



BIBLIOMETRIC AND VISUALIZED ANALYSIS OF GENERATIVE AI CHATBOT FOR LEARNING: A STUDY FROM SCOPUS DATABASE

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ABSTRACT

Phenomenon/Issue:

The rapid advancement of generative artificial intelligence (AI) chatbots in the field of education has significantly increased the volume of scientific publications in recent years. Despite this growth, comprehensive bibliometric analyses that specifically examine this research area remain relatively limited.

Purpose:

This study aims to provide an in-depth analysis of Generative AI Chatbot research in education using a bibliometric approach.

Novelty:

This research fills the gap in existing literature by utilizing Garza-Reyes's five-phase framework to provide a systematic and comprehensive visualization of the evolution of the field, specifically identifying emerging social-emotional themes.

Research Methods:

Data were obtained from the Scopus database, yielding an initial set of 16,590 documents. After a rigorous screening process, 230 relevant articles published between 2020 and 2025

Results:

The results identify six major research clusters representing key themes. Dominant topics include artificial intelligence, chatbots, and education, while emerging topics such as empathy, trust, feedback, and interpersonal communication offer potential directions for future research. Furthermore, the co-authorship analysis suggests that collaboration among researchers remains relatively limited.

Research Contributions:

This study offers a comprehensive overview of current research trends and identifies strategic opportunities for the further development and integration of generative AI chatbots in educational settings.

INTRODUCTION

Artificial intelligence (AI) has changed transformative paradigm in the digital era, reshaping human-machine interaction across multiple sectors. As a multidisciplinary field, AI focuses on replicating and augmenting human cognitive capabilities through systems capable of learning, reasoning, and decision-making. These capabilities enable machines to process complex data and perform tasks traditionally requiring human intelligence, such as speech recognition, computer vision, and natural language processing (Noble & Noble, 2023). This current era, artificial intelligence (AI) is extensively applied across various sectors, including healthcare, finance, transportation, education, and entertainment (Mukhamediev et al., 2022). One of the trending innovations is generative AI-powered chatbots such as ChatGPT, Gemini AI, DeepSeek, Perplexity, and Grok, which leverage natural language processing

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(NLP) and generative AI to generate coherent and contextually relevant responses in real time (Nguyen et al., 2022; Rahmawati, 2025).

The growing integration of AI-driven chatbots into educational systems reflects their increasing significance in shaping contemporary digital learning environments (Chen et al., 2022). Chatbot AI is increasingly being utilized as a digital assistant to support learning processes in higher education, such as helping students understand course materials, simplifying complex concepts, and enhancing the efficiency and personalization of learning (Limna et al., 2022; Selwyn, 2024). In this context, chatbot AI stands out as a transformative technology with the potential to reshape educational processes (Jaiswal & Arun, 2021). For example, by analyzing student data, AI can develop personalized learning programs tailored to individual learning styles and paces, thereby enabling students to learn more effectively (Genc & Kocak, 2024). Over recent years, chatbot AI has been increasingly integrated into science education, with numerous studies exploring its application across various areas, including teaching, learning, assessment, and curriculum development (Xu & Ouyang, 2022; Akhmadieva et al., 2023; Arıcı, 2024; Lee et al., 2025). Previous research identified that AI-based learning systems have successfully increased effectiveness in the context of improving students academic performance across various disciplines (Zhou, 2025), and the majority of higher education students have incorporated AI chatbots into their routine academic practices (Kelly, 2024).

The rapid use of research on generative AI chatbots has urged on the need for comprehensive overviews of existing studies. As the results, systematic reviews have emerged as a prominent methodological approach for critically evaluating and synthesizing the growing body of academic literature (Gandasari et al., 2024). In this context, bibliometric analysis is widely employed to assess the performance and impact of scientific publications. It involves a systematic and quantitative examination of scholarly works and their citation patterns to evaluate research trends and contributions (Genc & Kocak, 2024). Bibliometrics utilizes statistical, mathematical techniques, and employs various analytical approaches to examine texts, citations, content, and keywords within scholarly publications (Dias, 2019). Bibliometric analysis has proven to be an important method for assessing the development and impact of scientific knowledge across various fields of research (Hammouti et al., 2025). In addition, Donthu et al. (2021) explain that the use of bibliometric analysis is not limited to monitoring trends in scientific activity, but is also crucial for identifying research gaps and untapped opportunities, by comparing the performance of different publications and mapping global collaboration networks, this method allows us to understand structural changes and the overall development of a scientific field.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Despite the surge in Artificial Intelligence in Education (AIED) research, a significant gap remains, as most existing bibliometric reviews tend to provide only general overviews and lack in-depth analysis of specific emerging topics, particularly in the context of generative AI chatbots. Khosravi et al. (2023) conducted a bibliometric study on chatbots and ChatGPT using the Scopus and Web of Science (WoS) databases, covering the period from 1998 to 2023. The analysis consisted of two main phases: a literature review on chatbots and a comprehensive review specifically focused on scientific documents related to ChatGPT. The results showed significant annual growth (19.16% in WoS and 27.19% in Scopus), with ChatGPT identified as the most dominant recent trend. Analysis of 45 ChatGPT-specific studies revealed three main areas of focus: AI technology, evaluation of conversational agents, and the use of digital technology in mental health.

Subsequent bibliometric studies have further highlighted the evolving trends in artificial intelligence (AI) research within education. For instance, Genc & Kocak, (2024) analyzed 867 publications on AI in science education from 2019 to 2023 using VOSviewer, revealing a significant increase in publications in 2022 and 2023, with the United States, China, and Australia emerging as leading contributors. Their findings also demonstrate that AI developments in higher education are closely associated with trends in machine learning, learning analytics, and data science, with Computers & Education identified as an influential source. Similarly, a study by Guo et al. (2024) which examined

6,843 publications from Web of Science and Scopus, highlights the rapid and multidisciplinary growth of Artificial Intelligence in Education (AIED), with research predominantly concentrated in higher education and focused on STEM and language domains. In line with these findings, Kaban, (2023) identified a substantial increase in AI-related research following 2019 through an analysis of 1,153 Web of Science articles, further emphasizing the central role of Computers & Education in shaping the thematic structure of this research field.

Recent studies have increasingly focused on the specific applications of artificial intelligence within educational contexts, particularly in the use of AI chatbots, Lin and Yu (2024) reviewed the potential of AI chatbots in language education, revealing interdisciplinary trends as well as the crucial role of student perceptions in evaluating the technology's effectiveness. Meanwhile, López-chila et al., (2024) analyzed 870 articles in the Scopus database (2017–2023), confirming that AI integration in higher education holds promise for global learning personalization, although ethical challenges remain a primary concern. The focus on competency models is also discussed by Radu et al. (2024), who, through an analysis of 1,028 articles, found an annual increase of 8.43% since 2017 and highlighted the influence of global events such as COVID-19 on the acceleration of AI adoption.

Trends regarding chatbot AI (ChatGPT, Deepseek, Gemini AI) have specifically garnered attention in several recent studies. Research by Harahap et al. (2025) provides an overview of the evolution of chatbot technology from rule-based systems to more advanced generative language models. Through an analysis of Scopus data (2020–2024), this study documents a massive growth in publications and highlights the significant contributions from the Southeast Asian region. In addition, Oliński et al. (2024) analyzed 814 publications using VOSviewer to uncover ChatGPT's influence in the social sciences, revealing a diversity of perspectives ranging from ethical to sociological. On the other hand, Shang (2024) mapped the evolution of ChatGPT related themes in education, which shifted from a focus on school courses toward investigations into AI performance, language models, and patient education. Collectively, these studies demonstrate the dominance of contributions from the United States and China in global AI scientific output.

Unlike previous studies, this research offers a more detailed and focused analysis of publications from 2020 to 2025 on the use of generative AI chatbots in educational contexts. Drawing on data from the Scopus database, this study examines multiple dimensions, including publication trends, authorship patterns, citation structures, journal distribution, country contributions, and keyword co-occurrence, in order to uncover underlying relationships and emerging research trajectories. Accordingly, this study aims to provide a comprehensive overview of the current landscape of generative AI in education while identifying potential directions for future research.

The **urgency** of this research lies in the need to synchronize the rapid technological growth of AI chatbots with academic documentation. By addressing this urgency, this study aims to provide a comprehensive bibliometric landscape to answer the following research questions (RQ):

RQ1: Annual trends

RQ2: Leading journals published

RQ3: Leading authors who have contributed

RQ4: Fields of study or academic disciplines

RQ5: Major research topics

RQ6: Potential topics for future research

RQ7: Leading authors and their collaborations?

METHOD

This study used bibliometric methods to provide an overview of studies related to Generative AI Chatbot for learning. The study adopts a five-stage framework developed by Garza-reyes, (2015) to conduct a bibliometric analysis of the literature on Generative AI Chatbots for learning. The application

of this systematic procedure aims to ensure the overall validity of the data and to guarantee the accuracy of the evaluation in mapping publication trends (Gandasari et al., 2024).



Source: Garza-reyes, (2015); Gandasari et al., (2024).

Figure 1. BIBLIOMETRIC ANALYSIS STAGE

Defining Search Keyword

The first stage involves identifying relevant terminologies to capture the most comprehensive dataset. The search was conducted on March 18, 2026, focusing on titles, abstracts, and keywords. The search formula utilized was: "chatbot AI" OR "AI chatbot" AND "artificial intelligence" OR "generative AI" AND "education" OR "learning". The information source for this research is the Scopus database. Scopus was selected because it is a leading global database that ensures the high quality and peer reviewed nature of indexed articles (Krisnaningsih et al., 2021).

Initial Search Results

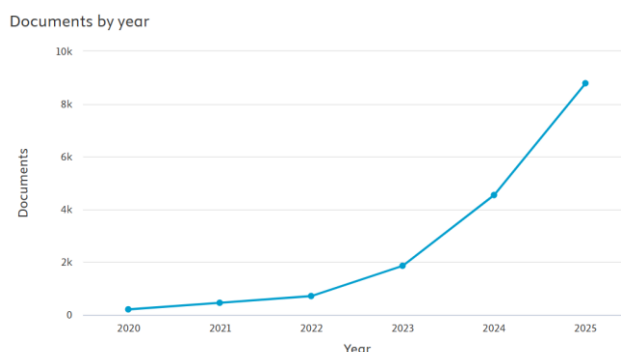
In the second stage, the search was conducted using a predefined search formula in the Scopus database. To ensure that this study remains up-to-date and highly relevant to the latest technological advancements, the authors limited the publication years to the range of 2020 to 2025. Through this application, 16,590 documents were identified, representing global scientific output related to Generative AI Chatbots in an educational context over the past five years.

Refinement of Search Results

To enhance the precision and academic quality of the dataset, specific inclusion were applied, such as documents must be written in English to ensure international accessibility and standardization, the document type is strictly limited to "article" to ensure that the data originates from original research published in peer-reviewed journals. In addition, conference proceedings, book chapters, editorials, notes, and short surveys were excluded to maintain a high level of scholarly rigor. Duplicate paper will also be excluded to prevent data skewness. The findings were stored in RIS format for further analysis.

Compile Preliminary Data Statistics

The refined data was managed using reference management software (RMS) Mendeley to verify metadata completeness, including author, title, keywords, abstract, and name, year, issue, volume and pages of the journal. A verification process was conducted to ensure that all 16,590 documents met the established criteria. This stage is crucial to provide a clean dataset before the visualization process begins. Then, data were undergone analyzing and classifying based on the number of documents published annually, journal name, author and discipline.



Source: Scopus Database (2026)

Figure 2. TREND OF GENERATIVE AI CHATBOT ARTICLES PUBLISHED PER YEAR

Figure 2 shows that the number of articles on Generative AI Chatbots published per year demonstrates a clear and consistent upward trend since 2020, with an initial total of 213 articles. This growth reflects the increasing research interest in this field, which has accelerated significantly in recent years. The trend aligns with global advancements in artificial intelligence technology, particularly over the past three years, where a substantial surge in scholarly attention is evident. As illustrated in Figure 2, the number of publications rose sharply in 2023, reaching 1,866 articles, and continued to grow in 2024 with 4,548 articles. The trend peaks in 2025, with a total of 8,780 articles. This exponential increase highlights that Generative AI Chatbots have become a central focus in contemporary scientific discourse, reinforcing the relevance and timeliness of this research in capturing this rapidly evolving phenomenon.

Data Analysis

This study used VOSviewer software to visualize RIS format the bibliometric data in identifying thematic clusters and emerging trends in the use of Generative AI Chatbot for learning. VOSviewer is a widely used software tool for conducting in-depth analysis and generating visual representations in the form of bibliometric maps (Hudha *et al.*, 2020). Furthermore, according to Eck & Waltman (2010), VOSviewer has proven capable of processing large-scale maps and effectively creating visual representations of citation relationships between documents, even when the data comes from various major scientific publications. This tool can generate various types of maps, including maps for authors, journals, publications, and countries, by utilizing co-citation networks or creating keyword maps, overlay visualization, and density visualization through topic modeling (Rohmawatia & Nugrahab, 2024).

RESULTS AND DISCUSSIONS

An initial search of the Scopus database using the keywords: “chatbot AI” OR “AI chatbot” AND “artificial intelligence” OR “generative AI” AND ‘education’ OR “learning” produced 16,590 articles. However, to ensure the relevance and quality of the data, a screening process was conducted based on topic relevance, the latest research trends, and publication year restrictions. This study focuses on articles published between 2020 and 2025. Additionally, the selection process considered representation across each year to provide a more balanced picture of research developments. After the screening process, 230 articles were identified as relevant and aligned with the study’s objectives.

Table 1.
TOP JOURNALS PUBLISHING GENERATIVE AI CHATBOT ARTICLES

No	Publisher	Articles
1	IEEE Access	287
2	International Journal of Human Computer Interaction	287
3	Education and Information Technology	226
4	Applied Sciences Switzerland	172
5	Scientific Reports	159

Source: Scopus Database (2026)

Table 1 shows the journals or publishers that have published the most articles related to Generative AI Chatbots. It is evident that IEEE Access and the International Journal of Human Computer Interaction are the largest contributors, followed by Education and Information Technology, Applied Sciences Switzerland, and Scientific Reports. This indicates that this topic is widely studied in the fields of technology, human-computer interaction, and technology-based education. Additionally, Table 2 lists the five authors with the most contributions to the topic of Generative AI Chatbots, with Gwo-Jen Hwang ranking first.

Table 2.
TOP CONTRIBUTING AUTHORS IN GENERATIVE AI CHATBOT

No	Author Name	Articles
1	Hwang, G.J.	29
2	Chiu, T.K.F.	26
3	Dwivedi, Y.K.	23
4	Jo, H.	22
5	Chai, C.S.	20

Source: Scopus Database (2026)

Table 3 shows the countries with the highest number of publications. The United States ranks first, followed by China, the United Kingdom, India, and Germany. These data indicate that research on Generative AI Chatbots is dominated by countries with strong technological development and research capabilities.

Table 3.
TOP CONTRIBUTING COUNTRY IN GENERATIVE AI CHATBOT

No	Country	Articles
1	United States	3,790
2	China	3,107
3	United Kingdom	1,284
4	India	1,134
5	Germany	890

Source: Scopus Database (2026)

Meanwhile, Table 4 shows the fields of studies that have contributed the most to research on generative AI chatbots. This indicates that AI chatbot research is not limited to technical aspects but is also extensively studied in social, health, and business contexts.

Table 4.
SEVERAL DISCIPLINES OF GENERATIVE AI CHATBOT

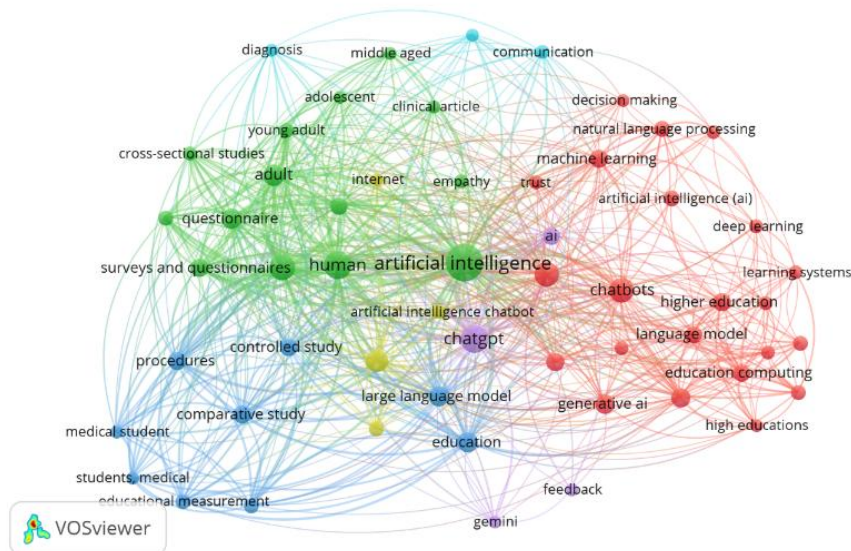
No	Subject Area	Articles
1	Computer Science	6,625
2	Social Sciences	6,254
3	Medicine	3,380
4	Business, Management and Accounting	2,711
5	Engineering	2,228

Source: Scopus Database (2026)

Visualization of Topic Areas

VOSviewer visualizations were used to identify keywords with high frequency of occurrence, as described by Gandasari et al. (2024). Additionally, relationships between topics were revealed through cluster analysis based on the methodology of Hudha et al. (2020). This study mapped research topic trends over a 5-year period (2020–2025) by applying three bibliometric visualization models: network, overlay, and density. Each cluster in this study represents a distinct topic domain, which simultaneously serves as a roadmap or recommendation for future research in the field of AI chatbots. When a keyword has a higher frequency of occurrence, its level of importance also increases and is represented by a larger circle in the visualization. The keywords “artificial intelligence” and “chatbot” have the highest frequencies and are therefore displayed as the largest circles. Next, filtering was performed by setting a minimum occurrence threshold of 5 times for each keyword. Of the total 1,568 identified keywords, only 59 met these criteria. The analysis then grouped the keywords into six main clusters reflecting research topic trends in the field of AI chatbots, distinguished by different colors. Each cluster represents a distinct topic and can serve as a basis for recommendations for future research in the field of AI chatbots.

The first cluster focuses primarily on the AI technology ecosystem and its implementation in educational systems. The second cluster addresses human factors and research methodologies, highlighting psychological aspects. Next, the third cluster focuses on the integration of AI in medical education and controlled clinical studies. The fourth cluster addresses practical applications in information provision. The fifth cluster specifically groups currently popular large language models. Finally, the sixth cluster highlights aspects of interpersonal communication and diagnosis in technology-based interactions.



Source: VOSviewer (2026)

Figure 3. Network Visualizations Of Generative AI Chatbot

Figure 3 shows the network visualization of research on Generative AI Chatbots, illustrating the relationships between key terms based on their co-occurrence in scientific publications. The map is divided into several clusters, each represented by different colors, indicating distinct but interconnected research themes. The red cluster highlights topics related to technological development, such as artificial intelligence, machine learning, natural language processing, chatbots, and generative AI, as well as their applications in education and learning systems. This cluster reflects the core technological foundation of Generative AI Chatbots. The green cluster focuses on human-centered and methodological aspects, including terms such as human, surveys and questionnaires, controlled study, and empathy. This indicates a strong research emphasis on user interaction, evaluation methods, and the social impact of AI technologies. The blue cluster represents educational and medical research contexts, including medical students, procedures, and measurement, suggesting that Generative AI Chatbots are widely explored in applied fields, particularly in education and healthcare. Meanwhile, the yellow and purple clusters include emerging concepts such as large language models, ChatGPT, and Gemini, which are closely linked to recent advancements in AI systems. These clusters demonstrate the rapid evolution of tools and models that drive current research trends. Therefore, it can be said that figure 3 reveals a highly interconnected research landscape, where technological innovation, human interaction, and practical applications converge, highlighting the multidisciplinary nature of Generative AI Chatbot studies.

Table 5.
OCCURRENCE CLUSTER ANALYSIS

No.	Cluster	Most frequent keywords	Keywords
1	The first cluster (red) 22	chatbots / chatbot (34), generative ai (16)	ai chatbot (6), artificial intelligence (ai) (9), chatbot (34), chatbots (34), decision making (5), deep learning (6), e-learning (6), education computing (10), educational technology (7), engineering education, (6) generative ai (16), high educations (5), higher education (14), language model (10), large language models (12), learning systems (6), machine learning (13), natural language processing (9), natural language processing system (6), students (16), teaching (8), and trust (6).
2	The second cluster (green) 14	artificial intelligence (116), human (49)	Adolescent (5), adult (21), artificial intelligence (116), clinical article (5), cross-sectional studies (6), cross-sectional study (11), empathy (6), human (49), humans (37), middle aged (5), psychology (7), questionnaire (17), surveys and questionnaires (13), and young adult (8).
3	The third cluster (blue) 9	education (19), large language model (18)	comparative study (12), controlled study (11), education (19), educational measurement (7), large language model (18), medical education (7), medical student (5), procedures (13), and student medical (5).
4	Fourth cluster (yellow)	generative intelligence (24)	artificial intelligence chatbot (6), generative artificial intelligence (24), internet (5), and patient education (7).
5	Fifth cluster (purple) 4	chatgpt (49)	Ai (11), chatGPT (49), feedback (5), and gemini (5).
6	Sixth cluster (sky) 4	Communication (6)	Communication (6), diagnosis, interpersonal (5), and communication (5).

Source: Processed By Researcher (2025)

Table 5 shows the occurrence cluster analysis of keywords related to Generative AI Chatbot research, grouped into six main clusters. The first cluster (red) is the largest, emphasizing technological and educational themes, with dominant keywords such as chatbot(s) and generative AI. The second cluster (green) focuses on human-centered and methodological aspects, highlighted by artificial intelligence and human-related terms. The third cluster (blue) represents educational and medical research contexts, particularly education and large language models. The fourth cluster (yellow) centers on generative artificial intelligence and its applications, while the fifth cluster (purple) highlights emerging tools such as ChatGPT. Finally, the sixth cluster (sky blue) reflects communication-related aspects, including interpersonal communication and diagnosis.

The Main Topics of Research in Generative AI Chatbot Field

A visualization of the six clusters and their interrelationships is shown in Figure 3. Each cluster reveals keywords that demonstrate strong correlations among them, reflecting the study's focus on the use of AI chatbots in learning. This study focused on the two keywords with the highest frequency of

occurrence to identify dominant trends. The first cluster consists of 22 items. The two keywords with the highest occurrence frequency in this cluster are “chatbots” with 34 occurrence keywords, 45 links, and 131 total link strength, followed by “generative AI” with 16 occurrence keywords, 27 links, and 47 total link strength. The second cluster includes 14 items focused on human subjects and methodology. The most frequently occurring keyword is “artificial intelligence” with 116 occurrences, 54 links, and 443 total link strength, followed by “human” with 49 occurrences, 42 links, and 350 total link strength. The high frequency of “artificial intelligence” in this cluster indicates that this technology is widely studied in relation to human characteristics, ranging from the ‘adult’ group (21) to psychological aspects such as “empathy” (6).

In addition, the third cluster consists of 9 keywords related to medical education and study methods. The keyword with the highest frequency in this cluster is “education,” with 19 occurrences, 39 links, and a total link strength of 136, followed by “large language model,” with 18 occurrences, 40 links, and a total link strength of 123. In the fourth cluster, the keyword with the highest frequency is “generative artificial intelligence” with 24 occurrences, 39 links, and 127 total link strength, followed by “patient education” with 7 occurrences, 21 links, and 43 total link strength. This cluster highlights the intersection between internet usage and patient education through more intelligent chatbot systems. The fifth cluster consists of 4 items representing specific language models. The keyword with the highest frequency is “ChatGPT,” which is the keyword with the highest frequency, with 49 keyword occurrences, 46 links, and 221 total link strength, far surpassing other models such as ‘Gemini’ with 5 keyword occurrences, 15 links, and 22 total link strength, and the general keyword “AI” with 11 keyword occurrences, 30 links, and 53 total link strength. This solidifies ChatGPT position as the most-researched generative AI platform, providing significant feedback (5) in the current academic literature. The final cluster the sixth cluster includes 4 items related to clinical interactions. The main keyword in this cluster is “communication,” with 6 keyword occurrences, 19 links, and a total link strength of 34, which is closely related to “diagnosis” (5) and “interpersonal communication” (5). This cluster highlights the role of AI in bridging the communication process in diagnostic scenarios.

The Potential Topics in Generative AI Chatbot Research for Further Research

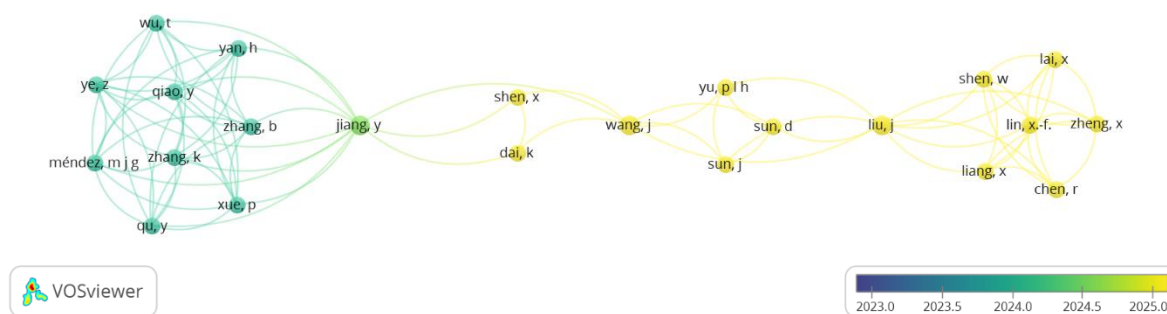
Table 3 indirectly provides an overview of keywords with low occurrence frequencies. These terms have the potential to serve as topics for in-depth analysis in future research. Research topic trends based on publication year are presented in Figure 3, which shows that the most dominant keywords appeared between 2023 and 2025. Based on the overlay visualization analysis, the distribution of keywords by publication year is as follows:

1. 2023: Research focused on the fundamentals of technology and initial implementation, such as artificial intelligence, chatbot, chatbots, empathy, trust, controlled study, clinical article, middle age, diagnosis, adolescent, decision making, internet, and e-learning.
2. 2024: Research begins to expand toward human subjects and educational systems, covering keywords such as human, humans, ChatGPT, education, cross-sectional studies, adult, questionnaire, young adult, surveys and questionnaires, procedures, comparative study, medical student, educational measurement, Gemini, patient education, higher education, students, language model, AI chatbot, teaching, educational technology, and feedback.
3. 2025: Highlights the latest trends in generative technology and specific fields, such as educational computing, engineering education, generative artificial intelligence, large language models, generative AI, AI chatbots, psychology, and student health.

Authors and Co-authorship Relations

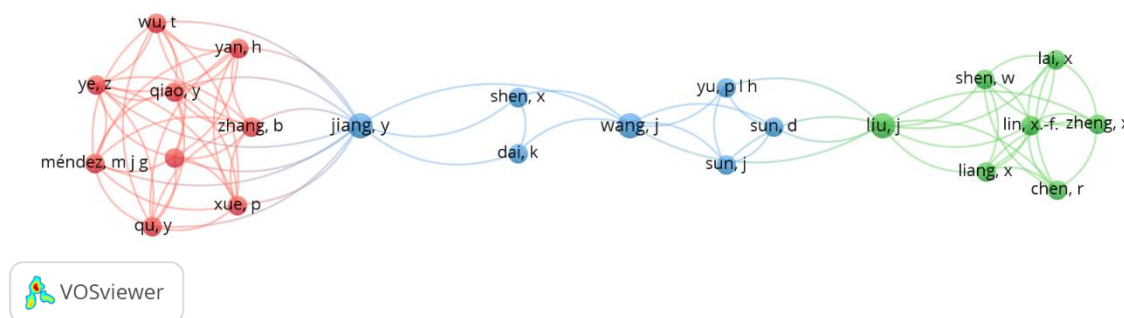
An analysis of co-authorship and collaboration networks illustrating patterns of cooperation among authors is presented in Figure 6. In this network, each node represents an individual author, while the connections between nodes indicate relationships based on jointly authored publications. This analysis allows for the integration of various dimensions, such as collaboration intensity, proximity among authors, and the dynamics of changing relationships over time, thereby providing a more comprehensive picture of the structure of the scientific network.

In addition, the visualization in Figure 7 displays the authors collaboration network analyzed by publication year. With this approach, relationships between authors are not only viewed in terms of the existence of collaboration but are also classified based on specific time periods. This allows for the identification of annual collaboration patterns, such as the emergence of new groups of authors, the continuity of cooperation, and the development of collaboration networks over a specific period. These findings can provide insights into the evolution of scientific collaboration and identify authors or groups playing a significant role in the development of the research field under study



Source: VOSviewer (2026)

Figure 6. CO-AUTHORSHIP OVERLAY VISUALIZATION OF GENERATIVE AI CHATBOT



Source: VOSviewer (2026)

Figure 7. CO-AUTHORSHIP NETWORK VISUALIZATION OF GENERATIVE AI CHATBOT

The bibliometric analysis identifies 889 authors, yet only 32 demonstrate connections within the co-authorship network of the selected database. This result indicates that collaboration in the field of AI chatbots remains relatively limited and has not yet formed a well-established research network. The visualization also reveals three main clusters, each represented by different colors, indicating groups of authors who collaborate more intensively within their own cluster than with those in other clusters.

Table 6.
CO-AUTHORSHIP CLUSTER ANALYSIS

No.	Cluster	Most frequent Author	Author
1	The first cluster (9)	Zhang, B. (9)	Méndez, M. J. G.; Qiao, Y.; Qu, Y.; Wu, T.; Xue, P.; Yan, H.; Ye, Z.; Zhang, B.; dan Zhang, K.
2	The second cluster (7)	Liu, J. (10)	Chen, R.; Lai, X.; Liang, X.; Lin, X.-F.; Liu, J.; Shen, W.; dan Zheng, X.
3	The third cluster (7)	Jiang, Y. (12)	Dai, K.; Jiang, Y.; Shen, X.; Sun, D.; Sun, J.; Wang, J.; dan Yu, P. L. H.

Source: VOSviewers (2026)

Overall, this clustering analysis indicates that research collaborations have formed into several relatively distinct groups, yet they continue to contribute to the development of the same topic. Additionally, based on the overlay visualization, relationships among authors can also be analyzed according to publication dates. More recent research is marked in yellow, indicating the latest developments in this field, while other colors represent older research. This helps in identifying collaboration trends and research developments over time.

CONCLUSION

This study used bibliometric analysis approach to examine the development of research on Generative AI Chatbots in the context of learning, utilizing the Scopus database. Initial search results revealed a very large number of publications 16,590 articles which were subsequently filtered down to 230 articles based on inclusion criteria such as topic relevance, document type, language, and the publication timeframe of 2020–2025. This indicates that the field of Generative AI Chatbot research has experienced rapid growth in recent years. The findings reveal a significant increase in publication trends, particularly from 2023 to 2025, signaling high academic interest in the application of generative AI in education. In terms of publication sources, journals such as IEEE Access and the International Journal of Human Computer Interaction are the primary contributors, highlighting the dominance of technology and human-computer interaction fields in this research. Additionally, authors such as Hwang, G.J. and countries like the United States and China have made significant contributions to the development of the global literature.

A disciplinary analysis shows that research on Generative AI Chatbots is multidisciplinary, with a predominance in Computer Science and the Social Sciences, followed by Medicine, Business, and Engineering. This underscores that the application of AI chatbots is not limited to technical aspects but also encompasses social, educational, and health dimensions. Furthermore, keyword analysis using VOSviewer identified six main clusters representing research topic trends, ranging from the implementation of AI technology in education, user psychological aspects, and medical education, to the development of large language models such as ChatGPT and Gemini. Although some topics such as artificial intelligence and chatbots dominate, there are a number of low-frequency keywords such as empathy, trust, feedback, and interpersonal communication that have the potential to become future research directions.

In terms of collaboration, the results of the co-authorship analysis show that only a small fraction of authors are connected within a collaborative network specifically, 32 out of 889 authors divided into three main clusters. This indicates that research collaboration in this field remains relatively limited and tends to be fragmented into small groups. Overall, this study successfully mapped the structure, trends,

and direction of research on Generative AI Chatbots in education through bibliometric visualization using VOSviewer. The main contribution of this study lies in providing a comprehensive overview of the current research landscape and identifying future research opportunities. However, this study has a limitation, namely that it uses only one database source, namely Scopus. Therefore, future research is advised to combine several databases, such as Web of Science or Google Scholar, to obtain broader data coverage and more comprehensive analysis results.

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