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Charting the Landscape of Artificial Intelligence in Higher Education: Ethics, Adoption, and Faculty Preparedness

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Abstract

The use of Artificial Intelligence (AI) is transforming the landscape of teaching, learning, and administration in Higher Education Institutions (HEIs). While the transformative potential of AI in higher education is evident, educators still grapple with important pedagogical, ethical, and professional issues. The study uses bibliometric analysis to explore the intellectual structure, thematic development, and current research trends in the field of AI in higher education. The review places a special emphasis on the readiness of educators, ethical issues, faculty perspectives, and the responsible use of AI technologies in educational settings. The study maps the current state of scholarly discourse in this domain using bibliometric indicators like publication trends, citation patterns, influential authors, collaborative networks, and keyword co-occurrence analysis. The results indicate a shift towards responsible AI use, academic integrity, data privacy, faculty readiness, and human-centered pedagogical strategies. The study builds on the growing body of research on AI in education by highlighting research clusters and future research directions that can inform policy, institutional leadership, and teaching practices in the creation of ethically sound and pedagogically sound approaches to the use of AI in higher education.

1. Introduction

Artificial Intelligence (AI) integration into education field has become one of the most debatable innovations, and it has fundamentally changed the way teaching and learning has always been performed. The most important technologies of AI, such as natural language processing and machine learning are transforming the educational structure and teaching delivery processes (Ahmad, Rahmat, Mubarik, et al., 2021). As technology is rapidly evolving, teachers and those in charge of institutions are becoming interested in learning more about the bigger picture of AI rather than rejecting it outrightly.

The embracing AI technology has been gradual process and there have been many factors that shapes the integration of AI in higher education. Much of the effective application of AI in education is hinged on the fact that these technologies are embraced by educators, students, and institutions (Al Darayseh, 2023; Chou et al., 2023). After COVID-19, researchers have considered how AI tools can be used in student assessment, making it essential to implement more flexible and adaptable ways of assessment (Chaudhry et al., 2023). From an institutional perspective, several factors determine educators' adoption of AI technologies, including perceived utility, user-friendliness, and institutional support levels (Demir & Güraksın, 2022).

It has been shown that favourable views of AI among teachers can boost its use in classrooms (Tan et al., 2025). As an example, educators that acknowledge the pedagogical importance of AI tools tend to implement them into their classroom settings more frequently (Chou et al., 2023). Structured training programs and pedagogical alignment are emphasized by framework-based studies as the tools of forming positive perceptions of AI (Qian, 2025).

Studies emphasize that teachers should be provided with continuous training to successfully incorporate AI technologies in their classroom routines so that they could align with the changing technological conditions (Ng et al., 2023b).

Also, AI facilitates smart tutoring mechanisms and enables addressing the needs of individual learners, which creates more exciting and effective learning environment. Hence, personalized learning improves learning processes which is a key reason why AI has been embraced in higher educational institutions (do Lago et al., 2026; Xie et al., 2025). Research in individualized systems in the classroom shows that it has been more effective approach to engage and motivate the students to achieve academic success (Xie et al., 2025). All these outcomes reflect on the disruptive aspect of AI when it comes to supporting the individualized and interactive form of learning.

Investigations employing structural equation modelling demonstrate that these elements serve as significant predictors of teachers' intentions to integrate AI into classroom practices (Wang et al., 2021). On the whole, these results show that AI-related perceptions are not developed in a vacuum and that the perception is shaped by the interaction of personal cognition, institutional support, and pedagogical compatibility. These factors should be addressed to achieve positive, inclusive, and sustainable adoption of AI in learning settings (Ng et al., 2023a).

The results indicate that both individual and institutional factors contribute to educators' attitudes toward the use of AI. In the micro-level, educators' willingness to adopt and use AI-powered tools in pedagogy is shaped by certain individual factors, including technological expertise, self-efficacy, confidence, and openness to innovation. At the same time, institutional factors such as professional development programs, organizational support systems, infrastructure availability, leadership commitment, and regulatory frameworks are crucial to enabling or hindering the effective implementation of AI in higher education institutions (HEIs). Taken together, current scholarship suggests it is not only the viability of the AI systems that is important to the successful implementation of AI, but the attitudes of the users, the institution's readiness to implement AI, and the capacity of the education ecosystem to adapt to an ever-changing learning landscape (Matos et al., 2025).

Moreover, the use of AI in higher education has changed significantly in the last 10 years, with a growing interdisciplinary and diverse research field (Al-Zahrani & Alasmari, 2024; Schmidt et al., 2025). The academic work focused on AI adoption, implementation, and pedagogical use in education has seen significant growth, especially since 2020, as a result of the recent advancements in AI, digital transformation efforts, and the increased need for educational spaces that are driven by technology (Vieriu & Petrea, 2025). Notwithstanding this vast amount of literature, the field continues to be fragmented in disciplines, contexts and thematic areas, requiring an in-depth review of the existing research trends and intellectual frameworks (Mustafa et al., 2024). It is therefore essential to be able to understand how AI is being used in HEIs and the areas where its use is most prevalent to aid in shaping future education strategies and policy measures.

In this context, the current research aims to systematically and comprehensively explore the changing research environment of AI adoption and use in higher education. The study provides insight into the evolution of educational AI research through the analysis of publication trends, authorship patterns, institutional and international collaborations, as well as thematic evolution in the literature. It is hoped that the results will provide important guidance to educators, researchers, institutional leaders and policy makers in terms of identifying areas of future research, emerging themes and under-researched research areas to be explored in future scholarly works.

2. Method and Materials

Bibliometric analysis was deployed to explore the perspectives, trends, opinions, key researched topics in the context of AI application in HEIs. Data was gathered from scholarly publications in SCOPUS[1] database.

A systematic methodology as suggested by the PRISMA protocol was used to achieve the goals of research transparency, dependability and reproducibility. The literature was identified through a logical combination of keywords related to the field of artificial intelligence, AI, pedagogy, and educational contexts. Selection criteria included scholarly, peer-reviewed articles in English language journals in the fields of business, social sciences, arts and humanities, and interdisciplinary studies. Research publications from 2020–2025 were included in the scope of the study. After the initial search, manual search was done to eliminate irrelevant and duplicate entries. The output data was analyzed using bibliometric software such as Biblioshiny[2] and VOSviewer[3] to discover trends and patterns and to determine the main research themes. This methodology framework offers a clear and detailed understanding of the factors that affect the use of AI in educational settings and adds to the current debate on the use of AI in pedagogy.

The boolean string used during extraction of the data from Scopus is mentioned in Fig. 2. Remaining documents manually cleaned by the authors and after the last exclusion filtration step, they ended up with 203 documents. The bibliometric analysis of 203 documents was done using Biblioshiny (R package) and Vosviewer software.

3. Content Analysis

3.1. The Domain-wise Diversity of AI adoption in Higher Education

Table 1 depicts a variety of AI application in education, evidencing that it is changing the way learning takes place. The papers demonstrate the application of AI technology in the fields of personalised learning, intelligent tutoring system and autopilot grading and assessment. It is anticipated that AI implementation in academic settings will enhance student engagement, offer increased learning flexibility, and deliver valuable insights that will optimize educational methodologies.

Table 1

AI in Higher Education

Paper Info	Purpose	Methodology	Results	Limitations
(Cox, 2020)	Explore AI and Robots' impact on higher education	Literature-based design fictions	Discussed the potential implications on the higher education, including more personalisation of the learning process, the automation of the administrative process and development of AI-based tutoring systems.	With speculative possibilities only, the realisation of these effects depends on a number of technological and societal issues.
(Allen et al., 2023)	Guide to instructing AI to higher education students.	Framework development	Raised the idea of an all-encompassing framework of teaching AI concepts to higher education students, both theoretical and practical.	Theory, not empirically verified, needs more confirmation and improvement in practice.
(Ahmad, Rahmat, Mubarak, et al., 2021)	AI's role in education	Literature review and analysis	Some of the possible applications of AI in education that were determined include personalised learning, smart tutoring systems, and automated grading.	Lack of the primary research underscores the need to have an empirical research that would be undertaken to support the usefulness and effectiveness of AI applications in the field of education.
(Al Darayseh, 2023)	AI acceptance in teaching science	Survey of science teachers	Found out that the attitude of the science teachers to the usage of AI in the learning process was favorable, and it has the potential to enhance student engagement and learning performance.	Narrow generalization because of the narrow concentration on science teachers, and possible self-report bias on attitudes.
(Al Saad et al., 2022)	Knowledge and attitude of medical students to AI.	Online survey	The attitudes of analyzed medical students towards AI which were largely positive in terms of AI technologies and, more specifically, in medical education and medical practice.	Potential response bias on self-reported attitudes (limited to medical students) and the study may not be able to elicit subtle attitudes.

Source: Author’s Compilation

Paper Info	Purpose	Methodology	Results	Limitations
(Allen et al., 2023)	Framework for teaching AI	Framework development	Suggested a multifaceted model of teaching AI, including the main concepts, ethical aspects, and applications, which will help offer an organized and non-discriminatory model.	Theoretical, which is not empirically tested and effectiveness of the framework must be proved by realization in various educational settings.
(Almaraz-López et al., 2021)	Comparative study of students' attitudes toward AI	Comparative analysis	Investigated variations in attitudes of students towards AI among various disciplines and found discipline-specific factors that affected the perceptions.	The findings can also not be entirely generalized to other fields of academics because they are limited to two disciplines.
(An et al., 2023)	Modelling English teachers' intention to use AI	Behavioural intention modelling	Established the impact on the intention to use AI among English teachers in their instructional activities on perceived usefulness, ease of use, and institutional support.	Only English teachers were allowed, and reality implementation can be affected by other contextual issues outside the study.
(Bucea-Manea-Țoniș et al., 2022)	AI potential in higher education	Case study analysis	Learned about the opportunities of AI in higher education, applied case studies of AI implementation in learning and administration.	The findings are also restricted to certain areas and hence they might not be comprehensive enough to understand the variety of educational situations across the globe.
(Chaudhry et al., 2023)	Revisit student performance evaluation with ChatGPT.	Case study	Answered the question about the effects of incorporating ChatGPT in student performance assessment, which demonstrated an efficient and better quality of feedback.	Having turned into a case study, the findings should be generalized in a diverse range of educational situations.
(Chiang, 2021)	Artificial intelligence: Learning efficiency to educate civil engineers	A case study to Taiwan	Article examined the applicability of AI to civil engineering learning in Taiwan that indicated the applicability to improve	Its results are also limited to one field (civil engineering) and one geographic area (Taiwan) and, as such, may not necessarily be universalized into

Source: Author’s Compilation

Paper Info	Purpose	Methodology	Results	Limitations
			learning outcomes and student engagement.	other fields and scenarios at the international level.
(Chou et al., 2023)	Perceived efficacy of AI-based teaching applications	Survey	Discussed the attitudes of teachers to the effectiveness of AI-based teaching applications that revealed that they were optimistic about the application of AI based teaching applications in the teaching learning process.	The perceived efficacy is the only limit as the actual effectiveness might be different depending on implementation and user experiences.
(Chounta et al., 2022)	The attitudes of teachers to AI in the Estonian K-12 education.	Qualitative study	Investigated the attitudes of AI towards teaching and learning at the K-12 level in Estonian schools among teachers and provided results that portrayed an ambivalent response concerning how AI impacted education and learning.	The results are limited to the K-12 education of Estonia; consequently, the results may not be representative of the perceptions of the teachers in other cultural and educational contexts.
(Cruz-Jesus et al., 2020)	Artificial intelligence approaches to measure academic performance.	AI methods application	Investigated how AI approaches can be used in measuring academic performance, which suggests that assessment can be performed in a more objective and effective way.	The practicality and moral aspects of mass AI-based evaluation should be further reviewed because they are confined to particular circumstances.
(K. Dai et al., 2026)	Promoting students' well-being in the AI age	Conceptual framework	Proposed a theoretical framework of the way to enhance the welfare of students in the age of AI and emphasize the need to balance the utilization of technologies and stimulate socio-emotional competence.	To determine the effectiveness of the framework in the real-world educational environment, theoretical, but empirically untestable and practical implementation and validation are necessary.
(Y. Dai et al., 2023)	Collaborative construction of AI curriculum	Collaborative construction	Discussed the application of AI in legal education and the way it would be applied	Restricted to legal studies, and the application of AI to the legal studies

Source: Author’s Compilation

Paper Info	Purpose	Methodology	Results	Limitations
			to enhance legal research, legal analysis and practice-oriented learning.	needs to be approached with care of ethical and regulatory issues.
(Oliveira & Martins, 2011))	AI in legal education	Literature review	Researched the application of AI in legal studies and emphasized its value as legal research, legal analysis, and practice-based learning.	Restricted to legal studies, the application of AI to legal education must be treated cautiously through both ethical and regulatory factors.
(Demir & Güraksın, 2022)	Students of middle school perceive AI.	Metaphor analysis	Studied the views of middle school students about AI by examining their view through the lens of metaphors, which exhibits multiple metaphorical expressions to reflect the negative and positive views towards AI.	The study is restricted to middle school learners, and the results might not be the most accurate representation of how the perceptions of students are changing as they progress.
(Douali et al., 2022)	Concerns and beliefs in AI in learning.	Qualitative analysis	Investigated teacher anxieties and beliefs regarding AI in education, bringing up the issue of job loss, ethical implications, and the possibility of positive learning experiences.	The qualitative dimension of the study can be restricted to perception, as well as the results, which may not be relevant to subsequent extrapolation to educational contexts.
(Eitner, 2023)	Challenges in education with AI technologies	Deweyan assessment	Discussed the issues in the field of education that are related to AI technologies and viewed through the lenses of philosophical thought and ethical aspects.	As far as limited to theoretical views, practical issues should be investigated with the help of empirical research in the actual educational environments.

Source: Author's Compilation

Paper Info	Purpose	Methodology	Results	Limitations
(Essel et al., 2022)	Effect of a virtual teaching assistant on learning.	Impact assessment	Looked into how a virtual teaching assistant can help students learn and the role played a positive role in engagement and comprehension of course materials.	Applicability of the virtual teaching assistant model is restricted to Ghanaian higher education and, thus, requires validation in other cultural and education settings.
(Friedrichs et al., 2023)	ChatGPT in medical school	Progress testing analysis	Analyzed the effectiveness of ChatGPT in medical school-level progress testing, which means that it is implementing a promising and various set of questions.	Restricted by medical education, a particular emphasis on the progress testing, and the generalization to the alternative assessment formats demand further research.

Source: Author's Compilation

3.2 The works on Ethical Considerations of AI adoption in Higher Education

Developing the ethical considerations with AI, Table 2 encircles a spectrum of discussions on Ethical considerations in AI including concerns of algorithmic bias and equity, transparency and accountability. Scholars in this area continue to grapple with the challenge of advancing AI innovation while simultaneously safeguarding broader societal and ethical interests.

Table 2
Ethical Considerations in AI

Paper Info	Purpose	Methodology	Results	Limitations
(Nazer et al., 2023)	Bias in AI algorithms	Experimental analysis	Researched the biases present in AI algorithms and their effects on the decision-making process, which led to the requirement of algorithmic fairness and transparency.	AI biases may be situation-specific, which requires monitoring and corrections constantly, due to limitations to certain algorithms and datasets.
(Dignum, 2021)	Ethical effects of AI in the governance.	Case study analysis	Delved into AI ethical implication in governance and addressed concerns of accountability, transparency, as well as its effects on the democratic process.	The generalizability of findings to other types of political systems should be taken into account due to the limitations in generalizing findings to other contexts of governance.
(Jobin et al., 2019)	Classification of Artificial intelligence risks	Risk analysis	Offered a universal taxonomy of risks of AI, both technical and ethical and social, and attempted to inform risk assessment and risk management.	The classification is also subjective and might not exhaust the potential risks, and the validity of the risk management strategies is to be empirically validated.
(Mittelstadt, 2019)	Ethical principles for AI in healthcare	Ethical framework development	The issues of privacy, consent, and fairness are considered in the establishment of ethical principles in the use of AI in the healthcare field.	The model might need to be adjusted to other care systems and practical application might have difficulties in harmonizing conflicting ethical aspects.
	Algorithmic accountability in AI systems	Case study and analysis	Explored responsibility of the AI systems by algorithms with the revelation of bias and discrimination, and suggested principles of better accountability and transparency.	The usefulness of accountability measures is confined to particular cases, and it is the desire of organisations to implement them.

Source: Author's Compilation

Paper Info	Purpose	Methodology	Results	Limitations
(Pant et al., 2024)	AI ethics in business applications	Content analysis	Researched how AI ethics is represented in business applications, trends, challenges, and how ethical guidelines are needed.	Restricted to content analysis, the real ethical business application practices can differ depending on the industry standards and legal regulations.
(Taddeo & Floridi, 2018)	AI and the ethics of cyber conflict	Ethical analysis	Theoretical reflection on the issue of autonomy, accountability, and unforeseen consequences as the ethical aspects of AI in cyber conflict.	Existence of highly theoretical and practical dilemmas of controlling AI in cyber conflict situations should look into geopolitical considerations.
(van Wynsberghe, 2021)	Ethics of AI in robotics	Ethical analysis	Studyed the ethics of AI in robotics the topics of responsibility, transparency, and impact on human dignity.	Very abstract, and ethical implication has a possibility to evolve with the rise of robots and AI technology where ethical reflection is required.
(Afreen et al., 2025)	Bias mitigation in AI-assisted decision-making	Experimental study	Researched techniques of reducing bias in AI-assisted decision-making, emphasizing the capacity of pre-processing methods and algorithmic modifications to reduce bias.	Being restricted to certain methods of bias mitigation, the best method can be different based on the field of application and the nature of the dataset.
(Wei et al., 2024)	Public perceptions of AI ethics	Survey	Researched personal attitudes towards AI ethics, showing a lack of trust in the privacy and responsibility of AI usage and its application, as well as the necessity of ethical principles of AI development and implementation.	The answers to the surveys can be impacted by the media images, and the research should be considered concerning the generalizability to other cultural and demographic groups.

Source: Author's Compilation

4. Bibliometric Analysis

4.1 Descriptive Analysis

The descriptive analysis of 80 documents in 49 sources published in years 2016-23 with an annual growth of 60.97 is provided in Table 3. The value of the mean 1.23 in relation to age of documents implies recency, but the value of 8.3 citation per document implies strong academic background. This dataset consists of 294 Keywords Plus, and 285 Author's Keywords with a diversity of topics. Global engagement in research Global involvement is apparent with 3.12 authors per document and a proportion of 23.75% of international collaboration. Preference to in-depth exploration is indicated by the overwhelming number of articles-type publications. In general, there are significant data growth, interdisciplinary orientation, and robust collaboration research trends.

Table 3
Descriptive Analysis

MAIN INFORMATION ABOUT DATA	
Description	**Results**
Timespan	2016:2023
Sources (Journals, Books, etc.)	49
Documents	80
Annual Growth Rate %	60.97
Document Average Age	1.23
Average citations per doc	8.3
References	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	294
Author's Keywords (DE)	285
AUTHORS	
Authors	232
Authors of single-authored docs	19
AUTHORS COLLABORATION	
Single-authored docs	19
Co-Authors per Doc	3.12
International co-authorships %	23.75
DOCUMENT TYPES	
Article	80
Source: Author’s Compilation	

4.2 Annual Scientific Production and Citation

The changing trends of research product and impact are presented in Table 4 illustrating the yearly scientific production and annual cited impact on the perspective of the year 2016 to the year 2023. The years in which the publications were lesser were first few years and the articles have been more referenced. Despite a notable increase in publication volume in recent years, the median citation count per article has declined. The median citations per article dropped from 43.5 in 2019 to 2.82 in 2023, potentially indicating shifts in citation practices or research perspectives. A greater extent of a period of

citation indicates that there are studies with a lasting effect. It can be seen that such trends indicate the academic world is shifting, and it is worth considering how the habits of publishing and the tendency to cite are changing to gain a better insight into what will be the most influential in academic circles in the future.

Table 4
Annual Scientific Production and Citation

Annual Scientific Production and Citation				
Year	**MeanTCperArt**	**N**	**MeanTCperYear**	**CitableYears**
2023	2.82	28.00	2.82	1
2022	3.04	27.00	1.52	2
2021	11.69	13.00	3.90	3
2020	28.12	8.00	7.03	4
2019	43.5	2.00	8.70	5
2017	21	1.00	3.00	7
2016	18	1.00	2.25	8
Source: Author's Compilation				

4.3 Most Relevant Sources

The key sources that have been significant in the debate on educational technology and sustainability are indicated in Table 5. In terms of citation, sustainability, particularly the Swiss one includes 11 references demonstrating the extent to which sustainability is associated with education. The third publication, featuring nine citations, is the International Journal of Emerging Technologies in Learning, which supports scholarly inquiry into novel educational technologies. Seven citations appear in publications such as the International Journal of AI in Education and Computers and Education: AI, indicating growing scholarly interest in AI applications within educational contexts. Collectively, these sources indicate that the existing body of research is highly interdisciplinary, which is why sustainability, AI, and educational innovation are being united to form the future of the academic research.

Table 5
Top Ten Most Relevant Sources

Top Ten Most Relevant Sources	
Sources	**Articles**
SUSTAINABILITY (SWITZERLAND)	11
INTERNATIONAL JOURNAL OF EMERGING TECHNOLOGIES IN LEARNING	9
INTERNATIONAL JOURNAL OF AI IN EDUCATION	3
COMPUTERS AND EDUCATION	2
COMPUTERS AND EDUCATION: AI	2
EDUCATION AND INFORMATION TECHNOLOGIES	2
EDUCATION SCIENCES	2
EDUCATIONAL TECHNOLOGY AND SOCIETY	2
HELIYON	2
INTERNATIONAL JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION	2
Source: Author's Compilation	

4.4 Most Relevant Sources by Bradford Law

Table 6 was developed based on the Law of Bradford, which indicates the rank of the sources based on their frequency and significance in the area of Educational Technology. In the former, Sustainability (Switzerland), there are 11 contributions and in the latter, International Journal of Emerging Technologies in Learning, there are 9 contributions, which shows the importance of these sources in academic research. Additional prominent sources within Zone 1 encompass the International Journal of AI in Education, Computers and Education, and Computers and Education: AI. Such journals are Education and Information Technologies, Heliyon, and Education Sciences in zone 2 and have a frequency of 2. This division helps scholars to identify core and periphery of literature sources that are helpful in the field.

Table 6
Most Relevant Sources by Bradford Law

Most Relevant Sources by Bradford Law				
SOURCE	**Rank**	**Freq**	**cumFreq**	**Zone**
SUSTAINABILITY (SWITZERLAND)	1	11	11	1
INTERNATIONAL JOURNAL OF EMERGING TECHNOLOGIES IN LEARNING	2	9	20	1
INTERNATIONAL JOURNAL OF AI IN EDUCATION	3	3	23	1
COMPUTERS AND EDUCATION	4	2	25	1
COMPUTERS AND EDUCATION: AI	5	2	27	1
EDUCATION AND INFORMATION TECHNOLOGIES	6	2	29	2
EDUCATION SCIENCES	7	2	31	2
EDUCATIONAL TECHNOLOGY AND SOCIETY	8	2	33	2
HELIYON	9	2	35	2
INTERNATIONAL JOURNAL OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION	10	2	37	2
Source: Author’s Compilation				

4.5 Most Relevant Authors

CHAI CS and KIM J had three publications each and DAIY Y, GUOY Y and LEUNG JKL had two publications each in the first position in Fig. 1. Such authors as LIANU C and NG DTK demonstrate budding power as well. Along with output, their research quality and impact indicate an increasing stature in the area.

Source

Author’s Compilation

4.6 Authors' Productivity over Time

Table 7 indicates that there is a change in the production of authors in 2020–2023. In 2020, CHAI CS achieved its maximum TCpY value of 7.5, which subsequently decreased to 3 by 2023, notwithstanding a growth in publication volume. KIM J demonstrated a good level of TCpY of 10.25 in 2020 and dropped to 1 in 2022. Other authors, such as DAI Y, GUO Y and JONG MSY, too had their citation impact depreciating with time. These tendencies indicate a shift in the research interest and different impact, which should be further examined by the content and relevance of publications.

Table 7
Authors' Productivity over Time

Author	year	freq	TC	TCBY
CHAI CS	2020	1	30	7.5
CHAI CS	2023	2	3	3
DAI Y	2020	1	30	7.5
DAI Y	2023	1	1	1
GUO Y	2020	1	30	7.5
GUO Y	2023	1	1	1
JONG MSY	2020	1	30	7.5
JONG MSY	2023	1	1	1
KIM J	2020	1	41	10.25
KIM J	2022	1	2	1
Source: Author's Compilation				

Table 8 uses Lotka Law to show the distribution of productivity of authors. Most (93.1) of authors only made a single contribution (216 instances), with 6% of authors making two contributions (14 instances). The production of three documents was only done by 0.9% (2 authors). This skewed distribution is in corroboration of the Law of Lotka which states that the large percentage of contributors are occasional with but a few prolific contributors. The data shows that it is important to research the content and impact of the works by such prolific authors to achieve their contribution to the progress of the field.

Table 8
Lotka Law (Author's Productivity)

Documents written	No. of Authors	Authors' Productivity
1	216	93%
2	14	6%
3	2	0.9%
Source: Author's Compilation		

4.7 Top Most Relevant Institutions

The research is in the limelight in Table 9 lists the top ten institutions that have most publications. Beijing Normal University demonstrates the most impactful publication output, suggesting substantial expertise in this research area. The University of Salamanca occupies the third position with three publications, while Ajman University and Al Ain University hold the fourth rank with two publications

each. Among the institutions showing notable geographical research activity are the Chinese University of Hong Kong and National Central University. The global involvement of the given distribution suggests the bright perspectives to be received in the international collaboration and reveals the expanded and diversified character of the scholarly contribution to the given sphere of research.

Table 9
Ten Top Most Relevant Institutions

Ten Top Most Relevant Institutions	
Affiliation	**Articles**
BEIJING NORMAL UNIVERSITY	5
UNIVERSITY OF SALAMANCA	3
AJMAN UNIVERSITY	2
AL AIN UNIVERSITY	2
BEIJING UNIVERSITY OF CIVIL ENGINEERING AND ARCHITECTURE	2
CADI AYYAD UNIVERSITY	2
CHINESE UNIVERSITY OF HONG KONG	2
KIST MEDICAL COLLEGE	2
NATIONAL CENTRAL UNIVERSITY	2
SOUTH CHINA NORMAL UNIVERSITY	2
Source: Author's Compilation	

5.8 Word Cloud

Figure 2 indicates that there is a high emphasis on AI, which is relevant to the educational process. Words like learning and students are frequent, which proves the intentions of studying AI to identify its implementation in the sphere of teaching and learning. The name of such words as engineering education or computer-aided instruction suggests the more precise analysis of the influence of AI on certain areas of study. The way the words are arranged indicates that AI is seen as an important and revolutionary force of education. This picture summarizes the key points, demonstrating the level of importance of AI and what it might bring to the future of education. Even though the picture provides a rough picture of the general terms in use, a closer examination of the study will provide the in-depth discussions and studies that are defining the relationship between AI and education.

5.9 Bibliographic Coupling of Journals

Bibliographic coupling represents the link between papers that cite a common reference. Figure 3 shows the clustering of Journals based on bibliographic coupling. The sphere with highest density or

prominence represents greater connectivity with papers from other journals which give an idea that it has been widely referenced. Sustainability (Switzerland) has strongest link with all other journals in terms of bibliographic coupling followed by International Journal of Emerging Technologies in Learning as second strongest journal with maximum bibliographic coupling.

5.10 Bibliometric Coupling of Authors

There are three major networks represented by green, yellow, and purple colours (Fig. 4). The green network is the most linked network which shows maximum backward and forward referencing and is connected to all other networks, the authors on green network are Hwang G H, Aung Z H, Abdullah. The yellow and purple networks are sparsely related network which indicates they are linked with specific authors with specific themes (niche themes, emerging and declining themes)

5.11 Most Cited Countries

Table 10 shows the top ten highest countries in regards to the total and average articles cited. China also records the most citations of 191 and this shows that the level of research in China is heavy. At the second place, there are U.S. which has 65 citations. The United Kingdom demonstrates the greatest citation frequency at 59 instances, while simultaneously exhibiting the highest mean citations per publication at 29.50, suggesting a concentrated academic influence. The same case applies to Brazil and Portugal which had fewer articles and big averages. Hong Kong, Greece, and Australia are not far behind and this indicates that the number of publications (as well as quality of citations) is important in the way academic work is acknowledged internationally.

Table 10
Top Ten Most Cited Countries

Top Ten Most Cited Countries		
Country	**TC**	**Average Article Citations**
CHINA	191	10.60
USA	65	9.30
UNITED KINGDOM	59	29.50
BRAZIL	39	19.50
PORTUGAL	28	28.00
HONG KONG	26	6.50
GREECE	21	10.50
PAKISTAN	19	19.00
ESTONIA	12	12.00
AUSTRALIA	11	3.70

5.12 Thematic Map

And thematic map in Fig. 6 is in line with the overall theme in the paper about AI in education, with the most significant keywords, including, AI, education, machine learning, e-learning. Recent issues like data mining, personalised learning or performance analysis models demonstrate how the paper discusses AI-based teaching tools and data-driven learning. The research into AI in specific areas is supported by more specific disciplines such as the engineering education. The map also represents the thoughts regarding the ways institutions may establish AI and use it responsibly. Although it is just built on what is presented visually, the map actually serves as a more detailed explanation of what is being presented in the text and this demonstrates various factors in which AI and education research undergo changes over time.

6. Discussion and Implications

This study is an in-depth analysis of the changing research environment of the use of Artificial Intelligence (AI) in Higher Education Institutions (HEIs). The findings reveal that the research on AI and education has increased markedly over the last several years, and the application of AI in learning environments is increasingly vital in education. The 60.97% annual growth rate illustrates the increasing importance of AI in higher education, moving beyond being a peripheral technological innovation to becoming a key academic and institutional focus.

The most notable finding in the study is the shift towards the preparedness and readiness of teachers and institutions for the adoption of AI. As with the other factors, the availability of technologies is also becoming an increasingly critical factor in the successful implementation of AI in educational contexts, as evidenced by existing research. Existing research also shows that teachers' pedagogical compatibility and institutional support mechanisms are crucial to the successful implementation of AI in educational contexts, alongside technological confidence. The study results are consistent with previous research which highlighted that teachers' perceived usefulness, ease of use and organizational support significantly affect AI adoption. The bibliometric trends indicate that the research on AI is moving from technology towards humans and pedagogy.

The thematic analysis also reveals that personalized learning, intelligent tutoring systems, automated assessment, and AI-assisted instructional support are still the major research areas in higher education. The results indicated that AI is becoming a pedagogical augmentation tool than administrative technology. The use of terms such as “learning”, “students”, “teaching” and “engineering education” is also common, indicating a strong emphasis on improving learning experiences, adapting teaching, and improving learning outcomes. This change is indicative of the increasingly data-driven and learner-centric education environments in higher education.

The study also highlights the interdisciplinary nature of the study of AI in higher education. This is not a computer science subject: the books and journals collected by this subject focus on journals such as Sustainability, Computers and Education, Education and Information Technologies and the International Journal of AI in Education. Instead, the influence of AI is more multifaceted than sustainability, ethics, pedagogy, governance, educational psychology and digital transformation. The interdisciplinary development suggests a requirement to take a collaborative strategy combining educators, technologists, policymakers, ethicists, and institutional leaders to build successful future educational AI frameworks.

The study's findings also highlight the rising significance of ethical issues in the use of AI in higher education. The literature is consistent in the occurrence of algorithmic bias, algorithm transparency, algorithm accountability, academic integrity, data privacy, and overreliance on algorithmic results. The increasing use of generative AI tools such as ChatGPT has added to the plagiarism concerns, plagiarism authenticity, and changing assessment practices in HEIs. Institutions, therefore, are increasingly being urged to develop ethical governance structures, AI literacy programs, and policies on responsible use of AI technologies to enable a balanced and transparent use of AI technologies.

Furthermore, the bibliometric coupling analysis and the thematic mapping analysis show that the research on this topic continues to gain in intellectual diversification. Content areas that have been long-standing and are well known—such as “artificial intelligence,” “education,” and “teaching”—continue to be important, but new and developing content—such as machine learning, AI literacy, data mining, virtual learning, and personalized learning—are emerging in scholarly publications. This is a change towards "application oriented" and "governance oriented" investigations, reflecting a shift from exploratory

research. Concurrently, a number of special themes on teacher training and teacher performance analysis indicate the possible future directions of the empirical and policy-oriented scholarship. Geographical distribution of citations indicates that today, countries like China, the USA and the UK play the major role in scholarly contributions in this field. The large number of citations is indicative of China's heavy investment in educational transformation and digital infrastructure, driven by AI technology. The comparatively high average citations for countries like the United Kingdom and Portugal, however, suggest the size of academic impact of targeted and high-quality contributions. The results indicate that while the adoption of AI in higher education is spreading worldwide, there are considerable differences in terms of capabilities of institutions, digital infrastructure, research funding and policy preparedness between countries.

The results further revealed that the research field is still rather unintegrated, with the majority of authors publishing one paper. The fragmentation suggests that AI in higher education is a relatively new and on-going field with relatively few theoretical advancements and longitudinal empirical studies. Conceptual/review studies dominate the literature, and there is a need for more empirical studies of how the concepts and suggestions are applied in the classroom, what impact they have on learning, how teachers adapt the materials, and how long-term implementation has an impact on the institution.

Theoretically, the study fits into the ongoing conversation about the adoption of technology and digital transformation in the educational landscape and looks at how the individual, institutional and ethical dimensions of the use of AI interact. The results suggest that an AI adoption in HEIs can't be explained exclusively by technological determinism. Instead, it is formed by a dynamic between the pedagogical alignment, the digital skills of the educator, the culture and environment of the institution, the institutional governance, and the readiness of the educator. Therefore, future theoretical frameworks focused on the use of AI in education should consider the social and ethical dimensions of AI use, in addition to technological considerations.

In practice, the study has several policy and institutional implications, which the Policy Makers and Institutional Leaders can use. The universities need to focus on faculty training initiatives that lead to an increased understanding of AI, ethical considerations, and pedagogical skills in the integration of AI. The development of institutional governance structures, transparent AI policies and the processes to handle issues related to academic integrity should be addressed as well as technology infrastructure. Moreover, there is a need for critical AI literacy to be integrated into curriculum redesign so as to equip students and teachers in increasingly AI-mediated learning environments.

Although the study has been helpful, it has some shortcomings. The analysis was limited to documents published in English and included in the Scopus database, which is likely to exclude relevant regional or other non-English scholarship. Moreover, the bibliometric approach mainly serves to uncover publication trends and thematic landscapes, yet fails to give direct evidence on the effectiveness of the implementation of AI in education. Research can use mixed-method and/or longitudinal design to

investigate the experiences of educators, the preparedness of educational institutions, and the outcomes of learners in authentic educational contexts in the future.

8. Future Research Directions

While AI in higher education has been a field of growing research, there are still several areas that need more scholarly attention. To begin, future research could focus on the long-term educational outcomes of generative AI, including how it affects student learning outcomes, critical thinking, creativity, and academic performance. Second, empirical studies are needed for the assessment of the competences that teachers have in AI, the institutions' readiness to adopt AI, and the performance of teachers' training programs for the responsible use of AI.

Further studies should also include the ethical and regulatory aspects of AI use, including algorithmic bias, data privacy, transparency, accountability, and academic integrity. In addition, the development and validation of the AI readiness, AI literacy, and ethical AI adoption scales in the higher education context have yet to be explored in detail and warrant further investigation. Further comparative cross-cultural and cross-institutional studies could help to better understand contextual and socio-economic impact on the implementation of AI in different educational contexts.

Declarations

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Ethics Statement

Although there was no formal ethics approval obtained as the affiliated institute of the primary investigator does not have an ethics approval committee, however, all ethical guidelines were strictly followed during this research. Since no human participant are involved, hence, consent to participate is not applicable.

Author contributions statement

Substantial contributions to the conception and design: All authors. Data, acquisition, analysis, and interpretation of data: First author. Final approval of the version to be published: All authors.

Competing interests policy

No potential conflict of interest was reported by the author(s).

Data availability statement

The raw data are available upon request from the corresponding author.

Consent to publish

Authorship of the paper is accurately represented. All authors who participated are credited and have given consent for publication of this approved version.

Author Contribution

All authors made significant contributions to the conception or design of the work. Authors N.M., N.C., and A.R. were responsible for the acquisition, analysis, and interpretation of data.Authors G. M. S. and M.A. drafted the manuscript. All authors revised it critically and contributed for important intellectual content.All authors approved the version to be published.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Footnotes

1. https://www.elsevier.com/en-in/products/scopus
2. https://www.bibliometrix.org/home/layout/biblioshiny
3. https://www.vosviewer.com/

Figures

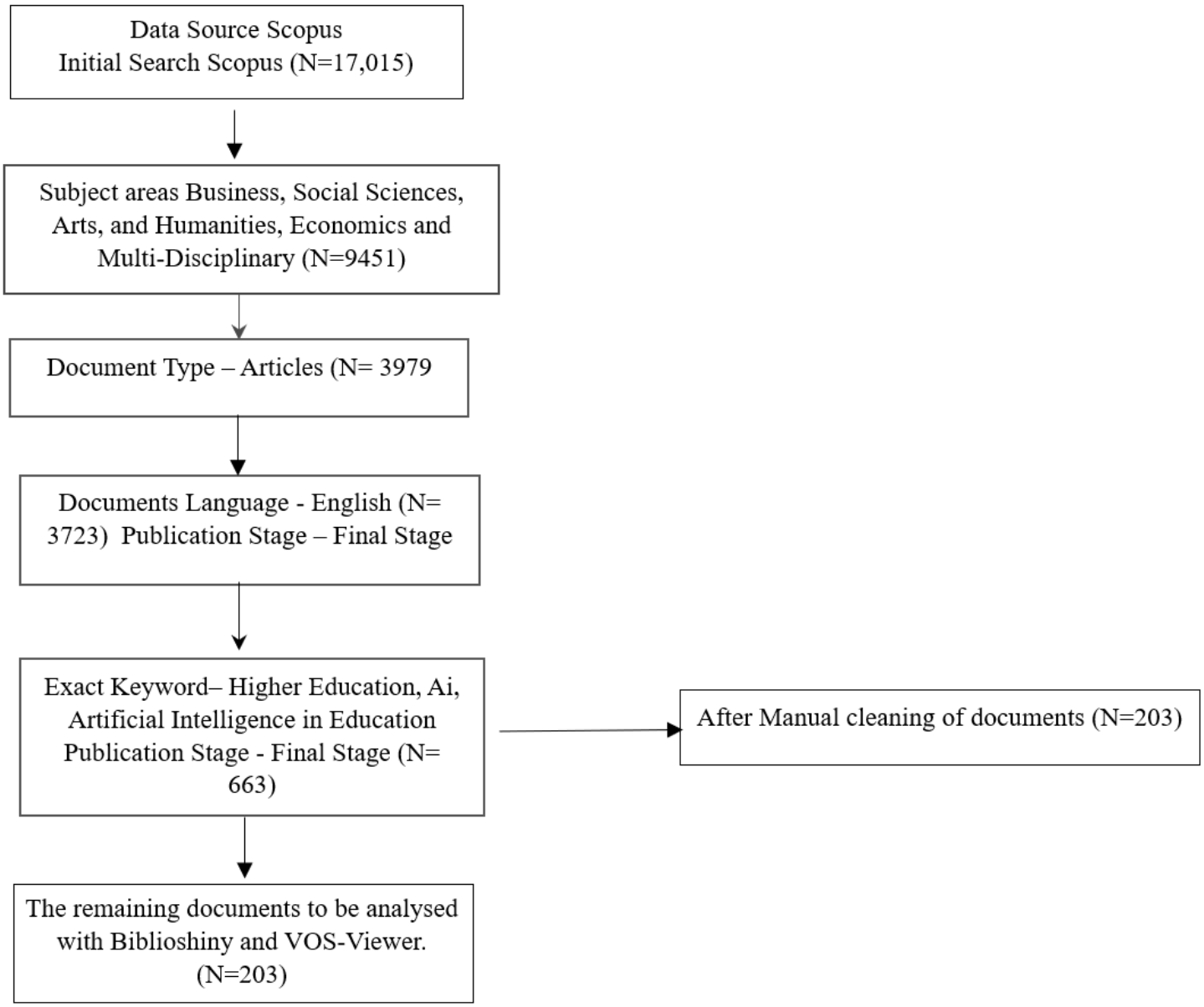


Figure 1

Data Extraction Strategy

(((TITLE-ABS-KEY(ai) OR TITLE-ABS-KEY(artificial AND intelligence*) AND TITLE-ABS-KEY(education) AND TITLE-ABS-KEY(teaching)) AND PUBYEAR > 2012 AND PUBYEAR < 2024) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (SUBJAREA,"BUSI") OR LIMIT-TO (SUBJAREA,"SOCI") OR LIMIT-TO (SUBJAREA,"ARTS") OR LIMIT-TO (SUBJAREA,"MULT") OR LIMIT-TO (SUBJAREA,"ECON")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (EXACTKEYWORD,"Artificial Intelligence") OR LIMIT-TO (EXACTKEYWORD,"Teaching") OR LIMIT-TO (EXACTKEYWORD,"Education") OR LIMIT-TO (EXACTKEYWORD,"Artificial Intelligence Technologies") OR LIMIT-TO (EXACTKEYWORD,"Teaching And Learning") OR LIMIT-TO (EXACTKEYWORD,"Higher Education") OR LIMIT-TO (EXACTKEYWORD,"AI") OR LIMIT-TO (EXACTKEYWORD,"Artificial Intelligence (AI)") OR LIMIT-TO (EXACTKEYWORD,"Artificial Intelligence In Education") OR LIMIT-TO (EXACTKEYWORD,"AI Technologies") OR LIMIT-TO (EXACTKEYWORD,"AI Education") OR LIMIT-TO (EXACTKEYWORD,"Colleges And Universities")) AND (LIMIT-TO (PUBSTAGE,"final")))

Figure 2

Boolean String for Data Extraction

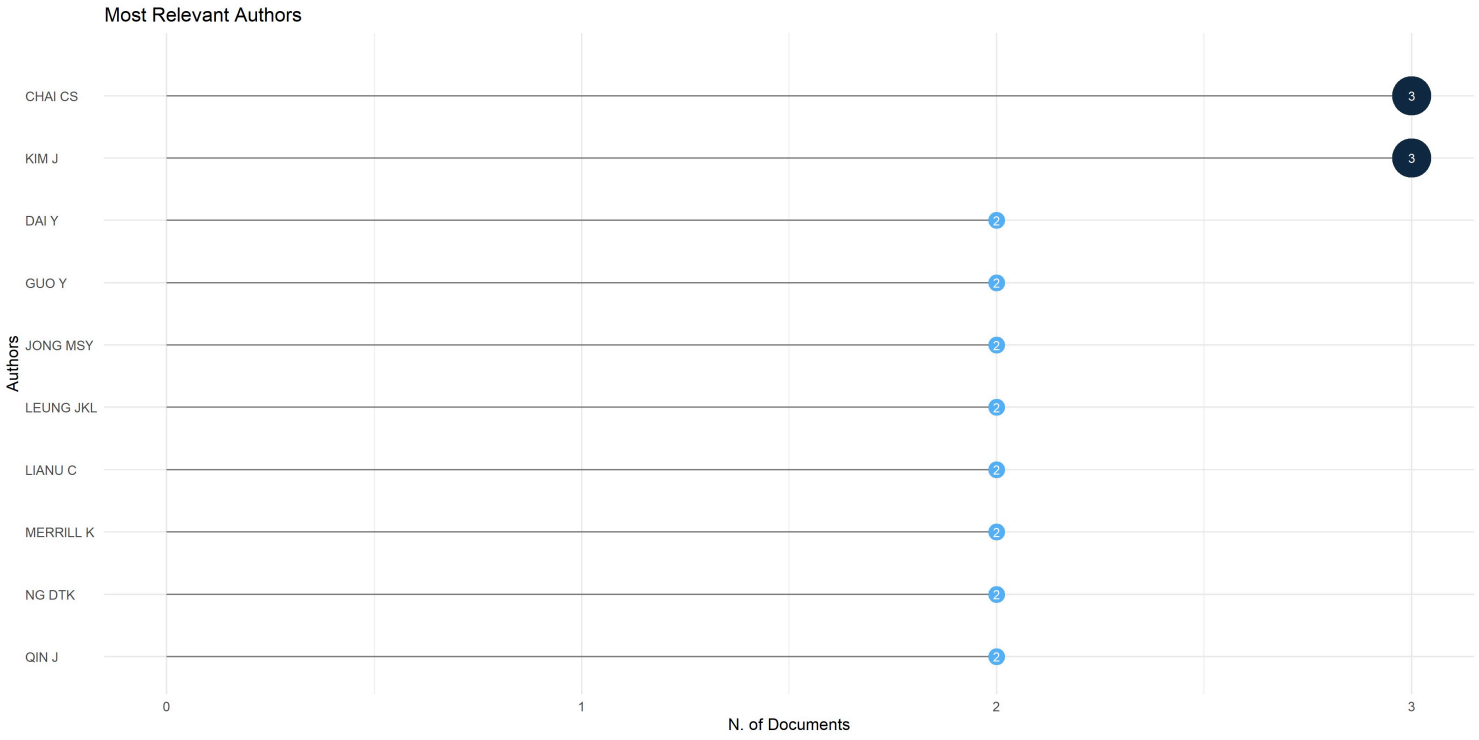


Figure 3

1. Top Ten Most Relevant Authors

Source: Author's Compilation



Figure 4

2. Word Cloud

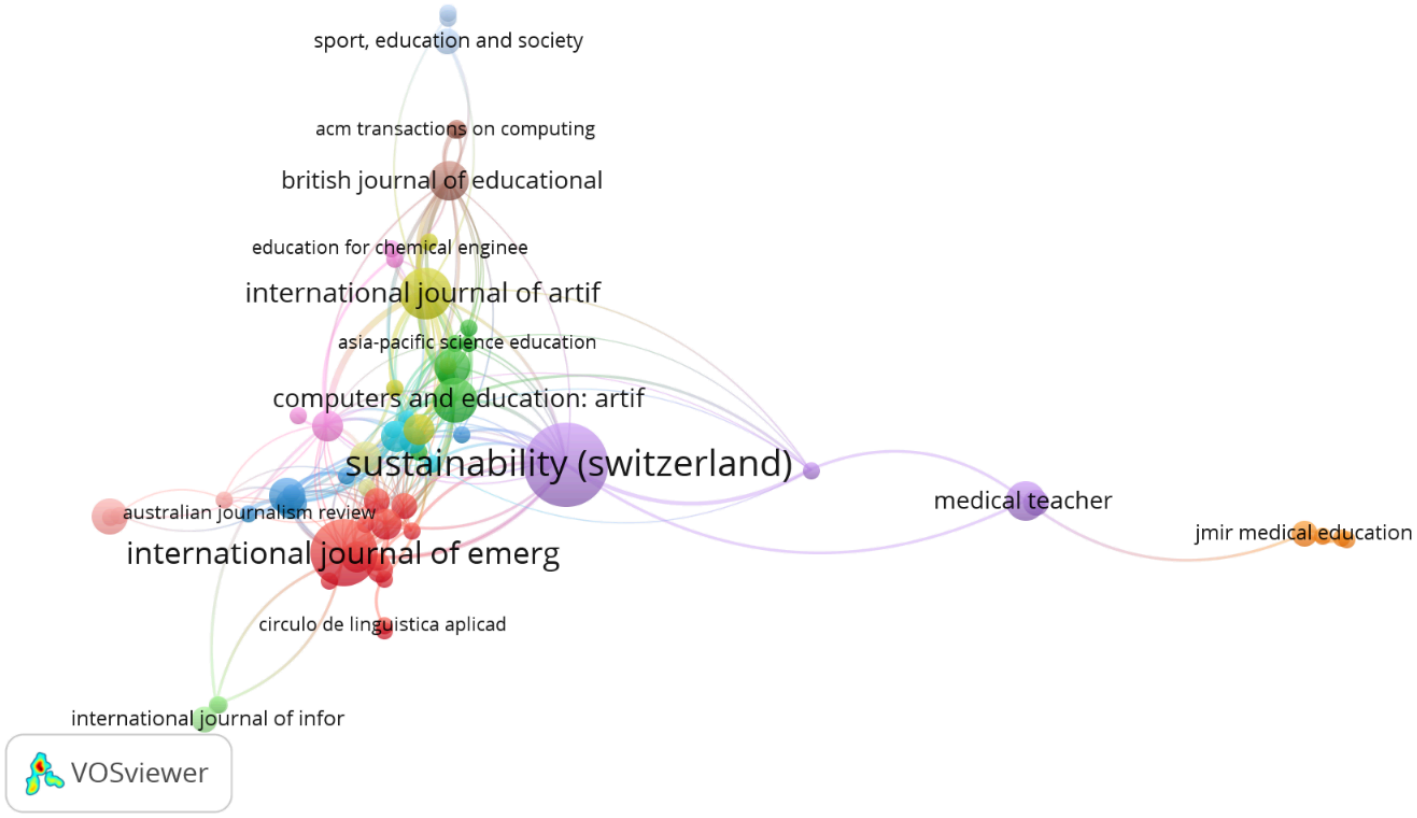


Figure 5

3. Bibliographic Coupling of Journals

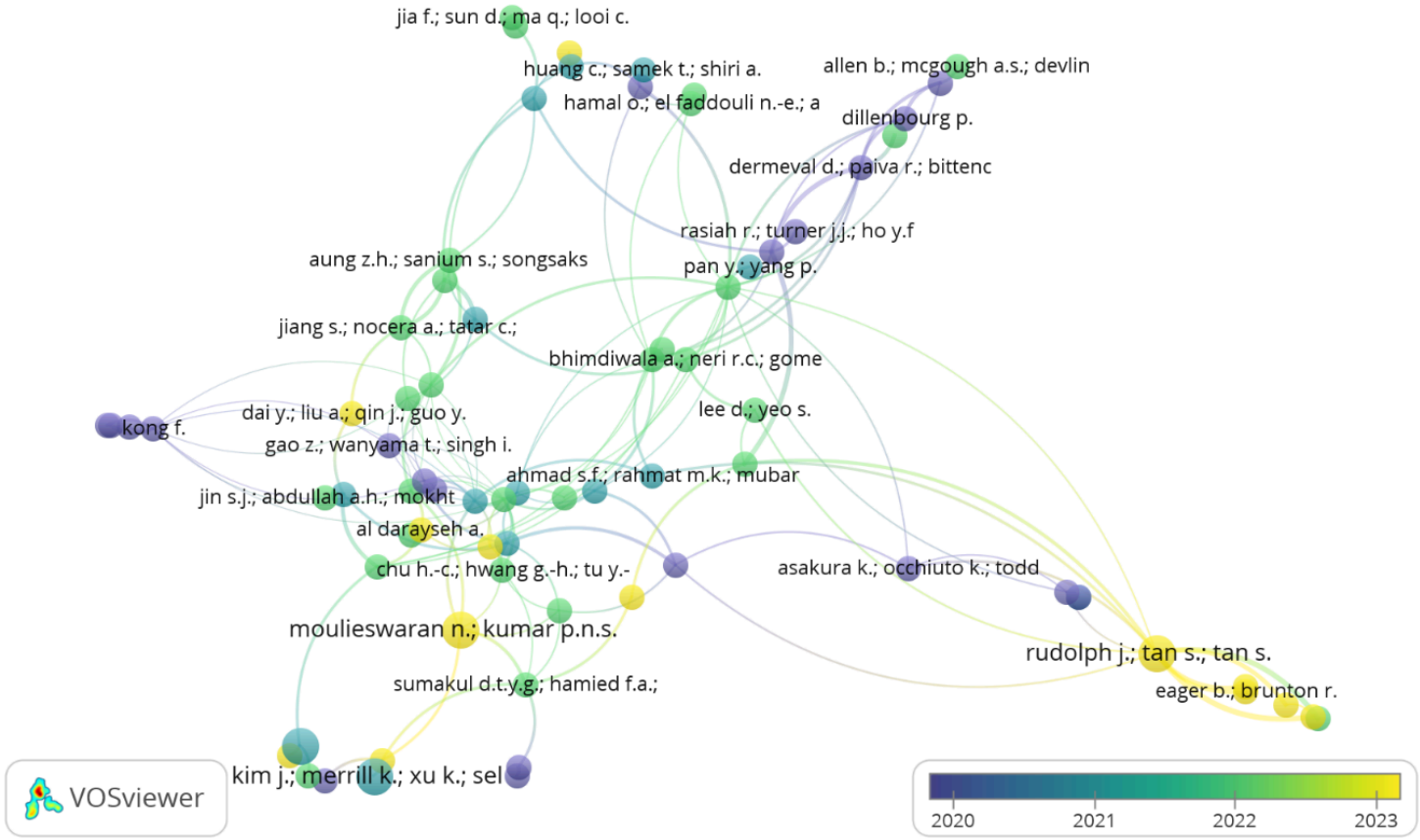


Figure 6

4. Bibliometric Coupling of Authors

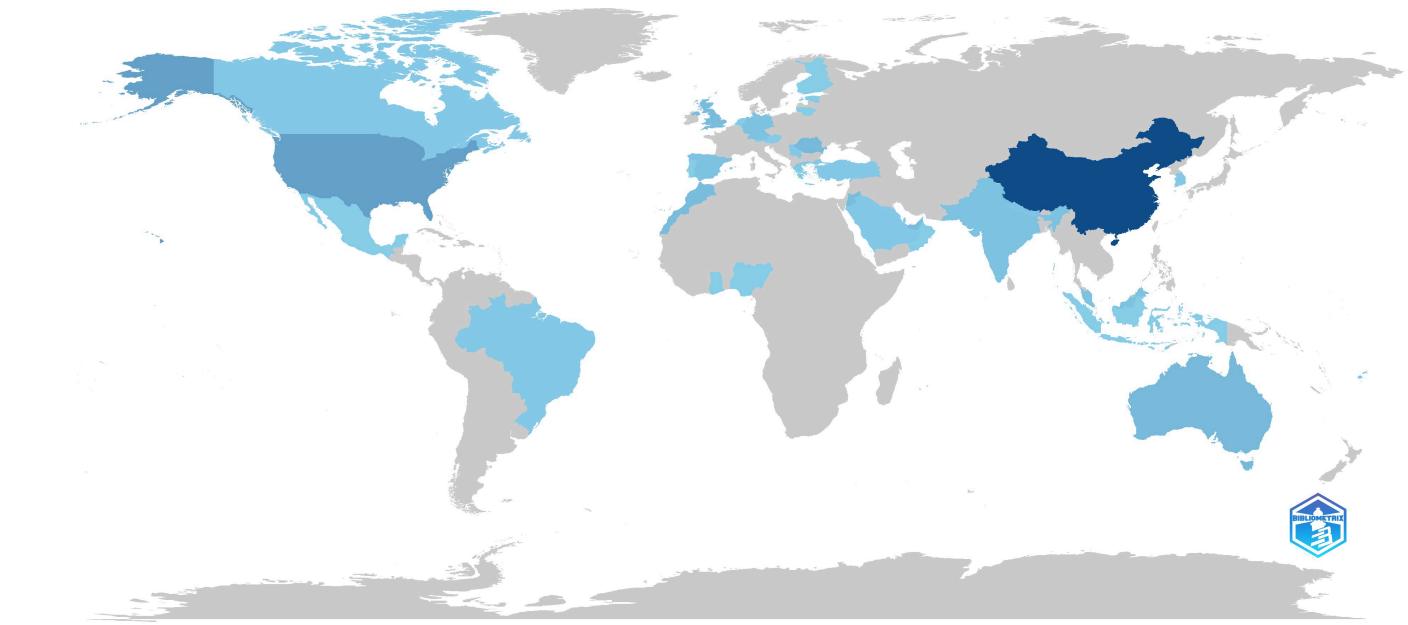


Figure 7

5. Most Relevant Country - Heat Map

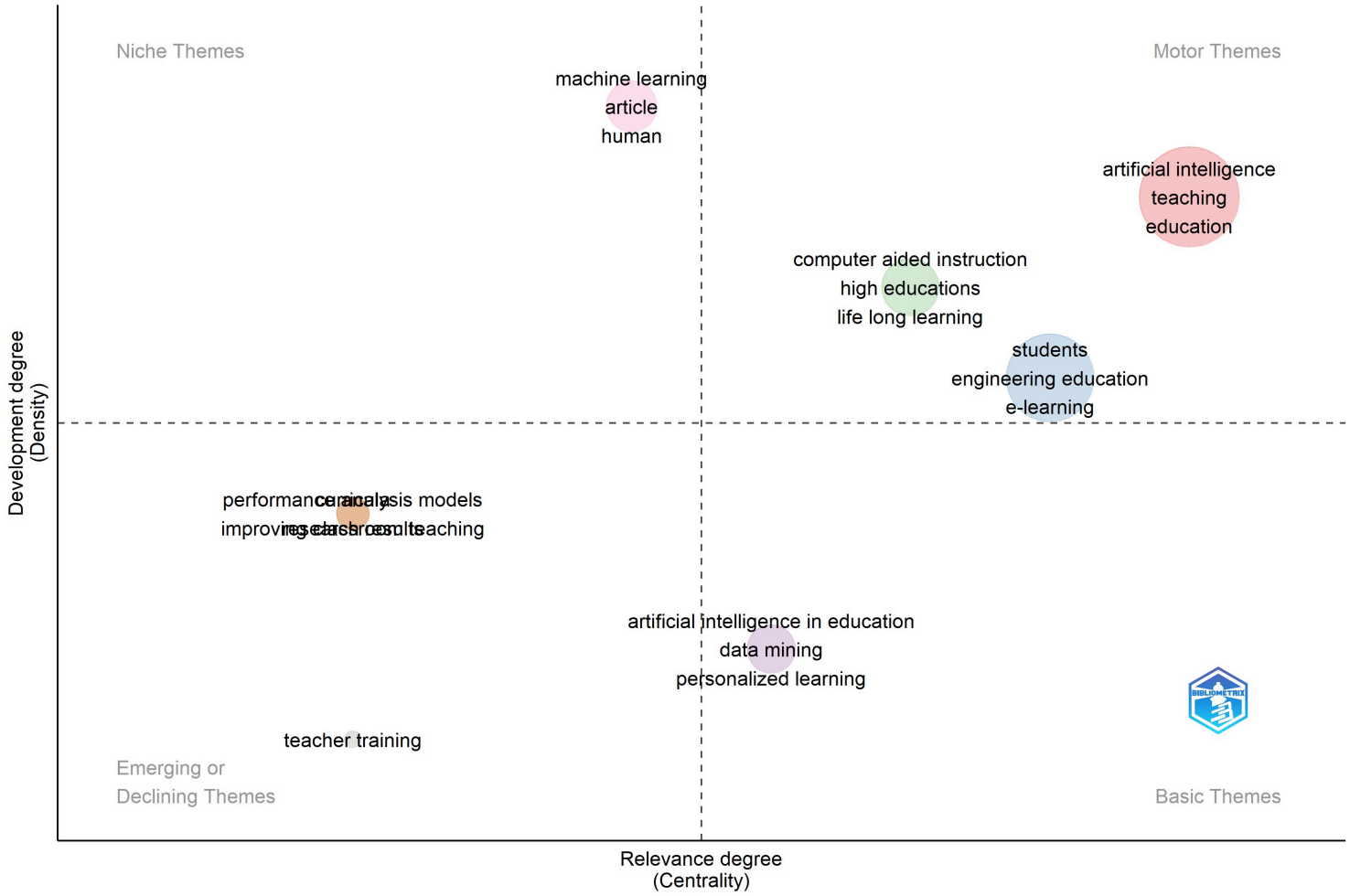


Figure 8

6. Thematic Map