Evaluating the Functionality and Integration of AI Tools in VOSviewer for Enhancing Research Outcomes

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Abstract

Researchers employ several strategies to improve their studies, especially since most resources, including data visualization and analysis tools, are already made public. VOSViewer, a prominent data visualization and network analysis tool, is important for massive datasets and complex research. It shows trends and links in co-citation, co-authorship, word co-occurrence networks and more. This study evaluates VOSviewer's role in research outcome together with AI language model ChatGPT evaluating its capabilities and effectivity in improving research outcome. This paper presents a pragmatic method for integrating these with human and implementable steps to leverage their combined effectiveness for possibly better research outcomes.

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1. Introduction

Data visualization tools and artificial intelligence (AI) have become essential for research, providing robust techniques for examining intricate datasets and aiding multiple phases of academic research. The amalgamation of these technologies has become a prominent focus, proficiently tackling issues in big data analytics. This includes visualization approaches across all phases of research, encompassing data pretreatment, model evaluation, and result interpretation (Xia & Wei, 2024) and more.

Recent research highlights the growing importance of diverse methods and tools in scholarly analysis. Due to the difficulties associated with manually exploring and assessing extensive datasets, tools such as VOSviewer are indispensable. VOSviewer has emerged as a key tool for data visualization and network analysis, capable of handling large datasets and providing excellent network mapping for bibliometric analysis (Bukar et al., 2023; Park & Stek, 2022). It successfully analyzes co-occurrences of word, co-citation and co-authorship in various fields, including AI and ChatGPT research (Lim et al., 2024; Mardiani & Iswahyudi, 2023; Afjal, 2023). Because it possesses advanced visualization capabilities, it is able convert intricate data into comprehensible pictures, hence improving research quality (Van Eck & Waltman, 2009; McAllister et al., 2021).

On another note, AI-driven systems may effectively examine extensive datasets, expediting literature reviews and knowledge acquisition (Jhajj et al., 2024) making it equally valuable when used properly with

certain tools and phases of research. AI technologies improve data visualization through real-time analysis, predictive functionalities, and customized tools (Devineni, 2024)

An exemplary instance is ChatGPT, among other AI methodologies, which possess the ability to enhance data processing and interpretation (Torres-Salinas et al., 2024). Its large-scale language model, has garnered significant attention in academic research, with studies exploring its impact on translation, coding, academic writing (Tian et al., 2023), data analysis and interpretation, knwledge discovery and more (Aithal et al., 2023). Large language model (LLM) tools like this are being used in various industries making it necessary for scrutiny (Palmer et al., 2024).

The transformative role of these tools have provided researchers improved ways to do their studies and continiuously shows promise in enhancing research outcomes and addressing the challenges of analyzing complex datasets (Afjal, 2023; Bukar et al., 2023). This combination may also improve data handling, visualization, and understanding across study fields. Technical communicators must adapt to new user bases and learning needs produced by open-source software development because this community lacks support given that it prioritizes software development (Swarts, 2019). Hence, it is crucial to evaluate these tools to improve research outcomes and determine using them together is helpful.

2. Literature Review

The Role of Research Tools & AI in Research Outcomes

These technologies assist scholars in examining literature, composing papers, identifying pertinent journals, and enhancing their impact (Ebrahim, 2010). Comprehending the growth of knowledge, intellectual frameworks, and research trends necessitates bibliometric analysis and visualization (Pradhan, 2017). This tool assists in analyzing and interpreting vast quantities of academic data (Solomon, 2015). Bibliometric analysis software choices include general performance analysis, science mapping, and libraries. The widely used software Bibliomtrix, VOSViewer, and SciMAT are capable of pre-processing, analyzing, and visualizing data (Moral-Munoz et al., 2020). These instruments encompass social network analysis, geographical analysis, theme analysis, and bibliographic coupling analysis (Alhuay-Quispe et al., 2022). These tactics improve users' knowledge of bibliometric data network structure and relationships. Publications using VOSViewer, a popular bibliometric mapping and visualization tool, have increased significantly since 2020 in academic research (Patty et al., 2024). Its strength is creating meaningful bibliometric maps for extended visualization, making it useful for representing complex data in an intelligible fashion (Van Eck & Waltman, 2009). With co-citation networks connecting cited papers, co-authorship networks showing research collaboration and domain leadership, and word co-occurrence networks revealing literary themes and patterns, study analysis is easier (Yan & Ding, 2012).

Artificial intelligence in research tools is also changing academia. Some new academic tools and databses such as WikiGenDex and Dimensions.ai to analyze millions of researcher profiles to identify demographic trends and gender parity in science (González-Salmón et al., 2024). Some AI research assistant tools including Elicit and Scite help researchers with information extraction and citation context. Since 2018, various studies have focused on AI (Bhagat et al., 2022). World-renowned ChatGPT and VOSviewer enhance research and bibliometric analysis. ChatGPT generates new ideas, condenses long sentences, and more. (Rahman et al., 2023). The integration of these parts has not been fully studied.

Description of Study

This study intends to (1) determine if VOSViewer improves research outcomes and (2) illustrate ChatGPT's capabilities when used with VOSViewer. We used Web of Science data retrieved using ChatGPT prompts to test these tools' research-improvement capabilities. After extraction, we uploaded this data to VOSViewer for network analysis. After findings were released, ChatGPT helped us evaluate them again.

Testing Methods

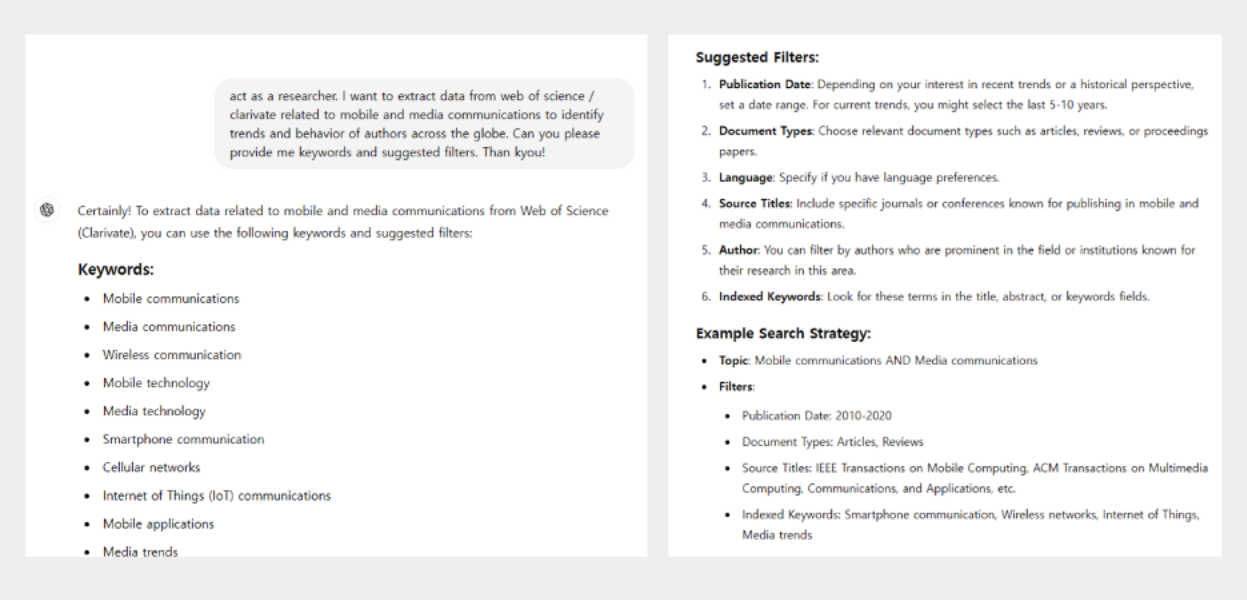

Figure 1: Example of a prompt it in ChatGPT to request suggested keywords for data collection in Web of Science platforms

As seen in Figure 1, ChatGPT guided our data collection from Web of Science, streamlining our efforts and letting us extract a desired data. It has also helped develop ideas and techniques that we may reconsider or better with our own.

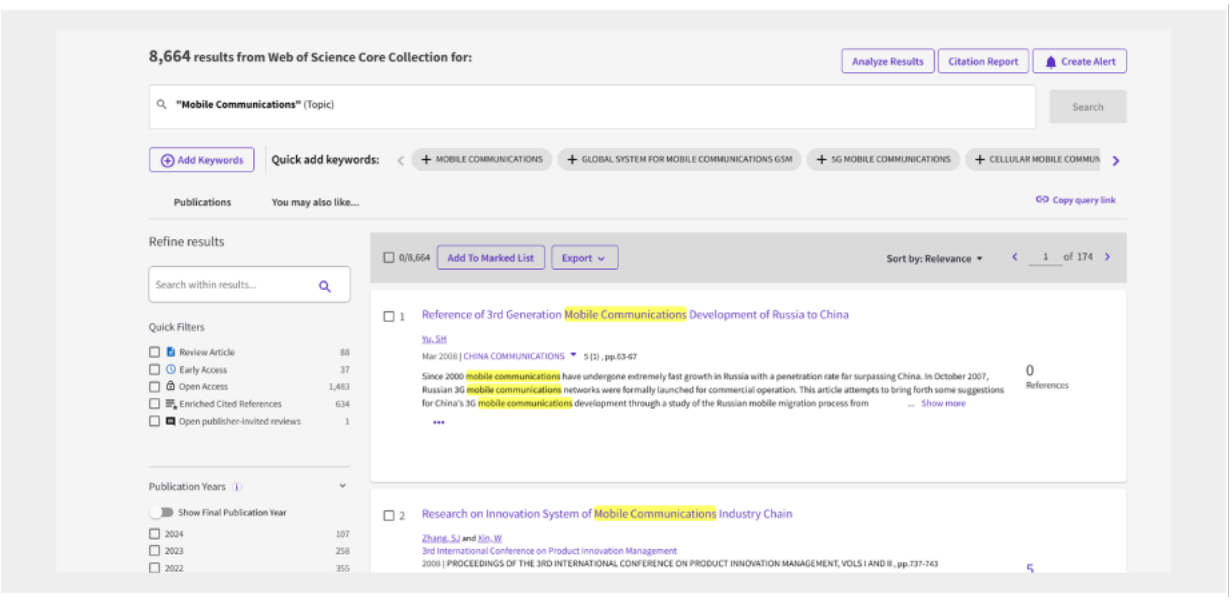

Figure 2: Example of data collection results using keywords suggested by ChatGPT

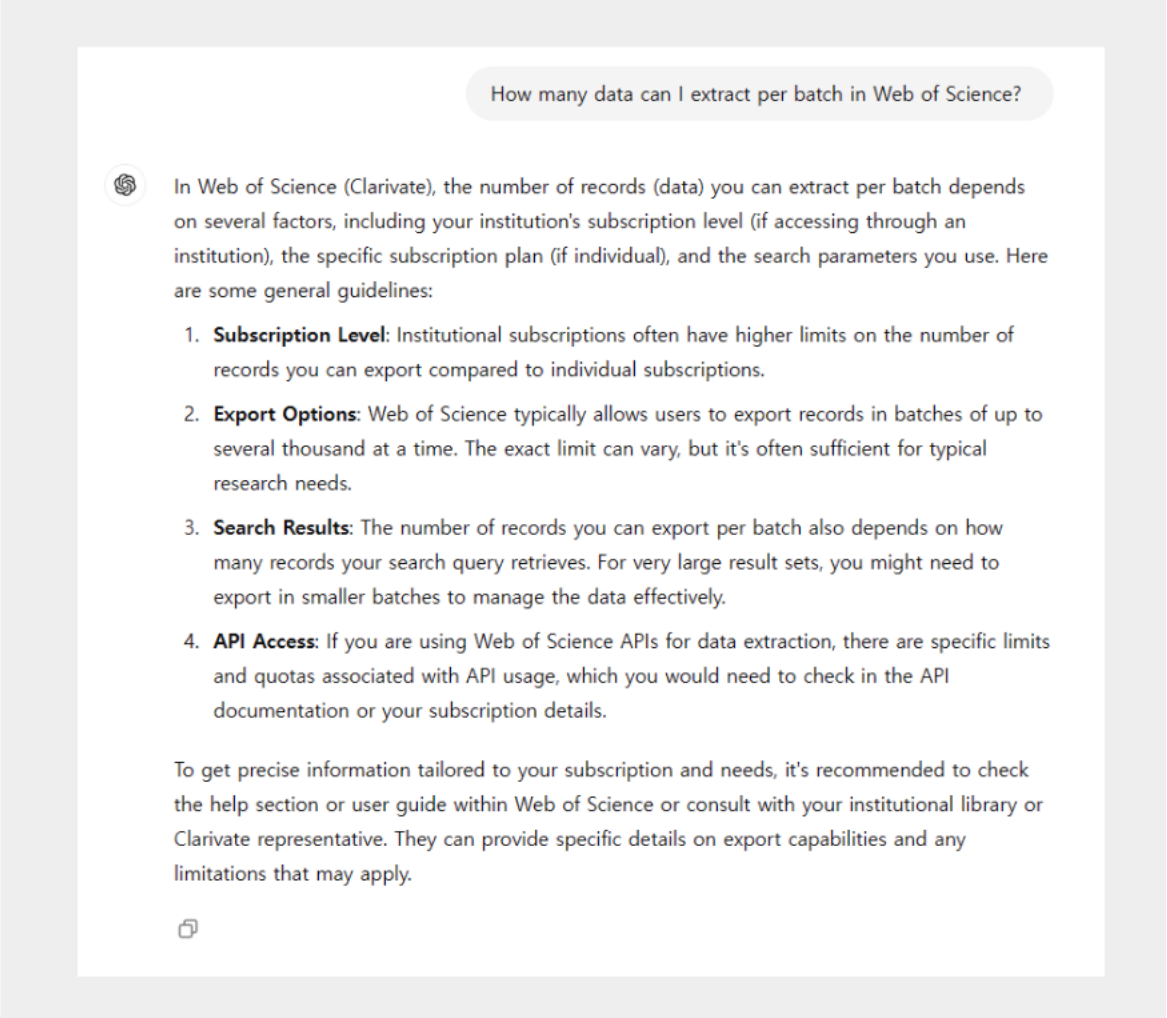

Figure 3: Example of ChatGPT Response from a bottleneck that researcher encountered during data collection stage

VOSviewer offers even more benefits, when combined with ChatGPT as it improves researchers' speed and efficiency, addressing a major issue throughout research. As seen in Figures 2 and 3, ChatGPT helped filter data gathering by suggesting keywords and extraction parameters that would have taken longer to find.

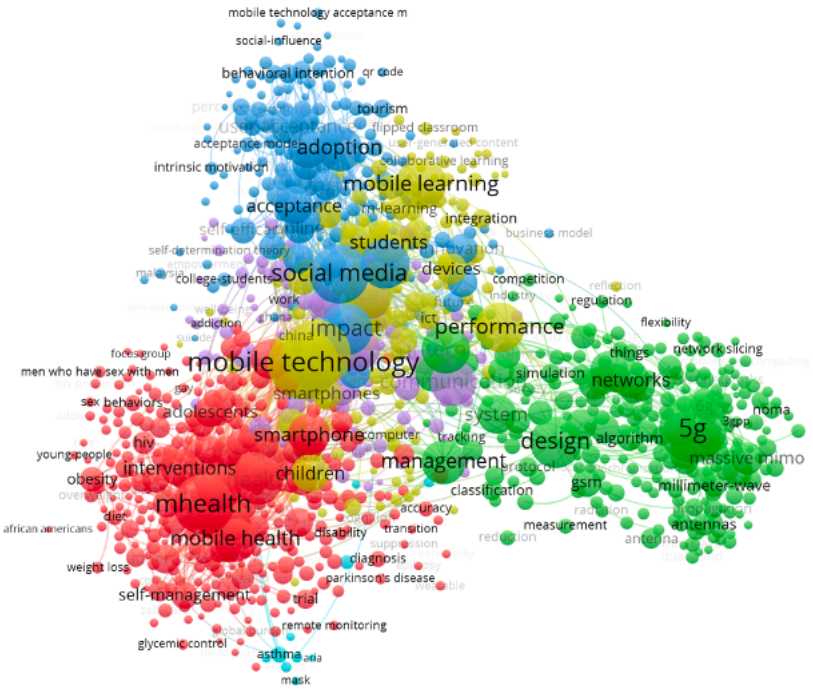

Figure 4: VOSviewer-based network visualization using the data collected following the guidance from ChatGPT

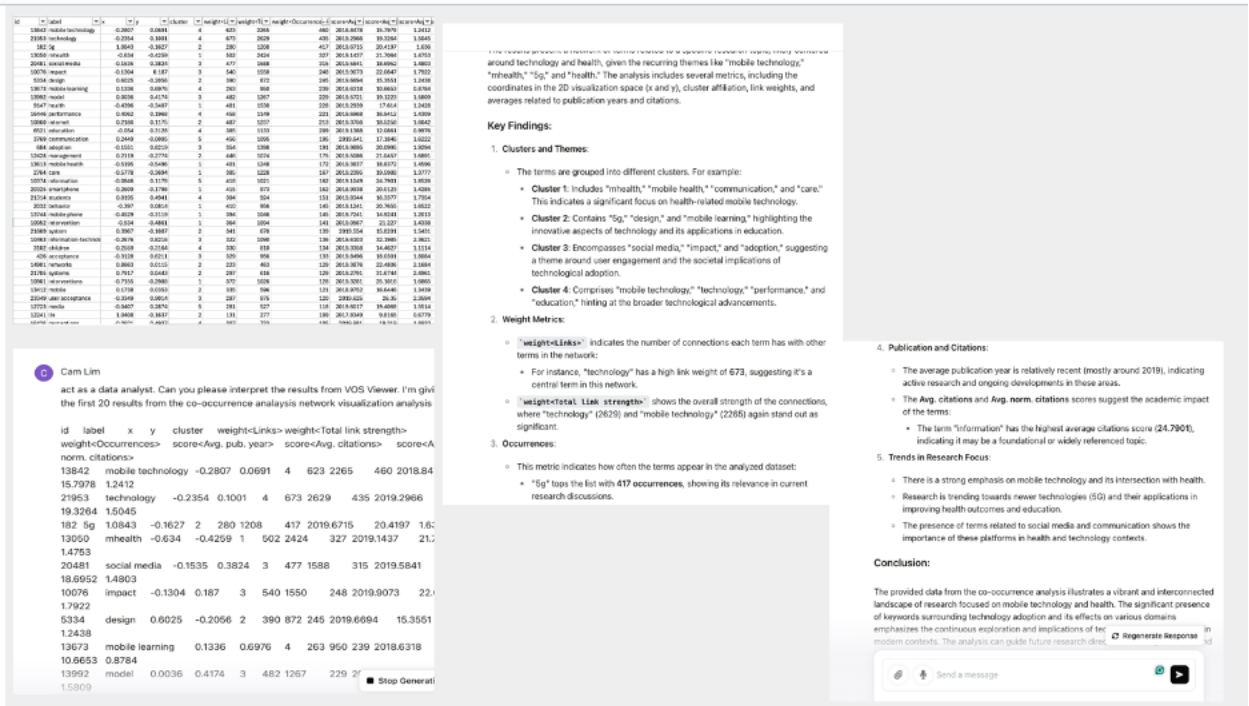

Figure 5: Results of using the assistance of ChatGPT to interpret the results of VOSViewer network visualization

ChatGPT's analytical skills revolutionize research methodologies by analyzing visual data, creating unique visual representations, and improving literature reviews (Biswas, 2024), as shown in Figure 4. picture 5 shows how ChatGPT detected and analyzed keyword clusters in data analysis from picture 4. Health technologies in mobile communications were the most important cluster, followed by 5G, design, and

mobile learning. The field relationships may have been missed.

ChatGPT also improves writing, outline structure, and stylistic choices, helping researchers create ideas (Huang et al., 2023). The program promotes critical thinking during time-consuming tasks like brainstorming and data analysis (Javaid et al., 2023). The VOSviewer display and ChatGPT analysis give researchers a complete toolkit. This toolkit aids researchers in smarter analysis, which may improve study results (Afjal, 2023).

3. Results

The experiment shows how VOSviewer's clear graphics help scholars understand complex bibliometric links and detect research trends and collaborative networks. ChatGPT helps researchers find gaps and future study opportunities through interpretive insights, fostering innovation. This connection speeds up research and provides reliable data analysis through user-friendly interfaces for researchers of all technical levels. Recently, machine learning quality score systems have been shown to predict article quality using metadata and citations. However, using these criteria to assess research publication strength and originality is difficult. Chen et al. (2022b) stress the significance of balancing quantitative data with expert human judgment in the age of AI.

4. Discussion: Do VOSViewer and ChatGPT improve research outcomes?

VOSviewer is indeed an effective tool for enhancing research outcomes. By simplifying complex datasets into clear representations, it supports literary pattern recognition and helps visualize academic landscapes. This capability streamlines the identification of significant trends and collaborations within the research community, facilitating a deeper understanding of the scholarly environment based on the process that was done above.

Additionally, the potential integration of ChatGPT with VOSviewer has notable implications for both research outcomes, as well as research promotion for academics and publications (Park, 2024a; Phan et al., 2024). While AI can automate certain methodologies and enhance data interpretation, there are challenges associated with such integration. Technical competence is necessary for seamless adoption, and access to accurate bibliometric data remains crucial for reliable analysis (Thelwall, 2024). Although advanced tools like Dimensions.ai demonstrate sophistication, their developers face ongoing challenges in accurately evaluating complex research contexts without compromising data integrity (Hook et al., 2020; Park, 2024b). Thus, while the integration can significantly boost productivity and analysis, balancing AI-driven automation with human expertise is essential. Nonetheless, it does help in improving research outcomes with proper usage. In the future, developing a design with more intuitive interfaces to increase integration and data processing to maintain data quality. Adding PubMed and EndNote could improve literature reviews and information collection (Kim et al., 2020).

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