Charting the Rise of ChatGPT in Education: A Bibliometric Analysis of Global Research Trends

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Abstract
This study provides a comprehensive bibliometric analysis of ChatGPT-related research in education, mapping its growth trajectory, thematic structures, and geographic distribution since the tool's public release in late 2022. By situating ChatGPT scholarship within broader AI-in-education trends, the analysis identifies dominant publication outlets, most cited works, and critical research gaps. Data were retrieved from the Web of Science Core Collection for the period 2022–2025, including peer-reviewed journal articles indexed in SSCI and SCIE. A total of 672 records were analyzed using VOSviewer and bibliometric mapping techniques to examine publication trends, author collaboration networks, keyword co-occurrence patterns, and citation structures. Results reveal an exponential increase in publications, from a single article in 2022 to 325 in 2025, with China, the United States, Türkiye, and Australia accounting for over 65% of global output. Leading publication venues include Education and Information Technologies, BMC Medical Education, and the Journal of Chemical Education. Thematic analysis identified five major clusters: (1) technological foundations and large language models, (2) assessment and writing support, (3) interdisciplinary applications, (4) medical education, and (5) chatbot-supported language learning. Highly cited works predominantly address academic integrity, student perceptions, and discipline-specific implementations. However, the field remains methodologically limited, with most studies based on short-term surveys and experiments.

Keywords: ChatGPT, education, bibliometric analysis, AI in education, research trends, VOSviewer

1. Introduction

In recent years, artificial intelligence (AI) has profoundly influenced education, reshaping how learners interact with content, instructors, and peers. One of the most transformative developments has been the rise of generative AI, with OpenAI's ChatGPT emerging as a particularly impactful tool. Since its public launch in late 2022, ChatGPT has attracted global attention for its capacity to generate human-like text, deliver instant feedback, and assist with diverse educational tasks. As noted by recent scholarship, "the release of ChatGPT marked a turning point in public engagement with AI, combining advanced natural language processing with unprecedented accessibility" (Deng et al., 2025; von Garrel & Mayer, 2023). ChatGPT reached over one million users within days of its release, representing one of the fastest adoption rates for any digital tool in recent history (Grassini, 2023). Recent analyses further emphasize that "the introduction of ChatGPT has brought significant attention to the educational domain due to its potential to transform teaching, learning, and assessment practices" (Zhu et al. 2023).

While some praise its ability to enhance engagement, personalize learning, and support formative assessment, others raise concerns about academic integrity, critical thinking, and the erosion of students'

original expression. Educators and policymakers are grappling with how to leverage ChatGPT's affordances while mitigating potential risks such as plagiarism, misinformation, and inequitable access (Trust et al., 2023). Moreover, ChatGPT has been suggested as an academic aide, generating explanations, examples, and even lesson plans—helping both learners and educators streamline the educational process (Adeshola & Adepoju, 2023). Generative AI tools like ChatGPT differ from earlier AI applications in education by enabling "open-ended, conversational interactions that simulate human discourse" (Lo et al., 2024), thus altering the dynamics of learner–technology interaction. . Its ability to "act as a personalized tutor, providing immediate feedback and explanations tailored to individual learner needs" further distinguishes it from previous tools (Zhu et al. 2023).

The growing volume of scholarly work on ChatGPT in educational contexts reflects this duality. Researchers have explored ChatGPT's role as a cognitive partner, writing assistant, feedback generator, and even a simulated peer in collaborative learning environments (Teng, 2024; Imran & Almusharraf, 2023). At the same time, critical voices have highlighted the risks of over-reliance, automation bias, and ethical ambiguity, particularly in assessment and knowledge construction (Božić et al., 2024; Halaweh, 2023; Rahman & Watanobe, 2023). Rahman and Watanobe (2023) emphasized that "without explicit guidelines and AI literacy initiatives, the risk of misuse in assessment and scholarly writing will remain high." Similarly, Xiao et al. (2025) stress that "concerns include plagiarism, erosion of academic integrity, and the outsourcing of cognitive effort to machines." These concerns align with recent findings noting "the challenge for educators is to balance the benefits of AI tools with the need to maintain students' independent problem-solving abilities" (Zhu et al. 2023).

While the scholarly literature on ChatGPT has grown rapidly, prior reviews have often taken a broader AI-in-education perspective, overlooking ChatGPT-specific patterns across disciplines, education levels, and geographical contexts. Existing bibliometric analyses have not yet comprehensively mapped thematic developments, methodological trends, and collaborative networks in this domain. This study addresses that gap by systematically analyzing publications from 2022 to 2025, with the aim of identifying dominant research themes, methodological approaches, disciplinary focuses, and collaboration patterns.

- RQ1: How has the number of publications on *ChatGPT in education* evolved over time between 2022 and 2025?
- RQ2: Which countries have contributed most to the scholarly literature on ChatGPT in educational contexts?
- RQ3: Who are the most prolific authors in the field?
- RQ4: Which journals publish the most research on ChatGPT in education, and which publications are most frequently cited?
- RQ5: What are the major research themes and keywords emerging from the literature on ChatGPT in education?
- RQ6: How have the research themes related to ChatGPT in education evolved over the 2022–

2. Theoretical Background

2.1 Pedagogical Implications of Transition from Artificial Intelligence to Generative AI

AI has evolved from early rule-based systems to advanced machine learning models capable of natural language processing (NLP) and human-like interaction. Generative AI represents the latest frontier, producing coherent, contextually relevant text, images, and other media. ChatGPT, based on transformer architectures (GPT-3.5 and GPT-4), exemplifies this shift, enabling sustained and dynamic exchanges rather than static outputs (Lo et al., 2024). This transition marks a paradigm shift in educational technology—from AI as a background computational tool to an active conversational partner in teaching and learning (Adeshola & Adepoju, 2023; Deng et al., 2025).

ChatGPT functions as more than a tool; it can act as a pedagogical agent capable of influencing the learning process. Studies report its utility in instructional design, lesson planning, example generation, and translation of abstract concepts into accessible language (Ngo, 2023; Pokkaliah et al., 2023). Rather than simply delivering static content, it facilitates interactive and responsive learning, adapting to learners' needs (Adeshola & Adepoju, 2023).

In pre-service teacher education, ChatGPT supports both content knowledge acquisition and pedagogical reasoning, embedding itself in the "what" and "how" of teaching (Memarian & Doleck, 2023). Additionally, it has been used to foster writing, comprehension, and conceptual elaboration (Mosaiyebzadeh et al., 2023), offering opportunities for scaffolding complex tasks. As Lee & Wu (2025), "educators are beginning to explore ChatGPT's potential as a partner in instructional design, formative feedback, and scaffolding complex tasks."

However, as Pradana et al. (2023) caution, without critical engagement, such tools may inhibit the development of higher-order thinking skills. Wei et al. (2025) similarly observes that "when used critically, ChatGPT can foster higher-order thinking by prompting learners to question, refine, and extend their ideas," but this benefit is contingent on intentional pedagogical design.

2.2 Risks and Ethical Challenges

Despite its pedagogical potential, ChatGPT also presents notable challenges, particularly in relation to over-reliance, academic dishonesty, and the erosion of original thinking (Božić et al., 2024; Halaweh, 2023). Without explicit guidance, students may over-rely on AI-generated outputs, bypassing opportunities to engage in critical thinking and independent problem-solving (Trust et al., 2023). A key concern is automation bias, whereby learners uncritically accept AI-generated outputs, potentially undermining metacognitive regulation and independent judgment (Lim, 2025; Fan et al., 2024). As Xiao et al. (2025) observe, these risks encompass plagiarism, the deterioration of academic integrity, and the outsourcing of cognitive effort to machines.

Moreover, issues of equity and access remain salient, as the benefits of generative AI integration are not uniformly distributed across educational systems, disciplines, or socioeconomic contexts. Addressing such disparities requires strategic safeguards to mitigate misuse and ensure that AI adoption aligns with educational values (Rahman & Watanobe, 2023). In this regard, comprehensive ethical frameworks are essential—clarifying authorship, delineating intellectual responsibility, and incorporating cultural and contextual considerations—so that generative AI is conceptualized not merely as a technological tool but as a transformative force reshaping the epistemological and normative foundations of education. As emphasized by Von Garrel and Mayer (2023), educational institutions should establish transparent policies

for AI use, embed AI literacy training within curricula, and critically evaluate the long-term implications of generative AI on learning outcomes.

3. Method

3.1 Data Source and Search Strategy

The data for this bibliometric analysis were retrieved from the Web of Science Core Collection (WoSCC), a database widely recognized for its comprehensive coverage of high-quality scholarly publications. WoSCC was selected because it indexes journals with established academic credibility in both the Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCIE). Other databases such as Scopus or ERIC were not included in order to maintain consistency in indexing standards and citation metrics, and to avoid potential overlaps or discrepancies between databases. While this choice ensures data reliability and quality, it also introduces a coverage bias, as relevant publications indexed exclusively in other databases may not be represented.

The search was conducted on [25/07/2025], using the following query:

TS=("ChatGPT" AND "education") OR TS=("ChatGPT" AND "learning") OR TS=("ChatGPT" AND "teaching") OR TS=("ChatGPT" AND "instruction")

All search terms were enclosed in straight quotation marks to ensure accurate retrieval, avoiding typographic quotation marks that can cause mismatches in search results. The search was restricted to publications in the Education Educational Research category, written in English, classified as peer-reviewed journal articles, and published between 2022 and 2025.

3.2 Inclusion and Exclusion Criteria

The inclusion criteria for the study were as follows:

1. The publication explicitly addressed ChatGPT in the context of education, teaching, learning, or instruction.
2. The publication was indexed in SSCI or SCIE within the *Education Educational Research* category.
3. The article was written in English and published between 2022 and 2025.
4. The document type was peer-reviewed journal article.

Exclusion criteria included:

1. Publications not directly related to educational contexts (e.g., technical AI development papers without an educational focus).
2. Non-article formats such as editorials, letters, conference abstracts, or book reviews.
3. The publication indexed in AHCI or ESCI
4. Duplicates and retracted papers.

3.3 Data Extraction and Preparation

The bibliographic records of all retrieved publications were exported from the Web of Science Core Collection (WoSCC) in plain text format, including full records and cited references. The exported dataset was imported into Microsoft Excel for preliminary processing, which involved the removal of duplicate entries, incomplete records, and studies irrelevant to the scope of this research.

For each included publication, the following information was extracted:

- Bibliographic details (title, authors, publication year, journal, DOI)
- Author affiliations and corresponding countries
- Keywords (both author-provided keywords and Keywords Plus)
- Citation counts
- Abstracts (for subsequent thematic analysis)

During the keyword cleaning process, semantically identical or closely related terms were standardized to ensure consistency and to prevent fragmentation in the co-occurrence network. This step was crucial for generating accurate and meaningful clusters in VOSviewer. For example, "AI" was merged with "artificial intelligence"; "GenAI" and "generative AI" were merged with "generative artificial intelligence"; "chatbot" was merged with "chatbots"; and "large language model" was merged with "large language models." Such standardization reduced redundancy and ensured that conceptually similar keywords were analyzed as unified entities within the bibliometric mapping.

3.4 Data Analysis

The bibliometric analysis combined descriptive statistics and thematic and temporal mapping. Descriptive Analysis included annual publication trends, distribution by journals, authors, institutions, and countries, citation metrics (total citations, average citations per article). Thematic and temporal mapping included keyword co-occurrence clusters to identify major research themes. The visualizations produced by VOSviewer were interpreted to identify patterns of term relationships. For the keyword co-occurrence analysis conducted in VOSviewer, a minimum occurrence threshold of five was applied, and the full counting method was used to generate the co-occurrence network and thematic clusters.

4. Findings

4.1 Number of publications on *ChatGPT in education* evolved over time

The distribution of the 664 publications examined in the bibliometric analysis by year indicates that the research topic first gained visibility in the academic field in 2022. As shown in Figure 1 while only a single publication (0.15%) appeared in 2022, the number rose sharply to 71 (10.69%) in 2023, 267 (40.21%) in 2024, and 325 (48.95%) in 2025, indicating an exponential growth trend. With the rapid increase in interest, the number of publications reached 267 (40.21%) in 2024 and 325 (48.95%) in 2025. These findings demonstrate that ChatGPT became a prominent subject in academic discussions within the educational context, particularly in 2024 and 2025, reflecting its growing relevance and the continuing upward trend in research.

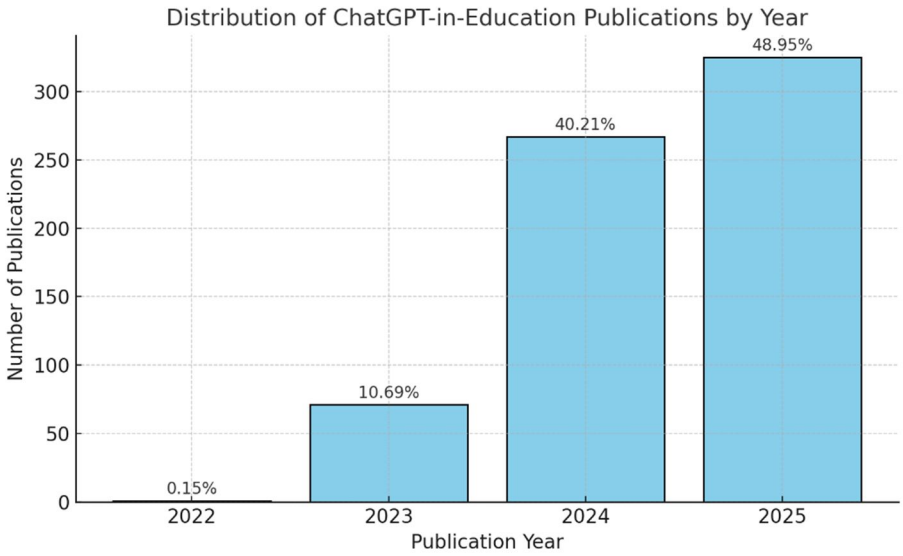

Figure 1: *The distribution of ChatGPT in Education Publication by Year*

4.2 Top Contributing Countries in ChatGPT-Education Research

The bibliometric analysis reveals a strong global interest in ChatGPT's application in education, with contributions spanning over 70 countries. The leading contributors are China (n = 173, 26.05%), the United States (n = 165, 24.85%), Türkiye (n = 49, 7.38%), and Australia (n = 47, 7.08%), which together account for over 65% of all publications (Figure 2).

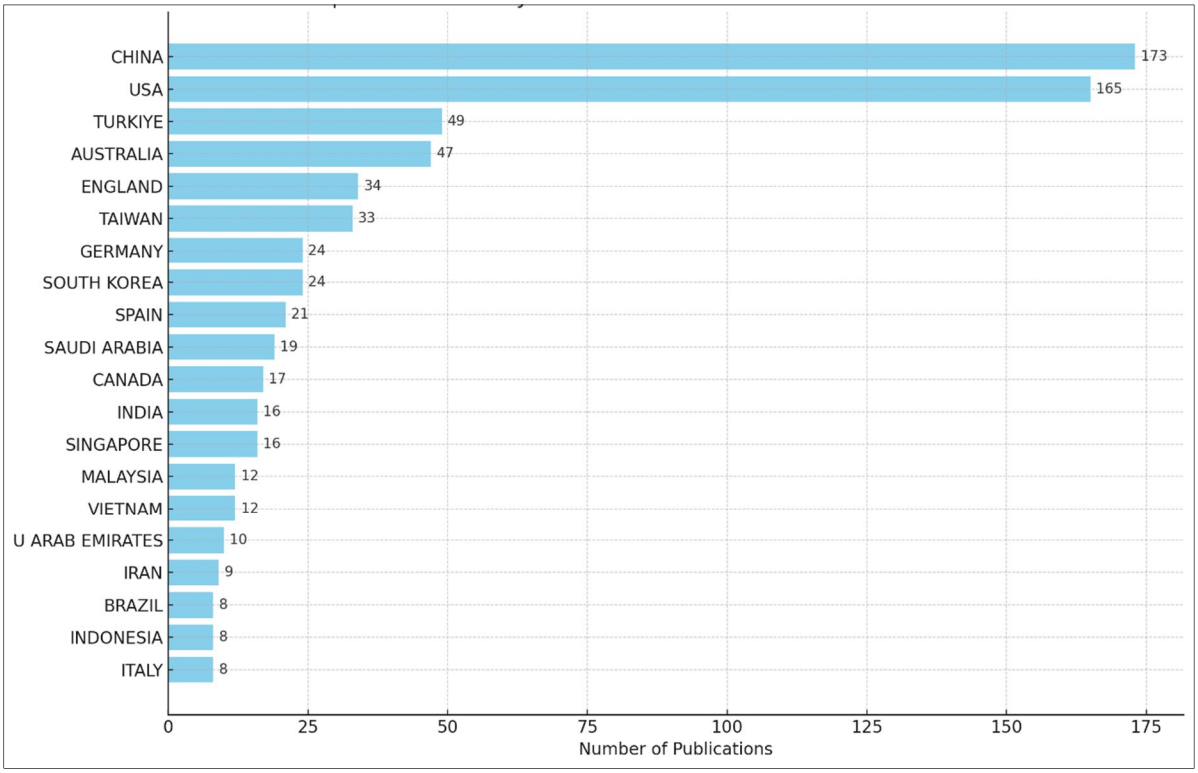

Figure 2. Top 20 Countries with the Number of Publications on ChatGPT in Education

To account for population size, the number of publications per million inhabitants was calculated, revealing that smaller nations with strong research infrastructures—such as Australia and the United Kingdom—have

a higher relative research output compared to larger countries like China and the United States. This normalization highlights countries with disproportionately high engagement in ChatGPT-in-education research despite smaller populations or academic communities.

4.3 Leading Journals and Most Cited Publications in ChatGPT-in-Education Research

According to Web of Science data covering 2022–2025, limited to SSCI and SCIE indexed journal articles in English, ChatGPT-related educational research is concentrated in several key outlets. The most prolific journal is Education and Information Technologies (n = 86), followed by BMC Medical Education (n = 53) and the Journal of Chemical Education (n = 34) (Figure 3). Other notable venues include Medical Teacher (n = 29), Educational Technology & Society (n = 27), IEEE Transactions on Learning Technologies (n = 24), International Journal of Educational Technology in Higher Education (n = 24), Interactive Learning Environments (n = 20), System (n = 18), and the European Journal of Education (n = 18).

These findings show that ChatGPT-in-education research spans discipline-specific (e.g., medical education, chemistry education) and interdisciplinary technology-enhanced learning journals, with a notable dominance of technology and health-related venues. Publication trends indicate that most of these articles appeared in 2023 and 2024, coinciding with the rapid expansion of ChatGPT scholarship.

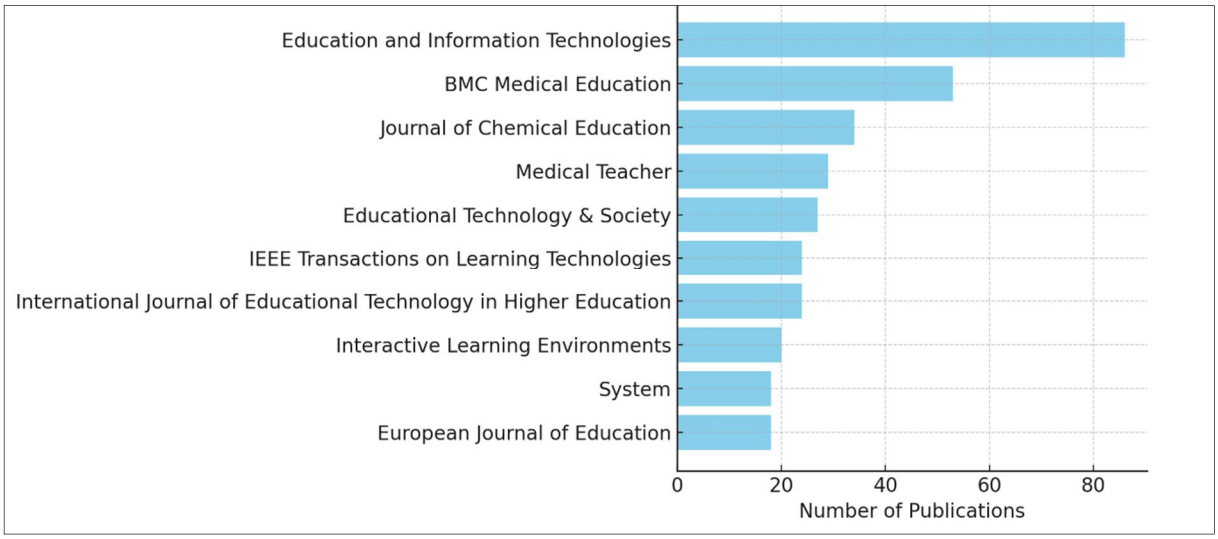

Figure 3. *Top 10 Journals Publishing ChatGPT-in-Education Research (2022–2025)*

Citation analysis revealed that the most highly cited works in this domain are predominantly early, high-impact publications addressing both conceptual and empirical aspects of ChatGPT's role in education. The top five papers alone account for over 35% of all citations in the dataset, highlighting a strong concentration around a small number of seminal works.

Table 1: Top 10 Most Cited Publications in ChatGPT-in-Education Research (2022–2025)

Rank	Authors	Year	Title	Source	Citations
1	Cotton, D. R. E.; Cotton, P. A.; Shipway, J. R.	2023	Chatting and cheating: Ensuring academic integrity in the era of ChatGPT	*Innovations in Education and Teaching International*	781
2	Chan, C. K. Y.; Hu, W. J.	2023	Students' voices on generative AI: Perceptions and experiences	*International Journal of Educational Technology in Higher Education*	490
3	Cooper, G	2023	Examining science education in ChatGPT: An experimental study	*Journal of Science Education and Technology*	489
4	Lim, W. M.; Gunasekara, A.; Pallant, J. L.; Pallant, J. I.	2023	Generative AI applications in management education	*International Journal of Management Education*	483
5	Farrokhnia, M.; Banihashem, S. K.; Noroozi, O.; Wals, A. E. J.	2023	A SWOT analysis of ChatGPT: Implications for education	*Innovations in Education and Teaching International*	468
6	Chan, CKY	2023	A comprehensive AI policy education framework for university teaching and learning	*International Journal of Educational Technology in Higher Education*	351
7	Strzelecki, A	2024	To use or not to use ChatGPT in higher education? A study of students' acceptance and use of technology	Interactive Learning Environments	308
8	Yan, D	2023	Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation	Education and Information Technologies	262
9	Jeon, J; Lee, SY	2023	Large language models in education: A focus on the complementary relationship between human teachers and ChatGPT	Education and Information Technologies	251
10	Chiu, TKF	203	The impact of Generative AI (GenAI) on practices, policies and research direction in education: a case of ChatGPT and Midjourney	Interactive Learning Environments	247

The most cited article is by Cotton, Cotton, and Shipway (2023), which examines ChatGPT use in higher education through the lens of academic integrity, with 781 citations. This is followed by Chan and Hu (2023), who explore students' perceptions and experiences with generative AI (490 citations). An experimental study on ChatGPT's potential in science education ranks third (489 citations), while a paper on generative AI in management education is fourth (483 citations). The fifth, by Farrokhnia, Banihashem, Noroozi, and Wals (2023), presents a SWOT analysis of ChatGPT in educational contexts (468 citations).

These findings indicate that the most cited literature on ChatGPT in education predominantly focuses on (i) ethics, academic integrity, and policy, (ii) student perceptions and experiences, and (iii) discipline-specific implementations. Furthermore, the citation distribution shows a strong concentration around a small number of seminal works, suggesting that the field remains anchored to a limited set of guiding references that continue to influence subsequent research.

4.4 Most Prolific Authors

The bibliometric analysis identified the most productive authors contributing to the scholarly literature on ChatGPT in educational contexts (Figure 4). The most prolific author is Lee, H.Y., with six publications, followed by Li, Y., Huang, Y.M., Wu, T.T., Guo, K., Ji, Y., Hwang, G.J., Wang, L., Masters, K., and Shin, D., each with five publications. While the distribution of publication counts among these authors is relatively close, Lee, H.Y.'s slight lead suggests an emerging leadership role in shaping the discourse on ChatGPT in education. As illustrated in Figure 4, the publication distribution among the top authors reflects a relatively balanced yet influential core of researchers actively engaging in this emerging research domain.

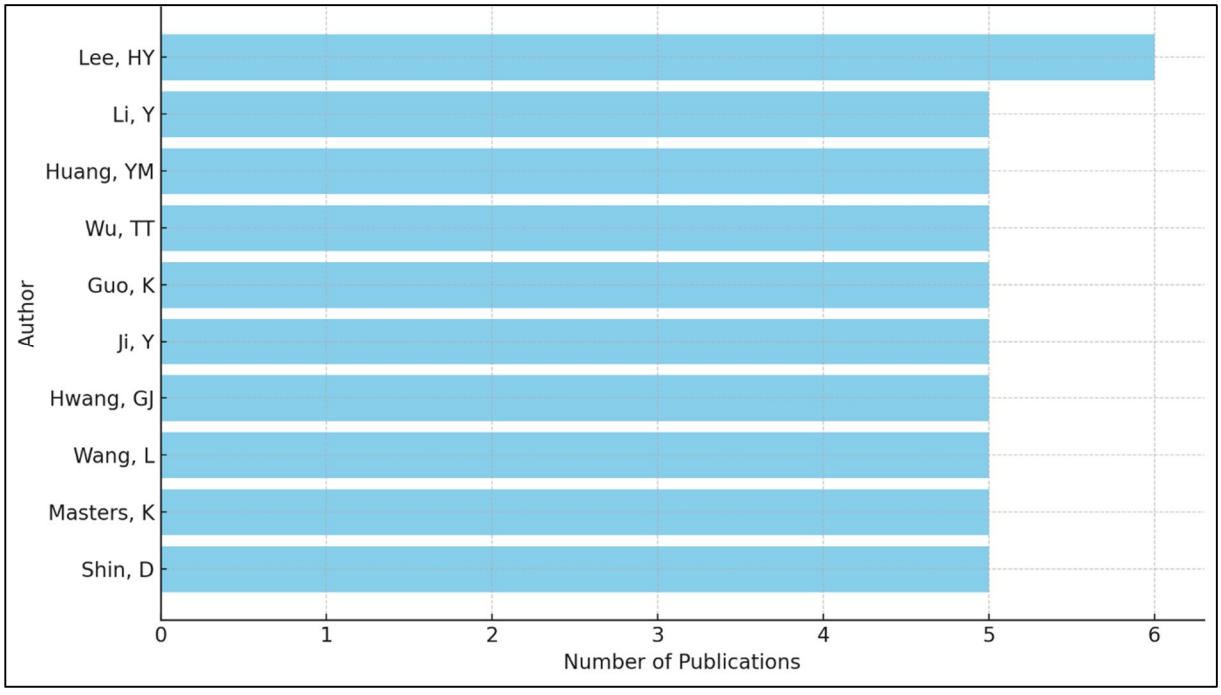

***Figure 4**: Top 10 prolific authors on ChatGPT in educational contexts.*

The concentration of publications among a limited group of researchers indicates the presence of a core set of authors driving the field forward. This core group likely plays a significant role in setting research agendas, establishing conceptual frameworks, and fostering collaboration networks in the area of AI-enhanced education.

4.5 The major research themes and keywords emerging from the literature on ChatGPT in education

The co-occurrence network analysis and the cluster statistics collectively reveal five prominent thematic clusters in the literature on ChatGPT in education. Each cluster is distinguished by its core keywords, cluster size, and total link strength, reflecting the thematic breadth and relational density of the research landscape (Table 2).

Table 2: *Clusters and representative keywords from the ChatGPT-in-education literature*

Cluster (Color in Figure)	Core Keywords	Cluster Size	Total Link Strength	Thematic Focus
Cluster 1 (Red)	artificial intelligence, large language models, natural language processing, technology acceptance, university students,	60	485	Technological foundations and user acceptance in higher education AI adoption
Cluster 2 (Green)	Assessment, general public, writing, first-year undergraduate, upper-division undergraduate, curriculum, internet/web-based learning	24	69	Assessment and writing skills development across academic levels in online learning contexts
Cluster 3 (Blue)	Chatgpt, generative artificial intelligence, higher education, engineering education, technology acceptance, Colloborative Learning	56	283	Interdisciplinary applications of ChatGPT in higher education with a focus on engineering and collaborative learning
Cluster 4 (Yellow)	medical education, critical thinking, educational technology, medical students, machine learning, self-directed learning	16	89	AI-enhanced learning and critical thinking in medical education
Cluster 5 (Orange)	Chatbots, engineering education, L2 writing, automated writing evaluation	15	39	Chatbot-supported writing and language learning integration in engineering education

Note. Cluster colors correspond to the VOSviewer network map (see Figure 1).

Cluster 1 (Red) is the largest, comprising 60 keywords with a total link strength of 485, and centers on artificial intelligence, large language models, natural language processing, technology acceptance, and university students. This cluster primarily reflects research on the technological foundations of ChatGPT and its adoption within higher education contexts.

Cluster 2 (Green) consists of 24 keywords (total link strength: 69), anchored around assessment, writing, first-year undergraduate, upper-division undergraduate, curriculum, and internet/web-based learning. The

thematic focus here is on evaluation and writing skills development in online learning contexts across various academic levels.

Cluster 3 (Blue), with 56 keywords and a total link strength of 283, revolves around ChatGPT, generative artificial intelligence, higher education, engineering education, technology acceptance, and collaborative learning. This cluster reflects interdisciplinary applications of ChatGPT in higher education, particularly in engineering and collaborative learning environments.

Cluster 4 (Yellow) comprises 16 keywords (total link strength: 89) such as medical education, critical thinking, educational technology, medical students, machine learning, and self-directed learning. It represents studies integrating AI tools in medical training, often with a focus on fostering critical thinking skills.

Cluster 5 (Orange), the smallest with 15 keywords and a total link strength of 39, includes chatbots, engineering education, L2 writing, and automated writing evaluation. This cluster captures research on chatbot-supported applications for writing and language learning, particularly in engineering education contexts.

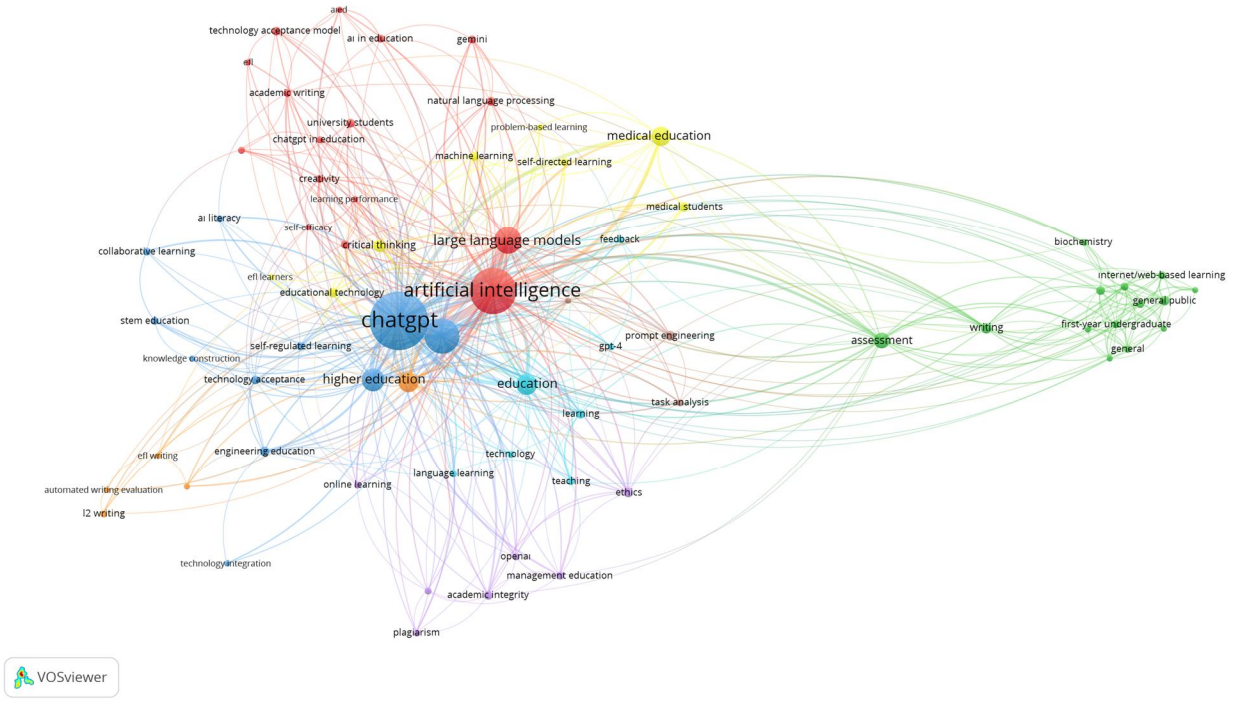

Figure 5: *Keyword co-occurrence network of ChatGPT-in-education literature (VOSviewer output)*

The network visualization (Figure 5) illustrates how these clusters interconnect, with high-density linkages between the artificial intelligence and ChatGPT nodes in the red and blue clusters, indicating their centrality in the research discourse. Similarly, the green and orange clusters share thematic overlaps in writing and assessment, while the yellow cluster maintains more discipline-specific connections in medical education. Together, these findings highlight both the thematic diversity and the interdisciplinary nature of ChatGPT-related educational research.

Overall, the network structure reveals that research on ChatGPT in education is multi-clustered, bridging technical AI research with practical educational implementation and ethical debates. The strong

interconnections between clusters indicate that most studies adopt interdisciplinary perspectives, combining pedagogy, assessment, ethics, and AI technology.

5. Discussion

This bibliometric analysis provides a comprehensive overview of the emerging body of literature on ChatGPT in education, situating its development within broader AI-in-education research trends. By integrating bibliometric findings with insights from recent empirical and conceptual studies (e.g., Guo et al., 2024; Pradana et al., 2023; Grassini, 2023; Lee, 2024), the discussion highlights temporal growth patterns, geographic and disciplinary distributions, thematic structures, and critical research gaps.

The rapid escalation in ChatGPT-related educational research following its public release in late 2022 reflects the tool's exceptional global uptake. While only a single publication (0.15%) appeared in 2022, the number rose sharply to 71 (10.69%) in 2023, 267 (40.21%) in 2024, and 325 (48.95%) in 2025. This trajectory mirrors patterns observed in broader AI-in-education research, where initial feasibility discussions quickly evolve into more diverse applications (Guechairi, 2024; Guo et al., 2024). Consistent with Lo's (2023) rapid review, this surge reflects both the novelty of the technology and its perceived capacity to address persistent educational challenges such as scalable individualized support, efficient feedback mechanisms, and flexible knowledge access. However, as both Lo (2023) and Zhu et al. (2023) emphasize, the majority of current research is exploratory in nature, with limited longitudinal evidence to confirm sustained educational benefits.

This growth has been accompanied by a clear geographic concentration of research activity. Publications are heavily clustered in China, the United States, Türkiye, and Australia, which together account for more than 65% of the total. Such dominance underscores both the global appeal of ChatGPT and the persistence of digital research divides, with contributions from regions such as Africa and parts of South America remaining minimal. Similar imbalances have been reported in related bibliometric reviews (Akhmadieva et al., 2023), suggesting that infrastructural capacity, funding availability, and policy frameworks play decisive roles in determining research participation. Lo (2023) further notes that regional adoption is often influenced by language accessibility, regulatory stance toward AI, and institutional readiness, factors that merit closer examination in future studies. This geographic concentration is mirrored in the authorship landscape, where a relatively small core group of scholars—often working within medical education, computer science education, and applied linguistics—drive the field. Although interdisciplinary engagement is present, collaborations often occur within parallel but partially overlapping networks, limiting broader cross-disciplinary integration.

The journal analysis further illustrates how publication activity is concentrated in specific domains. Technology-enhanced learning and medical education journals dominate the field, with Education and Information Technologies, BMC Medical Education, and the Journal of Chemical Education emerging as leading venues. The most frequently cited works tend to be systematic reviews and conceptual syntheses, reflecting a scholarly demand for theoretical consolidation in a rapidly developing field. These findings align with the prominence of thematic clusters identified in the keyword co-occurrence analysis, which span technological foundations, assessment and writing, interdisciplinary applications, medical education, and chatbot-supported language learning. The strong interconnections between these clusters indicate a research landscape in which technological affordances are being explored alongside subject-specific pedagogical strategies.

The reviewed literature positions ChatGPT as a technology with substantial potential to transform educational practices, yet its adoption is accompanied by a combination of opportunities, challenges, and unresolved research gaps. Teacher education programs must equip future educators with the AI literacy skills needed to critically evaluate and effectively integrate tools like ChatGPT in ways that enhance, rather than undermine, student learning (Trust et al., 2023). Pedagogically, ChatGPT offers notable affordances such as personalized learning experiences, automated formative feedback, writing assistance, and multilingual support. Studies indicate its capacity to enhance idea generation, facilitate collaborative problem-solving, and support domain-specific learning, particularly in STEM and language education (Grassini, 2023; Wei et al., 2025). Furthermore, ChatGPT has been found to improve accessibility for learners with different needs, foster motivation, and support self-paced learning when appropriately integrated into instructional design (Oranga, 2023). This echoes Zhu et al.'s (2023) findings that educators have begun to harness ChatGPT to provide differentiated instruction and scaffold complex cognitive tasks, yet many implementations remain.. However, these benefits are primarily documented in short-term interventions, leaving questions about their long-term impact unanswered.

Alongside these opportunities, ethical and academic integrity concerns remain prominent. Risks such as plagiarism, the erosion of original thinking, and automation bias—where learners accept AI-generated outputs without critical evaluation—are consistently identified in the literature (Xiao et al., 2025; Rahman & Watanobe, 2023). While some institutions have begun developing guidelines and AI literacy initiatives to mitigate these risks, the extent to which such measures are effective across different educational and cultural contexts remains largely unexplored. Addressing these challenges will require a more deliberate integration of governance and policy frameworks that emphasize transparent institutional guidelines, targeted AI literacy training, and culturally responsive approaches (Von Garrel & Mayer, 2023).

Methodologically, the current body of research is dominated by perception-based surveys and short-term experiments. While these approaches are valuable for capturing early adoption patterns, they are insufficient for understanding longitudinal outcomes or variations across cultural and disciplinary contexts. The field would benefit from mixed-method designs, comparative cross-disciplinary experiments, and long-term tracking of learning outcomes. Moreover, the observed geographic disparities highlight the need for targeted efforts to support research in underrepresented regions, addressing barriers such as limited infrastructure, insufficient teacher training, and lack of supportive policy environments.

In summary, the thematic structure identified in this study reflects a field in transition—from early explorations of technological capacity toward more sophisticated pedagogical applications and ethical considerations. The strong interconnections between thematic clusters indicate that effective integration of ChatGPT in education will depend not only on technological advancement but also on deliberate instructional design, equity-focused policy measures, and evidence-based governance. Bridging the gap between conceptual promise and long-term educational impact will require sustained empirical inquiry, interdisciplinary collaboration, and the inclusion of currently underrepresented voices in the global research landscape.

6. Conclusion

This study makes a distinctive contribution to the rapidly expanding body of literature on ChatGPT in education by offering the first comprehensive bibliometric mapping of publications between 2022 and 2025 indexed in SSCI and SCIE under the Education Educational Research category. Theoretically, it advances

understanding by identifying five interconnected thematic clusters that reveal how pedagogical, technological, and ethical dimensions converge in the emerging research landscape. Methodologically, it applies a rigorous, transparent bibliometric approach using WoSCC data, standardized keyword cleaning, and VOSviewer-based co-occurrence analysis, enabling both descriptive and thematic insights. Practically, the findings provide educators, policymakers, and technology developers with an evidence-based overview of global research trends, prolific authors, influential journals, and emerging themes, informing strategic integration of ChatGPT into diverse educational contexts. By combining these contributions, the study not only synthesizes the current state of research but also establishes a foundation for future inquiry that bridges conceptual understanding and applied implementation.

7. Limitations and Directions for Future Research

While the study offers robust insights, several limitations should be acknowledged. First, the dataset was restricted to the Web of Science Core Collection, which, although ensuring high-quality indexing, may omit relevant publications indexed in other databases such as Scopus or ERIC. Second, the inclusion criteria limited the analysis to English-language journal articles, potentially underrepresenting non-English scholarship and alternative publication formats. Third, the keyword co-occurrence analysis, while systematically conducted, relied on a minimum occurrence threshold that may have excluded emerging niche topics with lower frequency. Finally, the study provides a snapshot up to mid-2025, and the rapidly evolving nature of ChatGPT-related research means that trends may shift significantly in the near future.

Future research should address these limitations by conducting cross-database bibliometric analyses to expand coverage and ensure inclusivity of diverse languages and publication types. Longitudinal studies that track thematic evolution over extended periods are needed to capture the maturation of the field. Moreover, comparative analyses across cultural, linguistic, and socioeconomic contexts would deepen understanding of geographic disparities and inform equitable adoption strategies. Integrating bibliometric mapping with systematic literature reviews or meta-analyses could also enrich interpretation, linking publication patterns to empirical evidence of pedagogical impact.

Statements and Declarations

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