IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Generative AI And Higher Education: A Visualized Bibliometric Analysis

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Abstract. The emergence of generative AI has significantly influenced the higher education sector, prompting considerable contemplation and exploration. This domain remains relatively unexplored within research contexts. The bang of Generative AI in higher education and its significance in pedagogy has led to a noticeable increase in published research on this topic. Consequently, the purpose of the study is to conduct a bibliometric analysis of literature related to generative AI and higher education, with an objective of reviewing and identifying emerging areas within the field. By doing so, this research not only contributes to the existing literature but also illuminate the current status and future trajectories of research within the domain. In the bibliometric analysis, an electronic search was performed using the Scopus database. The analysis was conducted using VOSviewer, a data visualization tool. Bibliographic coupling examines a lack of strong connections between studies, indicating that there is still insufficient depth of research on this emerging topic.

Keywords: Generative AI, higher education, bibliometric analysis, VOSviewer.

1 Introduction

1.1 Generative Artificial Intelligence (Gen AI)

The introduction of Generative Artificial Intelligence (GenAI) has sparked significant upheaval in the realm of higher education. Generative AI is a subset of artificial intelligence (AI) technology distinguished by its ability to create distinctive outputs (Peres et al., 2023). GenAI algorithms are designed to create new samples resembling existing ones. These models learn patterns to generate text, images, sounds, videos, and code. GenAI, which began with a rule-based approach in the 1950s, has evolved rapidly with breakthroughs like generative adversarial networks (GANs) and transformers. Over the last few years, some ground-breaking work has happened in foundational large language models (LLMs).

1.2 Generative AI and Higher Education

The introduction of Generative AI (GenAI), such as ChatGPT, has posed opportunities and challenges to the traditional model of education. In early 2023, the use of GenAI tools skyrocketed, especially after the release of ChatGPT, an advanced AI chatbot that revolutionized human-computer interactions. GenAI tools like ChatGPT, Bard, Stable Diffusion, and Dall-E are some well-known examples. ChatGPT's November 2022 release spurred GenAI's adoption in higher education. The application of GenAI stands to provide significant advantages across a spectrum of industries, including education, entertainment, and product design, by providing innovative solutions (Castelli & Manzoni, 2022). Much discussion revolves

around GenAI's potential to transform and enhance teaching and learning in higher education (Adiguzel et al., 2023; Baidoo-Anu & Ansah, 2023). Various tools possess distinct features and advantages, AI text generators like ChatGPT aid students in brainstorming and receiving writing feedback, while text-to-image AI tools like DALL-E and Stable Diffusion support teaching in arts and design (Chan & Lee,2023; Atlas, 2023; Dehouche & Dehouche, 2023). GenAI technologies aid researchers in conceptualizing, integrating, and streamlining data to facilitate smoother research processes (Berg, 2023; Chan & Zhou, 2023). Additionally, it has the potential to elevate the quality of publications (Kitamura,2023; van Dis et al., 2023). Educators stand to gain from GenAI. It could significantly enhance the evaluation process thereby potentially revolutionizing traditional assessment methods and improving the overall learning experience (Crompton & Burke, 2023). It was explained by (Mizumoto and Eguchi , 2023) that GenAI has the potential to transform the teaching and learning process and improve student outcomes in higher education. Focusing on the negative impact of Gen AI (Kumar,2023) highlighted that GenAI tools may lack a personalized perspective and could potentially include inaccuracies in references. Later on (Warschauer et al., 2023) concluded that overdependence on Gen AI tools will hamper the writing abilities.

Training GenAI on inaccurate datasets could result in detrimental outcomes for users therefore it necessitates human intervention (Harrer,2023; Lubowitz, 2023). Another challenge associated with the tool is verifying the authenticity of work, ensuring whether it belongs to author or not (Peres et al., 2023). The next concern among researchers revolves around the implications of AI generated content and whether it falls under the category of unethical behavior and academic integrity may be compromised in higher education (Chan (2023 a). To provide a holistic view (Chan & Tsi ,2023) elucidated the advantages and disadvantages of GenAI, noting its role in nurturing creativity and critical skills alongside its inherent limitations. The necessity for further research is emphasized to ensure its effective integration into the teaching process.

1.3 Research Questions

Table 1. Research Question and their Significance

Research Questions	Significance
Which authors and journals have taken the charge to contribute to this new topic of Generative AI and Higher Education?	It would help researchers to find specific studies to carry out high quality research in the given area.
Which are the leading countries in the publication of Generative AI and Higher Education related papers?	It would help the researchers with valuable insights into the global research landscape with collaboration opportunities.
Which document type published more research work on Generative AI and Higher Education?	It would help the researchers to recognize the influential channels for key sources of information and scholarly engagement.
What is the keyword network of Generative AI and Higher Education?	It would help the researchers to identify central keywords, low connectivity keywords, evolving areas of interest, interdisciplinary connections and research themes. Also, it would provide insights into future research priorities and opportunities.

2 METHODOLOGY

2.1 Search Approach and Data Collection

The study undertook a bibliometric analysis by querying topic related keywords "Generative AI" and "Higher Education". The data was retrieved on August 1st 2024. Total 81 publication were retrieved from Scopus database. Documents published in English language were considered for the study (79 documents). The Scientific Procedures and Rationales for Systematic Literature Review (SPAR-4-SLR), as a review protocol, is designed to facilitate the systematic evaluation of publications (Paul et. al 2021). The stipulation that a domain contains a minimum of 40 articles indicates a level of maturity suitable for systematic literature reviews to provide substantial scholarly contributions (Paul & Criado, 2020). The SPAR-4-SLR comprises three distinct stages: assembling, arranging, and assessing (Figure1).

Assembling	**Identification** Domain: Generative AI and Higher Education Research Question: Which keywords are in focus in literature and explore research trend. Source Type: Journal, Conference Proceeding, Book Series, Book
	Acquisition Search Mechanism: Scopus Database Search period: 2023-2024 Search Keyword: "Generative AI" AND "Higher Education" Total Documents retrieved: n= 81
Arranging	**Purification** Document type excluded (and total number): Other than English (n=2) Document type included (and total number): English (n=79)
	Evaluation Analysis Method: Bibliometric Agenda Proposal Method: Keywords cooccurrence mapping, Bibliographic coupling
Assessing	**Reporting** Reporting Conventions: Figures by VOS Viewer Limitations: Database, search method

Figure 1. SPAR-4-SLR Review Stages

2.2 Data Analysis

Data was extracted from Scopus database. After selecting related studies, data extraction was done in MS Excel as CSV format. The data was collected on August 1, 2024. After extracting the data, it was carefully analyzed, and the findings were presented using detailed tables and figures. Bibliometric analysis is the optimal and preferred method for examining extensive datasets, while VOSviewer simplifies and enhances the clarity of visualizing bibliographic maps (Tamala et al. 2022).

3 Results

Distribution of Authors

The list of top five authors who have maximum publication is presented in Figure 2. At the top position in this list was Chan C.K.Y, who published four of the top papers. Crawford. J., Rudolph, J. and Tan. S each contributed to literature with three articles. Meanwhile, Bannister, P. contributed two articles.

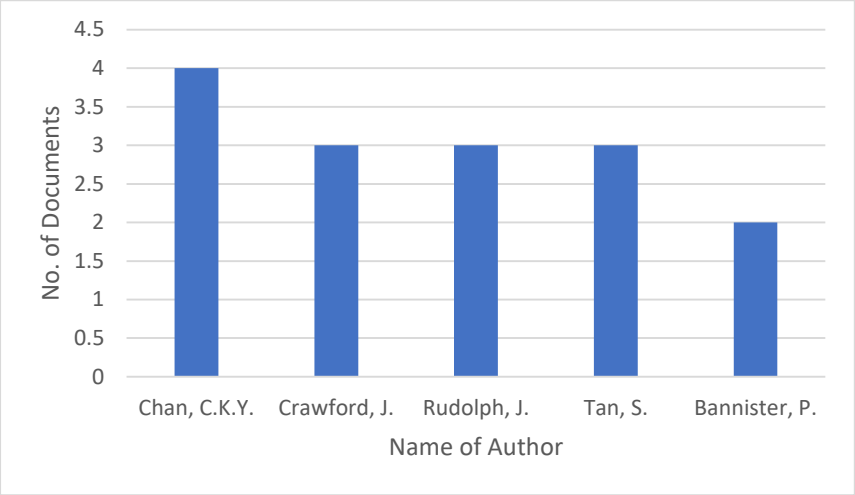

Figure 2. Top Authors Contribution

Distribution of Top Journals

A total of 59 journals published articles on Generative AI and Higher Education. In this study the top five Journals are reported. As Figure 3 shows, the maximum no. of publications was published in Journal of Applied Learning & Teaching (eight) and British Journal of Educational Technology was at fifth position with two publications.

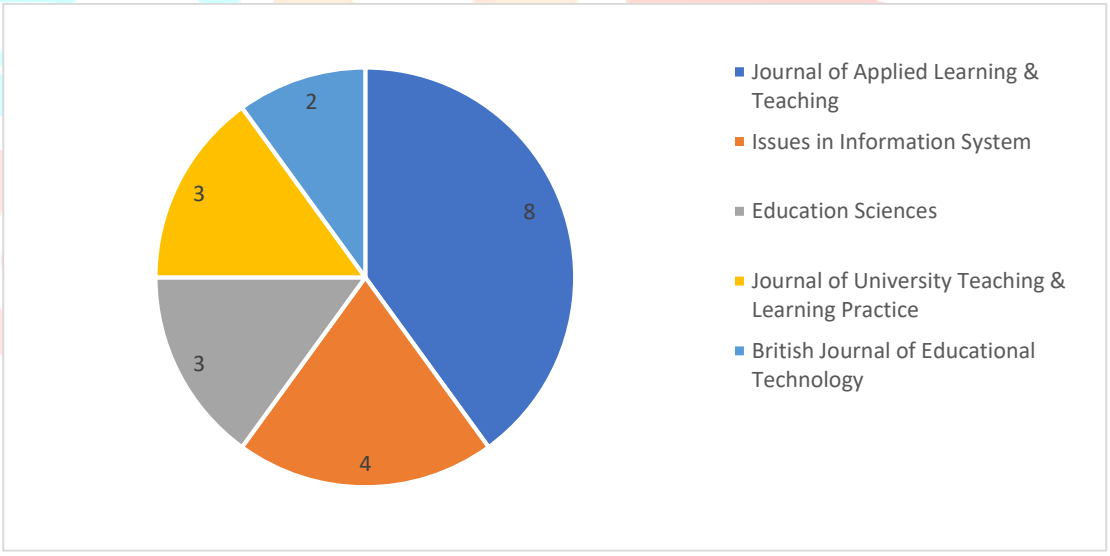

Figure 3. Journals having maximum publication

Distribution of Publications among Countries

The top five countries with maximum publication are presented. Australia published maximum documents (18) United States (16). Hong Kong, United Kingdom and Singapore have nine, six and four documents respectively.

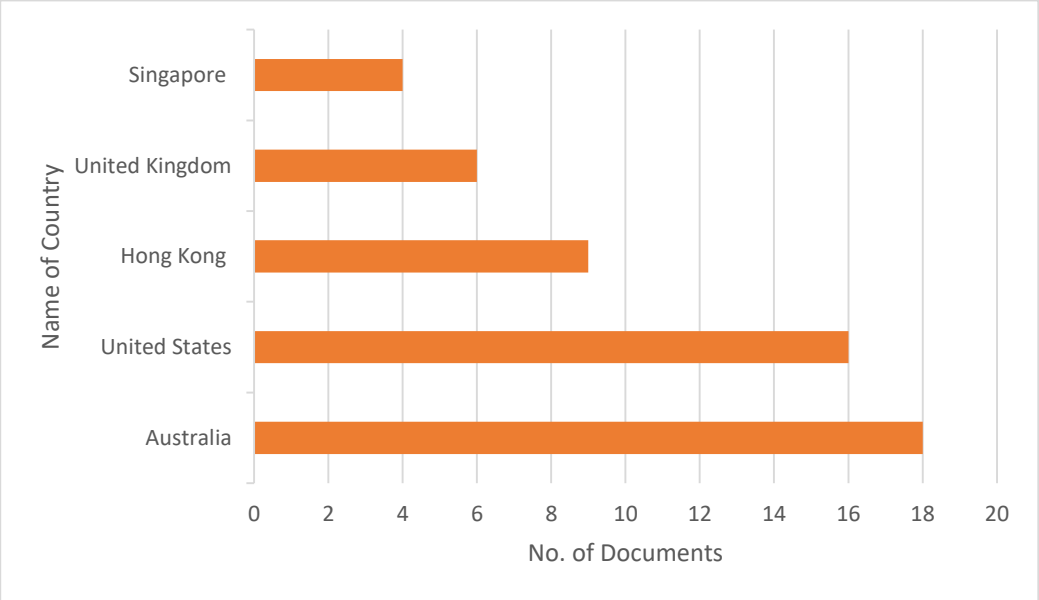

Figure 4. Countries with top Publication

Distribution of Document Type

A total of seven types were found in 79 documents The most frequent publication type is an article (55), accounting for 69.62 percent of total publication. Conference paper (14) is at second position with a proportion of 17.72 percent. Other document types include conference review (five), editorial (two), book chapter (one), short survey (one) and note (one). Figure 4 shows the numbers of various documents. It is clearly visible there is not much momentum in conferences, book chapter and others. As there will be more conferences topic will gain momentum and we could get quality documents of different types. With the anticipation of more conferences, the wave in this area is expected to increase, leading to the generation of diverse and high-quality documents across various types.

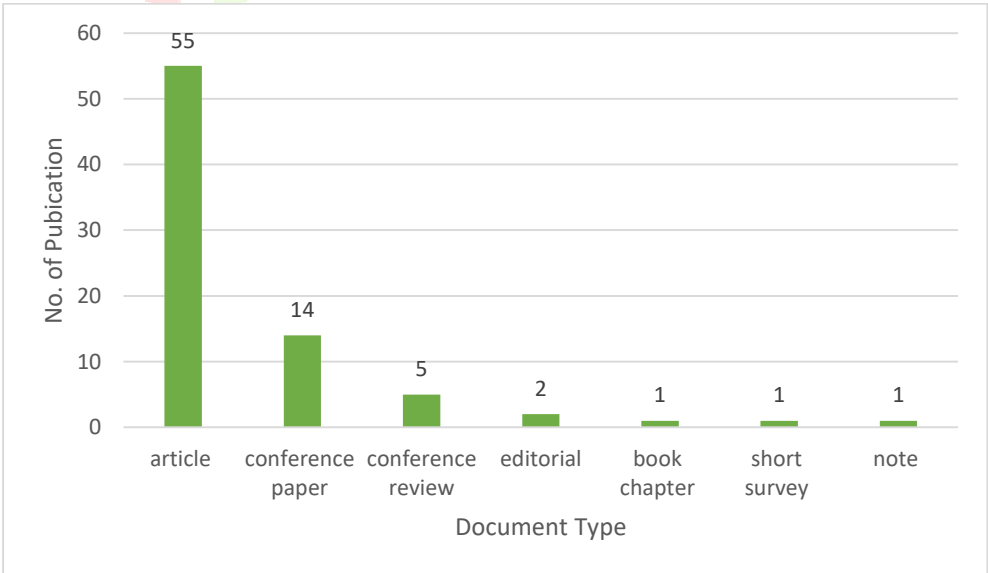

Figure 5. Types of Publications

Co-occurrence Mapping of keywords

Co-occurrence mapping of keywords based on textual data was conducted on articles. Keywords that appeared more than 10 times in the Scopus database were captured for mapping purposes. Size of nodes are proportional to their occurrence. Each color represents a group of terms amalgamated into clusters, indicating the association between topics. The connections between nodes illustrate their co-occurrence in publications (Van and Waltan, 2017). Three main clusters red, green and blue were found. There are 13 items in cluster one and 11 items in cluster two and two items in cluster three. The red cluster's main key items include chatgpt, gen ai tool, academic integrity, practice, tool, teacher, response, content, ai tool, tool, text, article and participant. This cluster appears to focus on the use of chatgpt within an academic context. Keywords like gen ai tool, academic integrity, practice, tool, teacher, responses, content, suggest a discussion around utilizing gen ai tool or any other similar ai tools in educational settings. The presence of terms like participant and article could indicate a focus on research or practical applications involving these tools in educational practices.

The green cluster's key terms are higher education, assessment, teaching, gen ai, framework, opportunity, implications, survey, recommendations, integration and role. This cluster revolve around broader themes related to higher education and teaching. Keywords like higher education, teaching, opportunity, implications, framework, integration, recommendation, assessment, survey suggest a discussion on the integration of artificial intelligence, particularly generative artificial intelligence into higher education system. The term role and assessment could imply a consideration of the impact and evaluation of ai integration in teaching practices.

Keywords (academic integrity, framework) also indicates a convergence of multiple disciplines such as education, technology, ethics, and psychology. This indicates that the discussion surrounding AI in education is not limited to one field but draws insights from various domains. Blue cluster represents two key items paper and context. This suggests that research areas remain broad and not yet specialized, with ongoing analysis of more general concepts.

From Figure 6, it can be seen that the dominant topics or keywords were higher education, chatgpt, teaching, generative ai, and assessment. This means that these topics in the year 2023 were the most discussed by researchers. Also, nodes or keywords that did not have a network with other keywords, have the potential to become new research topics in the future.

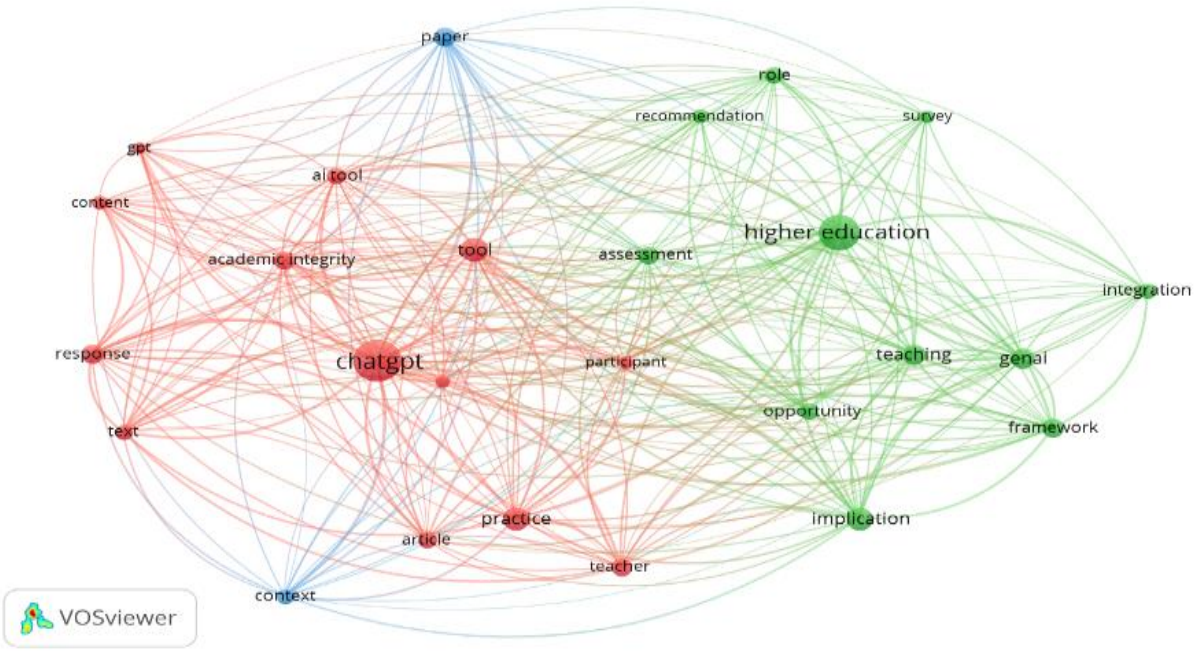

Figure 6. Network Visualization of keyword publications of Generative AI and Higher Education

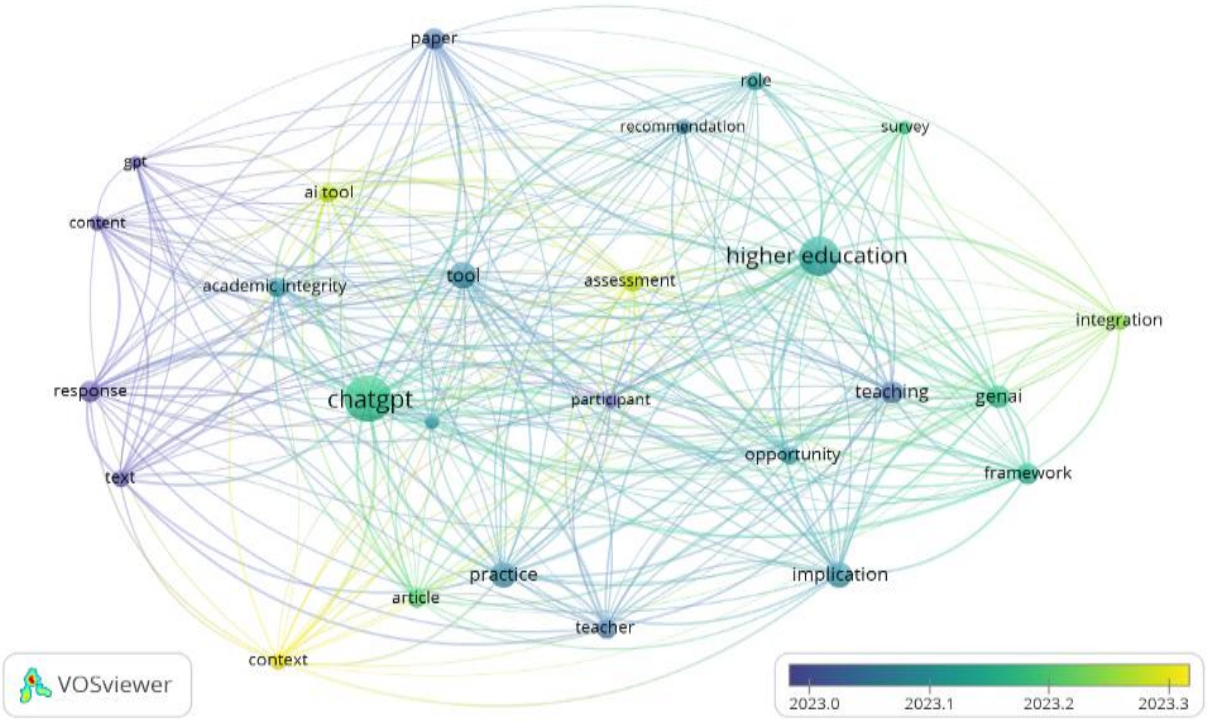

Figure 7. Overlay Visualization of keyword publications of Generative AI and Higher Education

Figure 7 shows the trends in year 2023 related to the keywords. Keywords color reflect the timeframe of the research. Focus has shifted from general themes and broader educational contexts to the practical implementation of AI tools specifically within higher education.

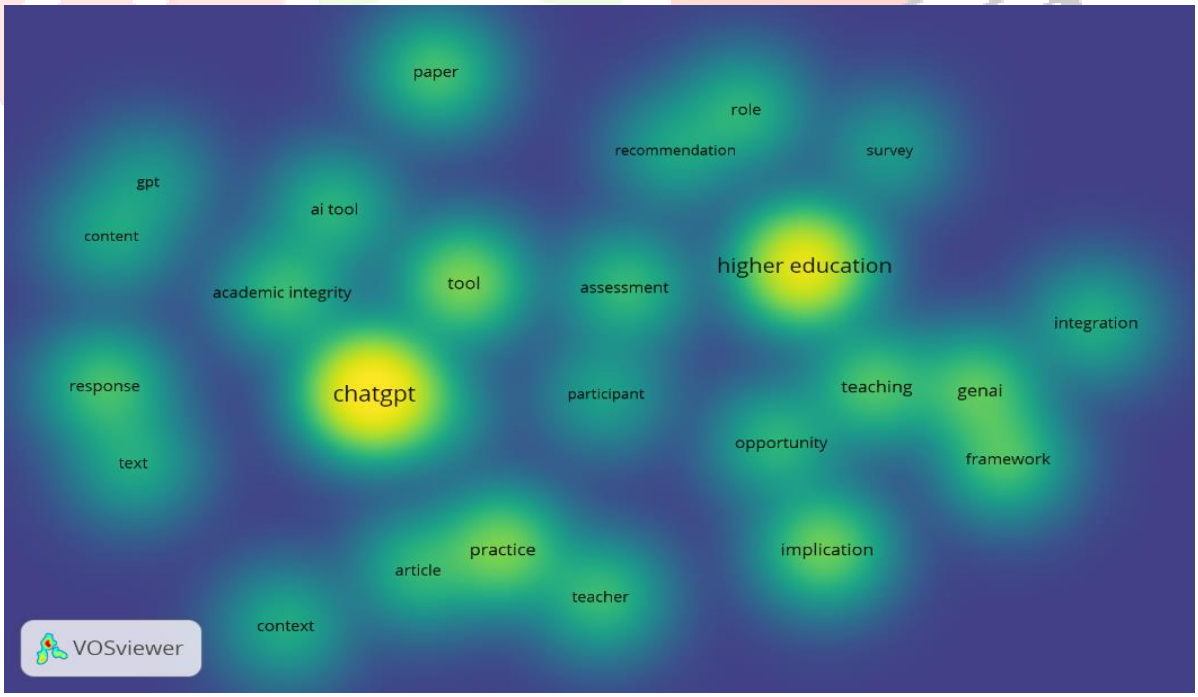

Figure 8. Density Visualization of keyword publications of Generative AI and Higher Education

Figure 8 provides a visual representation of the depth of research within the given area. The intensity of colors indicates the concentration of research activity, with brighter hues suggesting a higher level of scholarly attention. Especially, topics such as chatgpt and higher education are prominent in the scholarly literature, drawing significant interest and discussion.

Conversely, areas with lower density represent knowledge gaps, signifying topics that are less explored or underrepresented such as academic integrity, assessment, teacher, etc. Gradually, these themes are expected to gain prominence within the academic domain.

Bibliometric Analysis of the Bibliographic Coupling (By Sources)

Bibliographic coupling is used to measure the degree of similarity or relatedness between two documents based on their shared references. In Figure No. 9 clusters are shown as green, blue and red. The first source is listed as 'Journal of Applied Learning and Teaching' with eight documents , 135 citation and total link strength seven.The next source is 'Education Sciences' with three documents , total citation six with link strength eight .It is followed by 'Journal of University Teaching and Learning Practice' with three document , one citation and total link strength four .Low link strength in bibliographic coupling indicates shortage of shared references, possibly stemming from the novelty of the topic and the ongoing evolution of themes within the field.

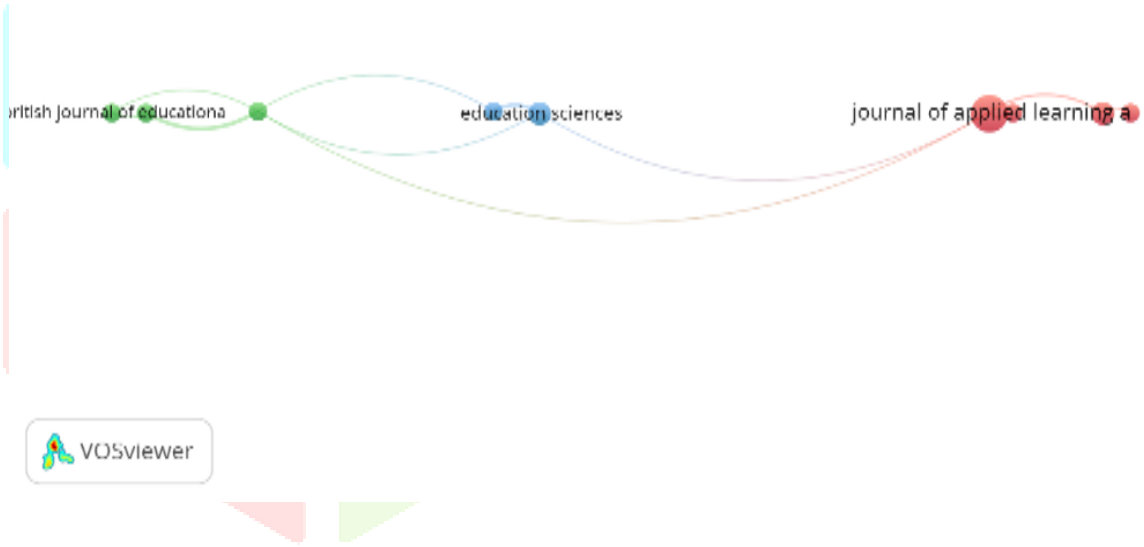

Figure 9. Bibliographic analysis for bibliographic coupling: Bibliographic coupling of sources

4 DISCUSSION AND FUTURE WORK

In the upcoming years, India's education sector is poised for a transformative shift propelled by cutting-edge technologies like AI, ML, IoT, and blockchain. Generative AI in higher education is in the early stage of development. A total of 81 papers were indexed in the Scopus database, with 79 of them written in English. Among these English-language papers, analysis was conducted pertaining to "Generative AI" and "Higher Education". Limitations are unavoidable and it is important to recognize the inherent limitations of the study. One main constraint is the reliance on a single database, which may not encompass the entirety of relevant literature on the subject. Research papers are being added to the data bases every day. Expanding the search to include additional databases could potentially uncover a broader range of documents, offering a more comprehensive understanding of the topic at hand. Future researchers can enhance the quality of their findings by broadening the scope of their database. This study paves the way for future research avenues, particularly in areas such as academic integrity and assessment. These terms,

or similar conceptual keywords, could serve as focal points for upcoming researchers. Scientific exploration remains confined to select countries (Australia, United States, Hongkong, United Kingdom and Singapore), and topics lack sufficient depth. The conceptual framework within the research domain is still evolving.

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