Journal of Thai-Chinese Social Science
Issue (1), Volume 1, 2024 (July-December)

Mapping Research Agenda of Educational AI Chatbots for Academic Performance：A Bibliometrics Insight

Fan Wang[1], and Ruiming Li[2*]
[1]Hospitality Management, Hebei Tourism College, Chengde, 067000, China,
Email:1652110381203@rmutr.ac.th,
[2*]Humanities, Kasetsart University, Bangkok, 10900, Thailand,
Email: ruiming.l@ku.th (Correspondence)

Abstract

Educational AI chatbots are gaining traction as transformative tools in the academic and educational domains, yet limited attention has been given to the evolving research focus and future directions within this field through bibliometric analysis. This study aims to explore the research landscape and developmental trajectories of educational AI chatbots for academic performance through systematic bibliometric analysis. Data was retrieved from Web of Science (WoS) using defined search terms related to educational AI chatbots, and CiteSpace was employed for co-citation and trend analysis, and we identified 965 publications between 2019 and 2024, with a significant increase in research outputs since 2021. The study highlights dominant categories such as Education, Psychology, and Computer Science, alongside emerging interdisciplinary themes in healthcare, ethics, and linguistics. Collaboration networks identify influential institutions and authors, including central contributors like the University of Hong Kong and leading researchers such as Waleed Mugahed Al-Rahmi. Country collaboration networks underscore the active participation of nations such as the USA, China, and England, with increasing contributions from Asian countries like Taiwan and India. Keyword analysis reveals evolving research priorities: early studies focused on user acceptance and trust, while recent trends emphasize privacy, ethics, and advanced AI technologies like large language models. The keyword bursts further indicate dynamic shifts in academic interest, highlighting innovation and sustainability as emerging areas.The results explained research trends, mapped collaborations of authors, institutions, countries, and most publications focus on education, psychology, and computer science. Key findings include prominent research themes such as AI chatbot integration in teaching, user interaction design, and ethical concerns. Future directions highlight the need for addressing security and privacy challenges, improving user engagement technologies, and expanding applications to support diverse educational needs. This study provides researchers with a comprehensive understanding of educational AI chatbots and offers valuable insights to guide future research in this emerging field.

Keywords: Educational AI chatbots, Academic performance, ·Bibliometric analysis, ·Co-citation analysis, Trend analysis

1. Introduction

Artificial Intelligence (AI) is significantly transforming the education landscape, presenting both opportunities and challenges (Lim, 2023). Generative AI tools like ChatGPT have demonstrated remarkable capabilities in facilitating knowledge acquisition and supporting academic tasks by generating human-like responses (Xames & Shefa, 2023). Within the educational context, educational AI chatbots have emerged as a promising tool not only for students but also for educators. For lecturers, these AI-driven conversational agents can serve as innovative pedagogical assistants, aiding in the delivery of personalized instruction, automating routine administrative tasks, and providing immediate academic support to students (Smith & Jones, 2022).

Academic performance refers to lecturers delivering educational outcomes and contributing to the overall quality of education in an institution. Lectures' academic performance is vital in achieving the desired quality of graduates (Andriani et al.,2018). However, many lecturers do not meet the required standards, not because of incapacity, but due to digital divide, insufficient or inadequate dataset training and distrust, which negatively impact their academic performance (Arifin & Barnawi, 2014; Armani & Margunani, 2017).

A Google search of 2024 for articles on "AI Chatbot for academic" yielded over 27,000 data and over 75,400 documents overall. And ChatGPT used for scientific research methods and conversation only prompts, including embellishment, summarization, discussion and other academic writing within the scope of the content has become a hot spot for academic research (Stöhr,2024).

Excellent academic performance is characterized by loyalty and high commitment to teaching tasks, mastery and development of learning materials, discipline, creativity in teaching, cooperation with school stakeholders, being a role model for students, possessing a good personality, and being honest and objective in student guidance (Renata et al, 2018). Academic performance, including the ability to develop lesson plans, conduct learning activities, build interpersonal relationships, assess learning outcomes, and carry out enrichment and remedial programs (Supardi, 2014). Thus, academic performance encompasses a combination of professional competencies, personal qualities, and the ability to foster a positive learning environment.

By improving academic performance, we can address a range of challenges such as high teacher-student ratios, shortages of qualified teaching staff, poor quality of educational leadership, political instability and the politicization of educational programs, automatic promotion issues, the varying ages of learners, and inadequate physical facilities and equipment (Rodríguez-Hernández et al., 2020). Enhancing academic performance attracts and retains excellent lecturers, optimizes educational management, ensures a stable learning environment, enforces rigorous academic standards, acknowledges individual student differences, and improves learning environments and resources. The significance of improving academic performance

lies not only in fostering individual growth and development but also in contributing to societal progress and prosperity (Tonta, 2014).

Many technological firms, including Baidu's "Wenxin Yiyan", Aliyun's "Tongyiqianwen", Huawei's "Pangu AI", Meta's "LLaMA", Amazon's "Titan" and others, have created their own big language model platform (Kuhail et al., 2022). So far, Educational AI chatbots, have recently become a heated discussion. AI chatbots have played an essential role in answering questions, writing articles, and creative writing, and even produced more at the user's request. otherwise, AI chatbots can be used as teaching resources to reduce the teaching burden, and provide teachers with instructional resources such as background knowledge for teaching and generating classroom handouts, practice questions, and quizzes (Mohd Rahim et al., 2022). Meanwhile, it deals with abundant data transmission, which cause potential information leakage, raise public privacy concerns, and affect AI chatbots security. These issues affect AI chatbots significantly and thus are worthy of attention (Mendoza et al., 2022).

The development of academic performance of AI chatbots, like ChatGPT, provide advanced natural language processing (NLP) to support students and educators (Chiu et al., 2021). ChatGPT can tutor, personalize learning, assist with grading, and provide study aids by understanding and responding to educational queries (Chang et al., 2023). Its continuous availability and multilingual support make it a valuable tool for inclusive, around-the-clock education, enhancing the overall learning experience by delivering accurate and timely academic assistance (Akiba & Fraboni, 2023).

Developing an educational AI chatbot is beneficial. However, relevant research is currently complicated and contains many detailed directions. For instance, firstly, user service faces challenges regarding accuracy, reliability, and user experience. Secondly, ethical considerations accompanying educational AI chatbots such as data privacy, transparency, and addressing algorithmic biases also require greater attention. These studies provide valuable references to improve educational AI chatbot's operation efficiently and prove that chatbots bring significant educational benefits (Mendoza et al., 2022).

To further explore the evolution of educational AI chatbots and understand its importance, we proceed with a bibliometric analysis of educational AI chatbots and provide a more comprehensive view from different detailed perspectives. Specifically, this research uses the software Citespace to analyze the educational AI chatbot-related literature from 2019 to 2024. We summarize the publication status, collaboration performances, popular or focused authors, the future research directions, these provide valuable references for scholars on educational AI chatbots and help them comprehensively understand it from various perspectives.

The objectives of this paper are 1) to comprehensively analyze the research progress on educational AI chatbots from multiple perspectives, including publication statistics, author collaboration, institutional involvement, and international contributions, thereby offering critical literature, dynamic visualized insights, and valuable perspectives for scholars. 2) to identify key research hot spots and potential

characteristics, providing clear technological directions and enablers to facilitate more efficient and focused future research efforts.

2. Literature Review

2.1 Educational AI Chatbots

Educational AI chatbots, designed to simulate human-like interaction through natural language processing, have garnered significant attention in various domains (Akiba & Fraboni, 2023). These systems facilitate real-time dialogue, offering tailored support and information to users, thereby positioning themselves as transformative tools in the education sector. By engaging learners through personalized interactions, Educational AI chatbots aim to enhance learning experiences and outcomes (Ahmad et al., 2022).

Current research on educational AI chatbots, as mapped through tools like CiteSpace, predominantly focuses on their applications in domains such as healthcare, business, and customer service (Xu et al., 2021). For instance, studies have explored their role in extending cognitive-behavioral therapies and improving accessibility to healthcare services. Similarly, in business, they serve as customer service agents, capable of handling repetitive tasks and providing efficient solutions, thus reducing operational burdens and improving customer satisfaction. These studies have largely examined themes of user engagement, technological design, and ethical considerations, emphasizing their usability and potential limitations.

In contrast, research exploring the application of educational AI chatbots in higher vocational education for lecturers' academic performance sector remains limited. While some studies highlight their use for student-centered purposes, such as tutoring, feedback provision, and administrative assistance, their influence on lecturers—particularly in enhancing teaching outcomes and academic performance—has received insufficient scholarly attention. This is especially evident in higher vocational education, where lecturers encounter unique challenges in integrating technology into curricula and pedagogy.

2.2 Academic Performance

Academic performance encompasses multiple facets of an academic's professional responsibilities, including teaching, research, and administrative contributions (Li et al., 2019). As a critical indicator of institutional excellence, it is often closely tied to the reputation and standing of universities, influencing faculty promotion, salary increments, and tenure decisions (Prasetio et al., 2017). For lecturers, academic performance reflects their contributions to teaching, research, and service, forming a critical basis for evaluations and strategic goals within academic institutions.

Research performance frequently dominates the evaluation processes in higher education. However, measuring research quality presents significant challenges, particularly across disciplines where publication practices and citation standards differ (Wu et al., 2022). Research performance involves assessing the quality and impact of scholarly work, primarily through publication outputs and citation metrics.

For example, bibliometric evaluations often favor journal articles in STEM (Science, Technology, Engineering, Mathematics) fields, while monographs and book

chapters hold greater importance in the humanities and social sciences (Diem & Wolter, 2012). These fields exhibit significant deviations from the norms of other disciplines, such as variations in publication formats and regional language use. Regional language barriers and differences in citation impact further complicate comparisons across disciplines and institutions.

These discrepancies raise questions about the validity of bibliometric techniques in capturing the true quality and impact of research performance (Long et al., 2008). Currently, using bibliometric analysis to assess research performance involves analyzing publication counts and citation frequencies to quantify scholarly impact. While this method provides quantifiable metrics and contributes to understanding research productivity, it has shortcomings—particularly when applied to fields like the humanities and social sciences.

Comparative analyses of research performance across disciplines—and even within subfields—must consider the nuances of publication practices, regional disparities, and cohort effects (Frandsen et al., 2015). For instance, the reliance on English-language journals in global citation databases can disadvantage researchers publishing in regional languages, especially in education sciences where local contexts often dominate the research agenda. Similarly, sub-disciplines within education vary widely in their output and citation patterns, adding layers of complexity to performance evaluations.

Teaching performance refers to the evaluation of educators' effectiveness in delivering quality education and engaging students in meaningful learning processes (Mohammadyari & Singh, 2015). It encompasses various activities such as lesson planning, instructional delivery, fostering critical thinking, and curriculum development. Bibliometric analysis has increasingly been applied to assess teaching performance by examining research trends, publication patterns, and emerging themes in teaching-related studies (Fosso Wamba et al., 2024). For example, publications on innovative pedagogical methods, such as flipped classrooms, project-based learning, and gamification, are analyzed to identify influential works and their broader impact on education. Additionally, studies often focus on the integration of digital tools in teaching, such as learning management systems or artificial intelligence, to evaluate their role in improving student outcomes and teaching efficiency (Fryer et al., 2020). Bibliometric analysis also highlights interdisciplinary teaching practices, showcasing collaboration across fields to address complex educational challenges.

The application of bibliometric methods extends to institutional comparisons, where teaching-related research outputs are evaluated to benchmark performance and identify best practices (Farhat et al., 2023). Furthermore, research on teaching innovations within specific disciplines—such as STEM, humanities, or social sciences—provides insights into how strategies adapt to varying academic contexts (Rodríguez-Hernández et al., 2020). Current trends include a growing emphasis on student-centered learning, equity and inclusion in education, and the digital transformation of teaching methods. For instance, the increasing number of publications on hybrid learning models and virtual classrooms reflects the broader shift toward technology-enhanced education.

Despite its utility, bibliometric analysis has limitations in fully capturing the essence of teaching performance (Lo, 2023). It often emphasizes measurable outputs, such as academic publications, which not directly reflect an educator's classroom impact or the nuanced interactions that define effective teaching. Additionally, significant contextual variations in teaching practices across regions and institutions challenge the standardization of metrics. Non-academic contributions, such as participation in community training or mentoring programs, are frequently overlooked.

Administrative performance refers to the efficiency and effectiveness of actions and processes aimed at achieving organizational goals, particularly within management and governance contexts (Fosso Wamba et al., 2024). Administrative performance highlights the contributions academics make through leadership roles, committee participation, and institutional service. This dimension supports the smooth functioning of academic departments and the broader institution, yet it is often undervalued in comparison to research and teaching. Traditionally, this concept has been extensively examined in business domains, often linked to firm performance indicators such as operational efficiency, resource management, and strategic implementation (Tao et al., 2021). In other areas, such as public administration, administrative performance is associated with service delivery, transparency, and accountability. In higher education, administrative performance is increasingly recognized as a pivotal determinant of institutional success, encompassing aspects such as resource management, policy implementation, and stakeholder collaboration. However, the evolution of administrative performance in higher education reveals emerging challenges. The integration of digital technologies has transformed traditional practices, yet disparities in adoption and implementation persist, limiting uniform progress across institutions. Furthermore, while bibliometric analyses have explored academic performance extensively, their application to understanding administrative performance in higher education remains sparse, highlighting a significant research gap that merits further exploration. Addressing these issues requires robust frameworks that integrate digital innovation with administrative efficiency to enhance institutional outcomes.

Bibliometric methods have become widely used to quantify and visualize academic performance across various disciplines (Lo, 2023). In medical education, these analyses often highlight publication trends and clinical impacts. Research productivity studies emphasize metrics such as publication counts, co-citation networks, and interdisciplinary collaboration. For service-related roles, bibliometric approaches evaluate contributions to professional bodies and community outreach. Despite their transformative potential, the application of bibliometric methods to AI tools, such as chatbots, in enhancing academic performance is still underexplored.

Although bibliometric studies provide valuable insights into traditional academic outputs, research on the integration of AI-supported technologies to advance teaching, research, and administrative efficiency remains scarce. Exploring how AI tools like chatbots can redefine academic performance presents significant opportunities to enhance teaching quality, foster innovative research collaborations, and streamline

administrative tasks, ultimately transforming the academic landscape.

2.3Data base

We choose the publication of the Web of Science (WoS) as the data source. WoS is the premier, global, highly recognized, and reliable academic publication database with multiple scientific fields (Dindorf et al., 2022). We collect the data on August 6, 2024, using the following search formula.

Select Web of Science.

TS =(“educational AI chatbots”) And LA =(“English”) And DT =(“Article” or “Review”)

We screen data with the following principles: (1) the topic of the data is relevant to chatbots. (2) the data can provide real value to the domain. Finally, we select 965 publications (data) for analysis.

2.4 Data analysis

A bibliometric analysis of the literature has been performed, chosen because it offers the opportunity to systematize a scientific field that includes a high degree of contamination among research areas. The adoption of bibliometric research allows researchers to develop new knowledge through the analysis of a field based on a rigorous approach (Rosato，2021).

Bibliometrics is a statistical analysis of extant literature and is used to provide quantitative analysis of publications in a given field (Mayr & Scharnhorst 2014). The main categories of information analyzed with respect to bibliometrics are the authors, keywords, references, journals, countries, institutions and the trends in a special field (Abramo, D’Angelo & Viel 2011). Bibliometrics originated from the quantitative research of literature that emerged in the early 1900s, and since then literature analysis based on bibliometrics has been widely applied in academic research (Diem & Wolter 2013). Graphical research and visualization studies of bibliometrics can be managed with the help of computer technology. Additionally, this method could help researchers determine the most recent developments in a special field and forecast the possible direction of such a field (Chen 2006). Co-citation analysis considers that any new theory comes from an existing one, and two articles are defined as having a co-citation relationship if they are cited by one or more articles at the same time; to what extent they are close to each other is called the co-citation degree, which is calculated by the number of citations (Small 2003).

CiteSpace is a free Java-based application for analysing co-citations and generating visual maps, as well as finding trends and patterns. This powerful and popular tool is designed for finding critical points in the development and evolution of a field, especially turning points and pivotal points. It provides various functions to help with identifying fast-growing topical areas, finding citation hot spots, decomposing a network into clusters, automatically labelling clusters with keywords from citing articles, finding geospatial patterns of collaboration and unique areas of collaboration and so forth (Chen 2006). In building the network image, three types of views – cluster view, timeline view and timezone view – can be used for analysing different information including knowledge structure, time span of a topic and

evolution trends, respectively. The primary source of input data for CiteSpace is the Web of Science (Chen 2013).

We use CiteSpace for mapping and analyzing the literature. With CiteSpace, node size, countries，authors，categories, journals and keywords clearly show the field research status and trends.

CiteSpace offers a range of advanced bibliometric analysis features that enable researchers to explore and understand academic trends effectively. The tool excels in uncovering and visualizing temporal research trends, helping scholars track the progression of topics and predict future directions using citation and keyword burst analysis (Diem & Wolter, 2012). By detecting research frontiers through citation surges and identifying pivotal publications, CiteSpace facilitates the discovery of key turning points and emerging areas of interest. Its robust author collaboration network visualizations highlight influential researchers and institutions, revealing the broader academic landscape. Furthermore, CiteSpace's clustering capabilities provide an in-depth view of research categories, allowing for the identification of hot spots and high-activity areas in academic fields (Salgado-Fernandez et al., 2022). Dynamic, interactive visualizations enhance understanding and accessibility, offering a comprehensive overview of current states and future trends in academic research, including the domain of chatbots for improving academic performance.

keywords are to identify potential hotspots and trends in educational AI chatbot research. By examining the co-occurrence networks of keywords, researchers can detect frequently used terms and their relationships, which indicate emerging topics and areas of interest. This analysis helps in identifying the current focal points in the research and provides insights into the evolving priorities and directions within the field. Understanding these hotspots and trends is crucial for identifying gaps in the research and potential areas for future investigation.

Collaboration analysis: including the institution and author collaboration network analysis. Collaboration networks reveal the correlations of educational AI chatbots from multiple perspectives.

3 Results

3.1 Statistical analysis

3.1.1 Number of publications by year

The annual distribution on publications aims to help us to understand the research outputs on educational AI chatbots. It explains the dynamics of educational AI chatbots research in the past and help scholars judge the future development status of educational chatbots. We can find that the overall publications are increasing with fluctuations: the number of publications in 2023 is nearly 3 times more than 2019. In particular, the accumulated publications for the latest 5 years (2019-2024) are 938, providing that educational AI chatbots research is obtaining increasing attention and producing more academic papers. Besides, we can find that annual publications fluctuate (the trend is not constantly increasing), which is common in academic research because there are study periods for research domains. The amount in 2024 is smaller because the data were collected in September 2024. And only reflect portions of 2024’s publication, but we are positive to assume the publication trend is upward.

In conclusion, the rising trend proves that research about educational AI chatbots is still prevalent.

The consistent growth in publications points to a promising future for this research area. Researchers are likely to expand their focus into new subfields or applications, potentially addressing practical challenges, refining AI chatbot algorithms, or exploring novel educational use cases. This trend also implies that the academic community sees educational AI chatbots as an important technology worth further exploration, potentially shaping future educational tools and strategies.

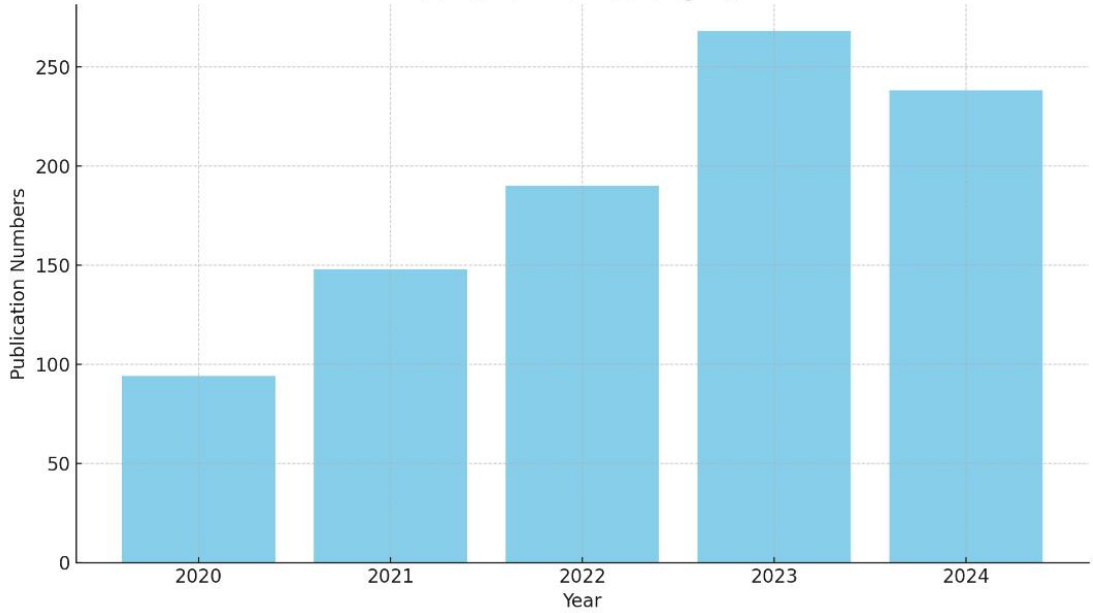

Figure 5. Number of publications by year

3.1.2 Number of publications by categories

The statistics of the journal categories aim to reveal the disciplines involve in educational chatbots, which can further hint to researchers whether this domain is specialized or integrated. These types are strongly related to the research topic of educational chatbots.

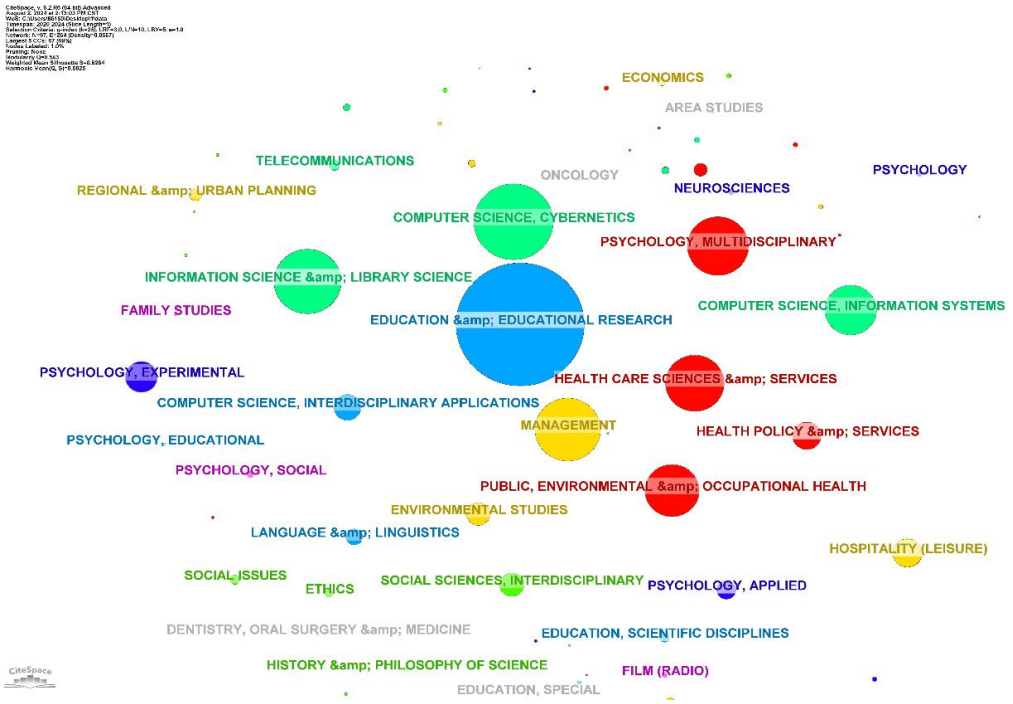

Figure 6. The maps of categories in educational AI chatbots

Figure 6 shows the most papers are published in Education & Educational Research, various subfields of Psychology, and Computer Science. It indicates a significant emphasis on understanding the educational impact of AI chatbots, their psychological effects on users, and advancements in their technical development. Additionally, there is notable research on the application of educational AI chatbots in healthcare and considerations of ethical and social implications. This suggests that current research aims to optimize AI chatbot functionalities while addressing their broader societal and psychological impacts.

This distribution highlights the primary application of educational AI chatbots in education, while their intersections with fields such as health sciences and social sciences suggest growing interest in diverse use cases. Smaller nodes like "Ethics" and "Language & Linguistics" indicate emerging research areas, potentially addressing concerns about ethical design, multilingual capabilities, and societal impact. The map suggests that future research will likely expand into broader interdisciplinary applications and address challenges such as privacy, trust, and equity in educational AI chatbot adoption.

3.2 Collaboration analysis

The collaboration networks are to understand the links between different institutions and authors on educational chatbots. Analyzing these collaboration links can help scholars understand the current research correlations and seek potential cooperation partners.

3.2.1 Institution Collaboration Networks

The institutional collaboration aims to show the connections among engaged in similar topics of educational AI chatbots.

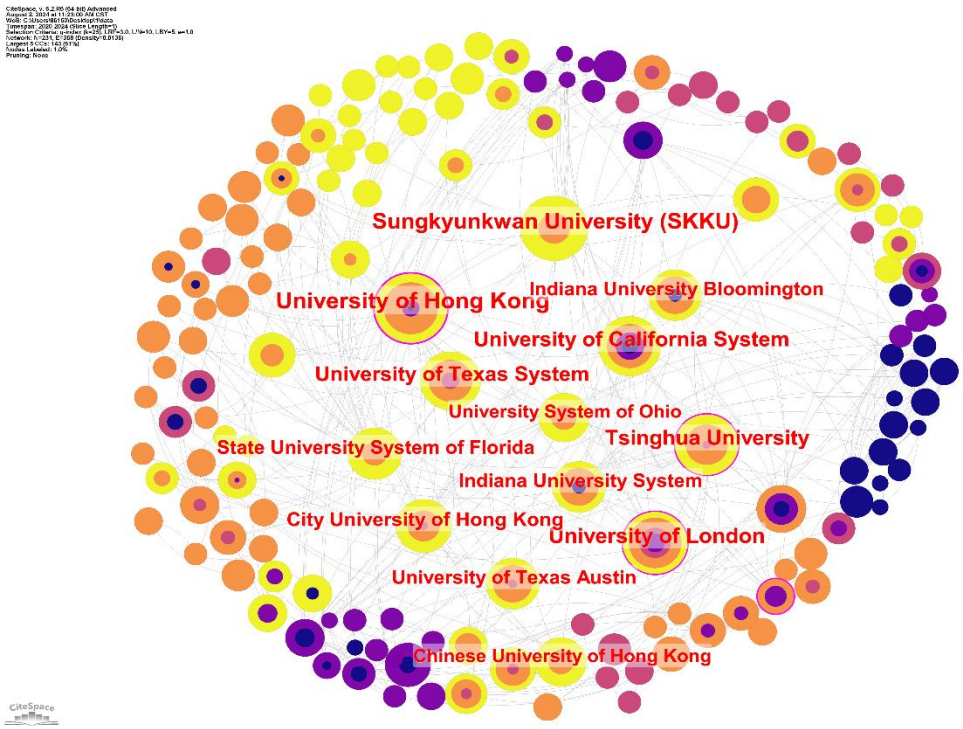

Figure 2. The maps of institution collaboration in educational chatbots

Figure 2 illustrates the collaborative research landscape in the field of educational AI chatbots, highlighting key institutions like the University of Hong Kong, Sungkyunkwan University, and the University of California System as central contributors. The dense connections between these nodes suggest strong partnerships and significant research output, emphasizing the collective effort in advancing educational AI chatbot technology for educational purposes. The prominence of these universities indicates their influential roles in driving innovation and integration of chatbots in learning environments, showcasing the importance of collaborative endeavors in this rapidly evolving field.

The map also highlights emerging contributors like the University of Texas System and the City University of Hong Kong, indicating expanding global participation. Future trends may involve strengthening these collaborations and increasing engagement from less-represented regions, broadening the scope and impact of research in educational AI technologies.

3.2.2 Author Collaboration Networks

Author collaboration networks refer to the counts and centrality, the partnership among authors.

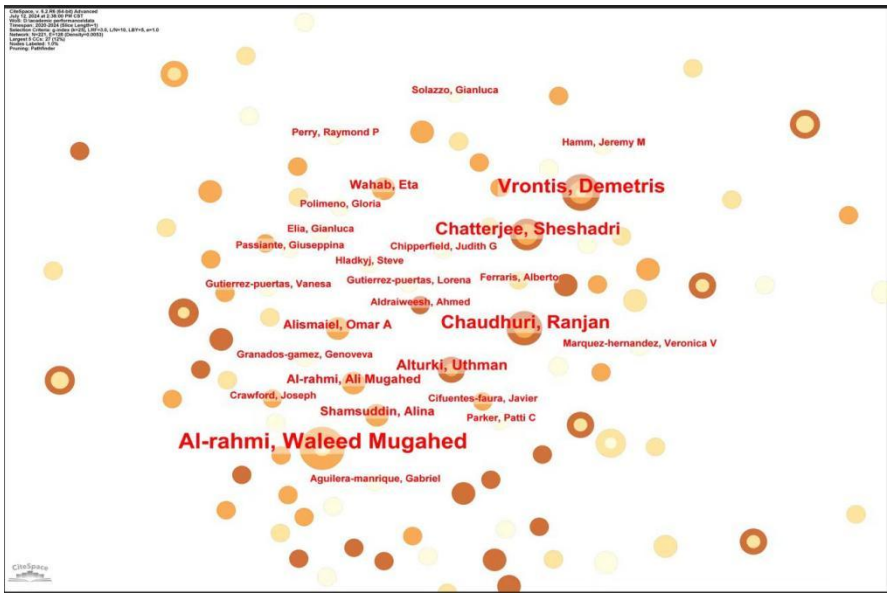

Figure 3. Maps of author collaboration in educational AI chatbots

Figure 3 depicts key authors and their collaborative relationships in the field of educational AI chatbots, with prominent contributors like Waleed Mugahed Al-Rahmi, Demetris Vrontis, and Sheshadri Chatterjee at the center, indicating their significant influence and extensive research output. The dense clustering of nodes around these authors suggests robust collaboration networks, emphasizing the importance of joint efforts in advancing educational AI chatbot technology for educational applications. This interconnected research landscape highlights the critical role of leading scholars in driving innovation and enhancing the effectiveness of educational AI chatbots in educational settings.

Additionally, key themes like user experience, trust, and performance metrics frequently intersect with technological adoption models, indicating their critical role in driving acceptance and sustained use of chatbots in educational settings. Future research may explore the long-term impacts of AI-driven tools on academic performance while addressing ethical considerations such as privacy, equity, and digital divide issues. These trends suggest a fertile ground for further interdisciplinary studies that combine educational technology, human-computer interaction, and behavioral psychology.

3.2.3 Country Collaboration Network

The top 3 collaborative countries, including 1 developing and 2 developed ones (USA and England). We aim to show that countries with different development conditions have different collaborative statuses on education.

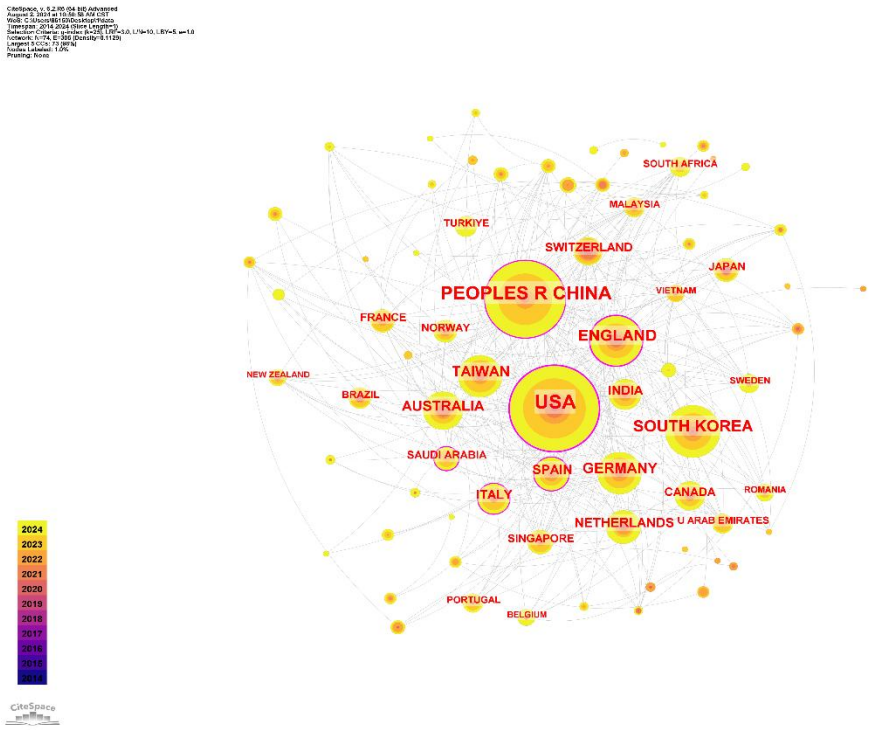

Figure 4. Maps of country collaboration in educational AI chatbots

Figure 4 shows that there are many country links. The node size reflects the citation frequency of the articles, which also illustrates whether the node is highly focused. There are many country links, revealing that country cooperation is relatively frequent. We can find several large nodes, such as the USA, China, England, South Korea, Taiwan, Germany, and Australia.

Other significant contributors include South Korea, Australia, and Germany, reflecting a widespread interest in integrating artificial intelligence into educational contexts. The visualization also shows increasing engagement from countries like Taiwan and India, suggesting a growing research capacity in Asia. The collaborative links between nations underscore the importance of cross-border knowledge exchange, fostering innovation and addressing challenges in the global implementation of AI technologies in education. Future efforts may further enhance these networks by involving underrepresented regions, promoting inclusivity, and addressing localized educational challenges.

3.3 Keywords analysis

3.3.1 Keywords cooccurance

In CiteSpace, keywords are pivotal elements used to understand the core themes and emerging trends within a specific body of literature. Keywords are terms frequently appearing in the titles, abstracts, and keyword lists of research papers, representing the primary topics of interest in the field. By analyzing the co-occurrence of keywords, researchers can identify how various themes are related, cluster-related topics, and uncover the structure and evolution of research domains. This analysis helps in understanding the focus areas and the interconnections of different research themes within the literature.

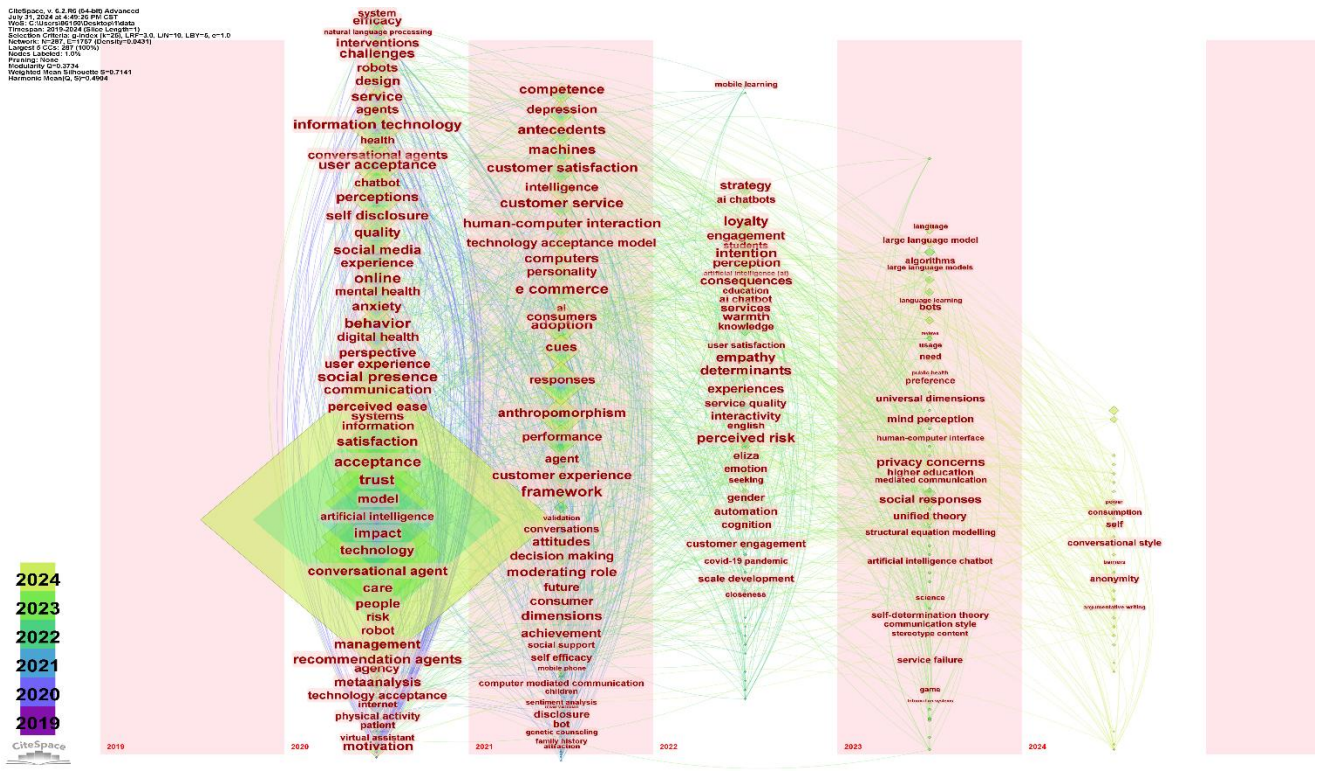

Figure 1. The maps of keywords in educational chatbots

The picture illustrates the evolving research landscape on educational AI chatbots from 2019 to 2024, highlighting key themes and trends. Early research (2019-2021) focuses on user acceptance, trust, and the integration of technology in user experiences, evident from prominent keywords like "chatbot", "user acceptance", and "customer experience". The middle period (2021-2022) shifts towards understanding the emotional and psychological aspects, with keywords like "empathy" and "perceived risk" gaining prominence. Recent trends (2023-2024) address technical and ethical challenges, as indicated by keywords such as "privacy concerns" and "large language models".

These trends suggest a future research direction that will likely delve into resolving the ethical implications and ensuring the privacy and security of advanced technological systems, particularly as they become more integrated into everyday life. Such as machine learning, AI, and various optimized algorithm models have been applied to address these issues.

3.3.2 Keywords bursts

The keyword citation bursts aim to reflect the emerging tendencies of the hotpots in the domain.

Top 17 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2020 - 2024
innovation performance	2020	4.57	2020	2021	
trends	2020	4.57	2020	2021	
dynamics	2020	3.35	2020	2021	
computer	2020	3.35	2020	2021	
company	2020	3.26	2020	2021	
prevalence	2020	3.04	2020	2021	
performance evaluation	2020	3.04	2020	2021	
ivory tower	2020	3.04	2020	2021	
developing country	2020	2.74	2020	2021	
business performance	2020	2.62	2020	2021	
level	2020	2.43	2020	2021	
organizational change	2020	2.43	2020	2021	
associations	2020	2.43	2020	2021	
sleep quality	2020	2.43	2020	2021	
cell phone use	2020	2.13	2020	2021	
ict	2020	2.02	2020	2021	
circular economy	2021	3.91	2021	2022	

Table 1. Top 17 key words on educational AI chatbots

Table 1 illustrates the top 17 keywords with the strongest citation bursts in research from 2020 to 2024, showcasing topics that experienced significant increases in academic attention over specific time periods. The burst strength indicates the intensity of focus on these keywords, with "Innovation performance" and "Trends" leading at 4.57, followed by other topics such as "Circular economy" and "Dynamics." Most bursts occurred between 2020 and 2021, reflecting a peak in research activity during this time, while a few, such as "Circular economy," extended into 2022. The keywords span diverse fields, including innovation, organizational change, ICT, and even niche areas like "Sleep quality" and "Cell phone use." This analysis provides insights into emerging research priorities and the dynamic shifts in academic interests.

The emergence of "circular economy" in 2021 signals a shift towards sustainability-oriented studies. However, the limited duration of these bursts suggests the need for deeper, sustained investigation into these areas. Future research could build on these trends by incorporating interdisciplinary approaches to address evolving global challenges.

4 Discussion and Conclusion

This study conducted a comprehensive bibliometric analysis to examine the evolving research landscape of educational AI chatbots and their implications for academic performance. The findings reveal a growing body of interdisciplinary research that spans education, computer science, and psychology, demonstrating the increasing recognition of educational AI chatbots as transformative tools in academic settings. The steady rise in publications between 2019 and 2024, along with the identification of key collaborative networks among authors and institutions, highlights

the strategic importance of this domain in addressing contemporary educational challenges.

4.1 Theoretical Implications

The study advances the academic conversation by identifying critical research trends and knowledge gaps in educational AI chatbot research. The results emphasize the multidimensional nature of this field, spanning education, psychology, and computer science. Key findings, such as the prominence of keywords like “trust” and “privacy,” underscore the growing focus on ethical and practical considerations in educational AI chatbot deployment. This work highlights the role of bibliometric methods in systematically mapping a rapidly evolving field, providing an empirical foundation for future theoretical models of educational technology adoption.

4.2 Practical Implications

For practitioners, the findings reveal actionable insights into the development and deployment of AI chatbots in educational settings. The identification of collaborative hubs, such as the University of Hong Kong and the University of California system, suggests potential partners for advancing technological integration. Furthermore, the emphasis on interdisciplinary applications, including healthcare and social sciences, signals opportunities to expand educational AI chatbot functionalities beyond traditional learning environments. Policymakers and institutional leaders can use these insights to prioritize investments in AI tools that align with current educational needs while addressing ethical and social considerations.

4.3 Research Limitations

Despite its contributions, this study is not without limitations. First, the reliance on bibliometric analysis, while systematic and data-driven, does not account for the qualitative depth of individual studies. Future research could complement this approach with content analysis or case studies to provide a more nuanced understanding of chatbot applications. Second, the focus on publications indexed in the Web of Science database may exclude relevant studies from other academic or regional sources, limiting the comprehensiveness of the analysis. Lastly, the field of educational AI chatbots is rapidly evolving, and the trends identified may shift as new technologies and use cases emerge.

4.4 Conclusion

To address these limitations and build upon the findings, future research should explore longitudinal studies that assess the long-term impact of chatbots on academic performance, particularly in underrepresented educational settings. Additionally, cross-cultural studies could shed light on how contextual factors influence the adoption and efficacy of these tools. By integrating these perspectives, scholars and practitioners can collectively enhance the theoretical robustness and practical utility of educational AI chatbots.

This study offers a foundational roadmap for understanding the current state and future potential of educational AI chatbots. By addressing their theoretical, practical, and ethical dimensions, the research not only contributes to academic discourse but also provides actionable insights for leveraging AI technologies to foster educational innovation and excellence.

5. New Knowledge Contribution

This study makes a significant knowledge contribution by providing an integrated bibliometric perspective on the emerging field of educational AI chatbots. Unlike previous studies that primarily focus on isolated applications or technical functionalities, this research synthesizes interdisciplinary insights to map the thematic, geographical, and collaborative dynamics shaping the field. By systematically identifying key research clusters—such as ethical considerations, technological design, and pedagogical integration—it positions educational AI chatbots within the broader discourse on educational innovation and digital transformation.

Moreover, the study introduces a nuanced understanding of the interplay between theoretical constructs like trust, user engagement, and performance outcomes, advancing the conceptual frameworks used to evaluate AI-driven tools in education. Through its exploration of research gaps and future trends, this work highlights critical areas such as equity in access, cultural adaptability, and the ethical governance of AI technologies. These contributions not only enrich the academic literature but also provide a strategic foundation for scholars and practitioners seeking to navigate the complexities of this rapidly evolving domain.

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