applications in various fields. Fears have been made regarding its ability to act like humans, although Morocco's education revolution has generated concerns about its future, with cautious optimism about technical help (Douali *et al.*, 2022). The research by Mohammadkarimi (2023) examines the implementation of transformation education in EFL teaching, focusing on leadership, policy, and community-centered teaching (Alshumaimeri & Alshememry, 2024). In Kazakhstan, researchers are investigating AI in education for individualized learning systems, employing social networking, chatbots, expert systems, machine learning, and virtual envi-

ronments (Wu *et al.*, 2023). The study by Sallam and Al-Salahat (2023) investigates the impact of artificial intelligence (AI) on Jordanian universities' digital transformation, discovering that AI significantly impacts leadership, strategic planning, and infrastructure.

The study by Avello-Sáez and Estrada-Palavecino (2023) and Martin-Núñez *et al.* (2023) looks at how digital technology affects higher education institutions in Latin America, looking at things like training, infrastructure, and internet access. On the other hand, Combita Niño *et al.* (2020) talk about how the Universidad de la Costa in Colombia's business intelligence governance framework focused on analytics maturity, organizational culture, data management, and governance, making sure that there were effective controls and aligned (Cusirramos *et al.*, 2023). Valdés *et al.* (2021) also looked at how institutions in Chilean universities were involved in the digital transformation. They found that it affected values and operations and emphasized the need for management to step in at different performance levels.

Cowling *et al.* (2023) and Chou *et al.* (2022) explored Australian HESD utilizing eLearning, indicating low teacher expertise, sustainability issues, student engagement, and resource allocation. On the contrary, Mukasa *et al.* (2023) stated that automated thinking in education policy utilizing the Australian State Department's policy analysis unit needs more research.

The Karakose and Tülübaş (2023) discovered that the Turkish government's state policy influences higher education, with both excellent and negative implications for institutions. They urge that policymakers and service providers explore these problems. Ahmad *et al.* (2023b) looks at governance problems in Pakistan's education system and suggests ways to use technology. Bin-Nashwan *et al.* (2023), on the other hand, investigates IT governance in Malaysian public universities and suggests an intelligent framework that aligns with COBIT and previous IDMSS research.

The higher education system in Serbia and Romania is undergoing significant transformations due to the introduction new technology and methodologies. These changes are expected to meet PISA requirements, increase the DESI (Digital Economy and Society Index), and mitigate inequity in higher education institutions (Bucea-Manea-Ţoniş *et al.*, 2022). A study was conducted on 139 teachers from ITS, Belgrade, and Spiru Haret University, Romania, to understand the challenges and opportunities associated with AI in higher education. The study aimed to develop an AI education policy for higher education by examining the perceptions and

implications of text-generative AI technologies (Popescu *et al.*, 2023). Data was collected from 457 students and 180 teachers in Hong Kong universities across various disciplines and proposed an AI Ecological Education Policy Framework to address the multifaceted implications of AI integration in university teaching and learning (Chen, 2023).

Existing reviews, policy recommendation and research questions

Apart from the above policy implementations, the vast literature, comprehensive reviews and scientometric studies are crucial for advancing research fields by providing a holistic understanding of current trends, identifying gaps, and guiding future directions. These studies often uncover contradictions or interesting facts, such as a bias towards studying materials in multi-material additive manufacturing and a need for more qualitative, multi-theory, and cross-cultural studies. Examples include (Ramy, 2017) research on Knowledge Management and (Marín-Rodríguez, 2024) analysis on landslide risk assessment. AI integration in higher education is transforming teaching, decision-making, and research integrity. However, ethical considerations and governance frameworks are lacking. A meta-analytic review, scientometric analysis, and policy implications are needed to balance innovation with ethical concerns and ensure AI governance aligns with educational values and societal needs (Khan *et al.*, 2025; Bond *et al.*, 2024). Highlighted the exciting insight, (Gellai, 2023) discussed the advanced cheating detection systems at US and UK universities include wearable technology, ocular scanning, and keyboard recording. It covers responsibility, policy, and student opposition, exposing dis-empowerment and cultural asymmetry (Oravec, 2022). With the amalgamation of generative AI in education, universities in every corner are working towards AI governance and ethical use of AI-based tools and technologies (Pellas, 2023; Zekaj, 2023). Therefore, with worldwide research output expanding exponentially, the digital revolution in education needs long-term governance.

This study aims to combine literature into a comprehensive review of AI governance in higher education. The existing literature sheds light on how pervasive AI is already in various industries and demonstrates the benchmark in the education sector. However, this research presents a thorough literature assessment and meta-analysis of AI governance with a limited scope in higher education. The critical research questions this systematic review tends to answer are:

RQ1: *How has research in AI governance in higher education evolved over the years, as reflected in scientific literature, thematic advancements, and future trends?*

RQ2: *What policies and initiatives are being taken to implement AI governance in higher education?*

Methods

The detailed insights clarify that the dataset encompasses information from 2022 to 2024 and originates from 72 diverse sources, constituting 142 article manuscripts. The data displays an average of 14.38 citations per document, with 528 authors involved in the research with more than 32% international co-authorship. Regarding document contents, there are 501 author keywords. Collaboration among authors is also evident, with an average of 3.86 co-authors per document. Year-wise trends show that 2023 produced the most (106 papers), with 14.12 mean total citations per article and 7.06 mean total citations per year.

This systematic review complies with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines. It is a set of guidelines that provide a standardized approach to conducting and reporting systematic reviews and meta-analyses. PRISMA enhances the review by providing transparency, reproducibility, clarity, and consistency. It includes a checklist for quality assessment and a standardized format for easy comparison (Page *et al.*, 2021) as depicted in Figure through a flow diagram. The articles were found using Scopus databases only. The reason for choosing only this database is that researchers, academic institutions, and scholars frequently use it to conduct literature reviews, find pertinent publications, identify influential articles and authors, and evaluate the impact and visibility of research through citation analysis.

Over 90 million records are available in the Elsevier-run bibliographic database Scopus (Rafiq *et al.*, 2023). The database is valuable for staying current with the latest research in a particular field and conducting comprehensive literature searches. The article must contain the keywords government, policy, administration, or regulation combined with artificial intelligence and higher education, along with the option of the following terms: education, e-learning, engineering, government, governance ap-

proach, higher education institutions, or e-government. Query 1 represents the query string for Scopus. Manual truncation is done for novel words with the same meaning and origin but in a shorter form. Acceptable submission formats are limited to English-language research articles, reviews, conference papers, and book chapters. The checks were made on February 6, 2024.

There were 25,320 results in the search streams. These are further restricted to the social science topic area (9899 articles). Because enough research was retrieved, only journal papers were included in the study, lowering the total to 7593 articles. Furthermore, 1070 entries were excluded because they were either in the process of being printed or lacked critical information for their target readership. As a result of the English-only reporting policy, 68 items originally written in Spanish, 56 Russian, 31 Chinese, 22 Portuguese, 9 Arabic, 8 Italian, 7 Persian, 7 French, 5 Korean, 3 German, 2 Turkish, 3 Estonian, 2 Slovenian, 2 Malay, 1 Swedish, 1 Romanian, 1 Moldovan, 1 Moldovan, 1 Lithuanian, and 1 Croatian were removed. The total number of articles that qualified for the evaluation was 6291. The number of publications was reduced to 3892 when only open-access papers were evaluated. Manuscripts were examined for keyword matches, whether within the research scope or lacking important sections. 57 education-related papers, such as hospitality and tourism, were deleted.

2752 papers were removed because of a keyword mismatch (only synonyms of AI, governance, and higher education: machine learning, university sector, higher education institutes, generative AI, etc.). 136 reports were omitted because they were beyond the scope of the study (AR/VR, computer vision, chatbots, K-12 education). 97 reports on e-learning and digital media were removed. The search results also excluded 104 publications on topics such as smart cities, cryptocurrency, and big data in education. 331 documents from the COVID-19 era were also removed. Finally, 210 reviews, editorials, comments, and opinion pieces were eliminated. These filters resulted in 142 publications being included in the review. The specific criteria for acceptance or rejection are listed in Table 2.

The studies' author names and affiliations were used to trace the origins of the investigation, together with the studies' dates, journals, abstracts, and key terms. The table also presents the insights from the articles on various aspects of education and technology, specifically related to digital transformation, artificial intelligence (AI), and other emerging technologies in educational contexts. The articles span a wide range of topics, including

the implementation of blockchain technology in Saudi Arabia's educational sector, leadership in transformative education, sustainability in higher education institutes, AI applications for personalized learning, cheating detection systems, the impact of AI on digital transformation in Jordanian universities, adoption of AI applications in online learning, data governance and integration for digital transformation in Saudi universities, and many others. The articles also explore the ethical implications, challenges, and opportunities of integrating AI and other technologies into education. Overall, the articles highlight the evolving landscape of education in the digital age and the need for thoughtful consideration of technology's role and governance in shaping the future of learning.

The scientometric analysis used the open-source R-Studio's Bibliometrix library (Aria & Cuccurullo, 2017). The dynamic graphical depiction of the biblioshiny() method was used for scientometric investigations, correlation analysis, and other relevant bibliometric maps.

Results

The findings are presented with meticulous alignment of research questions. The discussions in the subsequent subsections are twofold. The first one looks at the growth and trends of AI governance in higher education by looking at the number of annual reports, collaborations between countries, relevant sources, keyword analysis, and thematic findings. The second one shows the policies implemented by examining how countries, institutes, and organizations contributing to AI governance in higher education are connected.

The research trends and initiatives of AI governance in higher education

The annual scientific publications can justify the growth and trends of AI governance in higher education. 35 papers in 2022 increased to a drastic 151 in 2023, and there were already 19 papers in 2024, highlighting the exponential growth of scientific publications. The number of articles increased significantly due to the release of generative AI and large language models (LLMs). The trend has an upward stream, indicating that the number of scientific publications has increased over time and tends to increase in the future.

Relevant sources and publications in AI governance

The top 10 most relevant sources for publishing articles on AI governance are shown in Table 3. Elsevier's Computers and Education: Artificial Intelligence is the most appropriate source, which contains 14 articles and contributes to an h-index of 6 with 260 total citations. Other sources include the International Journal of Education Technology in Higher Education, with a h-index of 5 and 83 citations, and Simon Fraser University's Journal of Applied Learning and Teaching (6 articles and an h-index of 4, with a total citation of 162), sponsored by Kaplan Singapore. Springer's International Journal of Artificial Intelligence in Education is tenth on the list with six articles, contributing to an h-index of 2. Furthermore, the analysis also identifies a few dedicated journals in the field with high citations: the Education and Information Technologies, the International Journal of Management Education, the British Journal of Educational Technology, and the Journal of University Teaching and Learning Practice (6 articles and an h-index of 4, with a total citation of 162), sponsored by Kaplan Singapore. Springer's International Journal of Artificial Intelligence in Education is tenth of the list with six articles, contributing to an h-index of 2. Furthermore, the analysis also identifies a few dedicated journals in the field with high citations: the Education and Information Technologies, the International Journal of Management Education, the British Journal of Educational Technology, and the Journal of University Teaching and Learning Practice.

Keywords analysis, trending topics, and thematic findings

The detailed literature in Section 2 states that governments and educational institutions worldwide have accepted the need to integrate AI into the education sector and have implemented policies to guide its development and application. The same can be seen in keyword analysis, where AI, Chatgpt, higher education, ethics, digital transformation, privacy, policy, and sustainability are the trending keywords. This highlights the relevance of fair and transparent AI deployment among stakeholders during policy design.

The keyword collaboration network in Figure 2 depicts four significant clusters: artificial intelligence, students, ChatGPT, and learning. Other big names include sustainable development, academic research, ethics, policy, and paradigm shifts. The figure highlights the intersection of top keywords

in education technology, with "chatgpt" and "educating computing" as the most significant words. Sustainable development is a smaller word but still significant, as it emphasizes the environmental impact of AI technologies. As AI technologies become more powerful, it is crucial to develop them sustainably. Another analysis conducted in this study is the process of thematic analysis, which involves grouping authors' keywords into clusters and examining their interconnections to extract thematic patterns. Specific characteristics, such as density and centrality, define the density of these authors as graphically depicted on the vertical axis, while centrality is represented on the horizontal axis (Esfahani *et al.*, 2019). Centrality represents the level of correlation between different topics, while density assesses the interconnection of nodes. These two properties offer insights into the significance and maturity of subjects. Nodes with more connections to other nodes within the thematic network hold higher centrality, indicating their pivotal role. Likewise, a node's cohesiveness, reflecting the density of a research field, indicates its capacity for development and continuity. In Figure 3, the thematic map of the node's governance field is divided into four quadrants (Q1 to Q4).

We find dominant themes in the upper right quadrant (Q1); basic themes are in the lower right quadrant (Q4). The upper left quadrant (Q2) consists of highly specialized or niche themes, while the lower left quadrant (Q3) encompasses emerging or declining themes. In Q1, "artificial intelligence," "students," and "higher education" are motor themes, while "socio-technical" and "economic and social effects" are other important motor themes. The Q4 quadrant depicts that "artificial intelligence technologies and tools' remain the basic needs and essentials for developing AI governance. The thematic analysis shows that AI and Learning thrive in higher education and academic research for sustainable development.

The Q2 quadrant correctly highlights academic integrity and technology adoption as the niche themes to focus on while researching AI governance. Surprisingly, the Q3 themes—machine learning, student perception, cognitive science, and training systems—seem to be emerging. Still, the distance from the basic theme shows that these are not necessary for the evolution of AI governance.

Policies in progress to implement AI governance in higher education

Implementing AI governance policies in higher education ensures AI technology's responsible and ethical use (Huang *et al.*, 2023a). While governments acknowledge the significance of AI for future development, there remains a lack of comprehensive research regarding policies and their implementation tailored to AI in education (Adair, 2023). This has led to the establishment of various organizations and initiatives, such as the Organization for Economic Cooperation and Development's AI Policy Observatory, the Global Partnership on Artificial Intelligence, and the Ad Hoc Committee on Artificial Intelligence of the Council of Europe, among others (Yue *et al.*, 2022). The ongoing policies that are globally in action are discussed in the following headings:

Scientific publication production by region/countries

Figure 4 depicts the geographical distribution analysis of country-wise scientific production. The figure shows a significant disparity in scientific production between developed and developing countries. The top countries have high scientific output, and The UAE is emerging as a leader in production following its vision of the UAE's National Strategy for Artificial Intelligence to become the world's leader in AI by 2031 (Johnson *et al.*, 2022). The United States, Canada, the United Kingdom, Germany, Australia, China, and Japan also have significantly high scientific output levels. Progress is being made in narrowing the gap between developed and developing countries, with Russia, Mexico, India, and Brazil progressing in scientific output. The map also indicates significant collaboration among European, North American, and Asian countries. This phenomenon can be attributed to several factors, including the strong economic ties between countries, the existence of major research universities, and the accessibility of funding to support collaborative research.

Table 4 shows the quality of publications based on total citations and average article citations. The United Kingdom has 623 total citations and 47.90 average article citations, followed by China with 216 total citations and 27 average citations, and the USA with 216 total citations and 19.90 average article citations. Based on the number of articles, the USA (114 articles) has the most publications, followed by the United Kingdom (112 articles), Australia (104 articles), and China (81 articles). AI governance and

regulation strategies were adequately introduced in 2022, with the justification of these findings can be seen in the research by Atenas *et al.* (2023) that talks about how the United Kingdom established the Center for Data Ethics and Innovation (CDEI), where the Alan Turing Institute was crucial in shaping governance policies. Whereas Lim *et al.* (2023) discusses adopting a technological framework in an organization in Malaysia. The United Arab Emirates (UAE) government took a proactive stance toward regulating AI to take the lead in this area and has unveiled the "Ethics in AI Toolkit," a set of principles and best practices for the responsible application of AI to meet Vision-2030 (Halaweh, 2023; Alkhaaldi *et al.*, 2023).

Institutions, organizations, and collaborative network

Digging deeper into the contribution institute-wise, better visualization of top organizations contributing to the specific area of AI governance in higher education and the country is shown in Figure 5. In the three-field plot, the leftmost column represents active organizations; the middle column shows the contributing countries, and the rightmost column represents the author's keywords. The organizations publishing in AI governance are placed at the top based on their total link strength. The height of rectangular nodes corresponds to the frequency of appearance of a particular country, institution, or keyword within the collaborative network. Meanwhile, the width of the lines connecting the nodes is directly proportional to the strength of the connections. The figure shows that the United Kingdom (frequency = 169) is the country with the most contributions, contributing 14 articles with "artificial intelligence" as the keyword and 23 articles with "chatgpt" as a keyword. The top contributing institutions are Swansea University and the National University of Singapore. However, Jordan (frequency = 11) was the country with the least frequent appearances, contributing a total of 6 articles, with "artificial intelligence," "ethics," and "government" as keywords.

Discussion

This thematic review of AI governance in higher education provides a dual contribution by combining theoretical insights with practical implications to ensure the responsible integration of AI technologies in the higher edu-

cation sector. The review tries to provide a current perspective on AI governance in higher education and confirms that ethical AI and AI governance are already a subject of concern, with various organizations worldwide developing strategies and frameworks for their implementation.

Implication of the study

The education metaverse has outgrown merely being a synonym of AR/VR, and AI's role is nontrivial (Hwang & Chien, 2022). The icing on the cake is the release of ChatGPT in November 2022, which significantly disrupted the global higher education canvas (Lai *et al.*, 2023; Loos *et al.*, 2023). These technologies seem to develop possible student-to-generative AI relationships, focusing on two dimensions: student-to-AI and AI-to-human interactions (Pisica *et al.*, 2023). The current story of ethical AI and AI governance revolves around large language models (LLMs) and generative AI. The literature discusses ChatGPT in education and evaluates its impact on students and their learning. It focuses on the issues of equity and governance to ensure that the AI-based tool is used ethically and safely without restricting students' academic development (Abu Khurma *et al.*, 2023). On the contrary, in some cases, generative artificial intelligence (AI) integration in English language teaching presents opportunities and challenges for instructors (Kohnke *et al.*, 2023) and displays low knowledge, experience, and confidence in using these tools (Moorhouse, 2024). Therefore, using LLMs like ChatGPT in education presents both challenges and opportunities, and it is crucial to approach its use with caution and consider the ethical implications of academic integrity.

In a global context, Saudi Arabia's educational institutions utilize blockchain technology for improved verification and fraud prevention (Al-Abdullatif, 2023). Huang *et al.* (2023b) compares UK and Chinese academic libraries' strategic responses to AI applications, revealing that despite some AI-based applications, most plans do not explicitly mention AI. Qatar's nursing schools are implementing transformative education and investigating students' acceptance of early warning systems in online universities (Ahmad *et al.*, 2023a). Australia's Higher Education System (HESD) uses eLearning, but challenges include limited teacher knowledge, sustainability, student engagement, and resource allocation (Birks & Clare, 2023). Kazakhstan uses AI for personalized learning systems (Tapalova & Zhiyenbayeva, 2022); UAE contract cheating is also being studied (Dwivedi *et al.*,

2023); and the role of higher education in supporting economic growth in emerging economies is examined (Plata *et al.*, 2023). Some studies also examine the connection between political globalization (Rozado, 2023), higher education, and health development. Other studies talk about the role of AIA adoption in Gulf governmental institutions (Elshamly & Gameel, 2023), the possibility of representational scaffolding for digital simulations in higher education (Kim & Kim, 2022), and how AI changes research practice and culture (Ducasse *et al.*, 2023). Qawaqneh *et al.* (2023) research also explores the impact of network strategic capabilities (NSCs) and artificial intelligence (AI) on Jordanian universities' digital transformation, finding that AI significantly impacts leadership, strategic planning, and infrastructure. It also highlights the importance of high student engagement and a digitally transformed environment (Mohamed Hashim *et al.*, 2021).

The competitive intelligence industry thrives due to Information Age trends, requiring universities to prepare future practitioners with tech-savvy and soft skills (Aler Tubella *et al.*, 2024). In Industry 4.0, many IT sector companies use AI for competitive advantage, requiring management education to equip students with ethical skills in digitalized business environments (Quy *et al.*, 2023; Bernabei *et al.*, 2023). Critics argue that AI principles have been used for 'ethics washing' (Holmes *et al.*, 2023) and focusing on educational socio-technical achievements (Tarisayi, 2024; Henry & Oliver, 2022). Emerging technologies like big data (Berding *et al.*, 2022) and educational infrastructure (Vries, 2022) require adaptation and addressing job requirements, ethical responsibilities, and socio-cultural aspects. Traditional academic leadership models must prioritize managerial and transactional approaches and sustainability-centered pursuits (Shal *et al.*, 2024; Nguyen *et al.*, 2023).

Theoretical contribution

Theoretical contributions from this review encompass the growth in trends and the development of conceptual frameworks that facilitate a deeper understanding of AI governance in educational contexts. These frameworks provide structured lenses to analyze the multifaceted dimensions of AI governance, fostering a more systematic exploration of the field. Regarding conceptual trends in AI governance in higher education, the findings of the scientific visualizations highlight the importance of higher education, academic research, and sustainable development. These areas

are interconnected and crucial for the future of education. Higher education trains the next generation of scientists and engineers, generates the latest ideas and innovations, and develops fundamental knowledge for technological progress. Academic research develops essential knowledge, such as artificial intelligence, which can help solve complex problems like climate change and healthcare. Sustainable development ensures that technology benefits everyone, such as renewable energy research, without compromising the environment. Regarding policies and their implementation, various countries and institutions have already developed numerous strategies and ethical guidelines to outline approaches to governance, focusing on ethical AI, data privacy, AI in education, and responsible research. Some countries are developing regulatory frameworks for AI technologies, while others seek international collaboration to deal with global challenges. For example, Adarkwah *et al.* (2023) discusses the slow pace of digital transformation in Ghana's education system and its effect on 21st-century employability skills among students (Segbenya *et al.*, 2023). Al-Tkhayneh *et al.* (2023) highlights the lack of knowledge among academics about AI and its potential benefits in Pakistan. It also discusses the challenges of implementing AI in Pakistani university libraries, the impact of AI on entrepreneurship education, and the challenges of integrating AI in higher education. Overall, public-private partnerships between governments, industry, academia, and civil society are encouraged to create inclusive frameworks leading to certification mechanisms and standards being established to ensure adherence to best practices in AI applications. The UN's Sustainable Development 2030 agenda prioritizes quality education, with digital technologies playing a crucial role in emissions detection, energy efficiency, and pollution reduction (Kamalov *et al.*, 2023). The COVID-19 pandemic has institutionalized these technologies in education (Greiner *et al.*,2023). The theoretical contribution concludes that to cope with the AIED research, ethical concerns like fairness, accountability, transparency, bias, autonomy, agency, and inclusion must be addressed. A well-designed framework with a multidisciplinary approach and robust guidelines is crucial.

Practical implications

The practical implications of AI governance in higher education are significant and require careful consideration. Drawing from evidence-based

insights, institutions and governments are empowered to formulate robust policies that guide the ethical development and utilization of AI technologies. Universities must have clear procedures to secure student data and guarantee that AI systems are not utilized in ways that infringe on students' privacy. They must also have explicit accountability procedures to ensure that AI technologies are used fairly and ethically. They must provide training and development opportunities for students, instructors, and staff to utilize AI effectively and ethically as a moral obligation. New rules and processes concerning data protection, security, and accountability must be disseminated to the broader community. This review illuminates the need for effective strategies for bias mitigation, facilitating equitable AI-powered processes, integrating transparency and explainability into AI systems, and ensuring that decisions made by AI are understandable to stakeholders. The major takeaways are listed below:

1. Several vital issues must be resolved before AI-supported teaching and learning can be successfully integrated into the educational system. These issues are not limited to students' acceptance of and opinions on AI-based systems, the ethical use of generative AI tools, and the security of students' data.
2. This paper explores AIEd (Artificial Intelligence in Education) research, focusing on authorship and publication patterns. US-American, Chinese, and UAE authors dominate the field.
3. The study identifies several broad areas of AI application in higher education, each with multiple subcategories. Potential applications in higher education are emphasized as they can support students, faculty, and administrators, particularly in large institutions. However, the paper warns against focusing only on technology and highlights the importance of considering the pedagogical, ethical, social, cultural, and economic dimensions of AIEd.
4. The lack of critical reflection on AI implementation's moral implications and risks in education is also noted. The article suggests the need for more educational perspectives and greater integration of theory to advance pedagogical and psychological learning theories related to AI-driven educational technology. Researchers are encouraged to be explicit about the ideas underlying their studies to expand research and better understand the dynamic development and impact of AI in higher education.

Conclusions

This bibliometric study examines the need for and existence of AI governance in higher education, based on 204 articles published between 2009 and 2023. Detailed literature and bibliometric insights show that the government, higher education institutions, and the research community recognize the benefits of AI in education. AI is widely recognized as a potential transformative force in higher education by providing digital transformation, personalized learning experiences, adaptive assessments, and virtual tutors. However, ensuring that AI is used ethically and responsibly is critical.

The study explores the technical considerations inherent in AI governance and identifies progress in comprehensive regulations for its ethical use in higher education. These findings are published in journals of great repute, not limited to Computers and Education: Artificial Intelligence (Elsevier) and Education and Information Technologies (Springer). It can be concluded that the top universities, including Swansea University, United Kingdom, and the National University of Singapore, are a few that have embraced research production in the field of AI governance and regulatory compliance measures.

Healthy collaborative networks are forming between developed and developing nations to minimize the productivity gap. The United Kingdom is a standout country regarding citations, highlighting a growing emphasis on AI research. In contrast, the USA, China, and the UAE are the top countries in scientific production. Keyword and thematic analysis explore notable trends and interconnections encompassing AI, higher education, ChatGPT, ethics, digital transformation, privacy, policy, and sustainability, demonstrating their role in higher education.

The paper concludes that AI in education is accepted worldwide based on theories and evidence. However, strict rules are needed to ensure ethical development, strategies to reduce bias, fair AI-powered processes, transparency, and the ability to explain before it becomes fully integrated with higher education.

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Compliance with ethical standards

This article does not contain any studies with human participants or animals performed by the authors. Extracting and inspecting publicly accessible files (scholarly sources) as evidence, before the research began no institutional ethics approval was required.

Data availability statement

All data generated or analyzed are included in the published article. The raw data supporting the conclusion of this article will be made available by the authors, without undue reservation. The raw anonymized data can be provided by emailing the primary author.

Author contributions

All listed authors have made a substantial, direct and intellectual contribution to the work, and approved it for publication. The authors take full responsibility for the accuracy and the integrity of the source analysis.

Conflict of interest statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Annex

Table 1. Query string to access the Scopus database.

Query with filters	(ALL (AI) AND ALL (governance) OR ALL (policy) OR ALL (regulation) OR ALL (administration) AND ALL (higher AND education)) AND PUBYEAR ¿ 2021 AND PUBYEAR ¡ 2025 AND (LIMIT-TO (SUBJAREA , ”SOCI”)) AND (LIMIT-TO (DOCTYPE , ”ar”)) AND (LIMIT-TO (PUBSTAGE , ”final”)) AND (LIMIT-TO (LANGUAGE , ”English”)) AND (LIMIT-TO (OA , ”all”)) AND (LIMIT-TO (EXACTKEYWORD , ”Higher Education”) OR LIMIT-TO (EXACTKEYWORD , ”Artificial Intelligence”) OR LIMIT-TO (EXACTKEYWORD , ”Education”) OR LIMIT-TO (EXACTKEYWORD , ”Machine Learning”) OR LIMIT-TO (EXACTKEYWORD , ”ChatGPT”) OR LIMIT-TO (EXACTKEYWORD , ”Engineering Education”) OR LIMIT-TO (EXACTKEYWORD , ”University Sector”) OR LIMIT-TO (EXACTKEYWORD , ”High Educations”) OR LIMIT-TO (EXACTKEYWORD , ”Ethics”) OR LIMIT-TO (EXACTKEYWORD , ”Academic Integrity”) OR LIMIT-TO (EXACTKEYWORD , ”Higher Education Institutions”) OR LIMIT-TO (EXACTKEYWORD , ”Deep Learning”) OR LIMIT-TO (EXACTKEYWORD , ”Natural Language Processing”) OR LIMIT-TO (EXACTKEYWORD , ”Machine-learning”) OR LIMIT-TO (EXACTKEYWORD , ”Medical Education”) OR LIMIT-TO (EXACTKEYWORD , ”Trust”) OR LIMIT-TO (EXACTKEYWORD , ”STEM”) OR LIMIT-TO (EXACTKEYWORD , ”Generative AI”) OR LIMIT-TO (EXACTKEYWORD , ”Artificial Intelligence (AI)”) OR LIMIT-TO (EXACTKEYWORD , ”AI”) OR LIMIT-TO EXACTKEYWORD, ”University”) OR LIMIT-TO (EXACTKEYWORD , ”Governance”Approach”)
Query without filters	(ALL (artificial AND intelligent) OR ALL (ai) AND ALL (governance) OR ALL (policy) OR ALL (regulation) OR ALL (administration) AND ALL (higher AND education))

Table 2. Inclusion and exclusion criteria

Criteria		
Inclusion and exclusion results	**Inclusion**	**Exclusion**
The used keywords appear in the article (e.g., title, abstract, keyword)	✓	
The Study is published in a peer-reviewed journal (Scopus).	✓	
The paper is written in the English language	✓	
Studies that are duplicated within the search documents		✓
Studies that are not accessible, review papers and meta-data		✓
Studies that are not primary study		✓

Table 3. Top 10 most relevant sources based on h-index

Journal Name	h-index	Total Citations	Number of papers
Computers and Education: Artificial Intelligence	5	260	14
International Journal of Education Technology in Higher Education	5	83	7
Journal of Applied Learning and Teaching	4	162	6
Sustainability	3	88	7
ECNU Review of Education	2	36	2
Education and Information Technologies	2	109	2
International Journal of Educational Integrity	2	10	4
International Journal of Artificial Intelligence in Education	2	112	2
International Journal of Data and Network Science	2	7	3
International Journal of Emerging Technologies in Learning	2	16	4

Table 4. Top 10 countries' production over time for last five years with total citation and average article citations

Country	Total Citations	Average article citations
United Kingdom	617	51.40
China	216	27
USA	216	19.90
UAE	174	14.5
Malaysia	113	37.70
Hong Kong	83	9.20
Canada	68	9.70
Australia	59	7.40
New Zealand	51	25.50
Finland	42	42

Figure 1. The PRISMA flow diagram for the systematic review of the determinants

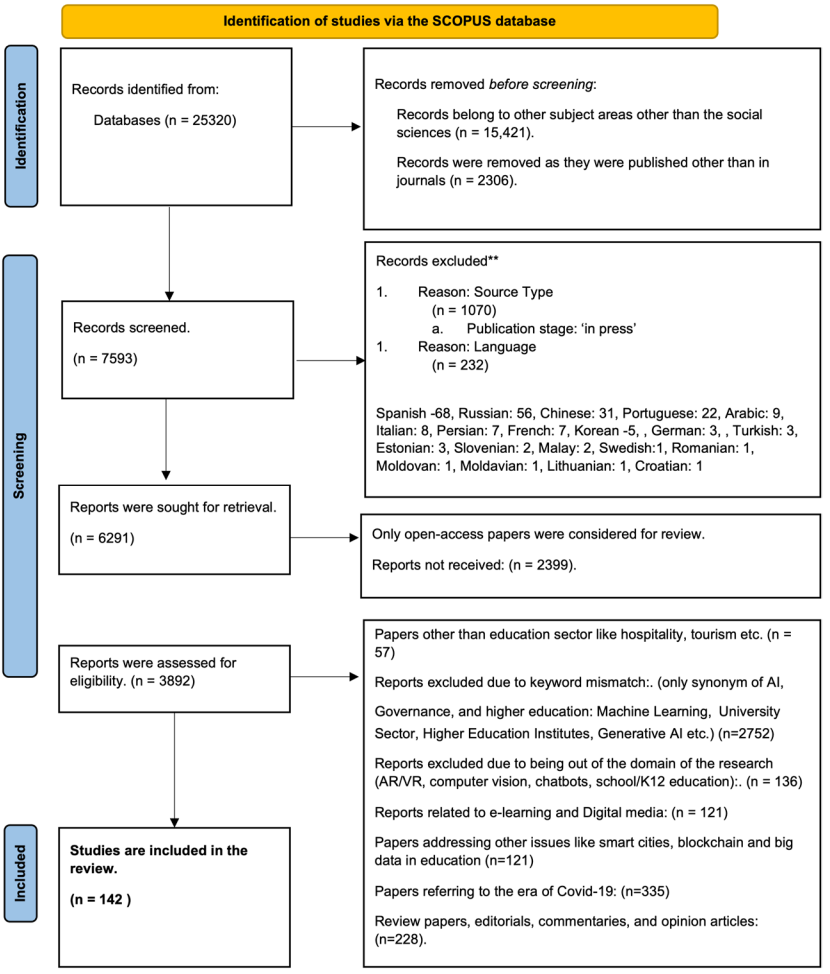

Figure 2. Keyword collaboration network

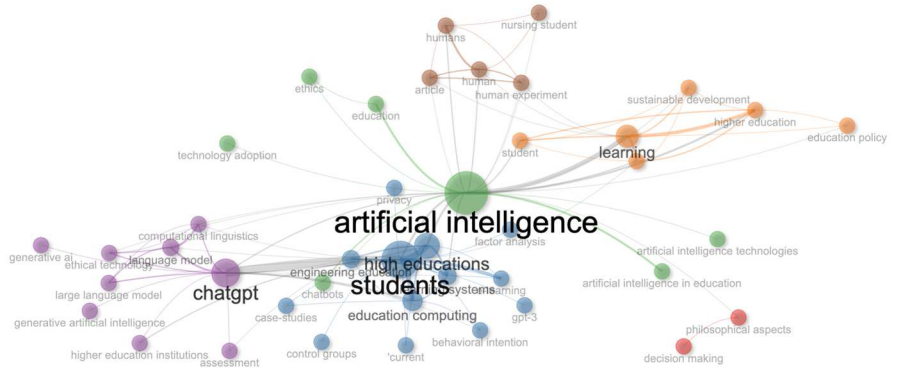

Figure 3. Thematic Map of the dataset

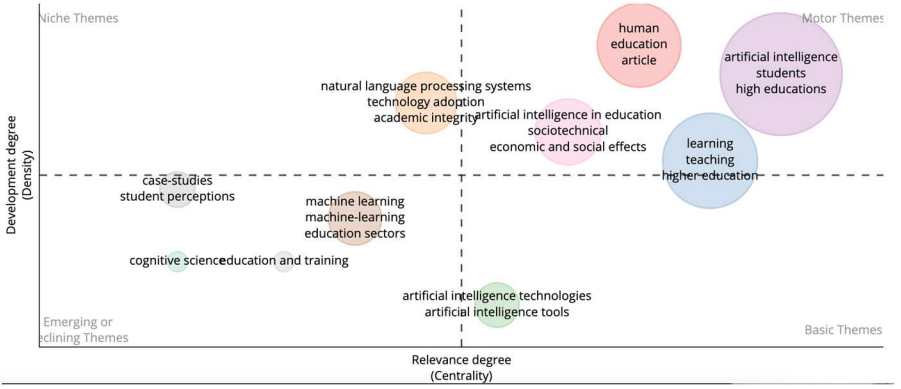

Figure 4. Country-wise collaboration for scientific production about AI governance in higher education

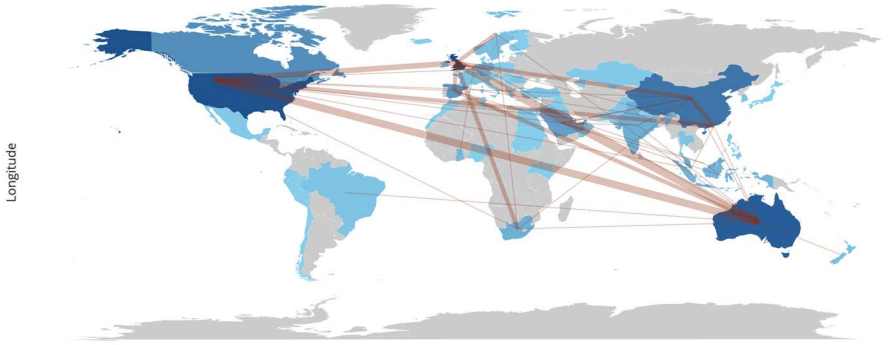

Figure 5. Three Field Plot of countries, organizations, and keywords