Bibliometric Study on ChatGPT

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Article Info	Abstract
	Bibliometric studies are an important approach to understanding trends and dynamics in scientific literature. In the context of artificial intelligence (AI), ChatGPT has become an interesting research subject in recent years. This article presents a bibliometric analysis of ChatGPT from 2022 to April 2024, with a focus on publication trends, journals that published the most articles, number of citations, and keyword trends. Data were analyzed using bibliometric methods and information visualization. The main findings show fluctuations in the number of publications from year to year, with a significant increase in 2023 and 2024. Ten major journals publishing articles on ChatGPT were also identified, providing insight into the distribution of publications. Additionally, citation analysis highlights the most influential articles in the ChatGPT literature. The keyword network provides an understanding of the concepts most frequently associated with ChatGPT in the scientific literature. This research makes an important contribution to understanding developments and trends in ChatGPT research, while also identifying areas where further research can be expanded.

Introduction

In today's digital era, interactions between humans and machines have undergone dramatic changes, leading to increasingly deeper integration of artificial intelligence (AI) technologies in our daily lives. One of the most prominent breakthroughs in AI is the development of ChatGPT, a generative language model built by OpenAI. ChatGPT is designed to enable natural, intuitive communication between humans and computers, using technology that processes and responds to text in a way that mimics human interaction. Its advanced ability to produce coherent and contextual text makes it a valuable tool in a variety of sectors, including customer service, education, and health.

Previous studies suggest that ChatGPT can improve understanding in medical education and support clinical decision making, but highlight also the need to navigate ethical issues and ensure responsible and transparent use of AI (Lower et al., 2023; Breeding, 2024). Particularly in education, ChatGPT has gained attention for its ability to customize responses based on user input, supporting more personalized and interactive teaching. However, over-reliance on this technology may reduce students' critical and investigative abilities, as revealed in a study on

the impact of using ChatGPT in online mathematics learning (Sánchez-Ruiz, 2023).

Given this dynamic landscape, the importance of bibliometric studies on ChatGPT cannot be understated. Such studies are essential to describe how the scientific literature has developed around this technology and to identify trends, research gaps, and possible future directions. With bibliometric analysis, we can measure the impact and growth of research on ChatGPT, helping academics, decision makers, and practitioners to better understand how this technology has and will continue to influence various fields. This article aims to provide a comprehensive framework to assess the current literature and guide future research in exploiting the full potential of ChatGPT in academic and professional contexts.

Various studies have highlighted the significant potential of ChatGPT as a rich area for further exploration. With rapid technological advances from 2022 to April 2024, researchers and practitioners from various disciplines have additional encouragement to engage in ChatGPT-related development and research. Important questions that can be answered through bibliometric studies between 2022 and April 2024 include:

Q1: What is the trend of publishing articles about ChatGPT in 2022- April 2024?

Q2: Which journal will publish the most articles about ChatGPT in 2022- April 2024?

Q3: How many citations and articles about ChatGPT were recorded from 2022 - April 2024?

Q4: What are the keyword trends frequently used by authors in articles about ChatGPT during the period 2022- April 2024?

Literature Review

A literature review of the use of Chat Generative Pre-trained Transformer (ChatGPT) in education and health care presents a complex picture. ChatGPT as a valuable educational resource for nursing students in expanding their basic knowledge (Athilingam, 2024). However, they also highlight challenges such as inaccurate information, bias, ethical issues, plagiarism, and privacy associated with the use of this technology. ChatGPT can provide satisfactory performance in the context of medical residency exams, although it shows reduced performance in questions requiring abstract thinking and complex reasoning (Khorshidi, 2023). Although Chat-GPT has potential in diagnosing obstructive sleep apnea, there are limitations in the level of agreement with experts (Mira, 2024). Although ChatGPT offers the potential to enhance personalized learning, there are limitations that need to be considered (Sallam, 2023). In the context of medical practice, ChatGPT has great potential in simplifying medical practice, education, and research. while there are also those who show its positive impact in the learning context in elementary schools (Villan, 2023). Other research provides a broader picture of the use of ChatGPT in various educational and healthcare contexts, highlighting its benefits as well as challenges and risks that need to be carefully considered.

ChatGPT has great potential to become a disruptive technology in higher education, especially in terms of writing and language use (Teel, 2024). ChatGPT highlights impressive developments in natural language processing. The use of the latest artificial intelligence (AI) technologies, such as ChatGPT, has great potential in language learning and teaching (Alam, 2024). In addition, the quality of the information system and hedonic motivation are more

influential in increasing performance expectations and perceived satisfaction compared to self-regulation in language learning with the help of ChatGPT (Cai, 2023). A deep analysis of the evolution of ChatGPT's architecture and performance from version to version reveals its ever-increasing capabilities in tasks such as language understanding, text generation, and dialogue modeling.

Research on the use of artificial intelligence technology, especially ChatGPT, in education reveals various potentials and challenges (Islam & Mumu, 2024; Kim et al., 2024; Serhan & Welcome, 2024; Yulia et al., 2024). Analysis of the use of ChatGPT in legal language learning shows the need for teacher expertise and challenges in student participation, showing the limitations of ChatGPT in managing complex tasks such as statistical process control, which is more suitable as an initial support tool (Alam & Asmawi, 2024; Megahed et al. , 2023). Studies also discuss the positive influence of ChatGPT on Project Based Learning, but with warnings of ethical risks and misuse, and emphasize the importance of ethical evaluation in curriculum development (Villan & dos Santos, 2023; Vargas-Murillo et al., 2023).

Additionally, increased student engagement in online mathematics learning and the development of more sophisticated versions of ChatGPT for academic contexts promise to improve the integrity and accuracy of teaching and research. This highlights the importance of ethical discussions and proactive policymaking regarding AI in higher education (Sánchez-Ruiz et al., 2023; Halaweh, 2023; Teel et al., 2024; Sullivan et al., 2023). In another context, it was found that although many students understand ChatGPT, its use is rare, and there are concerns about its negative impact on critical thinking and academic investigation skills. Additional research highlights the need for strong ethics education in health professional training and suggests that ChatGPT can support but not replace human-led ethics learning (Singh et al., 2023; Rahimzadeh et al., 2023).

A number of studies discuss the potential and challenges of ChatGPT in various educational fields, such as child health education, medical education, and digital humanities, and emphasize the importance of strict regulations and guidelines in the use of generative AI (Elmaoğlu et al., 2024; Rodrigues & Rodrigues, 2023) . Finally, several studies emphasize the importance of a critical and targeted approach in the use of ChatGPT to optimize learning and address ethical, legal, and social issues arising from our interactions with this new technology in various fields, including education and scientific research (Borger et al., 2023 ; Tlili et al., 2023; Liang et al., 2023).

Research on the use of ChatGPT in education highlights significant potential as well as profound challenges. From a potential perspective, ChatGPT offers increased student engagement, adaptability to various learning contexts, and broader access to educational resources. For example, the use of ChatGPT in online mathematics learning has shown increased student participation, reflecting AI's ability to personalize and facilitate a more interactive learning process (Sánchez-Ruiz et al., 2023).

However, these studies also reveal a number of challenges that should not be ignored. One major concern is how this technology may negatively impact students' critical thinking and academic investigation skills (Singh et al., 2023). Although ChatGPT can strengthen critical thinking skills in certain contexts, such as physics learning (Bitzenbauer, 2023), excessive dependency on AI-generated answers may reduce students' tendency to explore

and question concepts in depth. This raises questions about the balance between technology use and teacher-led learning, where the teacher's role as mediator and facilitator should not be replaced by technology.

In addition, research also highlights ethical issues and misuse of technology. For example, in the context of Project Based Learning, although ChatGPT can facilitate discussion and new ideas, there are ethical risks associated with misuse of data and privacy (Villan & dos Santos, 2023). Careful ethical evaluation, as emphasized by Vargas-Murillo et al. (2023), is critical in determining the boundaries of ChatGPT use, ensuring that this technology is used in a way that supports academic integrity and fairness.

Aspects of regulation and policy making have also received special attention in the literature. The need for more stringent and proactive guidelines for the use of AI in education suggests that integrating this technology requires careful consideration of its potential long-term impact on the education system (Teel et al., 2024; Sullivan et al., 2023). This includes considering how technology can enhance or disrupt the learning process, as well as its impact on equality of access to education. From this analysis, it is clear that while ChatGPT and similar AI technologies offer revolutionary opportunities for education, they also introduce a complex set of challenges that must be managed with thoughtful and ethical strategies. Education, in receiving the benefits of this innovation, must also be alert to the potential for misuse and unexpected impacts that may arise.

Methods

This research uses a bibliographic design by applying a systematic and explicit attribution method. The literature review process follows four stages (Julia, 2020), (Kristensen, 2024), (El-Tanahi, 2024), (Bulut, 2024) namely: (1) search, (2) bibliographic screening, (3) collection complete bibliography, and (4) bibliographic analysis. For the search method, this research uses the Publish or Perish (PoP) application as a tool for searching bibliographic databases (see Figure 1).
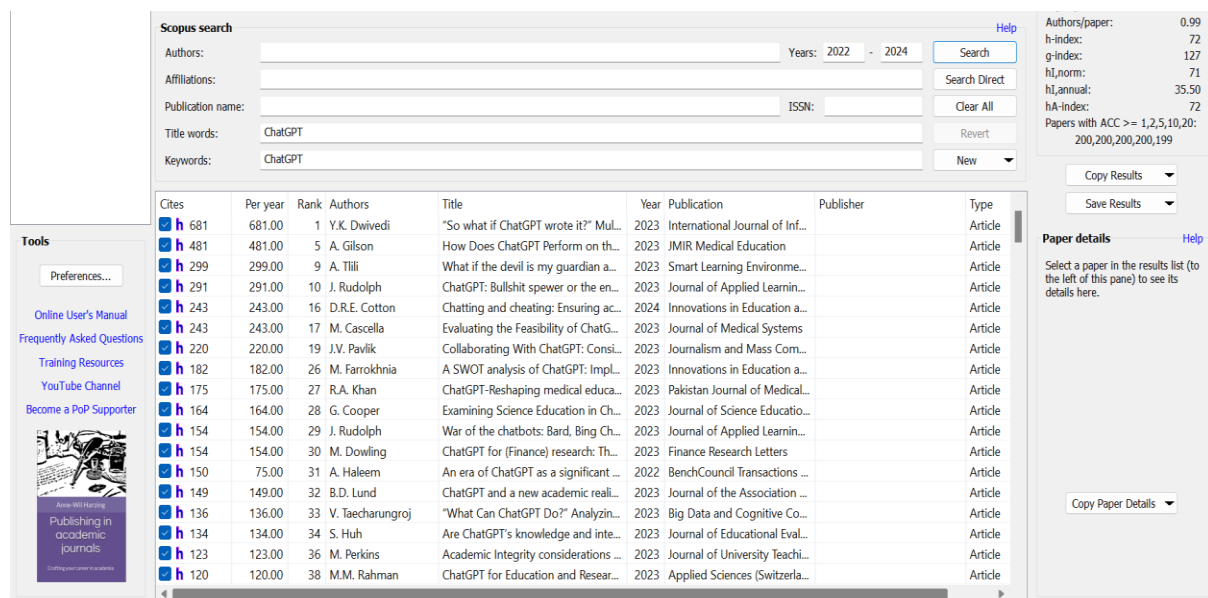

Figure 1. Bibliographic Search for PoP Applications

The use of the PoP application is integrated with Scopus as the main database source, considering its existence as one of the leading databases presenting peer-reviewed literature. Therefore, Scopus is the only database used in this research. Certain criteria were established for the selection of bibliographies to be included in the analysis, including (1) Journals with bibliographic types only, (2) Article titles containing the phrase "ChatGPT", and (3) The search year range was limited from 2022 to April 2024, because publication will only be in 2022. Bibliographic reference search results are saved in an application and exported into CSV file format, then opened using the Excel application. Files that have been saved are checked and given additional metadata.

Bibliography Selection

The selection of the bibliography was carried out using several criteria, namely (1) the context of ChatGPT; (2) use English; (3) published by a publisher that is considered established or has a good reputation in bibliographic databases. Each reference to be included or removed from the bibliographic analysis process is verified by searching it in the Scopus database taken from the PoP application. Only the article reference type is considered. Some references listed in the PoP application search process were not selected because they fell into the categories of conference articles, errata, notes, editorials, reviews, clones, or articles without an attached abstract. Initial search results using the PoP application produced a list of 404 references, which were then grouped into 101 references that met the criteria. A total of 108 other references did not meet the established criteria. Table 1 shows the total number of referrals generated over 16 months through PoP application searches.

Table 1. Bibliography Selection Results

Year	Inclusion	%	Exclusion	%	Total
2022	1	20%	4	80%	5
2023	108	54%	92	46%	200
2024 - April	133	66,5%	67	33,5%	200
Total	242		163		405

Table 1 illustrates the article publication trend over the last 28 months, showing the peak number of publications in 2024 even though it only reached April, producing 133 articles about ChatGPT, while the lowest number was recorded in 2022 with only 1 article. In 2021, no articles about ChatGPT were found in the Scopus PoP database search. The table also shows that the number of articles that do not meet the criteria (Inclusion) is higher than the number of articles that meet the criteria (Exclusion), with a total of 242 articles for inclusion and 163 articles for exclusion. From this data, it can be concluded that the comparison between the numbers of Inclusion and Exclusion has quite a significant difference.

Completeness of Bibliography

To carry out filtered bibliographic analysis, data is evaluated and refined. Evaluation includes various aspects such as article title, author's name, affiliation and country of publication, abstract, keywords, article link, publisher and year of publication. After the data has been evaluated, the bibliographic analysis can continue.

Bibliometric Analysis

Bibliographic analysis was carried out by considering four main aspects: (1) publication trends, (2) journals that published the most articles about ChatGPT, (3) articles about ChatGPT that were most frequently cited, and (4) keywords that were most commonly used in articles about ChatGPT. The process of bibliographic analysis and visualization of the results is carried out using the VOSviewer application. VOSviewer is designed to efficiently process large amounts of data and present a variety of visualizations, analyzes and observations. Additionally, VOSviewer can generate publication, author, and journal maps based on distributed co-citation platforms or channel-centric keyword maps. The files used in the VOSviewer application for analysis are EndNote bibliography files.

Results

First Question: What is the trend of publishing articles about ChatGPT in 2022- April 2024?

Figure 2 displays the trend of journal articles related to ChatGPT from 2023 to April 2024. Changes in the number of publications are visible over the period, with both increases and decreases observable. There will be an increase between 2023 and 2024. It can be concluded that the interest and popularity of research on the topic of ChatGPT reaches its peak in the 2024 period.
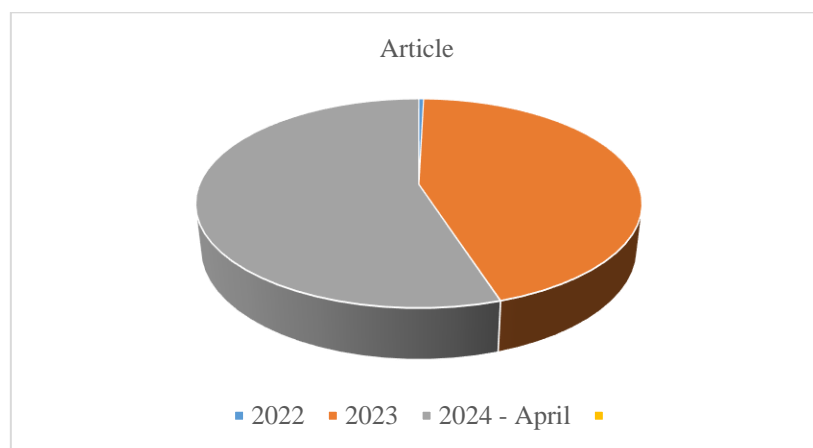
Figure 2. Publication Trends per Year

Figure 2 depicts the publication trend of journal articles focused on the ChatGPT topic from 2022 to April 2024. This diagram depicts changes in the number of articles from year to year, with a total of 242 articles. Overall, the data shows an increase in 2023, namely 44.63%, while in 2024 it reaches 54.96%.

Second Question: Which journal will publish the most articles about ChatGPT in 2022- April 2024?

Table 2 presents the top 10 journals that published the most articles about ChatGPT. Based on the data in Table 2, it can be concluded that the top ten journals have a diverse number of articles. The first top journal is European Archives of Oto-Rhino-Laryngology with 8 articles. The second top journal is the Journal of Applied Learning

and Teaching with 6 articles. Meanwhile, the journals with the fewest were Academic Radiology, Aesthetic Plastic Surgery, and American Journal of Emergency Medicine, each with only 2 articles.

Table 2. Journals that Publish the Most Articles about Mathematical Abilities

Journal	Number of Articles
European Archives Of Oto-Rhino-Laryngology	8
Journal Of Applied Learning And Teaching	6
Education And Information Technologies	5
Journal Of Medical Internet Research	5
Jmir Medical Education	4
Skeletal Radiology	3
Finance Research Letters	3
Academic Radiology	2
Aesthetic Plastic Surgery	2
American Journal Of Emergency Medicine	2
Total	40

Third Question: How many citations and articles about ChatGPT were recorded from 2022 - April 2024?

Figure 3 presents the number of citations on ChatGPT. The most citations occurred in 2023 with a total of 681 citations, and articles that did not have the lowest citations were also in 2023 which had 164 citations.
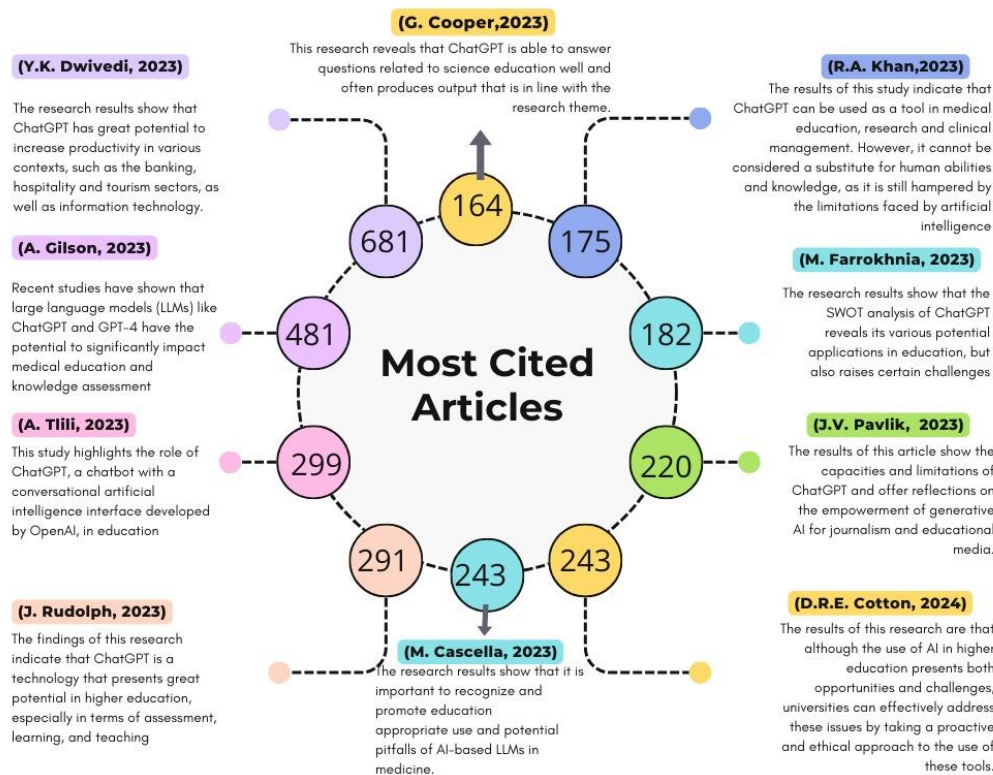

Figure 3. Most Cited Articles

Based on the data contained in Figure 3 above, it can be seen that the highest number of citations was first recorded in 2023 with 681 citations, which were related to works written by (Dwivedi, 2023). The second highest citation was recorded in 2023, which was attributed to work written by (Gilson, 2023). On the other hand, the lowest number of citations occurred for the first time in 2023, which was related to publications by (Khan, 2023) with 175 citations, and the second lowest number of citations was related to publications by (Cooper, 2023) with 164 citations.

Question Four: What are the keyword trends frequently used by authors in articles about ChatGPT during the period 2022- April 2024?

Figure 4 is a word network from a bibliometric analysis using the VOSviewer application that focuses on "ChatGPT" and various related concepts in contexts such as education, artificial intelligence, and technology.

Figure 4. Keyword Network Visualization

In this network, "ChatGPT" is at the center and associated with terms such as "education," "artificial intelligence," "risk," and "challenge," indicating the importance of ChatGPT in studies regarding its impact in education and AI as well as the potential risks and challenges it poses. There is. Terms such as "higher education," "generative AI," and "large language model" have close associations with ChatGPT, indicating their strong relevance in current research. There are also mentions of broader contexts such as "healthcare" and "cybersecurity," indicating that ChatGPT is also being considered in broader applications. The mention of "Google Bard" indicates that this analysis may also include a comparison or evaluation of similar technologies. Based on this picture, recommendations that may be useful are to dig deeper into research regarding the use of AI such as ChatGPT in

higher education to improve learning outcomes and academic integrity, integrate AI technology into the curriculum, conduct in-depth security studies considering the associated risks, and look at the potential for collaboration across disciplines in sectors such as health and cyber security to optimize the use of this technology. This visualization provides a rich view of how ChatGPT and related concepts are explored in the literature, which can help guide future research and educational initiatives.

Discussion

The data presented shows significant dynamics in research related to ChatGPT from 2022 to April 2024. Based on the journal article trends shown in Figure 2, there is a fluctuation in the number of publications with a marked increase in 2024. This phenomenon reflects the increasing interest and popularity that substantial impact on the topic of ChatGPT among academics and practitioners, in line with the acceleration of AI adoption that drives innovation across sectors (Dwivedi, 2023). This analysis is important because it illustrates the level of adoption and interest in AI, especially ChatGPT, which is influencing the way research institutions and universities apply this new technology in curriculum and research.

In the last 28 months, research on ChatGPT in educational contexts has begun to gain significant momentum. Although new research begins in 2022 and is published in journals indexed by Scopus, there is a marked increase in the number of publications until 2024, although with some declines (Scopus, 2024). The total number of articles published reached 242, with the largest increase occurring in 2024, with 133 articles. This shows that although ChatGPT has not yet become fully accepted in educational practice, interest in its application continues to grow. This paragraph underscores the importance of understanding trends in publications to assess how quickly technologies such as ChatGPT are being accepted and integrated into different disciplines.

Analysis of the distribution of publications across journals, as presented in Table 2, shows that journals with a focus on oto-rhino-laryngology have the highest number of publications, indicating the specific utility of ChatGPT in this medical field (European Archives of Oto-Rhino-Laryngology, 2023). Journals with a focus on applied learning and teaching and educational information technology also show strong adoption, which is consistent with the use of ChatGPT in education to support innovative teaching and learning processes (Journal of Applied Learning and Teaching, 2023). Journal selection and focus reveal how and where ChatGPT is considered most impactful, revealing the potential for collaboration between AI technology and specific fields such as medicine and education.

From the citation perspective depicted in Figure 3, the high number of citations in 2023 confirms the important impact of research conducted in that year, indicating widespread recognition and validity of that research in the scientific community (Gilson, 2023). Low-citation articles indicate that some aspects or applications of ChatGPT have not yet been fully explored or accepted in academic and professional practice (Khan, 2023; Cooper, 2023). The number of citations is an important indicator of the influence and importance of a study, showing how much the work contributes to existing knowledge and how much impact it has on other research.

Figure 4 provides powerful visual insight into the relationship of keywords and themes in ChatGPT research. From this visualization, it can be seen that ChatGPT is not only closely related to education and AI, but also to the risks and challenges that may arise from its use. Mentions of 'higher education', 'generative AI', and 'large language models' indicate a strong connection to current trends in academic research, while broader contexts such as 'healthcare' and 'cybersecurity' indicate ChatGPT's broad applications (VOSviewer, 2024). The mention of 'Google Bard' suggests that comparisons between similar technologies are also an important focus in research. Keyword analysis helps identify key focus areas in research as well as illustrate how ChatGPT is connected to major topics and current trends in scientific disciplines and their applications in industry.

From this analysis, several recommendations can be made for future research, including increasing focus on the integration of ChatGPT in educational curricula to maximize learning potential, exploring collaboration across disciplines to optimize the use of ChatGPT in broader contexts, and conducting more in-depth security studies to address the risks associated with the use of generative AI in sensitive contexts. This analysis underscores the importance of an interdisciplinary and collaborative approach in advancing the understanding and utilization of ChatGPT, ensuring that innovation is balanced with a deep understanding of its ethical, social, and technological implications (Strzelecki, 2023). These recommendations emphasize the importance of a comprehensive approach to research, combining technical, pedagogical, and ethical expertise to fully exploit the potential of generative technologies such as ChatGPT in diverse contexts.

Conclusion

In order to answer the questions asked, an overview can be seen of the trends and dynamics of research related to ChatGPT from 2022 to April 2024. First, the trend of publication of articles about ChatGPT shows significant fluctuations during this period, with a consistent increase towards the year 2024, indicating that interest in ChatGPT as a research subject continues to grow over time. This shows that artificial intelligence technology and its applications in various fields continue to be a topic of interest for the scientific community.

Second, regarding the journals that publish the most articles about ChatGPT, the analysis shows that journals with a focus on artificial intelligence, educational technology, and medical applications tend to publish the largest number of articles. Journals such as the 'Journal of Applied Learning and Teaching' and the 'European Archives of Oto-Rhino-Laryngology' are some prominent examples, illustrating the diversity of ChatGPT applications from education to medicine.

Third, in terms of citations, the total citations recorded from articles about ChatGPT published between 2022 and April 2024 reached a significant figure, reflecting the impact and relevance of this research in the academic community. The total number of articles published during this period also reflects a high volume of research, demonstrating how important this technology is in current academic discourse.

Fourth, keyword trends frequently used by authors in articles about ChatGPT during this period include terms such as 'education', 'artificial intelligence', 'generative AI', and 'large language models'. These terms not only

reflect the main focus in ChatGPT research, but also underscore the broad implications and applications of this technology in various sectors. Keywords such as 'risk' and 'challenge' also appear frequently, indicating a growing awareness of the challenges and ethical concerns that accompany the adoption of AI.

Overall, this analysis provides in-depth insight into recent developments in ChatGPT research, shows how this technology has the potential to change many aspects of life and work, and highlights the importance of a reflective and informed approach in its research and application.

Limitations and Recommendations

The limitations of this study are mainly related to two main factors. First, reliance on a single application for bibliometric analysis is a limitation because the variety of methods and approaches that can be used is limited. In future research, it is recommended to explore other applications or methods that can provide broader and detailed insights into trends and patterns in the ChatGPT-related literature. Second, limitations also exist in the bibliographic data source which only uses the Scopus database. The use of data sources limited to one platform may limit the scope of the literature explored in this study. Therefore, to improve the comprehensiveness of bibliometric mapping, future research is expected to consider utilizing different bibliographic databases, such as Web of Science, PubMed, or Google Scholar. In this way, understanding of trends and developments in ChatGPT-related literature can be broadened and deepened.

Suggestions for research in this area are to continue expanding the scope and depth of research by incorporating other applications or methods that can enrich understanding of ChatGPT. One approach that can be used is to utilize various additional bibliographic databases to expand bibliometric mapping in the context of ChatGPT research. In this way, research can gain a more comprehensive picture of trends, patterns, and developments in the ChatGPT-related literature.

Research could also broaden its focus to cover certain aspects of ChatGPT that have not been widely explored. For example, further research could explore the ethical, social, or cultural implications of using ChatGPT in various contexts, or integrate comparative analysis with other AI technologies to understand the comparison of strengths and weaknesses. Meanwhile, it is also important to adopt an interdisciplinary approach in ChatGPT research, involving experts from various disciplines such as education, computer science, psychology and languages. Collaboration across disciplines can bring new insights and diverse perspectives, which can enrich understanding of the implications and potential applications of ChatGPT. To increase the effectiveness of the learning process, research can also consider the development and implementation of ChatGPT in various educational contexts, from elementary to advanced levels. The use of ChatGPT as a tool in learning can be studied further to understand its impact on learning effectiveness, student-teacher interaction, and the development of cognitive skills.

Finally, in directing future research, it is important to remain mindful of and address the challenges that arise with the development and implementation of ChatGPT. This includes, but is not limited to, ethical issues such as data

privacy and security, algorithm bias, and the social impact of the use of AI technology in society. With a holistic and collaborative approach, research on ChatGPT can continue to develop as an innovative solution to increase learning effectiveness and enrich educational experiences.

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