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UNVEILING THE RESEARCH IMPACT: A VISUALIZATION STUDY OF CHATGPT'S INFLUENCE ON THE SCIENTIFIC LANDSCAPE

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ABSTRACT

Numerous industries, including research, have undergone a radical transformation because to the creation of cutting-edge NLP models. These models are very interested in ChatGPT due of its remarkable language production capabilities, which OpenAI developed. To assess the effect of ChatGPT on the research landscape, this study performs a bibliometric analysis utilizing Citespace, VOSviewer, and Biblioshiny. The Scopus database has been thoroughly explored for relevant publications published after ChatGPT's launch. Bibliometric methods like co-citation, authorship, and keyword analysis were used to analyze the retrieved dataset. The analysis's findings reveal a startling rise in papers that mention ChatGPT, demonstrating the tool's rising stature in the scientific world. Some major research trends have been discovered by analyzing the most popular keywords for ChatGPT research. The results demonstrate the interdisciplinary nature of ChatGPT research and its incorporation into different academic subjects. The findings give academics and industry professionals a thorough picture of existing ChatGPT research, making it easier to identify areas that can benefit from more research and encouraging interdisciplinary collaboration.

Keywords: *ChatGPT, Bibliometric Analysis, Natural Language Processing, Artificial Intelligence, CiteSpace, VOSviewer, Biblioshiny.*

1. INTRODUCTION

Artificial intelligence (AI) has advanced significantly in recent years, revolutionizing various facets of our lives, including how we interact with technology. The introduction of cutting-edge language models, like ChatGPT, which have transformed conversation generation and natural language processing, is one major breakthrough in this field [1]–[3]. ChatGPT, developed by OpenAI, is a cutting-edge language model that has garnered significant attention and adoption in diverse domains, including academia and research [4]-[10]. 'Unsupervised learning' is a branch of NLP that ChatGPT employs to produce responses. For the model to discover patterns and connections between words and sentences, much text data must be used during training [11]. ChatGPT leverages its acquired knowledge to produce contextually pertinent and grammatically sound responses whenever a new prompt or inquiry is presented [11], [12]. ChatGPT has experienced the fastest user application growth in history since its release on November 30, 2022, and just two months later, in January 2023, it had 100 million active users [13], [14]. A large language model (LLM) called Generative Pretrained Transformer 3.5 (GPT-3.5) was trained using a data set of more than 400 billion words from online articles, books, and other media [15], [16]. With a subscription,

ChatGPT-3 can be made faster; a newer, more potent version, GPT-4, was introduced in March 2023 [17], [18].

To evaluate ChatGPT's relevance, identify significant application areas, and explore its potential contributions to the advancement of science, it is essential to understand its impact on the research landscape [19]. The intellectual impact of research results and their influence on the scientific community can be evaluated using bibliometric analysis, which offers a systematic and quantitative approach. This study aims to conduct a comprehensive bibliometric analysis to explore the footprint of ChatGPT in the research landscape. We searched the Scopus database for pertinent scholarly works that mention or use ChatGPT in their research, including research articles, conference proceedings, and preprints.

We can comprehensively understand ChatGPT's effect and spread throughout many academic disciplines by looking at publication trends, citation patterns, and collaboration networks. This bibliometric analysis will highlight the scientific fields in which ChatGPT has significantly contributed, allowing academics to consider prospective directions for additional study. Additionally, this study will offer important insights into the research community's collaborative networks and knowledge-sharing processes by identifying significant authors, organizations, and nations active in ChatGPT-related research.

Bibliometric analysis is a statistical method used to evaluate articles on particular topics [20]–[24]. It might assess the calibre of publications, investigate the primary research subjects, and even forecast the course of future research [25]–[28]. Its capacity for handling massive databases also makes it possible to draw conclusions from a sizable corpus [29], [30]. This research style examines a wide range of academic literature to provide insight into how research on a specific topic has evolved [31], [32]. It uncovers novel patterns and trends by utilizing several quantitative methodologies, such as co-authorship analysis, keyword distribution, citation counts, and other published data [33]–[36].

CiteSpace is a software frequently used for bibliometric analysis, which has steadily increased in prominence as it analyses literature, and produces range of statistics and metrics of evolving scientific disciplines, such as patterns, collaborations, novel advances, and emerging trends that researchers recognize as essential [37]. The software program VOSviewer was created at the Centre for Science and Technology Studies at Leiden University by Nees Jan van Eck and Ludo Waltman. Bibliometric networks can be constructed and visualized using it. These networks might be created with a variety of data, including publications, authors, journals, and keywords. The bibliometrix R-package is a freely available software that offers a collection of resources for quantitative studies on bibliometric data. It encompasses various algorithms designed for statistical analysis and scientific mapping. Additionally, this package incorporates a user-friendly web interface tool, Biblioshiny, specifically developed to assist individuals without coding expertise in conducting bibliometric analysis [38].

The research objectives for this bibliometric analysis on ChatGPT are:

- Assess Scholarly Output: Evaluate the quantity and growth of scholarly publications related to ChatGPT over time. This includes examining the number of publications, the publication outlets, and the geographical distribution of research.
- Identify Key Research Themes: Analyze the main research themes and topics within ChatGPT-related literature. Identify emerging areas of interest and assess how these themes have evolved over time.
- Authorship Analysis: Examine authorship patterns to identify prolific authors, and collaborations. Determine if there are key individuals or institutions contributing significantly to the field.
- Citation Analysis: Investigate the citation impact of ChatGPT-related research. Identify highly cited papers and assess how influential ChatGPT publications are within the broader academic community.
- Publication Outlets: Determine the most common publication outlets (journals, conferences, preprint servers) for ChatGPT-related research. Assess the impact and quality of publications in different outlets.
- Geographical Analysis: Explore the geographical distribution of research on

ChatGPT. Identify regions or countries that are active in conducting research in this domain.

Despite the growing interest in and widespread deployment of ChatGPT across a range of sectors, the academic influence and evolution of publications connected to ChatGPT have not been adequately covered in earlier research. There is a substantial gap in the literature since there haven't been any comprehensive bibliometric analyses that are just concerned with ChatGPT. This work seeks to fill this crucial gap by conducting a complete bibliometric analysis of scholarly publications related to ChatGPT.

2. REVIEW OF LITERATURE

Alec Radford et al.'s publication "Improving Language Understanding by Generative Pre-training" from 2018 [39] was the first to use the GPT architecture, which OpenAI first developed. Based on self-attentional mechanisms, the Transformer model is the deep learning architecture used. By enabling models to recognize global dependencies and contextual links in text, transformers have revolutionized natural language processing processes. Pre-training and fine-tuning are the two stages of ChatGPT. The model is trained using a sizable corpus of online content freely accessible during pre-training. Predicting the subsequent word in a sentence is the goal, which aids the model's acquisition of grammar, syntax, and semantic representations. The next phase in training the model on particular task-related data is fine-tuning. With unique datasets, such as examples of proper behavior and rankings of responses, OpenAI enhances the fundamental GPT model. With the assistance of this procedure, ChatGPT can adapt to the desired conversational style and produce more pertinent responses [39]. The foundation of GPT models, such as ChatGPT, is the Transformer architecture, first presented by Vaswani et al. in the paper "Attention is All You Need." Transformers use self-attentional mechanisms to identify dependencies among several words in a sentence or a series of sentences. This architecture enables the model to analyze information efficiently and produce logical and appropriate responses [40].

In response to the inputs, GPTs produce textual output. "Prompts" is another name for the GPT inputs. Embedding is a vector representation of a piece of data intended to maintain some of its meaning or content. Data that is related in some way tend to have embedding's closer together than unrelated data. OpenAI provides text embedding models that take a text string as input and provide an embedding vector [41]. Embedding's are helpful for various tasks, including search, clustering, recommendations, anomaly detection, and classification. Tokens are the text processing units used by the GPT and embedding models. Frequently recurring character groups are represented via tokens. One restriction to be aware of is that, for a GPT model, the total length of the generated output and the prompt cannot exceed the model's maximum context length [41].

Table 1. A summary of the key points of top ten cited articles on ChatGPT in Scopus.

3. MATERIALS AND METHODS

Due to its greater coverage of journals than other bibliographical databases, Scopus was selected as the primary source for bibliographical data collection in this study [51]. The keyword "ChatGPT" was used to retrieve these publications and exclusively scholarly journal articles and conference papers were incorporated. There were no restrictions based on language, and the articles covered many subject areas such as medicine, Social Sciences, Computer Science, Engineering, Nursing, and more. Between 2022 and 2024, 809 articles were gathered from 523 distinct sources, and two of them were in early access publication by 2024. The results were saved as "CSV" files, and bibliometric analysis was conducted on the data using CiteSpace version 6.2.R3 (Advanced), VOSviewer and Biblioshiny software. The key aspects of this investigation are summarized in Table 2.

Table 2. Essential aspects of the investigation.

4. RESULTS

4.1 Annual Scientific Production

Figure 1 depicts the connection between the quantity of publications and the years in which they were published, presented visually through Biblioshiny. ChatGPT made its debut on November 30, 2022, and garnered recognition for its comprehensive and eloquent responses across diverse fields of knowledge. Between the introduction of ChatGPT in 2022 and 2023, there

has been a gradual rise in the number of publications in this particular field.

Figure 1. Annual scientific production visualized using Biblioshiny.

4.2 Most Significant Authors

The study on ChatGPT involved a total of 809 authors who published articles on the subject. The assessment of their impact was gauged by counting the articles they had authored. Wang F-Y and Wu H emerged as the most prominent authors with 7 published articles each. They were followed closely by Kim J and Li X, who had 6 articles each to their credit, while Li H, Li Y, Liu J, Liu Y, and Seth I each had 5 articles published, demonstrating their notable contributions. Table 3 provides an overview of the publication counts for these notable authors who consistently produced five or more articles over a period of time. Their extensive experience and expertise have enabled them to establish a strong presence in their respective fields, making them highly influential. Figure 2 illustrates the authors' productivity, depicting the number of articles they have published over time.

Table 3. The authors having five or more articles

Figure 2. Authors' Production over Time

4.3 Most relevant sources and affiliations

We examined a total of 523 journal sources and gathered 809 publications. Among these, the journal CEUR Workshop Proceedings stood out as the most productive, publishing a maximum of 23 articles. Following closely were Contemporary Readings in Law and Social Justice and JMIR Medical Education, each with 10 publications. The top 10 journals that produced the highest number of research papers on ChatGPT are listed in Figure 3.

Figure 3. The top ten sources in terms of the number of publications

Figure 4 presents the main organizations that have contributed to research publications on ChatGPT. The top spot on the list is occupied by New York University Abu Dhabi, which has published a maximum of 41 papers. Close behind is Wroclaw University of Science and Technology, with 24 publications. Other notable institutions that have conducted significant research in this area include National University of Singapore, ICAHN School of Medicine at Mount Sinai, University of California, Monash University etc.

Figure 4. Most relevant affiliations in terms of the number of publications

4.4 Three Field Plot of keyword, author and source

Figure 5 presents an illustration that explores the connection between keywords (on the left), authors (in the middle), and sources (on the right) in the field of ChatGPT literature. The investigation aimed to identify the frequently used keywords in the literature by different authors and published journals. The analysis of the top keywords, authors, and sources revealed several key phrases such as "ChatGPT," "artificial intelligence," "natural language processing," and "chatbot." It was observed that most authors like Kim J, Li X, Tan S, employed these keywords and published their work in sources such as International Journal of Surgery, Journal of Applied Learning and Teaching, and the Journal of Medical Internet Research.

Figure 5. Three Field Plot (keyword (left), author (middle) and source (right) using Biblioshiny).

4.5 Co-Occurrence of Keywords and Content Analysis

One of the beneficial features of the Biblioshiny software is the study of the co-occurrence of keywords that creates term clusters depending on the strength of their associations [52]. Figure 6 illustrates a word network that has been created by analyzing the co-occurrence of keywords. This network is designed to identify meaningful connections and research themes. In the diagram, each node represents a specific keyword, and the edges between nodes represent instances where these keywords appear together. The thickness of an edge indicates how frequently the keywords co-occur, while the size of a node and its label indicate the frequency of occurrence for that particular keyword. A thicker edge signifies a stronger relationship between the keywords. Furthermore, the color of each node indicates the cluster to which the keyword belongs, suggesting its association with a specific research area. Examining the keywords and their connections makes it apparent that each cluster is linked to a distinct research domain. The figure displays two distinct clusters identified by the Biblioshiny system. The initial cluster, depicted in blue,

highlights prominent terms such as "artificial intelligence," "humans," "language," "education," "medical education," and "human experiment," among others. This cluster represents a research focus on these topics. The second cluster, shown in red, includes keywords like "chatgpt," "machine learning," "deep learning," "learning systems," "natural language processing," and "language model," among others. This cluster represents a separate research domain, specifically focusing on these topics.

Figure 6. Co-occurrence network generated using Biblioshiny

4.6 Most Frequent Words and Word Cloud of the keywords

Figure 7 provides a graphical depiction showing the main phrases frequently employed along with their corresponding frequencies. The chart highlights the ten most widely used keywords, which include “chatgpt (475),” "artificial intelligence (277)", "large language models (69)", "chatbot (52)", "generative AI (50)", " natural language processing (49)", "education (45)", "AI (41)", "machine learning (36)", and "chatbots (35)".

Figure 7. The most frequently used author keywords created using Biblioshiny

Figure 8 and Figure 9 display word clouds that depict the authors' keywords and keywords plus. These word clouds explore frequently occurring phrases in the articles under investigation, concentrating on specific areas. A word cloud is a visualization technique that transforms text input into concise terms and represents their importance based on their size in the cloud. This method establishes associations between the main keywords utilized by the authors, which are scattered among the most prominent keywords such as "artificial intelligence," "ChatGPT," "humans," "Chatbot," "machine learning," "natural language processing,”” large language models,” ”natural language processing systems” and similar terms.

Figure 8. A Visualized Word-cloud of Authors Keywords Created using Biblioshiny

Figure 9. A Visualized Word-cloud of Keywords Plus Created using Biblioshiny

4.7 Conceptual Structure Map using Multiple Correspondence Analysis

Multiple Correspondence Analysis (MCA) is employed to demonstrate the conceptual organization of the subject area, facilitating the identification of document groupings that share similar concepts. The findings are then visualized on a two-dimensional map. The conceptual structure map, created through multiple correspondence analysis, integrates pertinent keywords while considering their interconnectedness within the network. By applying multiple correspondence analysis to the Keywords field, the resulting factorial network revealed two distinct groupings (Figure 10). The clusters containing a minimum of 50 terms, specifically cluster number of 2, are used as the graphical parameters. These clusters have a label size of 10 and are based on at least five documents. One cluster encompassed keywords such as "artificial intelligence," "Chatbot," "machine learning," "academic writing," “education,” and so forth, while the other cluster included keywords like "text generation," "NLP," "generative pre trained transformer," and so on.

Figure 10. Structure map created using Biblioshiny.

4.8 Thematic Map

We have identified several research themes that can greatly enhance the interpretation of our results. These themes can be categorized and analyzed using a strategic diagram, as depicted in Figure 11. The diagram presents a thematic map based on two key dimensions: density (y-axis) and centrality (x-axis). Centrality indicates the importance of a particular theme, while density reflects its level of development.

The diagram is divided into four distinct sections. Themes located in the lower left part are considered emerging or declining. These are new themes that have the potential to either improve and become more significant or diminish in relevance within the research field. Themes in the map’s lower right section are classified as basic or transversal. Although they exhibit low density, indicating that extensive research has already been conducted on these themes, they possess high centrality, suggesting their fundamental nature and wide applicability. The upper left part of the diagram represents themes with high density but lower centrality. These themes are highly

developed but remain somewhat isolated from other research areas. The upper right part of the diagram represents high density and centrality themes. These themes, known as motor themes, are essential and highly developed, playing a central role in the research landscape. In this study, the motor themes are "plagiarism", "bias", and "challenges". The size of each theme on the thematic map corresponds to the factors associated with that particular theme.

Figure 11. Thematic Map using Biblioshiny

4.9 Country/Region distribution of published papers

An analysis of where articles are published can reveal the academic connections between countries/regions, offering new perspectives for evaluating the influence of a country or region on scholarly progress. It also allows for a broader understanding of how research is distributed across different locations in the field of ChatGPT-based studies. Figure 12 presents a visual representation of the countries/regions that have contributed significantly to research output.

It is clear from the information presented in Figure 12 and Table 4 that the United States is clearly the leading region in terms of the number of research papers published. The size of the country name in the figure is significantly larger compared to other countries, indicating its dominance. The United Kingdom follows in second place with a frequency of 78, while China closely trails with a frequency of 70. Furthermore, Table 4 provides insight into the 15 most productive countries in ChatGPT research. It reveals that both developed and developing countries, such as the United States, the United Kingdom, China, India, Germany and Australia, are actively engaged in conducting research using ChatGPT.

Figure 12. Map of countries'/regions' distribution of published papers created using CiteSpace.

Table 4. Top 15 Productive Regions/Countries

Aside from frequency, centrality is another fundamental measure of a node's ability to connect with other nodes. Nodes with high centrality, ranging from 0 to 1, act as crucial links between different groups exhibiting transition patterns. This centrality measure also highlights the main themes and trending topics within a specific network. In Table 4, France stands out with a centrality value of 0.25, indicating its significant role in facilitating connections and collaborations between researchers from various countries in the ChatGPT field.

4.10 Reference co-citation analysis

Reference co-citation is when two or more papers are cited simultaneously by one or more subsequent papers, establishing a co-citation connection between the two original papers. The strength of this co-citation relationship is determined by the number of authors citing the papers. In Figure 13, the map of cited references is depicted. The number of cited references was set at a minimum of 15. A total of 23001 citations were produced, and 17 of those citations met the requirement. The lines connecting the nodes represent the co-citation relationships. The size of each node indicates the number of co-citations it has received, with larger nodes indicating a higher number of co-citations. Among the papers listed, the paper titled "ChatGPT is fun, but not an author" by Thorp HH, published in 2023, obtained the highest ranking with 25 citations, surpassing the other papers in the network.

Figure 13. Visual representation of the co-cited reference created using VOSviewer.

4.11 Author co-citation analysis

Author co-citation analysis, unlike reference co-citation analysis, refers to the situation where two authors are cited together in the work of a third author, regardless of which specific works of the two cited authors are being referenced. The frequency of their citations determines this co-citation relationship between the two authors. A higher frequency indicates a stronger academic connection, helping to identify the key authors in a particular subject area. By examining the breakdown of cited authors based on their citations, we can not only identify the most impactful and prolific authors, but also observe changes in the attention given to core authors over time. This analysis is useful for understanding how scientific disciplines are conceptually organized. The highly significant authors that are mentioned in this context are shown in Figure 14. In this analysis, authors with at least 20 citations were taken into consideration. 354 authors have featured out of 34894, exceeding the criteria. The size of the name denotes the number of times that author has been

cited, and each circle or node represents a distinct author. This shows that Wu J is the author who is cited the most often, with a total of 143 citations. Radford A holds down the second spot on the list with a frequency of 141.

Figure 14. Map of co-cited author created using VOSviewer

4.12 Timeline view of author keywords

Numerous keywords are associated with distinct subareas, as seen in Figure 15. This subsection shows their timeline view (Figure 15) to help the reader better grasp the dynamic development pattern. All terms are grouped into distinct groups or clusters based on this perspective: radiography, artificial intelligence, language model, State of the art, assessment and more. These study disciplines had new and ongoing subjects in 2022 and 2023. The amount of research will quickly increase due to ChatGPT technology's rapid development. As a result, it is crucial to timely summarize the research findings, underscoring the importance of this paper.

Figure 15. Timeline view of author keywords created using CiteSpace

5. DISCUSSION

Based on the analysis of 809 documents found in the Scopus database search, the gradual rise in the number of publications in the particular field between the introduction of ChatGPT in 2022 suggests that ChatGPT has likely contributed to increased interest and activity in this field. The availability of ChatGPT as a comprehensive and knowledgeable language model may have encouraged researchers, experts, and enthusiasts to explore and publish more in this area. This trend indicates that ChatGPT has positively impacted the generation of knowledge and the dissemination of information within the field since its debut in November 2022.

The study on ChatGPT has identified key authors who are influential in the field based on their publication counts. Wang F-Y and Wu H are the most prominent authors, each with 7 published articles. They are followed by Kim J and Li X, who have 6 articles each. A group of authors including Li H, Li Y, Liu J, Liu Y, and Seth I have also made significant contributions with 5 articles each.

The study on ChatGPT is well-supported, with information gathered from 809 articles and 523 journal sources. CEUR Workshop Proceedings is the most productive publication out of all of them, topping the field with 23 papers. With a combined 10 publications, Contemporary Readings in Law and Social Justice and JMIR Medical Education are also notable contributors. Overall, ChatGPT's research environment is vibrant and varied, with several journals adding to the corpus of knowledge.

With a total of 41 articles, New York University Abu Dhabi holds the top position in terms of research organizations that have published on ChatGPT. With 24 publications, Wroclaw University of Science and Technology ranks second in terms of output. The National University of Singapore, ICAHN School of Medicine at Mount Sinai, University of California, and Monash University are just a few of the esteemed organizations that have made major contributions to this field of study.

The purpose of the three-field plot was to find frequently used terms among authors and journals. Key terms including "ChatGPT," "artificial intelligence," "natural language processing," and "chatbot" are commonly utilized in this industry, according to the report. The use of these terms in study is prominent in authors like Kim J, Li X, and Tan S. Additionally, their work is frequently published in periodicals including the Journal of Medical Internet Research, International Journal of Surgery, and Journal of Applied Learning and Teaching. According to the analysis, there is a significant relationship between certain authors and keywords in the ChatGPT literature. These terms serve as the foundation for research that has been published in several respected publications, suggesting a narrow area of study within this academic field.

The Biblioshiny program's ability to look at keyword co-occurrence provides insightful information about study themes and regions. The two clusters that were identified emphasize the importance of research into how artificial intelligence will impact human-related concerns as well as advancements in machine learning and natural language processing.

The primary focus of the articles under investigation is on topics related to artificial intelligence and language models. The most frequently used keyword is "chatgpt," followed by

terms like "artificial intelligence," "large language models," and "chatbot." This suggests that ChatGPT and artificial intelligence are the dominant themes in the articles. Terms like "humans," "machine learning," and "natural language processing systems" also appear, indicating that the articles not only discuss AI and language models but also their applications and interactions with humans. Overall, the articles seem to concentrate on the advancements, applications, and implications of artificial intelligence, particularly in the realm of natural language processing and chatbots like ChatGPT.

When MCA is applied to the "Keywords" field, it reveals two distinct groupings or clusters. The parameters for these clusters are that they must contain a minimum of 50 terms and be based on at least five documents. One cluster focuses on topics related to artificial intelligence, chatbots, machine learning, academic writing, and education. The other cluster is centered around text generation, natural language processing (NLP), and generative pre-trained transformers.
The study uses a strategic diagram to categorize research themes based on their level of development (density) and importance (centrality). This approach helps in understanding the landscape of the research field, identifying themes that are emerging, basic, isolated, or central to the field. The motor themes, which are both highly developed and central, are identified as "plagiarism," "bias," and "challenges," indicating their pivotal role in the research landscape.

With the most research papers published, the United States stands out as the primary contributor in the field of ChatGPT-based research. China and the United Kingdom, who are ranked second and third respectively, also make substantial contributions. While both developed and developing countries actively participate in the study landscape of ChatGPT studies, it is noteworthy that nations like Australia, Germany, and India are also notably involved. The centrality indicator provides insights into the collaborative character of research beyond just publication frequency. In this setting, France appears as a key country in the ChatGPT research network, promoting interactions and bridging partnerships between academics from other nations. This emphasizes the significance of quality, interconnection, and quality in addition to quantity.

Understanding the connections and influences between academic articles is made easier with the help of the reference co-citation map. According to the most citations, the paper by Thorp HH, "ChatGPT is fun, but not an author," looks to be the most significant in this particular network. The author co-citation analysis is very helpful for identifying major players in a subject since a greater co-citation frequency denotes a more substantial academic relationship. Additionally, it makes it possible to follow changes in the focus on key writers through time, providing insights into how a scientific discipline's conceptual structure has changed.

The analysis offers a solid foundation on ChatGPT-related research's state, further exploration is needed to understand its depth, breadth, and future trajectories better.

While the analysis provides comprehensive insights, it does not delve deep into the quality of publications or the impact factor of journals, which could give a clearer picture of the field's impact. The analysis might benefit from a more detailed breakdown of emerging themes and how they relate to broader issues in the AI and NLP fields. The research relies heavily on quantitative measures. Qualitative assessment, such as the depth and novelty of research topics, remains underexplored.

While overarching themes are identified, more granular exploration into each theme's depth and the interrelation between them could be beneficial. More insight into the quality of research, potential groundbreaking studies, or controversial topics within the field would provide a richer understanding.

6. CONCLUSION

he study titled " Unveiling the Research Impact: A Visualization Study of ChatGPT's Influence on the Scientific Landscape" sheds light on ChatGPT's influence on the research landscape and offers insightful information. The study's findings show that ChatGPT has advanced considerably among the research community. The numerous publications in recent years are proof that it has attracted a great deal of interest. This indicates how ChatGPT is becoming increasingly valued as a tool across disciplines. The paper successfully captures this uptrend, reinforcing the idea that ChatGPT is not merely a technological marvel but also an academic stimulus. The

emphasis on AI, chatbots, and language models indicates the multidisciplinary disciplines' convergence, which is exemplified by ChatGPT. The research not only recognizes the pioneers in the subject by highlighting important writers and organizations, but it also identifies prospective centers of competence and collaboration. ChatGPT's fundamental position in contemporary scholarly discourses is evidenced by the identification of cornerstone works and the broad use of their citations. The geographic study demonstrated how ChatGPT's influence was universal, spanning national boundaries to become a topic of interest for researchers throughout the world. By letting scholars from several disciplines use its features, ChatGPT has fostered multidisciplinary collaboration. By giving scholars access to abundant resources and information, it has also contributed to disseminating knowledge. It highlights its expanding acceptance, variety of uses, and collaboration and knowledge exchange possibilities. Researchers and developers must address the difficulties and maximize ChatGPT's advantages in research projects as the field expands.

While the paper provides a bird's-eye view of the ChatGPT research landscape, a deeper dive into specific research topics, methodologies, or findings might have added richness to the narrative. The study's reliance on the Scopus database might have inadvertently overlooked significant research from other databases or grey literature. Expanding the database search would ensure a more holistic capture of ChatGPT's academic impact.

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Table 1. A Summary Of The Key Points Of Top Ten Cited Articles On Chatgpt In Scopus.

Author(s)	Title	Key Points
[42]	"ChatGPT is fun, not an author"	1. ChatGPT is an artificial intelligence program that creates text based on written prompts. 2. ChatGPT has become a cultural sensation in less than two months. 3. In research and academia, generative AI programs like ChatGPT have important ramifications. 4. Concerns relate to how ChatGPT will change education and writing scientific papers. Science journals have updated their license and editorial policies to specify that text generated by ChatGPT (or any other AI tools) cannot be used in work.
[43]	"ChatGPT listed as author on research papers: many scientists disapprove"	1. ChatGPT, an AI chatbot that generates convincing sentences by mimicking the statistical patterns of language, has made its formal debut in scientific literature and has been credited as an author on at least four published papers and preprints. 2. Publishers are debating whether citing an AI tool as an author in published literature is appropriate. 3. The White House has released guidance to protect government science from political interference. 4. Federal agencies have been asked to develop policies based on the standards outlined in the guidance.
[44]	"ChatGPT: five priorities for research"	1. Conversational AI technology has the potential to revolutionize research practices and publishing. 2. Concerns exist about the text's accuracy, bias, and transparency generated by large language models (LLMs). 3. Researchers need to remain vigilant and engage in a debate about the implications of this technology. 4. Five key issues need to be addressed, including human verification, rules for accountability, investment in open-source LLMs, embracing the benefits of AI, and widening the debate.
[45]	"ChatGPT Utility in Healthcare Education, Research, and Practice: Systematic Review on the Promising Perspectives and Valid Concerns"	1.It offers a thorough analysis of ChatGPT's contributions to healthcare practise, research, and education. It emphasises ChatGPT's adaptability and prospective uses in academic teaching. 2.Concerns are raised by the possibility that ChatGPT would provide knowledge that is scientifically valid but unreliable, as well as by the possibility of fraudulent research, plagiarism, and copyright problems. Despite these reservations, the study contends that ChatGPT has the power to revolutionise how humans may be improved in the field of healthcare. 3. Review contains a variety of records, with medRxiv being specifically mentioned as a popular preprint service. 4. The document also discusses how ChatGPT might help with scientific research, particularly in the areas of personalised medicine and report generation, by finding medication targets.
[46]	"AI bot ChatGPT writes smart essays — should professors worry?"	1. ChatGPT has been fine-tuned from a more recent version of GPT-3 and is designed to interact with users.

		2. The teachers might modify and advance their instructional strategies to take advantage of ChatGPT's advantages while addressing its drawbacks. 3. Students can develop skills that go beyond the capabilities of AI by emphasizing critical thinking, reasoning, and independent thought, which promotes a more well-rounded and intellectually engaging learning experience.
[47]	"How Does ChatGPT Perform on the United States Medical Licensing Examination? The Implications of Large Language Models for Medical Education and Knowledge Assessment"	1. The tool shows promise as an innovative tool for small-group education in medicine, particularly in problem-based learning or clinical problem-solving scenarios. 2. ChatGPT's responses to questions are coherent and provide contextual justifications, similar to human learners. 3. This suggests that the model could contribute to developing an interactive learning environment that offers on-demand student support, enhancing problem-solving skills and reflective practice with external guidance.
[5]	"Generating scholarly content with ChatGPT: ethical challenges for medical publishing"	1. Using generative AI in medical publishing raises ethical concerns around copyright, attribution, plagiarism, and authorship. 2. ChatGPT, an AI chatbot, has been used to generate university essays and scholarly articles. 3. The use of AI may increase scholarly output and democratize knowledge dissemination, but it also has the potential to produce misleading or inaccurate content. 4. The Lancet Digital Health and the Lancet family are called upon to initiate rigorous exchanges around the implications of AI-generated content within scholarly publishing and create comprehensive guidance.
[48]	"ChatGPT: the future of discharge summaries?"	1. It has the potential to generate high-quality discharge summaries for patients. 2. It can ease the burden on junior doctors and improve patient safety. 3. The chatbot can quickly output a formal discharge summary based on specific information and guidance inputted by doctors. 4. The proactive adoption of this technology could reduce the risk of issues in the future and improve efficiency and quality of processes in healthcare.
[49]	"So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy	1. The article discusses the opportunities, challenges, and implications related to generative AI technologies such as ChatGPT in the context of education, business, and society. 2. The experts acknowledge ChatGPT's capabilities to enhance productivity and suggest that it is likely to offer significant gains in various industries, but also consider its limitations, disruptions to practices, threats to privacy and security, and consequences of biases, misuse, and misinformation. 3. The article identifies questions requiring further research across three thematic areas: knowledge, transparency, and ethics; digital transformation of

		organizations and societies; and teaching, learning, and scholarly research. 4. The platform has been used for software development, academic essays, and song lyrics, but the output has been criticized for inaccuracy, lack of originality, and weak logical flow.
[50]	Can artificial intelligence help for scientific writing?	1. The article discusses the potential use of ChatGPT, an AI language model, in scientific writing, specifically in the field of critical care medicine. 2. ChatGPT can assist in organizing material, generating an initial draft, and proofreading. 3. The use of AI in scientific writing raises ethical concerns, such as the risk of plagiarism and inaccuracies, and potential accessibility issues between high- and low-income countries. 4. The authors emphasize that ChatGPT should always be used in combination with the expertise and judgment of human experts and its output should be validated before it is used in clinical practice.

Table 2. Essential aspects of the investigation.

Description	**Results**
Search Query	TITLE-ABS-KEY (ChatGPT) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp"))
Main Information About Data	
Timespan	2022:2024
Sources (Journals, Books, etc)	523
Documents	809
Annual Growth Rate %	0
Document Average Age	0
Average citations per doc	2.482
References	23575
Document Contents	
Keywords Plus (ID)	2734
Author's Keywords (DE)	2041
Authors	
Authors	2825
Authors of single-authored docs	170
Authors Collaboration	
Single-authored docs	174
Co-Authors per Doc	3.83
International co-authorships %	25.09
Document Types	
Article	664
conference paper	145

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Table 3. The authors having five or more articles

Authors	Articles
Wang F-Y	7
Wu H	7
Kim J	6
Li X	6
Li H	5
Li Y	5
Liu J	5
Liu Y	5
Seth I	5

Table 4. Top 15 Productive Regions/Countries

No.	Frequency	Centrality	Country
1.	278	0.05	United States
2.	78	0.1	United Kingdom
3.	70	0.1	China
4.	51	0.12	Australia
5.	46	0.02	Germany
6.	43	0.1	India
7.	37	0.18	Italy
8.	27	0.08	United Arab Emirates
9.	26	0.03	Canada
10.	24	0.09	Turkey
11.	22	0.09	Spain
12.	21	0.05	Switzerland
13.	18	0.25	France
14.	18	0.06	Poland
15.	18	0.04	Saudi Arabia

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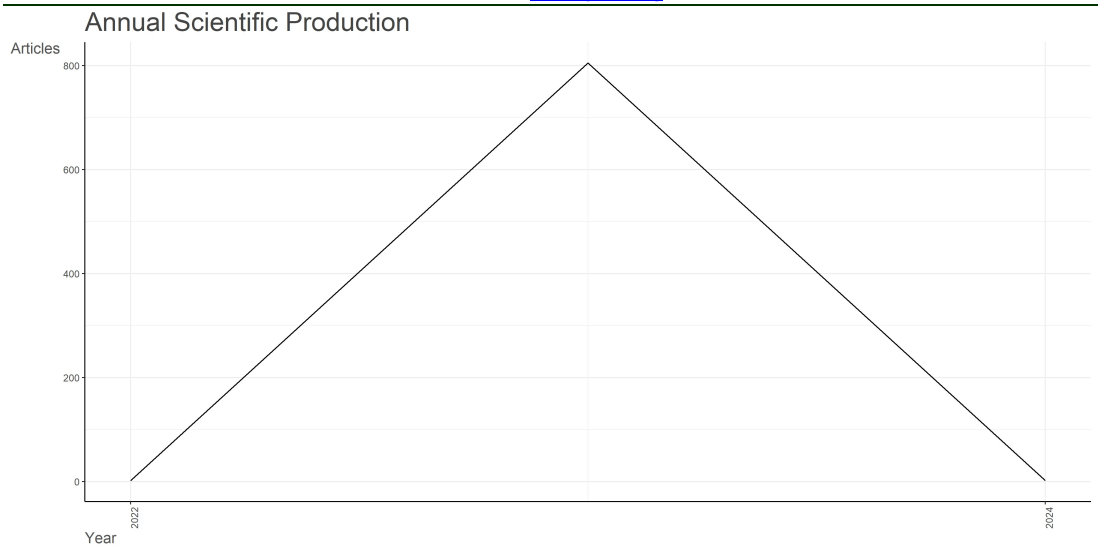

Figure 1. Annual scientific production visualized using Biblioshiny.

Figure 2. Authors' Production over Time

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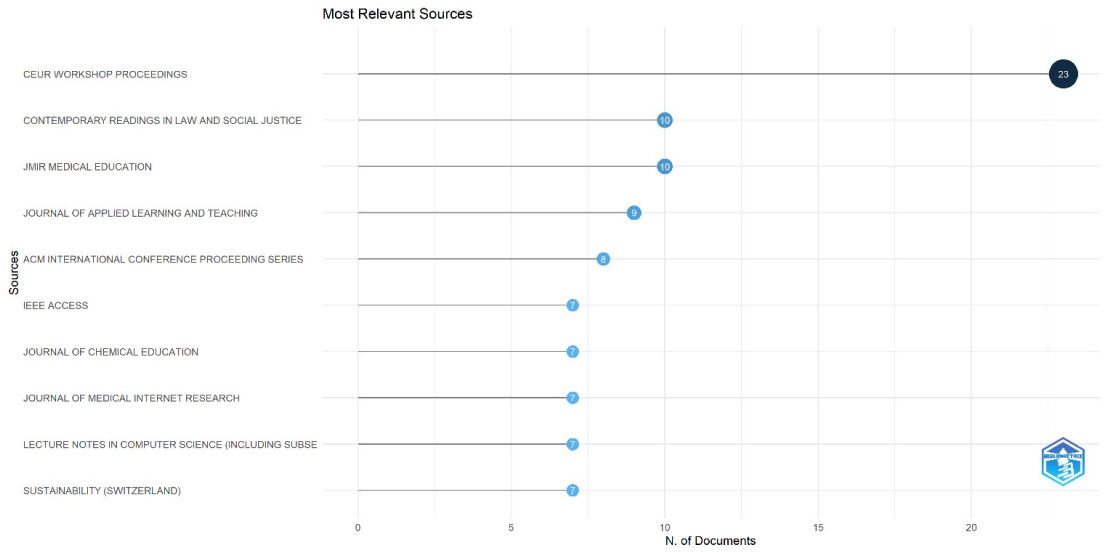

Figure 3. The Top Ten Sources In Terms Of The Number Of Publications

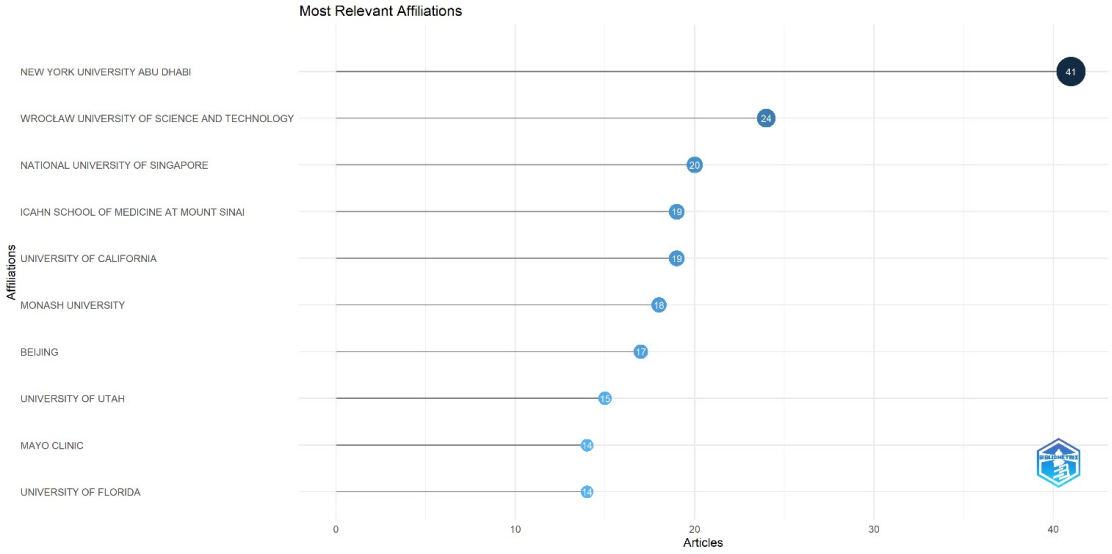

Figure 4. Most Relevant Affiliations In Terms Of The Number Of Publications

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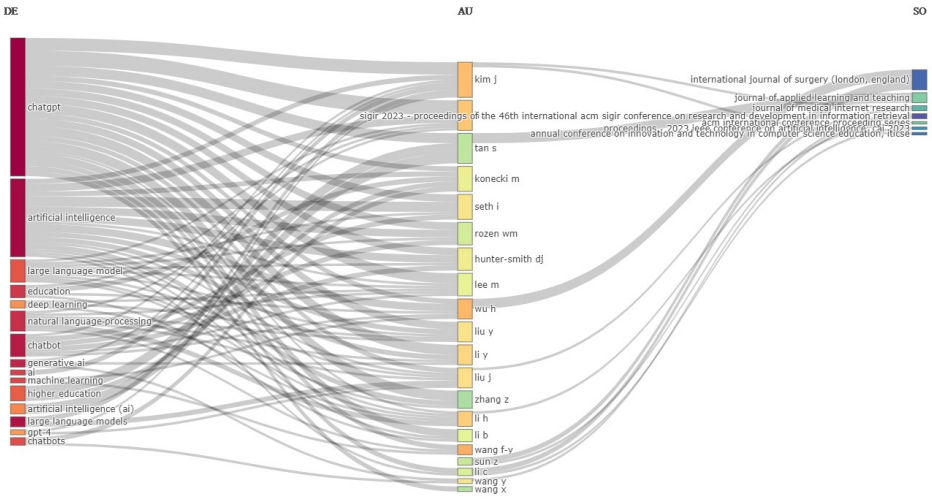

Figure 5. Three Field Plot (keyword (left), author (middle) and source (right) using Biblioshiny).

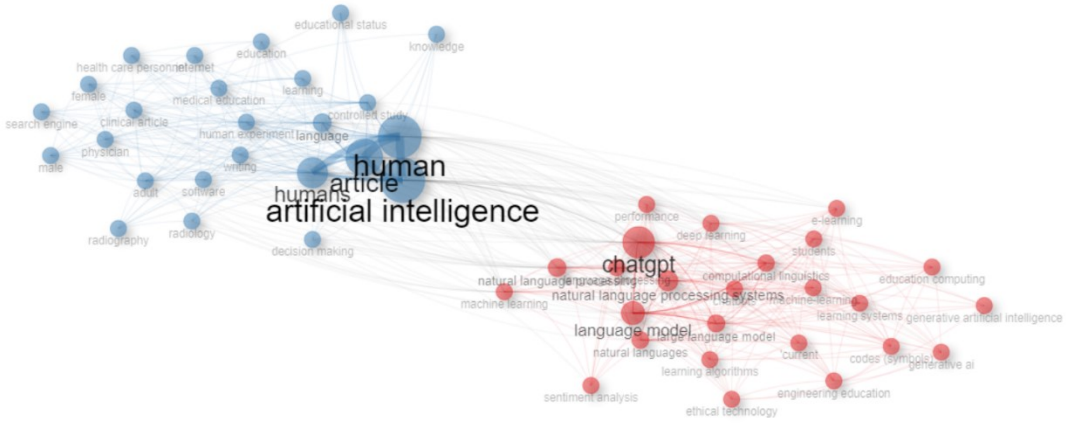

Figure 6. Co-occurrence network generated using Biblioshiny

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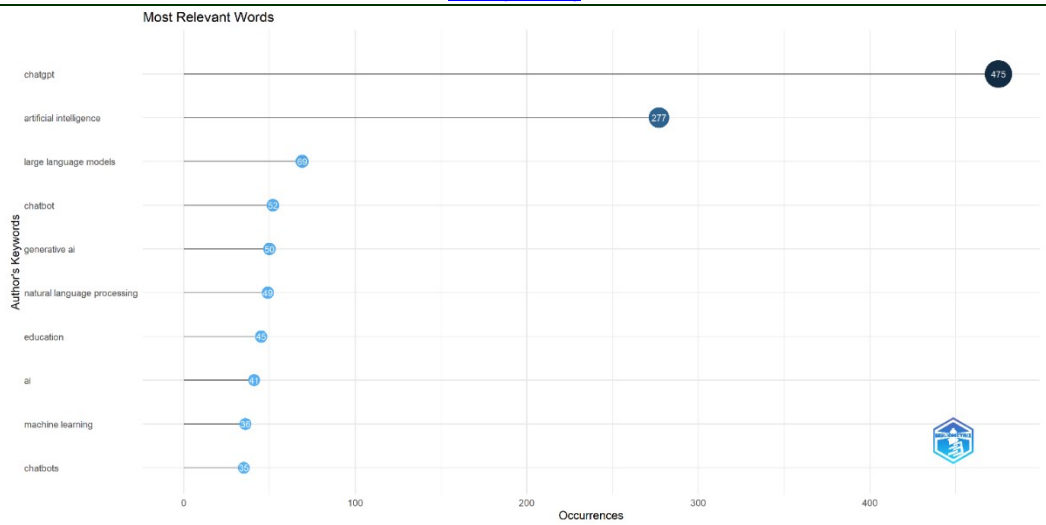

Figure 7. The most frequently used author keywords created using Biblioshiny

Figure 8. A Visualized Word-cloud of Authors Keywords Created using Biblioshiny

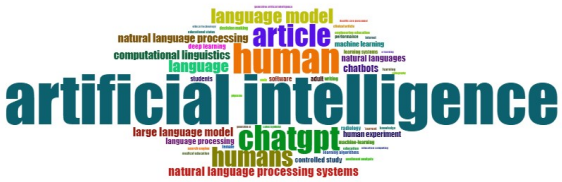

Figure 9. A Visualized Word-cloud of Keywords Plus Created using Biblioshiny

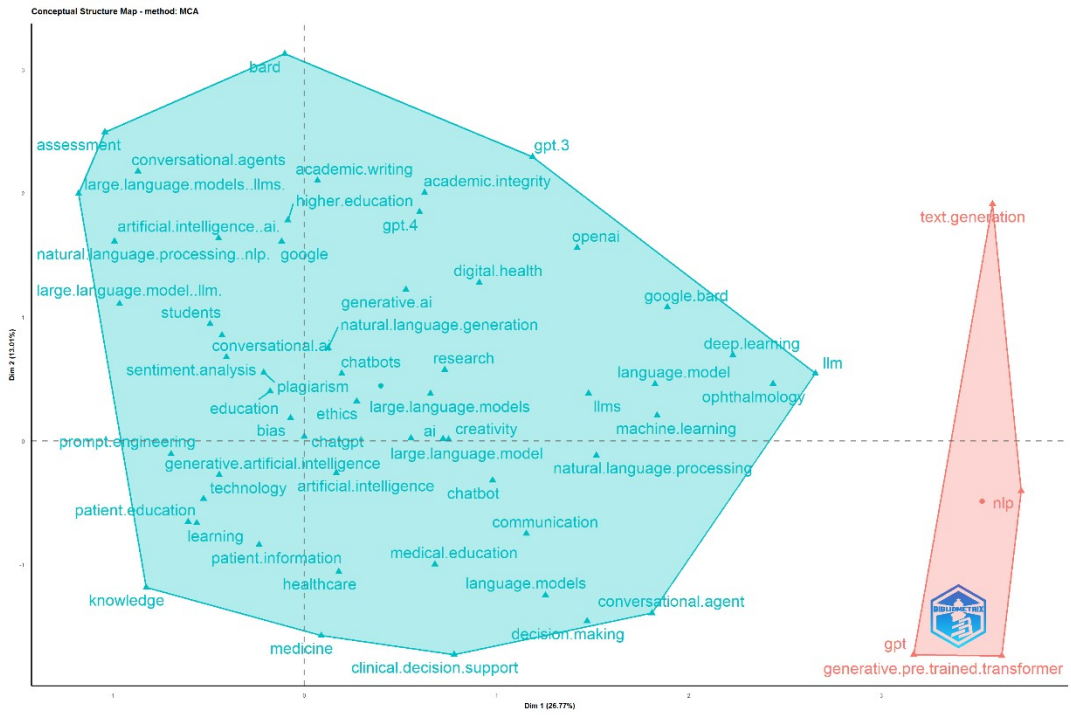

Figure 10. Structure map created using Biblioshiny.

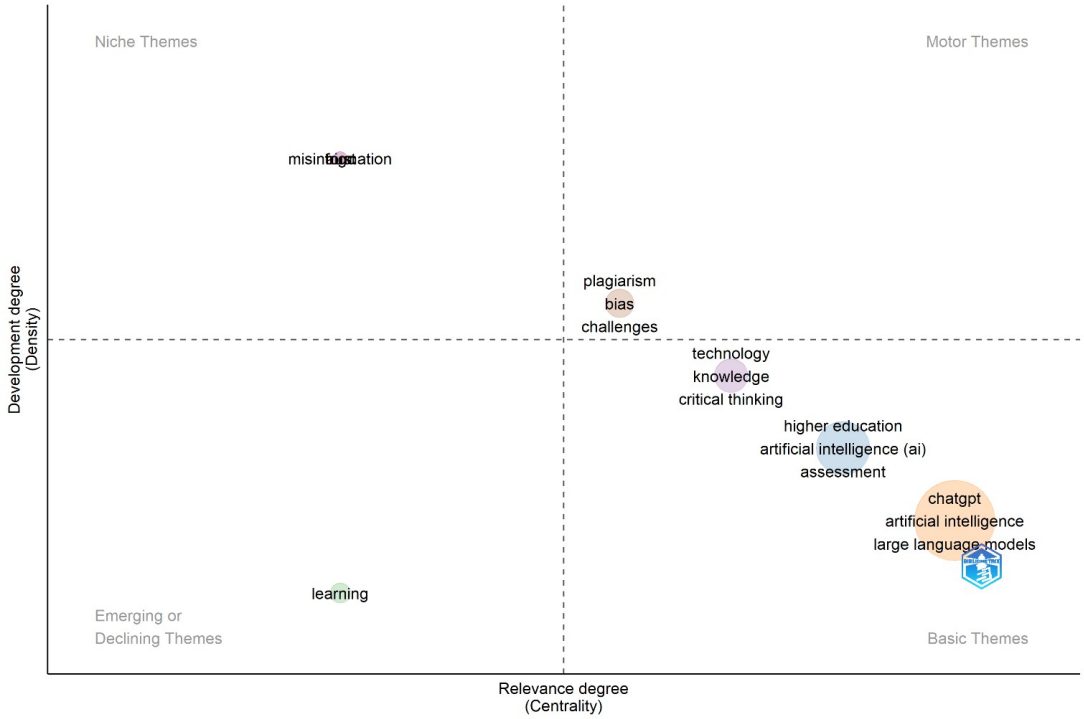

Figure 11. Thematic Map using Biblioshiny

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Figure 12. Map of countries'/regions' distribution of published papers created using CiteSpace.

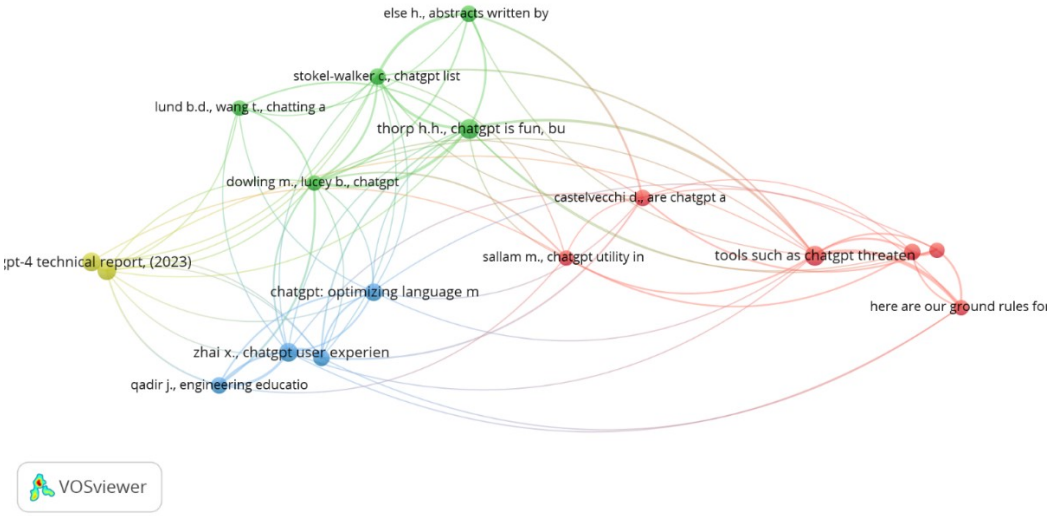

Figure 13. Visual representation of the co-cited reference created using VOSviewer.

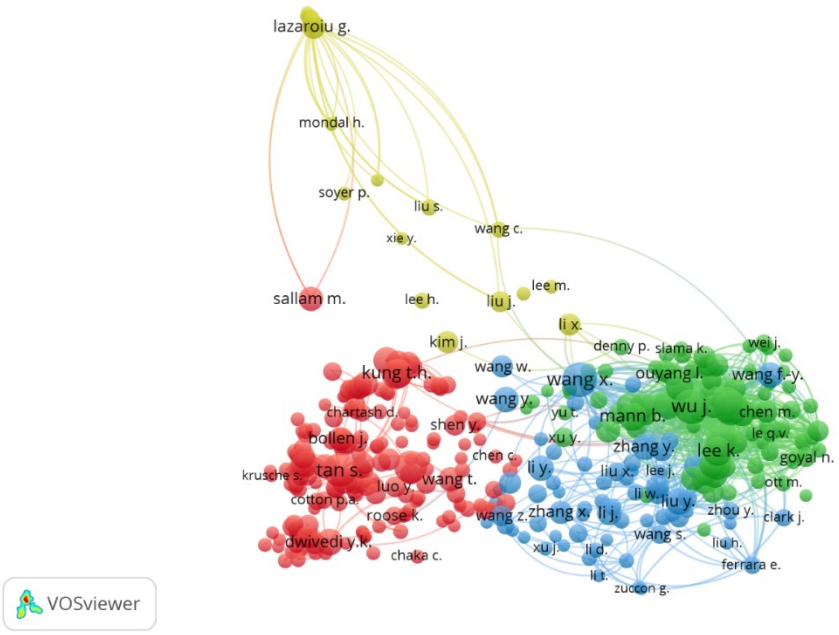

Figure 14. Map of co-cited author created using VOSviewer

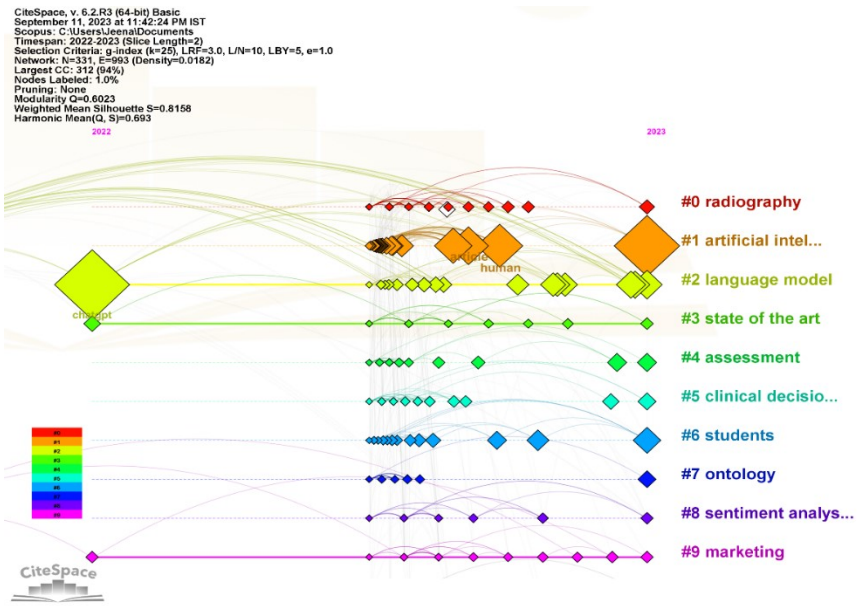

Figure 15. Timeline view of author keywords created using CiteSpace