Exploring the Potential of Generative Artificial Intelligence in Education: A Bibliometric Analysis

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Abstract
Generative artificial intelligence (GAI) has significantly disrupted the educational landscape, ushering in profound transformation. In this comprehensive research study, global databases such as Scopus and Web of Science (WoS) were meticulously curated for data collection within the publication years of the last five years, i.e., 2019–2023. The search criteria involved a thorough exploration of documents featuring "Generative Artificial Intelligence" and "education" in the article title, abstract, and keywords, assembling a refined dataset comprising 116 publications. The study design incorporated the widely recognized PRISMA and PICOC frameworks to ensure methodological rigor. Data analysis was conducted utilizing the advanced VOSviewer_1.6.20 software. The investigation delved into diverse aspects of citation patterns, revealing notable variations across sources, authors, and organizations. The research showcased a transdisciplinary nature by employing bibliographic coupling across multiple countries and co-citation among cited sources and authors. Incorporating PICOC components facilitated a critical analysis of the research problem, relating it to policy and practical considerations while identifying prevailing trends in current research. Consequently, the study provides insights into the potential impact on practices and policies and lays the groundwork for future lines of inquiry in the realm of GAI in education.
Keywords: generative artificial intelligence, educational transformation, bibliometric analysis, PRISMA and PICOC frameworks, transdisciplinary approach.

Исследование потенциала генеративного искусственного интеллекта в образовании: библиометрический анализ

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Аннотация
Генеративный искусственный интеллект (GAI) в значительной степени изменил образовательный ландшафт, положив начало глубинной трансформации систем. В данном исследовании проанализированы реферативно-библиографические базы данных Scopus и Web of Science (WoS). Авторами собраны данные на основе изучения статей, изданных за последние пять лет (2019-2023 гг). Осуществлялся анализ документов, содержащих термины «генеративный искусственный интеллект» и «образование» в названии статьи, аннотации и ключевых словах, что позволило собрать уточненный набор данных по 116 публикациям. При проведении исследования использовались инструменты PRISMA и PICOC для обеспечения методологической строгости. Анализ данных проводился с помощью современной программы VOSviewer_1.6.20. В ходе исследования были изучены различные аспекты моделей цитирования, выявлены заметные различия между источниками, авторами и организациями. Исследование носит трансдисциплинарный характер благодаря использованию библиографической связи между несколькими странами, а также совместному цитированию упоминаемых источников и авторов. Включение компонентов PICOC способствовало критическому анализу проблемы исследования в ее связи с политическими и практическими аспектами, выявлению преобладающих тенденций в современных научных изысканиях. Таким образом, исследование дает представление о потенциальном влиянии на практику и политику, закладывает основу для дальнейшего изучения генеративного искусственного интеллекта в образовании.
Ключевые слова: генеративный искусственный интеллект, трансформация образования, библиометрический анализ, инструменты PRISMA и PICOC, трансдисциплинарный подход.

Introduction

Artificial intelligence (AI) has brought significant disruption across various sectors of society. Mathematical algorithms play a critical role in producing desired outcomes through asynchronous communication between humans and machines within the realm of automation. What implications would arise from synchronous and dynamic communication? As a result of this exploration, the field of AI research has led to the development of generative artificial intelligence (GAI).

The capability of GAI to synthesize new information from existing data sets distinguishes it from traditional AI. Consequently, GAI represents an evolving and significant area for research and practical application. Since its introduction in late 2022, GAI has attracted considerable global interest (OpenAI, 2022). We are now immersed in an environment enriched by GAI tools such as ChatGPT, Bard, Bing, Midjourney,

Jasper, Copilot, DALL-E, among others. Naturally, questions arise regarding the potential impacts of GAI on various aspects of life and society.

The authors, in this study, analysed existing literature to substantiate the argument and maintain the discussion focused. Health science emerges as a primary concern for every nation within its policy framework. The Stanford University School of Medicine conducted a comprehensive examination of GAI, analyzing its advantages, limitations, and prospective future roles in medical education. Identified potential applications included writing assistance, simulation scenarios, and autonomous learning. Major challenges encompassed issues related to data accuracy, academic honesty, and potential impediments to learning (Preiksaitis & Rose, 2023).

Education is perhaps the second most critical societal need, followed by health. Zhai et al.'s (2021) study of AI in education used research evidences from 2010 to 2020. In light of AI 2.0's advancements in education, the authors argued that educators and AI engineers should work together to bridge the pedagogical and technological difference. As a result, the illustration offered a path from AI in education to generative AI in education (GAIED). Bahroun et al. (2023) conducted an exhaustive investigation into the applicability of GAI within educational settings. The study revealed that GAI appears to exert a more pronounced impact on the fields of medical and engineering education. Identified potential uses encompassed assessment, personalized learning, and intelligent tutoring systems. Areas highlighted for increased focus included interdisciplinary collaboration and ethical considerations.

A collective of researchers focused their investigation on the industrial application of GAI, particularly through the use of Large Language Models (LLMs) in such settings. Their exploratory study revealed that tools like ChatGPT offer a broad spectrum of functionalities, including improvement of accessibility, collaboration, and engagement. Additionally, the publication was supplemented with future guidelines for management scholars (Kar et al., 2023).

The research landscape concerning the use of GAI in materials science research and development was notably expanded by Liu et al. (2023). To enhance data availability and automate structure-activity relationship analysis, the researchers investigated various generative models. They discussed the potential applications of GAI in materials science research and engineering, specifically through the utilization of ChatGPT.

Slightly differing with the discussion above, a group of scholars adopted a skeptical viewpoint within the context of GAI applications. They elucidate the impact of digital disruption across multiple aspects of life. Advocating for a hybrid business model, the team devised a novel framework that proposes enhanced business strategies (Mondal et al., 2023).

The discussion underscores the rapid expansion of research in the field of GAI in correlation with the progression of civilization and the passage of time. It is understandably clear that GAI has made a significant impact across nearly every sector of society and facet of life. In fields such as engineering, business, and medical science, GAI is subject to extensive investigation. Likewise, the educational domain is explored from a variety of perspectives, encompassing insights from different professional education specialties. However, this research opts to concentrate exclusively on general education, deliberately setting aside other areas of professional education within the overarching framework of GAI research in education. Given the focused nature of the research agenda, the evolving global educational landscape, and the fluidity of technological advancements, it becomes imperative to regularly validate the research challenge. These considerations form the basis of the present study.

Research Questions

For a focused and streamlined discussion, the following research questions (RQs) were framed.

RQ1. How did research publications on GAI in education evolve over time from 2021 to 2023?

RQ2. Who are the leading author, organization and nation in this field of research?

RQ3. Which one appeared as the most frequently studied keyword in this research?

RQ4. Which document, source, author, organization and country have achieved maximum citation?

RQ5. What kind of network is noticed between bibliographic coupling and countries?

RQ6. What is the mapping pattern existed in the co-citation of cited sources and authors?

RQ7. How do the present research findings go at per or differ from previous related research findings?

RQ8. What is the current trend of GAI research in education?

RQ9. How do this research findings will impact the education community while its will be trying to incorporate GAI in education?

Methodology

The research methodology employed in this study is characterized as descriptive. The authors utilized the bibliographic technique to address the research question, citing its methodological superiority over conventional qualitative reviews due to its analytical depth and precision (Abafe et al., 2022). Istenič (2024) carried out a bibliometric analysis using VOSviewer in higher education. This study incorporated content and bibliographic analyses, with a primary focus on research pertaining to general education. A good number of literatures in social science research were found to associate PRISMA and PICOC frameworks simultaneously. Corresponding research problem includes the effect of social media on personal learning environments in the university settings (Gil-Fernández et al., 2023), human resource management practices and their impact on school performance (Hoque & Atheef, 2024), systematic review of action on university students with ADHD (Álvarez-Godos et al., 2023), basic education teachers' training (Lima et al., 2024), and so on. Therefore, the robustness of the research design was further enhanced by the incorporation of the tailor-made PRISMA and PICOC frameworks, contributing to a comprehensive and structured approach (Page et al., 2021; Renganayagalu et al., 2021). The two specified research frameworks were chosen because of their wide applicability in social science research. Consequently, a hybrid methodological approach was adopted.

Data was collected through NIT Silchar's institutional access on February 13, 2024. The investigation extended to global databases such as Scopus and Web of Science (WoS), targeting publications within the last five years (2019–2023). Due to the relatively recent emergence of GAI in 2022, the corresponding author successfully retrieved data from the Scopus database for 2021–2023, while the complete dataset for the past five years was accessible via WoS without any hindrances. This process resulted in a preliminary dataset of 222 publications, identified through detailed scrutiny of documents featuring "Generative Artificial Intelligence" and "education" within their titles, abstracts, and keywords. Of these, 36 were sourced from WoS, with the remaining 186 derived from Scopus. The data, downloadable in CSV and Excel formats from Scopus and WoS, respectively, was limited to manuscripts published in English.

The selection process excluded duplicate entries, missing data, and publications not aligned with the study's focus, particularly those delving into professional education

themes like entrepreneurship, media, engineering, health, management, architecture, and planning. Following the application of inclusion and exclusion criteria (Table 1), the dataset was refined to 116 publications from the Scopus database, available in CSV file format. Thus, the data selection process ended at Scopus paper inclusion. This curated collection comprised conference papers, articles, books and book chapters, editorials, reviews, and notes.

The PRISMA diagram, illustrated in Figure 1, visualizes the data screening process.

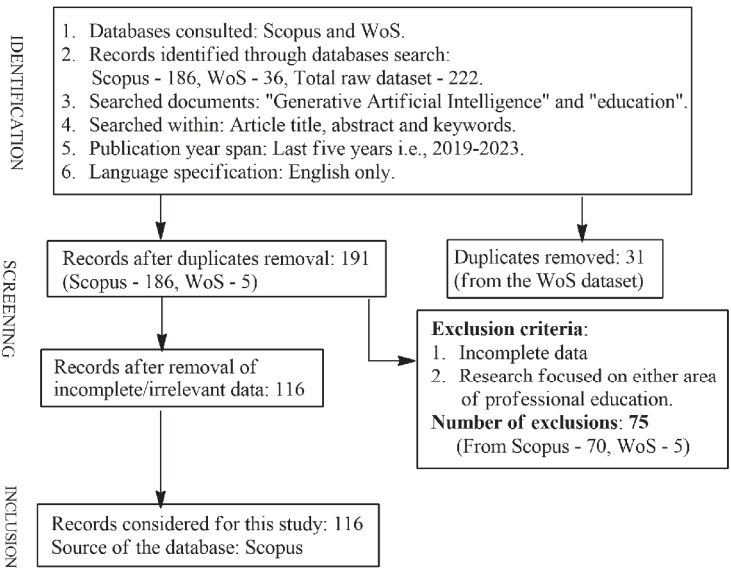

Figure 1. *The PRISMA view of data screening process*

The researchers employed the PICOC framework as a strategic tool to frame precise research questions (RQs), thereby enabling a more concentrated examination of the research challenge. The PICOC framework, an acronym for Population, Intervention, Comparison, Outcome, and Context serves as a guide for developing research questions by clearly defining these five components. This approach ensures that the questions are specific, relevant, and directly tied to the objectives of the study.

In Table 1, each component of the PICOC framework was detailed alongside the corresponding RQs it inspired. This structure not only facilitated the formulation of targeted inquiries but also organized the discussion around the central research challenge, ensuring that each aspect of the investigation was thoroughly addressed. By employing the PICOC framework, the researchers were able to maintain a focused and systematic approach to their inquiry, enhancing the clarity and efficiency of their research process.

Following Istenič (2024) researchers utilized the advanced software VOSviewer version 1.6.20 for data analysis, focusing on various units of analysis including authors, organizations, and countries. The analysis included multiple types, such as co-authorship, co-occurrence, citation, bibliographic coupling, and co-citation, employing the full counting method rather than fractional counting to ensure comprehensive inclusion of data.

Table 1. *Specifics of the PICOC framework and the research questions*

Initials	*Components*	*Details of the component*	*Specified RQs formulated*
P	Population	Research landscape and researchers of education dealing with GAI.	RQ1. How did research publications on GAI in education evolve over time from 2021 to 2023? RQ2. Who are the leading author, organization and nation in this field of research? RQ3. Which one appeared as the most frequently studied keyword in this research? RQ4. Which document, source, author, organization and country have achieved maximum citation? RQ5. What kind of network is noticed between bibliographic coupling and countries? RQ6. What is the mapping pattern existed in the co-citation of cited sources and authors?
I	Intervention	Application of GAI	
C	Comparison	Research findings in this research versus other related research findings	RQ7. How do the present research findings go at per or differ from previous related research findings?
O	Outcome	Trend analysis of this research	RQ8. What is the current trend of GAI research in education?
C	Context	Education community	RQ9. How do this research findings will impact the education community while its will be trying to incorporate GAI in education?

In this bibliometric analysis, visual parameters like circle proximity, size, and color variations were used to denote their conventional meanings, facilitating the interpretation of the data. Circle proximity indicated the strength of relationships between units of analysis, size represented the volume of output or level of activity, and color differences highlighted distinct clusters or groups within the data.

The carefully formulated RQs laid the foundation for further discussion, guiding the analysis and ensuring that it remained closely aligned with the core objectives of the study.

Results

RQ1. How did research publications on GAI in education evolve over time from 2021 to 2023?

This distribution of publications showcases a remarkable increase in interest and research activity within the field of GAI as it pertains to education. The data indicates that there was one publication each in 2021 and 2022, suggesting an initial but modest engagement with GAI research in these years. However, a significant increase is observed in 2023, with the researchers locating 114 publications.

This exponential growth in the number of publications within a single year reflects a significant interest in the capabilities and applications of GAI in educational contexts. The steep rise could be attributed to a variety of factors, including advancements in GAI technology, increased accessibility to GAI tools for researchers, and a growing recognition of the potential benefits of GAI in enhancing educational methodologies and outcomes.

RQ2. Who are the leading author, organization and nation in this field of research?

RQ2 yielded insightful results regarding the collaborative landscape of GAI research in education. A total of 396 authors have been identified as contributors to the dataset

underpinning this research. Among these contributors, Kshetri emerged as a notably prolific author, having authored three publications. Furthermore, a significant majority of scholars, numbering 279, were credited with authorship of a single publication. This indicates a wide distribution of contributions across the research community, with many scholars engaging in GAI research within educational settings.

Figure 2, which depicts the network of co-authorship, provides a visual representation of these collaborative dynamics. The largest network identified within this ecosystem highlights the intricate web of collaborations and academic interactions that underpin the development of GAI research in education.

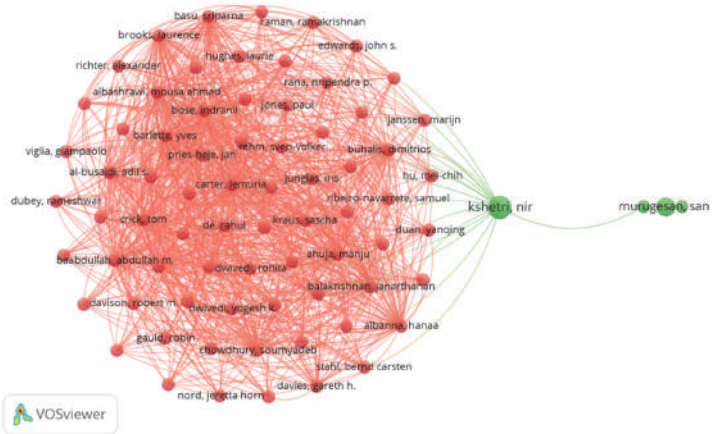

Figure 2. *Co-authorship network*

The analysis of organizational contributions to the research on GAIED reveals a broad engagement across the academic landscape, with a total of 324 organizations contributing to the pool of research data. The University of Tasmania, Australia stands out as the leading contributor, with three research outputs to its name, indicating a notable focus on GAI within its research agenda. Additionally, a group of five organizations has been credited with producing two records each, demonstrating their active involvement in GAI research. This highlights a collaborative effort among various institutions to advance the understanding and application of GAI in educational contexts.

Figure 3 showcases the organizational network, providing a visual representation of the connections and collaborations among these contributing entities. The most extensive network encompassing one cluster and 77 items, presumably representing individual organizations or collaborative groups. This vast network illustrates the complex interconnections that facilitate knowledge exchange and research development across the field.

Examinations of country-level contributions to the corpus of research on GAIED shows a wide geographical distribution, with input from 50 distinct countries. Leading the contributions, the United States stands out with a total of 35 documents, underscoring its significant role in advancing GAI research within the educational sector. Following the United States, several other countries have also made notable contributions, with a minimum of five publications each. These include Australia, United Kingdom, China, Spain, Hong Kong, and Canada reflecting a diverse international engagement in the exploration of GAI's potential for education. In the result, Hong Kong is recognized as a separate nation that is not a part of China. The fact that VOSviewer produced data from

the authors' affiliations portion of the CSVfile that was acquired from Scopus actually indicates the limitations of the technology itself. The authors of this paper felt obligated to draw attention to this technical problem in order to uphold research ethics.

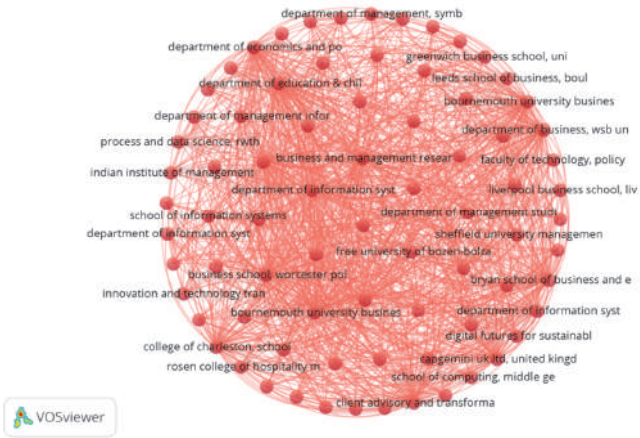

Figure 3. *Organizational network*

Figure 4 presents the network of the most connected nations, illustrating the collaborative dynamics at the international level. With 6 clusters and 37 elements, the network visualization captures the multifaceted relationships that span across borders, highlighting a global community of researchers dedicated to this area of study.

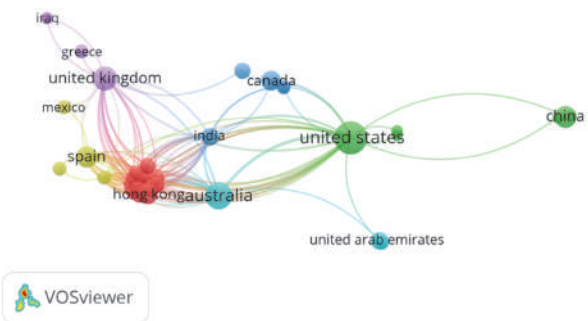

Figure 4. *Countrywide network*

RQ3. Which one appeared as the most frequently studied keyword in this research?

The RQ3 delved into the analysis of papers keywords to identify thematic concentrations and trends within the corpus of GAI research in education. A total of 312 papers keywords were examined, revealing the most frequently occurring terms and their centrality to the research community's interests. ChatGPT emerged as the most cited keyword, highlighting its prominence and relevance as a tool or topic within GAI research. The terms "higher education" and "generative AI" each, demonstrating significant interest in the application of GAI within tertiary education settings. "AI" itself, indicating the foundational role of AI in the discussions, while "GAI", underscoring the specific focus on generative aspects within AI research. For a precise presentation, only top 10 keywords are presented below (Table 2) with a minimum 5 occurrences.

Table 2. *Top 10 keywords with a minimum 5 occurrences*

Keyword	*Occurrences*	*Total link strength*
ChatGPT	45	72
Generative artificial intelligence	36	44
Artificial intelligence	27	39
Higher education	22	35
Generative AI	22	28
Education	11	17
AI	7	15
Academic integrity	7	13
Large language models	8	13
Assessment	6	8

Figure 5 illustrates the co-occurrence network of papers keywords, providing a visual representation of how these terms interconnect and cluster around central themes. This network, the largest connected within the study, comprises 299 objects (representing individual keywords), 40 clusters (indicating thematic groupings), 1,318 links (denoting relationships between keywords), and a total link strength of 1,476 (reflecting the intensity of these connections). This analysis underscores the dynamic and multifaceted landscape of GAI research, with ChatGPT, higher education, generative AI, AI, and GAI forming core focal points around which much of the current discourse revolves.

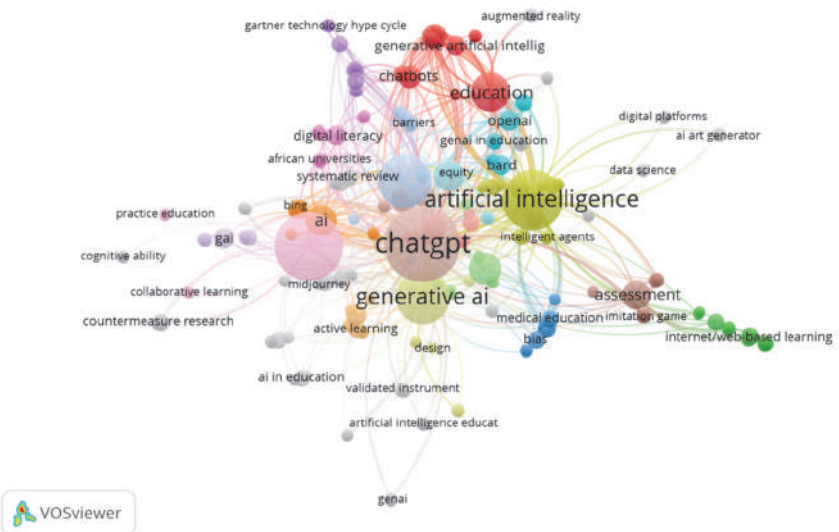

Figure 5. *Co-occurrence of papers keywords*

RQ4. Which document, source, author, organization and country have achieved maximum citation?

RQ4 focused on identifying the most influential documents within the field of GAI research in education based on the number of citations they received. Dwivedi et al.'s (2023) scholarly article emerged as the most cited piece, with a remarkable 474 citations, indicating its significant impact and relevance to the research community. Following Dwivedi et al.'s (2023), Cooper's (2023) and Sullivan et al.'s (2023) papers also

demonstrated considerable influence, with 112 and 73 citations, respectively, highlighting their contributions to advancing knowledge in the field. Emenike & Emenike (2023), and Murugesan & Cherukuri (2023) were next, each receiving 31 citations, followed by Ali et al. (2021), with 17 citations, showcasing the diversity of impactful research and the range of topics that have garnered attention within the GAI and education research community.

Figure 6 maps the documents that received a minimum of ten citations. This visualization included 15 objects (representing the cited documents), 14 clusters (indicating thematic or disciplinary groupings, if applicable), and a single link (denoting a direct citation relationship between two documents within this set). The graphic's depiction of 14 clusters with only one link suggests that while these influential documents are recognized across various themes or areas within GAI research, direct citations among them are rare, pointing to a wide but distinct spread of research foci. The significant citation count, particularly for Dwivedi et al.'s (2023) paper, underscores the critical role certain publications play in shaping the discourse and research agenda of GAI applications in education.

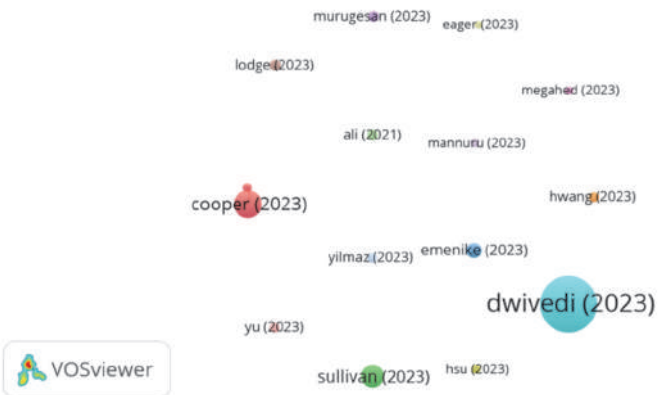

Figure 6. *Mapping of the document with minimum 10 citations*

When examining the sources of documents within the field of GAI research in education, the International Journal of Information Management stands out as the most cited source, with an impressive 474 citations. This highlights its pivotal role in disseminating influential research that significantly impacts the academic community's understanding and development of GAI applications in education. Next in the line was the Journal of Science Education and Technology having receiving 112 citations, while the Journal of Applied Learning and Teaching garnered 82 citations. Computers and Education: Artificial Intelligence and the Journal of Chemical Education also featured prominently in the citation counts, with 40 and 38 citations respectively.

Figure 7 was designed to map sources that have published at least one document and received a minimum of fifteen citations. A total of seven sources met these criteria (but the VOSviewer network visualization could locate only six sources, leaving out the Journal of Science Education and Technology), indicating a selective yet impactful group of publications that have contributed significantly to the field. The inclusion of sources spanning from information management to science and chemical education demonstrates the interdisciplinary nature of GAI research, reflecting its wide-reaching implications across various domains of education.

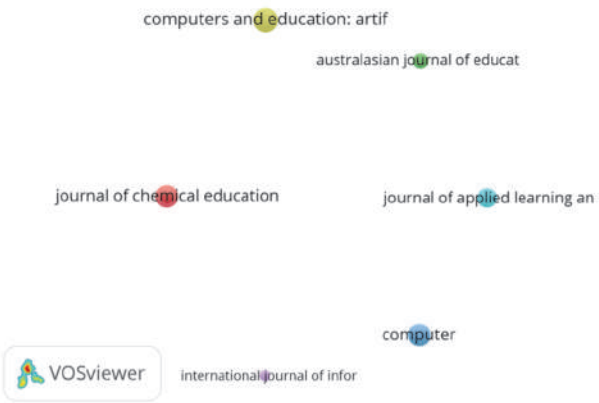

Figure 7. *Sources with minimum1 document and 15 citations*

Focusing on authors with at least two documents and fifteen citations in the field of GAI research in education, seven out of 396 authors met these criteria, highlighting their significant impact and contribution. Kshetri leads with 483 citations, demonstrating his prominent influence. Followed by Ali and Breazeal with 19 citations, Kelly and Sullivan with 75 citations, Murugesan with 25 citations, and Lodge with 18 citations, these authors represent the most cited within this select group.

Upon examining document citations and the contributions of various organizations, it was discovered that only 6 out of 324 organizations fulfilled the criterion of publishing at least two documents that have not received any citations. Notably, Edith Cowan University, Australia leads with 75 citations (but VOSviewer failed to locate it through the network visualization in Figure 8), distinguishing itself in terms of impact within the realm of GAI research in education.

Figure 8 incorporates citations from these organizations, illustrating their academic influence and contributions to the field. This analysis highlights the central role that certain institutions play in advancing GAI research, underscoring the importance of their work in shaping discussions and developments in educational technology and AI.

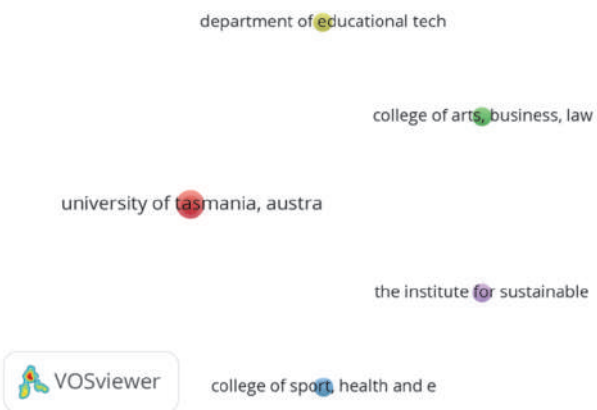

Figure 8. *Organizational citations*

Analyzing the impact of GAI research in education on a country level, only 7 out of 50 nations produced at least 5 documents each, meeting the set criterion for significant contribution. Table 3 and Figure 9 display these findings, detailing the number of documents, citations received, and overall link strength for each of these leading countries. This concise overview highlights the key players in GAI research, demonstrating their influence and contributions to the field globally.

Table 3. *List of country wise citations*

Country	*Documents*	*Citations*	*Total link strength*
Australia	19	739	11
Spain	8	479	5
United States	35	590	4
Hong Kong	6	499	2
China	9	20	1
United Kingdom	12	495	1
Canada	6	14	0

Table 3 reveals that Australia stands out for receiving the highest number of citations in GAI research in education, indicating its leading role and significant impact in the field.

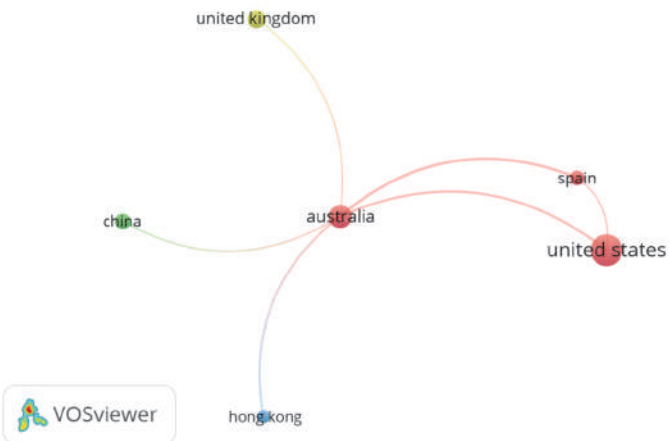

Figure 9. *Largest connected network among countries*

Figure 9 visually represents the largest connected network of countries involved in GAI research, comprising six elements.

RQ5. What kind of network is noticed between bibliographic coupling and countries?

In addressing RQ5, the study focused on the bibliographic coupling among countries with a minimum of five publications. This criterion was met by only seven countries, showcasing a select group with substantial contributions to GAI research in education. The United States stood out with the highest number of publications and the strongest linkages, as detailed in Table 4 and illustrated in Figure 10.

Table 4. *Statistics on bibliographic coupling and countries*

Country	*Documents*	*Citations*	*Total link strength*
United States	35	590	1405
Australia	19	739	1238
United Kingdom	12	495	1043
Hong Kong	6	499	1035
Spain	8	479	999
Canada	6	14	293
China	9	20	115

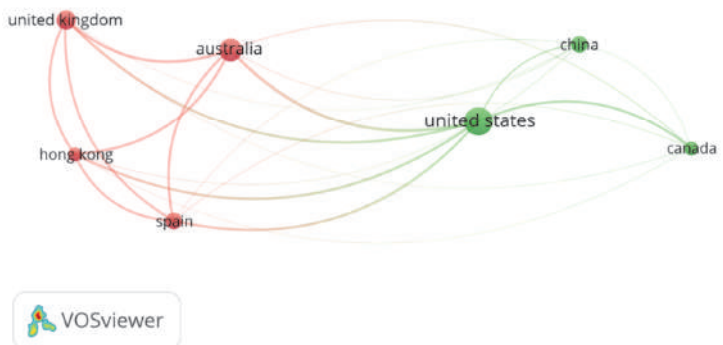

Figure 10. *Bibliographic coupling among countries*

RQ6. What is the mapping pattern existed in the co-citation of cited sources and authors?

This question examined the co-citation patterns of referenced authors and sources, setting a minimum threshold of 20 citations per source. Out of 2,391 sources, only 10 met this criterion, highlighting a focused group of highly influential sources within the field.

Figure 11 visualizes these critical findings, showcasing the co-citation network. The International Journal of Information Management emerged as the most interconnected source, with the highest total link strength of 156 across three clusters and seven linkages, receiving 37 citations.

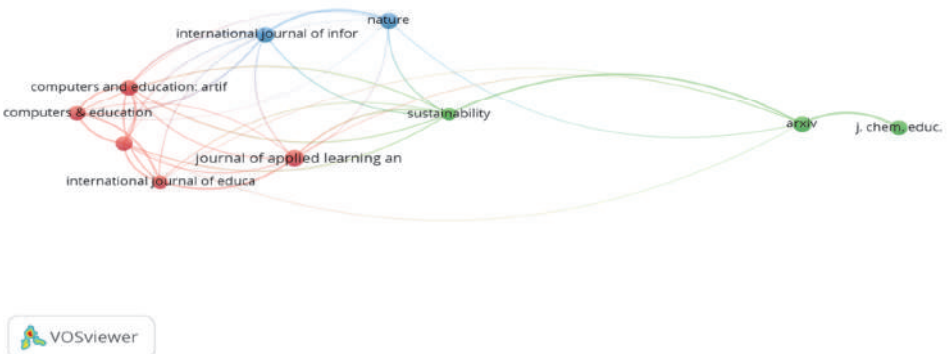

Figure 11. *Network between co-citation and cited sources*

A threshold of at least 20 citations per author was established regarding co-citation among referenced authors. Of 7,841 authors, 13 met this requirement, indicating a select group with significant influence in the field. Tan, Dwivedi, and Kshetri emerged as the top three authors with the strongest overall connections regarding co-citation. The co-citation network among these authors, featuring three clusters and 78 linkages and a total link strength of 1151, is illustrated in Figure 12.

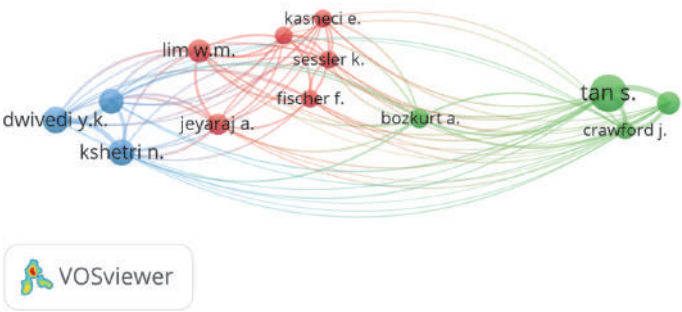

Figure 12. *Co-citation of the authors' network*

RQ7. How do the present research findings go at per or differ from previous related research findings?

The RQ7 is answered based on the findings of the above six RQs and comparing the findings with the existed reports.

RQ8. What is the current trend of GAI research in education?

The RQ8 also has a connection with the findings of RQs 1–6, Therefore, Henceforth, RQ7 and RQ8 have been addressed through the following discussion section where the first paragraphs were precisely articulated for answering the RQ7, and the last paragraph was solely dedicated to the RQ8.

Discussion

This section summarizes the findings across RQs 1–6, contrasting them with existing literature to streamline discussion. For RQ1, a notable surge in GAIED research was observed in 2023, aligning with Gartner's hype cycle trends (Bahroun et al., 2023).

RQ2 identified Kshetri as the most prolific author, contributing to three publications, with a total of 396 authors collaborating on 116 articles, highlighting a strong trend of cooperative research efforts. This suggests the multidisciplinary nature of GAIED, requiring networked research approaches as supported by Bond et al. (2024). The University of Tasmania led organizational contributions, with the United States producing the most documents nationally. The research's geographic spread, primarily among English-speaking countries, suggests a concentration of GAIED studies in these regions, a finding supported by Mannuru et al. (2023).

RQ3's keyword analysis revealed clusters around themes like LLM, AR, ML, EVT, and educational innovation, indicating potential GAIED applications in medical education, digital education, and higher education. Tools like ChatGPT and DALL-E were mentioned as practical GAI applications, pointing towards curricular exploration opportunities in education policies. This aligns with discussions by Chan (2023), while also highlighting areas for further research like autoethnography and countermeasure research (Bozkurt et al., 2023).

RQ4 focused on the impactful work of Dwivedi et al. (2023), suggesting the transdisciplinary nature of GAIED research. Kshetri's prominence in publications and citations highlights the importance of author contributions to the field. Australia's leadership in citations, despite the United States having more publications, underscores the significance of international networking in research impact.

RQ5 and RQ6 further emphasized the interdisciplinary and international collaboration essential in GAIED research, with a diverse range of journal types and a concentrated group of influential authors shaping the field. These findings confirm the infancy of GAIED research, suggesting it's at an emerging stage with a few scholars leading the discourse.

A hype in GAIED research in evident since 2022 (RQ1). The research underscores GAIED's cross-disciplinary nature, aligning with earlier report (Dwivedi et al., 2023) and highlighting the importance of collaborative, multidisciplinary approaches to advance the field.

RQ9. How do this research findings will impact the education community while its will be trying to incorporate GAI in education?

The demand of the RQ9 is associated with the implications of the study findings to the educational community. Hence, the RQ9 is addressed in the conclusion section**.**

Conclusion

This study focused on a bibliometric analysis to examine the literature landscape of GAIED, uncovering a significant growth in research by 2023. This surge underscores the rising interest in GAI's impact on education as an emerging technology, marking a notable hype in scholarly discussions. Kshetri's work emerged as a pivotal reference within the field, highlighting his substantial contribution. The United States and the University of Tasmania in Australia were identified as the leading contributors on a national and organizational level, respectively. These findings pinpoint the specific contributions of authors, organizations, and countries to the GAIED discourse. A geographical analysis revealed that the majority of contributions still emanate from English-speaking countries, indicating a concentration of research activity within these regions. Further examination of citations highlighted key entities such as ChatGPT, Dwivedi et al. (2023), the International Journal of Information Management, Edith Cowan University, and Australia as frequently mentioned keywords, documents, sources, organizations, and countries. This indicates the pivotal roles these elements play in shaping GAIED research. The study's cross-disciplinary nature was further evidenced by co-citation mapping, revealing a broad spectrum of academic interests converging within GAIED. Additionally, the varied distribution of author co-citations points to a still-evolving research field, suggesting areas ripe for further exploration. In summary, this bibliometric analysis not only sheds light on the current state and trends of GAIED research but also underscores its interdisciplinary and developmental nature. The insights gained pave the way for future investigations, particularly with respect to emerging technologies' roles in education, as the field continues to evolve and expand.

RQ9 delved into how the study's findings might influence the education community's adoption of GAI in classroom settings. The analysis of keywords, including EVT, LLM, AR, and ML, suggests the adaptability of theoretical models to achieve educational goals. These keywords point toward promising application areas such as medical education, digital education, general education, higher education, and digital platforms, indicating the wide applicability of GAI in various educational contexts. The research specifically highlights GAI tools like ChatGPT and Bard as instrumental in realizing the potential of GAIED, suggesting their utility in a range of educational activities. Additionally,

certain keywords guide the integration of course content with pedagogical strategies within educational policies and practices, advocating for a thoughtful application of the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra et al., 2023).

Further exploration into topics like countermeasures, autoethnography, ethics, and bias indicates an awareness of potential challenges and areas for future research, emphasizing the need to address possible threats that GAI integration might pose to educational integrity and effectiveness. However, the overarching narrative suggests GAI's significant potential to enhance educational outcomes, supported by existing literature linking GAI tools like ChatGPT to positive transformations in teaching and learning processes (Baidoo-anu & Owusu Ansah, 2023). In conclusion, RQ9 underscores the transformative potential of GAIED, backed by strategic insights from keyword analysis. It presents a balanced view of GAI's capabilities to innovate educational practices while also cautioning against potential pitfalls, suggesting a way forward for the education community to leverage GAI technologies effectively.

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