

Mapping the Knowledge Landscape of Generative AI in Higher Education: A Bibliometric Analysis of ChatGPT Research

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ABSTRACT

Since the release of ChatGPT in late 2022, its application in higher education has triggered extensive discussions around academic integrity, pedagogical transformation, and assessment redesign. To capture the research landscape and development trends, this study applies bibliometric analysis and uses VOSviewer to systematically examine 11,072 education-related publications from the Scopus database (2020–2025). By employing keyword co-occurrence, thematic clustering, and overlay visualizations based on average publication year, the study reveals the evolving structure of the field. Results indicate an exponential growth of literature since 2023, with research focus shifting from technical applications to educational practices and systemic issues, reflecting a highly interdisciplinary nature. The United States and the United Kingdom are leading contributors, with China, Taiwan, India, and Singapore representing key players in Asia. Although international collaboration is increasing, cross-national linkages remain limited. Thematic clusters include AI technological development, professional and medical education applications, assessment innovation, teaching ethics, cybersecurity, and regulatory challenges. This study recommends that academia strengthen integration of theory and empirical work, educational authorities develop timely policy and ethical frameworks, and frontline educators actively adopt AI-assisted teaching and enhance digital literacy. The findings address gaps in existing literature synthesis and offer guidance for future policy and practice.

Keywords: Generative Artificial Intelligence, ChatGPT, Higher Education, Bibliometric Analysis

Introduction and Research Objective

Since the launch of ChatGPT in late 2022, its application in higher education has sparked widespread discussion and controversy. Many researchers have raised concerns that students' use of ChatGPT to complete assignments may undermine academic integrity, leading to issues such as plagiarism and distorted assessment outcomes (Rahman & Watanobe, 2023; Lo, 2023). Scholars have also noted that the extensive use of ChatGPT may weaken students' critical thinking and creativity, reducing their motivation for autonomous learning and problem-solving (Grassini, 2023). Furthermore, the accuracy and reliability of ChatGPT-generated content remain questionable, especially in mathematical logic or professional domains, where outputs are often unstable (Lo, 2023). As the tool enables rapid completion of traditional tasks and assessments, it challenges current evaluation mechanisms in higher education, prompting calls for the redesign of assessment systems to uphold academic fairness (Rudolph, Tan, & Tan, 2023).

Despite its growing prominence, existing research on ChatGPT in higher education still shows limitations in terms of geographic scope and thematic breadth. Literature analysis reveals that most studies originate from English-speaking countries such as the United States, the United Kingdom, and Australia, with Asia mainly represented by Singapore, Taiwan, and South Korea (Lo, 2023). Research has largely focused on ethical risks, pedagogical applications, learning outcomes, and programming-assisted instruction, with relatively few studies addressing policy-level responses or conducting cross-national comparisons (Rahman & Watanobe, 2023; Grassini, 2023). Moreover, the publication venues remain relatively concentrated, with most related articles appearing in a small number of high-impact educational technology journals (Bhullar, Joshi, & Chugh, 2024). Overall, current literature lacks a macro-level perspective and systematic synthesis, making it difficult to fully understand the knowledge structure and developmental trajectory of ChatGPT integration in higher education.

In light of this, the present study aims to employ bibliometric analysis and knowledge mapping techniques to systematically examine literature from the Scopus database published between 2020 and 2025. Through thematic clustering, geographic distribution analysis, and journal mapping, this research seeks to identify research hotspots and developmental trends. By applying quantitative and visual approaches, this study intends to fill gaps in the existing literature, offering a clearer understanding of the knowledge structure and evolution of ChatGPT-related research in higher education, while also providing a theoretical basis and direction for future policy development and educational practice.

Hwang and Tu (2021) have noted that bibliometric analysis is a commonly used method for examining academic research output and publication trends. By focusing on a specific theme, it can systematically identify relevant publications, researchers, keywords, institutions, and geographical distribution. When combined with visualization tools such as VOSviewer, it can further reveal the structural landscape and future directions of a research field (Bahroun et al., 2023).

This study utilizes the Scopus abstract and citation database to collect literature related to the application of ChatGPT in the field of education. Employing bibliometric analysis, the research systematically examines the data from three perspectives: country/region, academic discipline, and keywords. The primary aim is to understand the development landscape of ChatGPT-related educational research and to address the following three research questions:

1. What is the geographical distribution of scholars conducting research on the educational applications of ChatGPT?
2. In which major academic disciplines are these studies primarily concentrated?
3. What are the most frequently used core keywords in this field?

Methodology

1. Data Sources and Analysis

This study conducted a systematic search on the Scopus abstract and citation database on May 26, 2023, to retrieve literature related to the educational applications of ChatGPT. Scopus is a comprehensive, interdisciplinary academic database covering over 11,000 publishers and more than 36,000 journals across diverse fields, including life sciences, social sciences, physical sciences, and health sciences.

Using "ChatGPT" as the main search term, the search was restricted to article titles, abstracts, and keywords, yielding an initial result of 19,886 publications. Further filtering using education-related keywords—"education," "learning," "teaching," and "training"—narrowed the selection to 11,072 relevant documents.

This study employs bibliometric analysis to explore the trends of generative artificial intelligence (GAI) applications in education. The methods include direct citation analysis (also known as inter-citation) and co-word analysis (Boyack & Klavans, 2010). Keywords offer essential information about each publication and help identify thematic focuses and shifts in research interest over time (Bodily et al., 2019). Co-occurrence analysis is used to examine the frequency with which keywords appear together, revealing thematic relationships within the literature (González-Zamar et al., 2020).

For data visualization and network mapping, the study uses VOSviewer software. This tool analyzes the relationships between journals and keywords and presents the findings in visual map formats. VOSviewer also performs clustering based on the strength of associations, using different colors to help researchers clearly identify the structural connections among publications (van Eck & Waltman, 2010).

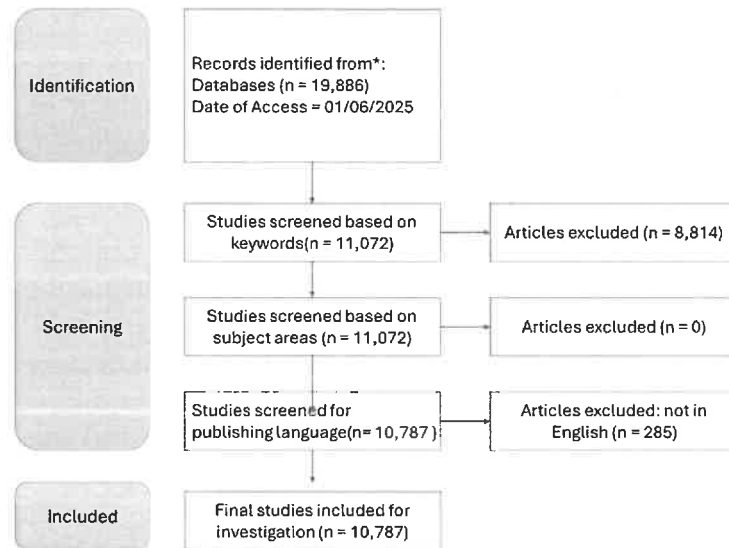


Figure 1: T Flowchart

2. Distribution of ChatGPT Applications in Educational Research

Figure 2 illustrates the publication trends related to the application of ChatGPT in educational research from 2022 to 2025. The data reveal a rapid increase in research output beginning in 2022, with a clear upward trajectory. While 2022 marks the initial emergence of this research topic, an explosive growth occurred in 2023, and the number of publications peaked in 2024, indicating a sharp rise in academic interest. This trend highlights the growing attention and investment of educational researchers in exploring the use of AI tools—particularly generative artificial intelligence—in teaching, learning, and assessment contexts.

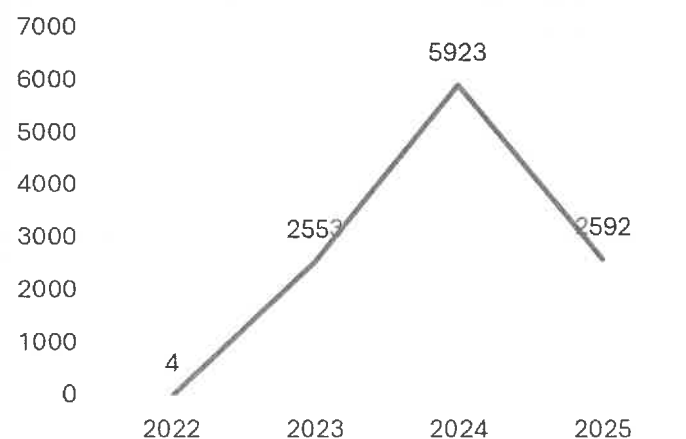


Figure 2: Distribution of Publications on ChatGPT Applications in Educational Research (as of June 1, 2025)

Findings and discussion

1. Publication trend

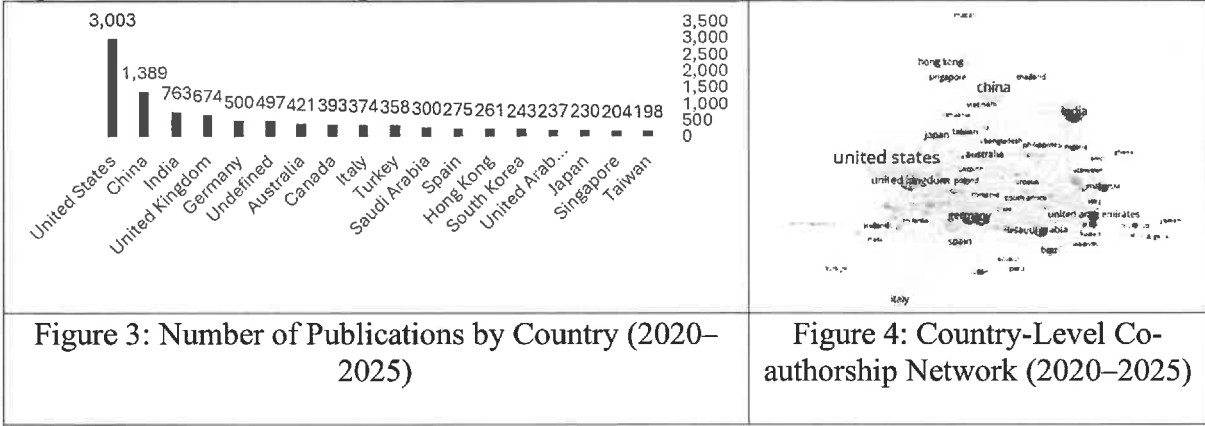
To understand the global research dynamics of Generative Artificial Intelligence (GenAI) in the field of education, this study analyzes two key aspects: national publication output and international co-authorship networks. Figure 3 presents the top 20 countries by the number of publications indexed in the Scopus database, while Figure 4 visualizes the co-authorship

network at the national level, illustrating each country’s relative position and connection strength within the academic collaboration system.

As shown in Figure 3, the United States ranks first with a total of 3,003 publications, significantly surpassing other countries and demonstrating its leading role in GenAI-related educational research. China (1,389 publications) and India (763) also rank among the top contributors, indicating rapid development in this area across Asia. Traditional research powerhouses such as the United Kingdom, Germany, Australia, Canada, and Italy continue to maintain robust research capacities, forming a globally distributed and multi-centered output structure. Notably, emerging Asian economies—such as Malaysia (497 publications), Hong Kong (261), and Taiwan (198)—have also entered the top 20, reflecting strong potential and increasing activity in the educational application of AI.

The co-authorship network depicted in Figure 4 further reveals that the United States is not only the most prolific in output but also the central node of the global research collaboration network. It maintains dense academic linkages with numerous countries. China, India, and Germany are also positioned at the core of the network, forming a tightly connected cluster with the U.S. and various countries in Europe and Asia. Meanwhile, emerging nations such as Malaysia, the Philippines, and Algeria, although contributing fewer publications, have begun to establish cross-regional collaborations, indicating a gradual diffusion of the research network beyond traditional centers of influence.

Overall, the findings reveal a strong correlation between research output volume and international collaboration density. Countries with higher publication counts tend to serve as key hubs within the collaboration network. This reflects the highly internationalized nature of GenAI-related educational research and the emergence of a distinct “core–periphery structure,” with the United States and other central countries driving the global dissemination and practical implementation of knowledge in this field.



2.Citation analysis

Table 1 presents the ten most highly cited academic publications on the application of ChatGPT in the field of education. Most of these papers were published in 2023, indicating that this is a rapidly emerging research area. The most cited article is “*ChatGPT for good? On opportunities and challenges of large language models for education*” by Kasneci et al. (2023), published in *Learning and Individual Differences*, with 2,367 citations. This study adopts both teacher and student perspectives to explore the potential and limitations of large language models (LLMs) in educational settings, emphasizing their role as instructional aids rather than replacements.

The second most cited article, “*So what if ChatGPT wrote it?*” by Dwivedi et al. (2023), appeared in the *International Journal of Information Management* and has been cited 2,127

times. This multidisciplinary analysis discusses the opportunities and challenges of generative conversational AI in research, practice, and policy, highlighting the importance of content ethics and accountability.

Ranked third is Kung et al.'s (2023) "*Performance of ChatGPT on USMLE*", published in *PLOS Digital Health*, cited 1,994 times. This study evaluates ChatGPT's performance on the United States Medical Licensing Examination (USMLE), analyzing its textual responses in terms of logic, information completeness, and relevance. The results suggest that ChatGPT performs comparably to a third-year medical student, demonstrating its potential as an interactive tool in medical education.

Other notable works include a systematic review by Sallam (2023) on ChatGPT in healthcare education (1,452 citations), Ray's (2023) article on technical and ethical risks (1,335 citations), and another USMLE-related study by Gilson et al. (2023) with over 1,000 citations. A short commentary by van Dis et al. (2023) in *Nature*, "*ChatGPT: five priorities for research*," has been cited 1,114 times and outlines five key areas for future investigation.

Also among the top-cited papers are "*ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?*" by Rudolph, Tan, and Tan (2023), published in the *Journal of Applied Learning and Teaching* (930 citations), Cotton et al.'s (2024) empirical study on ChatGPT and academic integrity (930 citations), and Lo's (2023) rapid literature review providing an initial overview of emerging trends (901 citations).

Overall, these ten influential publications span a range of topics, including educational policy, academic integrity, medical testing, technological ethics, and assessment practices—underscoring ChatGPT's role as a focal point of interdisciplinary research in education.

Table 1: Top 10 influential articles

Rank	Article Title and Author, Year	Citations
1	ChatGPT for good? On opportunities and challenges of large language models for education (Kasneci et al., 2023)	2,367
2	"So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy (Dwivedi et al., 2023)	2,127
3	Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models (Kung et al., 2023)	1,994
4	ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns (Sallam, 2023)	1,452
5	ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope (Ray, 2023)	1,335
6	How Does ChatGPT Perform on the United States Medical Licensing Examination? The Implications of Large Language Models for Medical Education and Knowledge Assessment (Gilson et al., 2023)	1,147
7	ChatGPT: five priorities for research (van Dis et al., 2023)	1,114
8	ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? (Rudolph, Tan & Tan, 2023)	936
9	Chatting and cheating: Ensuring academic integrity in the era of ChatGPT (Cotton, Cotton & Shipway, 2024)	930
10	What Is the Impact of ChatGPT on Education? A Rapid Review of the Literature (Lo, 2023)	911

Source: Scopus Database

3. Thematic clusters

To further examine the thematic structure and knowledge distribution of research on ChatGPT and generative artificial intelligence (GenAI) in education, this study employed VOSviewer to conduct a keyword co-occurrence analysis and generate a visualized network map (Figure 2).

The analysis was based on author keywords extracted from literature indexed in the Scopus database. By applying a minimum co-occurrence threshold and clustering algorithms, the study identified high-frequency terms and grouped them into thematic clusters through network association analysis.

The overall visualization reveals that "artificial intelligence" is the most frequently occurring keyword and occupies a central position in the network structure. It is closely connected with terms such as "large language models," "medical education," "deep learning," and "natural language processing," indicating that current research on ChatGPT is predominantly focused on AI technologies and their integration into medical education contexts.

Different colors in the network map represent automatically generated thematic clusters, which are described in detail as follows:

The first cluster, Technology-Oriented Cluster (Green), includes technical terms such as "*deep learning*," "*BERT*," "*copilot*," and "*multimodal AI models*." This group represents research focused on the core mechanisms of generative AI models.

The second cluster, Educational and Medical Applications Cluster (Orange), is centered around keywords such as "*medical education*," "*nursing education*," "*resident education*," and "*urology*," reflecting the integration of AI-assisted teaching particularly in clinical and professional medical education contexts.

The third cluster, Learning Assessment and Educational Ethics Cluster (Red), includes terms like "*formative assessment*," "*academic writing*," and "*automated grading*," indicating a research focus on the impact of generative AI on teaching practices and academic integrity.

The fourth cluster, Educational Attitudes and Societal Response Cluster (Blue), contains keywords such as "*attitude*," "*general public*," and "*quality assurance*," suggesting that researchers are increasingly paying attention to user perceptions and institutional frameworks related to AI adoption.

The fifth cluster, Information Security and Legal Issues Cluster (Purple and Pink), includes terms like "*cybersecurity*," "*copyright*," "*phishing*," and "*information security*," representing the ethical and governance challenges that have emerged as AI applications expand.

Additionally, peripheral nodes such as "*custom GPT*," "*predictive model*," and "*academic publishing*" indicate emerging keywords that are still in the early stages of diffusion and have not yet formed stable thematic groups—highlighting the dynamic nature of this field and its potential directions for future research.

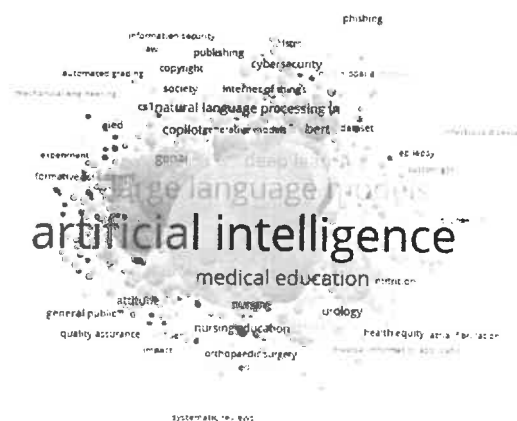


Figure 5: Keyword Clustering of ChatGPT Applications in Educational Research (2022 to June 2025)

4. Temporal Visualization of Keywords by Average Year of Publication

To further explore the temporal evolution of research themes related to Generative Artificial Intelligence (GenAI) in the field of education, this study conducted a keyword co-occurrence analysis using VOSviewer. The *Overlay Visualization* mode was employed to indicate the Average Publication Year of each keyword, as shown in Figure 6.

In this visualization, each node represents a keyword, with node size corresponding to its frequency of occurrence. The color scale reflects the average publication year, ranging from blue (indicating publications prior to mid-2023) to yellow (indicating publications from early 2024 onward), highlighting the relative novelty of each topic. Lines between nodes indicate co-occurrence relationships, with denser connections representing stronger semantic associations.

The analysis reveals that keywords such as “artificial intelligence,” “large language models,” and “medical education” are core terms within the literature. Their green-blue coloration indicates that these topics have been widely discussed since 2023, representing relatively mature research areas. In contrast, keywords like “custom GPT,” “copilot,” “multimodal AI models,” and “academic publishing” are colored more yellow, suggesting these are emerging research focuses with average publication dates concentrated in early 2024, reflecting rapidly growing scholarly interest.

Other keywords such as “formative assessment,” “nursing education,” and “resident education” fall between green and light blue, indicating a stable and sustained interest in applying GenAI in educational practice, particularly between mid-2023 and early 2024. Meanwhile, terms like “cybersecurity,” “copyright,” and “phishing” show relatively recent publication trends, pointing to a growing recognition of legal and ethical issues surrounding AI implementation in education systems.

Overall, this overlay visualization reveals a clear temporal trajectory in the development of ChatGPT-related educational research. The focus has evolved from technology-centered topics (e.g., AI systems, LLMs) to educational practices (e.g., curriculum, assessment), user experiences (e.g., attitudes, integrity), and finally to institutional and regulatory concerns (e.g., information security, copyright). This progression illustrates a typical pathway of “technological introduction → pedagogical implementation → societal response.”

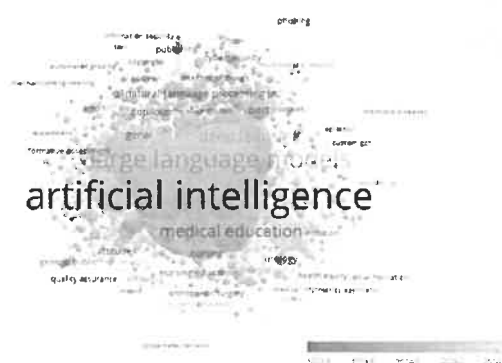


Figure 6: Average Publication Year of Keywords Related to ChatGPT (2022 to June 2025)

Conclusion and Recommendations

1. Conclusion

Based on the results of this bibliometric analysis, research on the application of ChatGPT in higher education has experienced rapid growth since 2022, demonstrating strong developmental momentum. The focus of scholarly inquiry has shifted from exploring the potential of AI tools in teaching to a more critical examination of their implications for

academic integrity, learning assessment, and educational ethics. This transition reflects not only the maturing of the technology but also a broader transformation in educational practices, indicating that research in educational technology is moving toward more complex and multidimensional analyses.

In terms of geographical distribution, most publications originate from English-speaking countries such as the United States, the United Kingdom, and Australia, with the United States occupying a central position in global knowledge production and research collaboration networks. In Asia, countries like China, India, Taiwan, and Singapore have emerged as key contributors, suggesting increasing attention to this topic in emerging edtech markets. Nevertheless, the overall frequency of cross-national and interdisciplinary collaboration remains relatively low, with many studies still led by single-country research teams. This indicates significant potential for future growth in international knowledge exchange and research integration.

Keyword co-occurrence and thematic clustering analyses reveal several well-defined research clusters in the current literature on ChatGPT in education. These include foundational discussions on generative AI technologies, applications in medical and nursing education, issues of academic integrity and assessment innovation, and emerging concerns related to cybersecurity and ethics. The diversity of these themes highlights the highly interdisciplinary nature of the field, spanning education, information science, law and ethics, and even domain-specific practices such as healthcare education. Furthermore, the temporal analysis shows a clear evolution from technology-oriented topics to practical applications and institutional reflections, illustrating a typical trajectory of “technological introduction → pedagogical implementation → societal response.”

2. Recommendations

(1) Recommendations for the Academic Community

- A. **Strengthen the Integration of Theory and Empirical Research:** Most existing studies focus on ethical concerns and pedagogical applications, with relatively limited attention to institutional-level issues such as assessment framework reform or the evaluation of teaching effectiveness. It is recommended that future research address this gap by incorporating longitudinal and comparative approaches. For example, while Kasneci et al. (2023) explore the potential of large language models (LLMs), their work remains preliminary and does not examine long-term educational impacts.
- B. **Promote Journal Diversification:** This study notes that current research is largely published in a small number of high-impact educational technology journals. This indicates a problem of publication centralization. Scholars should be encouraged to expand their dissemination efforts into broader academic domains such as educational sociology, humanities education, and interdisciplinary platforms, in order to foster a more diverse and inclusive scholarly dialogue.

(2) Recommendations for Educational Authorities

- A. **Strategic Allocation of Research Resources:** This study highlights the geographic and institutional concentration of research output, with leading contributions coming from institutions such as Monash University and research teams like Kasneci et al. This suggests an uneven distribution of research capacity. It is recommended that other countries invest more resources to support interdisciplinary research units in developing AI applications in education, thereby promoting a more balanced and globally distributed research landscape.
- B. **Strengthen Policy Guidance:** As noted in the literature (Rudolph et al., 2023; Lo, 2023), ChatGPT poses challenges to academic integrity and traditional assessment

systems. Educational policymakers should directly address these concerns by updating higher education policies to reflect the changing landscape. Specifically, new frameworks for academic integrity and instructional design should be developed to align with the evolving impact of AI on assessment mechanisms.

- C. **Enhance Ethical and Regulatory Frameworks:** The keyword clustering analysis identified terms such as “cybersecurity” and “copyright” as emerging topics (see Figure 3), signaling growing concerns about the risks associated with generative AI. Educational authorities should proactively establish clear regulatory guidelines to address issues related to information security and intellectual property, in order to prevent misuse and mitigate systemic risks.

(3) Recommendations for Frontline Educators

- A. **Effectively Utilize AI Tools:** As noted in this study, teachers can incorporate ChatGPT to support instructional activities. For instance, Kung et al. (2023) demonstrated ChatGPT's performance on the USMLE, while Kasneci et al. (2023) explored its potential in teaching contexts. Educators are encouraged to reference such studies and adopt large language models (LLMs) as instructional support tools rather than replacements, in order to enhance teaching effectiveness and student engagement.
- B. **Innovate Assessment Practices:** Thematic cluster analysis (particularly the red cluster) highlights keywords such as “formative assessment” and “automated grading,” pointing to emerging trends in AI-supported assessment. Teachers are encouraged to design open-ended, AI-assisted assessment models that leverage generative tools for feedback, evaluation, and personalized learning, in alignment with the evolving educational landscape revealed through keyword co-occurrence patterns.

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