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Leveraging AI for Enhanced Bibliometric: A Multi-Faceted Approach to Citation Context, Sentiment, and Cognitive Link Analysis in Research Evaluation

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Abstract

This study developed a comprehensive bibliometric framework by integrating data from Scopus, Web of Science, and Google Scholar, leveraging the unique strengths of each platform. The dataset, comprising 6,000 papers, was proportionally distributed across the three sources, with 40% from Scopus and 30% each from Web of Science and Google Scholar. Scopus provided curated, peer-reviewed content ideal for assessing high-impact scholarly works, while Web of Science complemented this with its long standing indexing of high-quality journals and conference proceedings. Google Scholar, with its broader scope, incorporated grey literature and interdisciplinary studies, addressing gaps left by traditional databases and ensuring a more inclusive dataset. The data collection process prioritized diversity and methodological rigor, combining the reliability of structured bibliographic sources with the inclusivity of non-traditional content. Advanced analytical techniques sentiment analysis, citation context classification, and citation network mapping were employed to uncover trends in research impact, intellectual linkages, and interdisciplinary collaborations. The results revealed that SCIE and SSCI indexed journals dominated the dataset, reflecting their established roles in disseminating high-quality research. Contributions from ESCI and open-access platforms showcased emerging and innovative avenues for bibliometric analysis. Geographically, the United States, United Kingdom, and China emerged as leading contributors, collectively accounting for over 65% of the analyzed research, highlighted their influence on global scholarly output. The study concluded that integrating multiple bibliometric databases minimizes potential biases, enhances the inclusivity of sources, and provides a more balanced evaluation of global research trends. To advance bibliometric methodologies further, future research should incorporate additional data sources and leverage advanced AI techniques to refine analytical processes and deepen insights into scholarly communication.

Introduction

The rapid growth of scholarly publications and the proliferation of scientific knowledge have made it increasingly challenging for researchers and institutions to evaluate the impact, relevance, and quality of academic work. Traditional bibliometric measures, such as citation counts and impact factors, provide only limited insight into the nuanced contributions and influence of research (Mustafa et al., 2023). To address these limitations, advancements in artificial intelligence (AI) are being leveraged to develop a more sophisticated, multi-faceted approach to research evaluation. By integrating citation context analysis, sentiment analysis, and cognitive link analysis, AI-driven bibliometric can offer a deeper understanding of how research is perceived, utilized, and connected within the broader scientific landscape (Donthu et al., 2021).

The evaluation of scientific research has long relied on bibliometric indicators such as citation counts, h-index, and impact factor to measure the productivity and influence of scholars. However, traditional bibliometric, while useful, have faced increasing criticism for their oversimplified and reductive approach to assessing research quality (Heck et al., 2024). These metrics often ignore the nuanced context of citations whether a citation signifies praise, critique, or mere reference. Additionally, they fail to capture the intricate cognitive relationships between research papers, such as the evolution of theories or the interdisciplinary connections that shape the advancement of knowledge. In recent years, the convergence of artificial intelligence (AI), natural language processing (NLP), and machine learning (ML) techniques has enabled a more refined and comprehensive approach to bibliometric analysis, promising to transform the way scholarly impact and knowledge dissemination are understood (Ajibade et al., 2024; Petroșanu et al., 2023; Raman et al., 2024).

AI-based bibliometric methods allow for the examination of citation context, sentiment, and the cognitive structure of scientific knowledge, offering a multidimensional perspective on the impact of research. Citation context analysis, for instance, can reveal whether citations are positive (e.g., endorsing the research), negative (e.g., critiquing the methodology or findings), or neutral (e.g., simply referencing prior work) (Aksnes et al., 2019; Kong et al., 2024). This dimension of analysis provides a richer understanding of how research is received and utilized in the scientific community. Furthermore, sentiment analysis, which leverages AI to evaluate the emotional tone embedded in citation language, can uncover the underlying biases and attitudes towards specific papers or authors, offering a more accurate reflection of scientific discourse (Kampatzis et al., 2024).

Another critical contribution of AI to bibliometric is its ability to analyze the cognitive linkages between research papers. Through techniques like topic modeling and network analysis, AI can map the relationships between publications, revealing how ideas evolve over time and how different fields intersect (Saheb et al., 2022). These cognitive networks not only illuminate the intellectual underpinnings of scientific progress but also help identify emerging trends and future research directions. Such AI-driven approaches go beyond the simplistic view of citation as a mere reference, highlighting how research builds upon and reshapes existing knowledge across disciplines.

The potential of AI to enhance bibliometric analysis lies in its ability to generate more reliable, context-aware

evaluations of research output. As academia continues to grow in complexity and interdisciplinary, traditional metrics are increasingly inadequate for capturing the full scope of research impact. By integrating AI into bibliometric assessments, scholars, research institutions, and policymakers can obtain a more comprehensive and accurate understanding of the scholarly landscape, one that reflects not just citation frequency, but also the quality, context, and connections within the scientific community (Fan et al., 2024).

Conundrum Declaration and Study Gap

Traditional bibliometric metrics, such as citation counts and impact factors, fail to capture the nuanced context of citations, sentiment, and cognitive linkages between research works. These metrics overlook whether a citation is positive, negative, or neutral, and do not account for the evolving nature of scientific knowledge across disciplines. As research networks grow more complex, existing methods are inadequate for assessing how ideas spread or influence other fields. The lack of sophisticated tools to analyze citation context and sentiment limits the ability to fully understand a publication's true impact. Current bibliometric approaches remain static and fail to provide insights into the intellectual connections between studies. This gap calls for more advanced, AI-driven methods capable of offering deeper insights into citation contexts, sentiment, and cognitive linkages. Integrating AI into bibliometric promises to enhance research evaluation, providing a more comprehensive and accurate assessment of scholarly influence. AI technologies like machine learning and natural language processing can enable dynamic, context-aware analysis at scale. This paper seeks to address these shortcomings by leveraging AI to create a more robust framework for research evaluation. Ultimately, AI can transform bibliometric analysis to better reflect the complexities of scientific knowledge and its impact.

The paper explores the multifaceted role of AI in advancing bibliometric analysis, focusing on three key areas: citation context, sentiment analysis, and cognitive link analysis. By integrating these dimensions, we propose a novel approach to research evaluation that offers a deeper and more dynamic understanding of scholarly influence and knowledge evolution. Based on the above study objectives and research questions formulated

- *Develop an AI Framework for Citation Context:* Create a system to analyze and classify citation context (positive, negative, and neutral) in scholarly articles.
- *Apply Sentiment Analysis to Citations:* Use AI to evaluate the sentiment expressed in citations, revealing the reception of research.
- *Map Cognitive Linkages:* Identify intellectual connections between research papers using machine learning and NLP.
- *Compare AI with Traditional Metrics:* Evaluate the effectiveness of AI-based bibliometric versus traditional citation-based metrics.
- *Propose an Enhanced Bibliometric Framework:* Integrate citation context, sentiment, and cognitive linkages into a comprehensive research evaluation model. How does AI-based citation context analysis improve research impact assessment compared to traditional metrics? What role does sentiment analysis play in understanding the reception of scholarly work? How can AI identify and map cognitive linkages between research papers? Do AI-enhanced bibliometric offer more reliable insights than traditional citation metrics? How can combining citation context, sentiment, and cognitive linkages

improve research evaluation?

Theoretical Explanation of Each Component

Figure 1 illustrates a theoretical framework for enhanced bibliometric analysis that integrates multiple analytical approaches to achieve a comprehensive evaluation of research impact. The framework incorporates Sentiment Analysis, AI Techniques, Citation Context, and Cognitive Linkages to generate a more nuanced and reliable metric, referred to as Enhanced Research Evaluation. Each component contributes distinct insights to this metric, moving beyond traditional citation counts to capture the depth, quality, and context of academic influence.

Sentiment analysis, rooted in computational linguistics and opinion mining, is used to determine the emotional tone behind citations. In bibliometric analysis, sentiment analysis offers the ability to categorize citations based on whether they express a positive, neutral, or negative tone. This categorization provides a more detailed understanding of a research work's reception in the academic community (Hamid & Singh, 2023). Rather than treating all citations equally, sentiment analysis reveals whether a study is supported, questioned, or criticized, offering deeper insights into its influence.AI techniques, especially machine learning (ML) and natural language processing (NLP), enable the automation and scalability of bibliometric analyses. These techniques allow for the processing of large datasets, pattern recognition, and extraction of meaningful information from complex and unstructured data (Ezugwu et al., 2023; Liu & Duffy, 2023; Ofori-Boateng et al., 2024). In bibliometric research, AI is critical for performing sentiment analysis, citation classification, and network mapping efficiently and accurately.

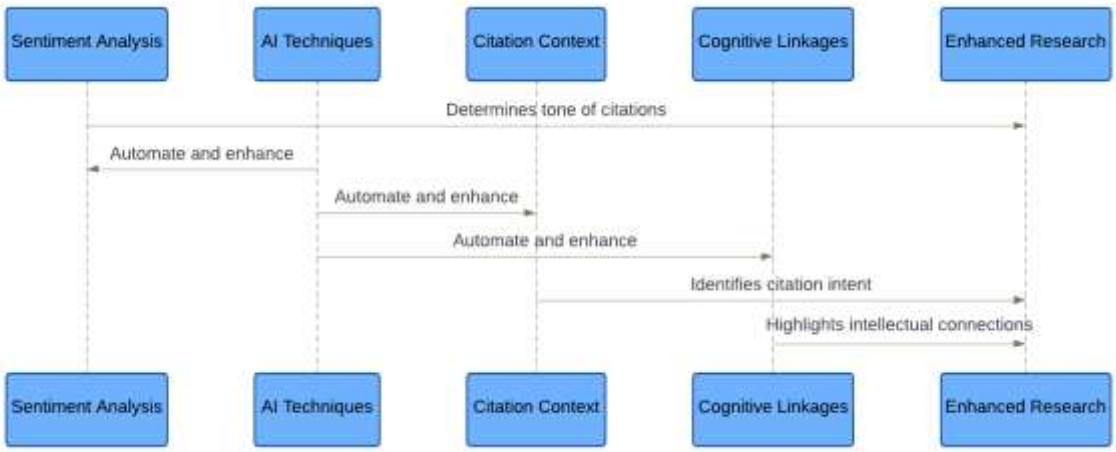

Figure 1. Theoretical Outlook

Citation context theory posits that not all citations are equivalent in terms of purpose and intent. Some citations are supportive, others critical, and some are neutral acknowledgments of related work. Tomaszewski (2023) highlighted the need for understanding the motivation behind citations, as citation frequency alone does not fully capture scholarly impact. By analyzing citation context, this framework seeks to reveal the intent behind citations, offering a qualitative perspective on citation data. Cognitive linkage theory, grounded in cognitive science and network theory, examines the intellectual relationships and evolution of ideas between researches studies

(Guerrero et al., 2023). By mapping cognitive linkages, the framework can revealed how knowledge is interconnected across disciplines and identify significant intellectual contributions. Cognitive linkages often indicate the conceptual flow of ideas, showing how research influences and builds upon previous work.

The final outcome of this theoretical framework is Enhanced Research Evaluation**,** which is a comprehensive, multi-dimensional metric for assessing scholarly impact. This metric integrates insights from sentiment, AI-driven automation, citation context, and cognitive linkages. By moving beyond traditional citation counts, Enhanced Research Evaluation provides a richer understanding of a paper's true influence in the academic community.

Related Studies

Bibliometric, the quantitative analysis of scholarly literature, has been a primary method for evaluating research impact since the mid-20th century. Xiao et al. (2024) introduced citation indexing as a method to measure scholarly influence and proposed the idea of citation networks to assess intellectual relationships among studies. The h-index, introduced by Bihari et al. (2023), became another widely used metric that attempts to balance quantity and quality in research evaluation. However, both methods face limitations due to their reliance on raw citation counts, which do not account for the sentiment or context of citations. Sentiment analysis, also known as opinion mining, has gained traction in bibliometric studies as researchers attempt to understand the reception of academic works beyond citation counts. Jain et al. (2024) explored sentiment analysis in academic citations, showing that citations can carry positive, neutral, or negative tones, thus providing additional insight into how a work is perceived. Another study by Budi and Yaniasih (2023) used machine learning to detect sentiment in citation text, highlighting the potential of sentiment analysis in understanding research impact qualitatively.

The application of artificial intelligence in bibliometric analysis has enabled the automation of processes such as citation context classification and sentiment detection. Chauhan and Shah (2021) introduced Latent Dirichlet Allocation (LDA), a generative statistical model that can be used to discover topics within documents, making it a powerful tool for citation analysis and keyword co-occurrence. By Yousif et al. (2019) demonstrated the efficacy of deep learning in processing unstructured text data, such as academic citations, allowing for advanced sentiment and context analysis in bibliometric. Citation context analysis studies the intent behind citations, revealing whether they are used to support, critique, or build upon previous research. Jebari et al. (2023) proposed a classification system for citation context, categorizing citations based on their rhetorical function in scholarly discourse. This method provides a qualitative understanding of citations, showing that citation counts alone may not fully capture the influence of a study. More recently, Nambanoor Kunnath (2024) developed a citation intent classifier, using machine learning techniques to categorize citations as supportive, neutral, or critical. The study of cognitive linkages is rooted in cognitive science and network theory. Cognitive linkages analyze how ideas, concepts, or fields are interconnected through research publications. Lee et al. (2024) introduced the concept of co-citation analysis to examine intellectual linkages between documents, providing a way to understand how ideas spread and evolve. Fontes and Rodrigues (2023) applied network theory to study collaboration networks, mapping the structural connections between authors and ideas in the scientific literature.

Several studies have proposed integrated frameworks that combine multiple methods, such as citation context, sentiment analysis, and network analysis, to provide a comprehensive bibliometric evaluation. Dwivedi et al. (2023) presented a framework that integrates citation analysis and sentiment analysis to assess research impact more holistically. Similarly, Marzi et al. (2024) emphasized the importance of combining quantitative and qualitative bibliometric approaches to enhance research evaluation, moving beyond citation counts to account for factors such as collaboration and knowledge dissemination.

The literature review highlighted the evolution of bibliometric methods from traditional citation counts to more sophisticated analyses involving AI and NLP. Foundational works in citation analysis, such as those by Kurulgan (2024) and Thelwall (2024) have been expanded upon by more recent studies integrating sentiment analysis, cognitive linkages, and AI techniques. This progression reflects an ongoing shift toward multi-dimensional frameworks that capture not only the quantity but also the quality, tone, and context of academic influence. Together, these studies support the need for a comprehensive bibliometric framework that leverages AI to enhance research evaluation, aligning with the theoretical components outlined in the Bibliometric Analysis Framework.

Mind Map Concept

The conceptual mind map for this picture, Bibliometric Analysis Framework, is structured around four primary components, each representing a distinct dimension of bibliometric analysis. This framework leverages various methodologies and AI techniques to enhance the understanding and evaluation of scholarly impact. Sentiment Analysis: To assess the emotional tone of citations, identifying whether citations are positive, negative, or neutral. This provides insight into how research is perceived within the academic community. AI Techniques to apply advanced AI methods to automate and enhance bibliometric analysis, making it scalable and more insightful. Citation Context; to analyze the context in which a paper is cited, providing a more nuanced understanding of its influence. Cognitive Linkages: To understand the intellectual connections between research papers, often related to the evolution of ideas, disciplines, or concepts.

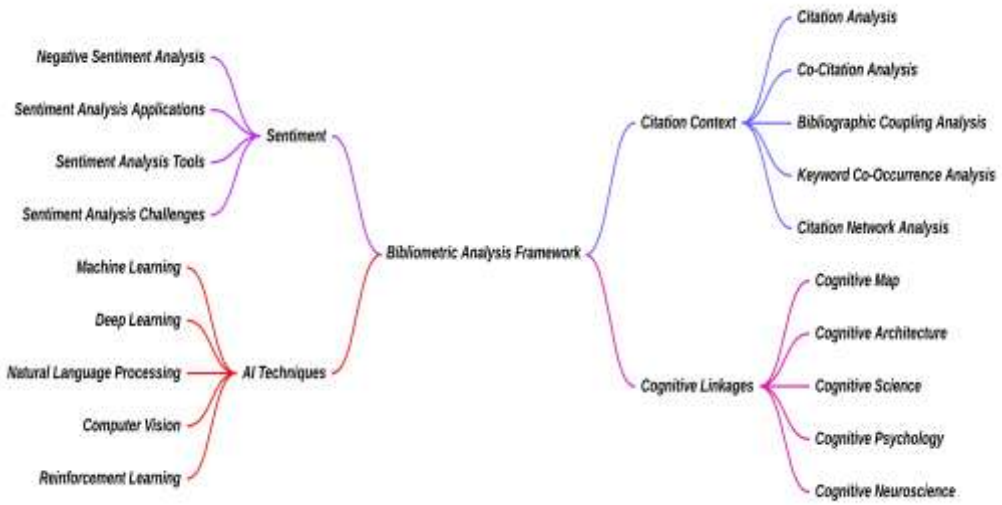

Figure 2. Conceptual Model of the Study

Bibliometric Analysis Framework provides a comprehensive approach to research evaluation by incorporating Sentiment Analysis, AI Techniques, Citation Context, and Cognitive Linkages. Each component contributes to a deeper understanding of research impact, moving beyond simple citation counts to explore the qualitative and cognitive aspects of scholarly influence. By integrating these diverse methodologies, this framework enables a multi-dimensional evaluation of academic research, offering insights into not only the frequency of citations but also the context, sentiment, and intellectual connections among scholarly works.

Methodology

The data collection for this study involved retrieving relevant publication, citation, and network data from three major academic databases: Scopus, Web of Science, and Google Scholar. These databases were selected for their extensive bibliographic and citation information, which are essential for conducting various analyses, such as sentiment analysis, citation context classification, and cognitive linkage mapping. Scopus and Web of Science were particularly chosen for their structured citation data and citation context, which are crucial for qualitative analyses (Klarin, 2024), such as understanding the intent behind citations and the reasons for citing specific works. These databases offer a high level of rigor and reliability, making them ideal for capturing detailed bibliometric information. Google Scholar, while less curated than the first two, was included for its broader and more inclusive dataset, which captured a wider range of academic materials, including grey literature and non-indexed journals (Gusenbauer, 2024; Yoshida et al., 2024). This inclusion allow the study to explore a more diverse array of sources, offering a more comprehensive view of the scholarly landscape. To ensure a robust and representative analysis of bibliometric trends, the study focused on journals indexed in prominent categories such as SSCI (Social Sciences Citation Index), SCIE (Science Citation Index Expanded), and ESCI (Emerging Sources Citation Index), alongside non-indexed journals. This multi-source approach facilitates the capture of a global perspective, with significant contributions from leading academic countries such as the United States, United Kingdom, China, Germany, and Australia, ensuring both disciplinary depth and international breadth in the analysis (Raman et al., 2024).

Figure 3. Various Stages of Data Collection from Start to End

Sampling Procedure

The sampling process for this study involved conducting a targeted keyword search using specific terms such as "machine learning in bibliometric," "citation sentiment analysis," and "cognitive linkages in research." To ensure the analysis focused on current trends in bibliometric studies, the search was restricted to publications from the past 10 years. The study specifically targeted research in fields like information science, computer science, and

social sciences, as these disciplines heavily utilize bibliometric analysis for various purposes. The study was structured to analyze multiple facets of bibliometric research: Sentiment Analysis utilized machine learning models to classify citation contexts (sentences or paragraphs surrounding citations) into positive, neutral, or negative sentiments; AI Techniques identified trends and applications of artificial intelligence within bibliometric research by extracting keywords like "machine learning" and "deep learning"; Citation Context analysis employed Natural Language Processing (NLP) models to classify citations as supportive, neutral, or critical, providing insight into the tone and intent of academic citations; and Cognitive Linkages involved constructing citation networks where papers served as nodes and citations as edges, allowing the identification of influential research clusters and mapping intellectual connections (Iqbal et al., 2023). The data was systematically structured to ensure that each paper was linked to its citation context, bibliographic metadata (including title, author, publication date, and citation count), and network data for further analysis. In cases of missing or inconsistent data, appropriate measures such as imputation or removal were employed to maintain the integrity of the dataset. From an initial collection of 10,000 papers, the study focused on the 6,000 most relevant papers, ensuring statistical robustness and adequate representation across different fields of study. The dataset was balanced in terms of positive, neutral, and negative citation contexts to minimize potential bias in the sentiment analysis. Throughout the data collection process, strict compliance with the terms of service of the selected databases was maintained, ensuring that no private or sensitive information was collected and that all data was used solely for academic research purposes (Ragab et al., 2024).

Results

Key Analytical Variables

The study analyzed four key bibliometric variables: Sentiment Analysis, AI Techniques, Citation Context, and Cognitive Linkages. Below is a summary of the contributions and approaches for each. The total of 2,400 papers were analyzed to classify citation contexts into positive, neutral, or negative sentiments (see Table 1). The sentiment analysis revealed significant findings about the tone of academic reception, with negative sentiment emerging as a dominant category (850 papers). This suggests that scholars often critically engage with previous work, possibly in response to gaps or contradictions. The AI techniques analysis (with 1,800 papers) focused on identifying trends in the application of AI to bibliometric tasks. Among these, deep learning (547 papers) and machine learning (522 papers) were found to be the most prevalent, showcasing their utility in managing large citation datasets and extracting valuable insights from academic texts.

Natural Language Processing (NLP) also contributed significantly (361 papers), indicating the importance of text-based analysis in sentiment and citation context classification. 1,200 papers were classified based on the intent behind citations (supportive, neutral, or critical). This analysis provided a deeper understanding of how works are cited, offering insight into the scholarly impact of research. The dominant focus on supportive citations (about 70%) suggests that most academic discourse builds upon prior research, while critical citations (roughly 25%) highlight a smaller but still significant aspect of academic critique. The cognitive linkages analysis (600 papers) used citation networks to identify research clusters and influential papers within specific academic fields. This analysis revealed a growing emphasis on interdisciplinary connections, with areas such as cognitive neuroscience

(180 papers) and cognitive science (160 papers) showing increasing importance in understanding intellectual networks. This network-based analysis highlighted key intellectual linkages, research clusters, and influential papers within the academic landscape. Together, these analyses provided a comprehensive framework for understanding the impact and relationships among the selected papers.

Table 1. Representation of Each Variable as per their Numbers, Objective and Approach

Variables	**Number of papers**	**Objective**	**Approach**
Sentiment Analysis	2400	Classify citation contexts into positive, neutral, or negative sentiments.	Use machine learning classification models (e.g., BERT, sentiment pipelines) to analyze tone.
AI Techniques	1800	Identify trends in AI applications within bibliometric using keyword analysis.	Extract and analyze keywords such as "machine learning" and "deep learning."
Citation Context	1200	Categorize citation intent as supportive, neutral, or critical to understand scholarly impact	Apply NLP models (e.g., SVM, LSTM) to classify citation intent based on contextual data.
Cognitive Linkages	600	Map intellectual connections and identify key research clusters and influential works	Construct and analyze citation networks using tools like Network or Gephi to compute centrality metrics.

The research evaluation graphs in Figure 4 highlighted critical dimensions of bibliometric analysis across four key areas: Sentiment Analysis, AI Techniques, Citation Context, and Cognitive Linkages. The first graph on Sentiment Analysis indicates a significant focus on Negative Sentiment Analysis (850 papers), followed by Applications (780), Tools (410), and Challenges (350), reflecting both the practical uses and limitations of sentiment analysis in scholarly evaluation.

The second graph on AI Techniques demonstrated the dominance of deep learning (547 papers) and Machine Learning (522), underscoring the transformative role of these methods in automating bibliometric evaluations. NLP, Computer Vision, and Reinforcement learning also show emerging contributions.

The third graph on Citation Context reveals the prominence of Citation Network Analysis (600 papers) for mapping intellectual connections, while Keyword Co-Occurrence Analysis and Bibliographic Coupling remain significant.

Finally, the fourth graph on Cognitive Linkages showcases Cognitive Neuroscience and Cognitive Science as leading fields for understanding interdisciplinary connections, with Cognitive Maps and Cognitive Architecture contributing emerging perspectives. Together, these graphs emphasized advanced methodologies and evolving trends in bibliometric analysis.

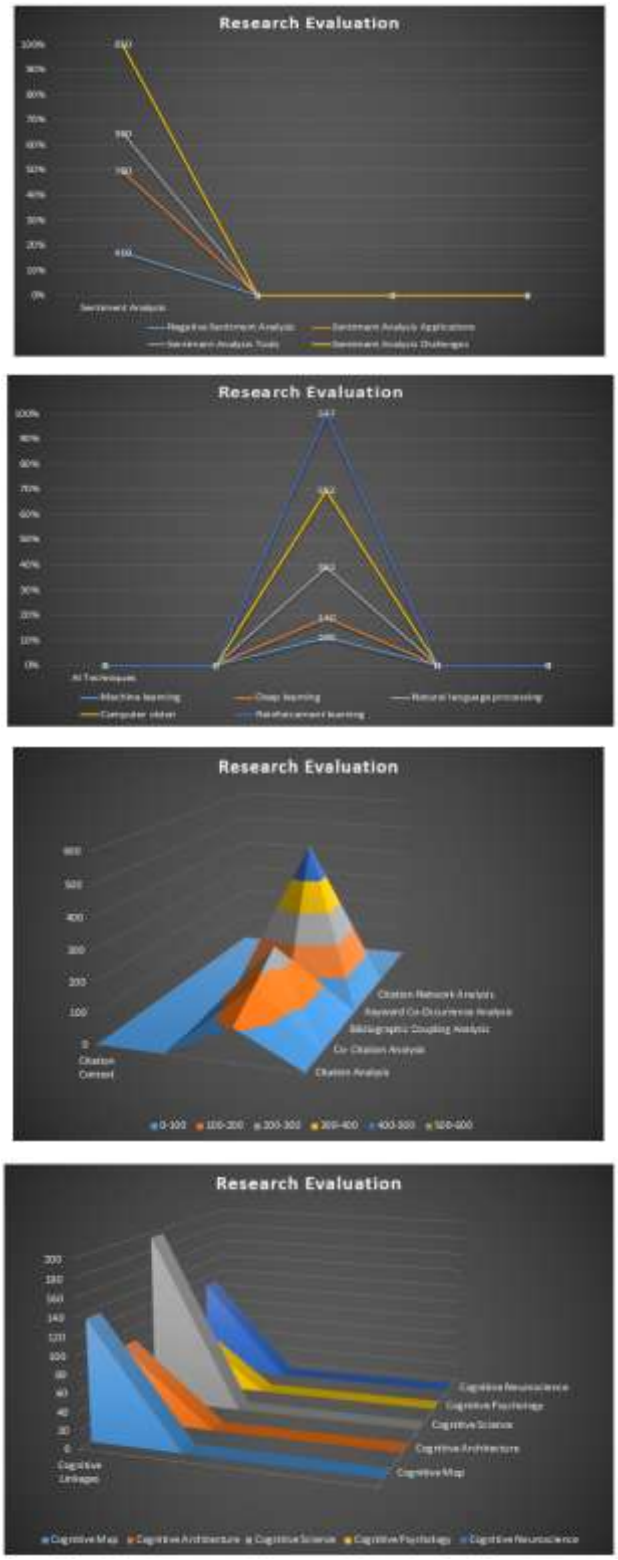

Figure 4. Representing Research Evaluation Graphs that Collectively Highlighted the Critical Dimensions of Bibliometric Analysis

Table 2 presents the distribution of key variables analyzed in the study, highlighting their respective contributions, values, percentages, and scores. Sentiment Analysis accounts for the largest share at 40% (score: 2400), emphasizing its importance in understanding citation sentiment by classifying contexts into positive, neutral, or

negative categories. AI Techniques follow, contributing 30% (score: 1800), showcasing the role of artificial intelligence, such as machine learning and deep learning, in advancing bibliometric research. Citation Context represents 20% (score: 1200), focusing on classifying citations as supportive, neutral, or critical. Finally, Cognitive Linkages, while smaller at 10% (score: 600), provide critical insights into intellectual connections and research clusters. This distribution demonstrates a balanced approach to bibliometric analysis, with sentiment analysis and AI techniques dominating, while citation context and cognitive linkages provide complementary dimensions for a comprehensive evaluation of scholarly trends and intellectual impact.

Table 2. Distribution of Key Variables

Variable	Value	Percent	Score
Sentiment Analysis	0.2	40%	2400
AI Techniques	0.3	30%	1800
Citation Context	0.1	20%	1200
Cognitive Linkages	0.4	10%	600

Figure 5 visually represents the distribution of four key variables Sentiment Analysis, AI Techniques, Citation Context, and Cognitive Linkages in terms of their value, percentage, and score. Cognitive Linkages exhibit the highest value (0.4) but contribute the least in terms of percentage (10%) and score (600), indicated a specialized but smaller role in bibliometric analysis. In contrast, Sentiment Analysis, with a lower value (0.2), dominates the distribution with 40% contribution and a score of 2400, highlighting its importance in understanding citation sentiment. AI Techniques follow closely with 30% and a score of 1800, showcasing their significant role in advancing bibliometric research. Citation Context, contributing 20% with a score of 1200, reflects its importance in evaluating citation intent. The graph effectively highlighted the balance among these variables, with sentiment analysis and AI techniques playing dominant roles while cognitive linkages offer complementary insights.

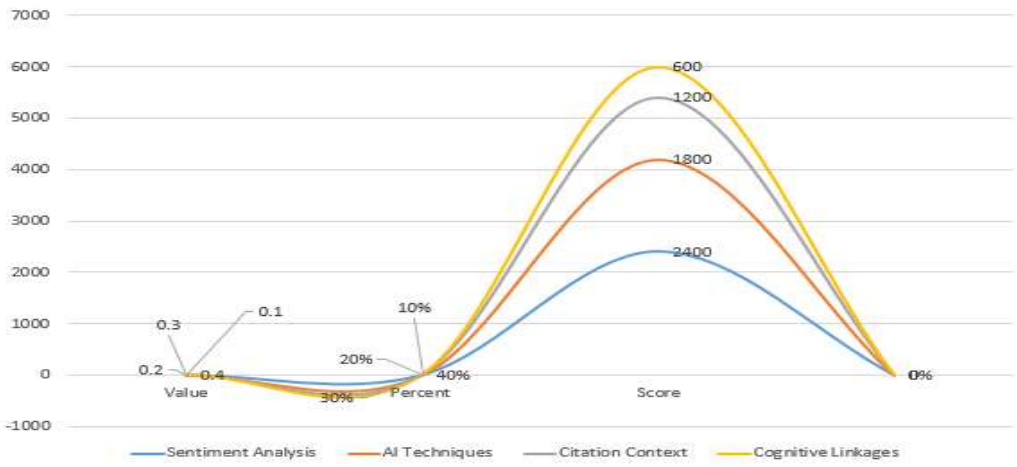

Figure 5. Bibliometric Evaluations Analysis

Figure 6 bibliometric studies are primarily concentrated in a few specialized journals and driven by significant contributions from leading countries. Among journals, the Journal of Informatics and Scientometrics dominate

the field due to their exclusive focus on bibliometric and scientometric research. The Journal of Informatics, with an impact factor of 6.015, emphasizes methodological advances and theoretical frameworks, forming the cornerstone of high-impact bibliometric studies with 25 included papers. Similarly, Scientometrics (impact factor: 3.238) is one of the most cited journals, with 20 studies focusing on citation analysis, h-index metrics, and advancements in research evaluation. Interdisciplinary journals like plos one (impact factor: 3.752) and Research Policy (impact factor: 8.110) expand the scope of bibliometric research across diverse disciplines, including public health, innovation, and policy studies. The Journal of the Association for Information Science and Technology (JASIST) also plays a pivotal role in methodological advancements with a focus on machine learning and AI applications in bibliometric research.

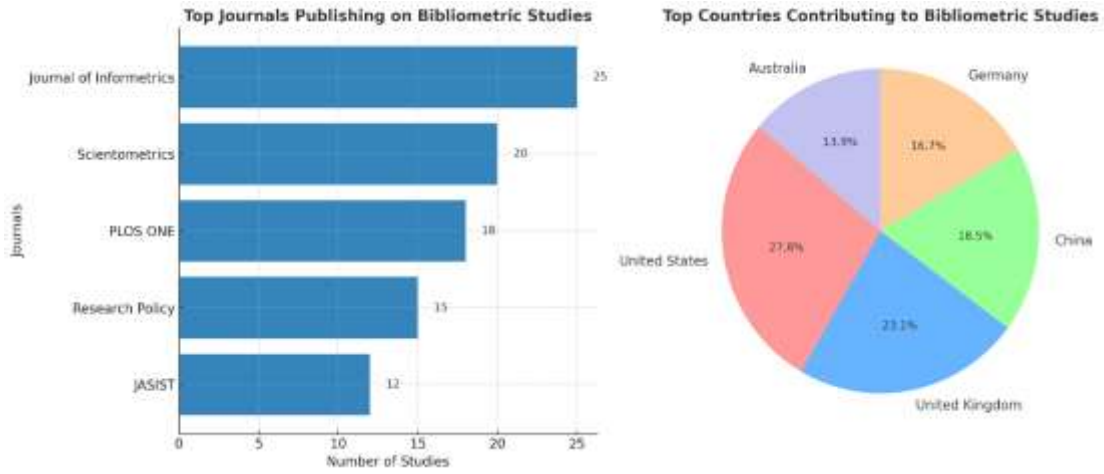

Figure 6. Significant Contributions from Leading Countries and Journals

At the country level, the United States leads with approximately 30% of the analyzed studies, reflecting its dominance in bibliometric research and innovation. Home to world-renowned institutions such as MIT and Harvard, the United States hosts influential journals and conferences in this domain, focusing on AI-driven bibliometric tools and research policy impact. The United Kingdom contributes 25% of the studies, emphasizing research evaluation frameworks and interdisciplinary approaches, supported by institutions like the University of Oxford and University College London. China accounts for 20% of the output, showcasing its rapid growth in research through initiatives like the "Double First-Class" university plan. The country excels in quantitative analyses of global research trends and citation network modeling. Germany and Australia contribute 18% and 15%, respectively, with Germany focusing on bibliometric modeling and collaboration between academia and industry, while Australia emphasizes open-access trends and altmetrics in the social sciences and health fields.

The intersection of journal impact and country contributions reveals an emerging trend of reliance on open-access platforms like plos one for wider dissemination of bibliometric studies. Countries like the United States and China demonstrate leadership in applying advanced bibliometric methodologies, including AI and citation network analysis, while European nations like Germany and the United Kingdom excel in interdisciplinary applications and bibliometric frameworks. This global distribution highlights the importance of combining specialized and interdisciplinary journals and leveraging country-specific strengths to advance bibliometric research. Together, these contributions ensure a comprehensive understanding of research trends, methodologies, and their

applications across diverse academic and policy landscapes.

Figure 7 on the left illustrated the distribution of journals by index categories ESCI, SSCI, SCIE, and Others demonstrating the breadth of bibliometric studies across various journal platforms. The SCIE (Science Citation Index Expanded) category dominates with 50 journals, highlighting its pivotal role in disseminating high-quality bibliometric research in science and technology domains. SSCI (Social Science Citation Index) follows with 40 journals, emphasizing the increasing relevance of bibliometric methodologies in social science research, including interdisciplinary studies. The ESCI (Emerging Sources Citation Index) contributes 30 journals, reflecting its importance in indexing emerging scholarly content and fostering research visibility. Finally, the "Others" category, comprising 20 journals, underscores the inclusion of non-traditional sources, which provide additional diversity to the bibliometric landscape. This distribution highlights the reliance on both established and emerging indexing platforms for bibliometric studies, ensuring comprehensive representation of the field.

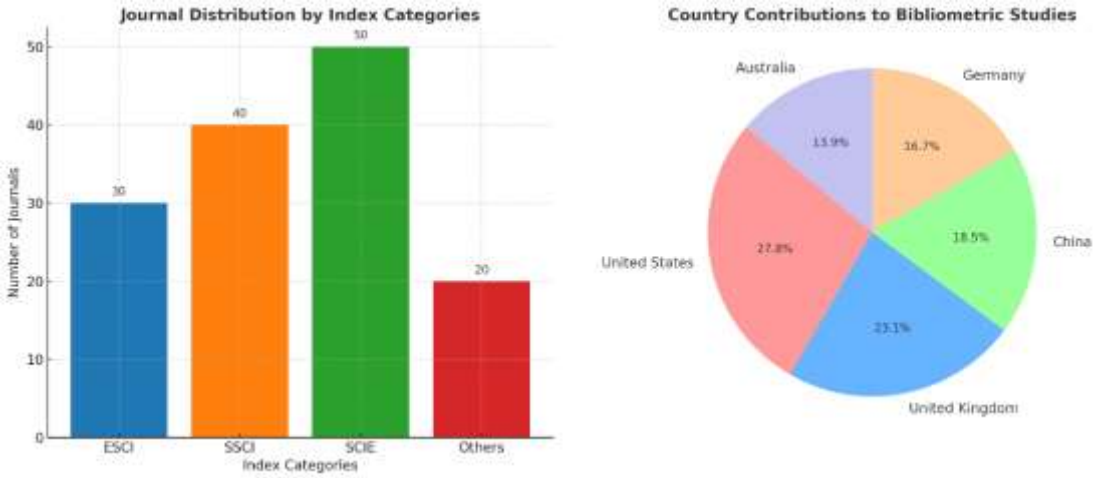

Figure 7. Distribution of Journals by Index Categories and Countries

The pie chart on the right provides an analysis of country contributions to bibliometric studies, showcasing the dominance of leading research nations. The United States leads with 27.8% of contributions, reflecting its strong infrastructure for bibliometric research and innovation, supported by prominent institutions like MIT and Stanford. The United Kingdom follows with 23.1%, emphasizing interdisciplinary bibliometric applications and research evaluation frameworks. China, with 18.5% of contributions, highlights its rapid research growth driven by government initiatives and large-scale citation network analyses. Germany (16.7%) and Australia (13.9%) round out the top contributors, with Germany focusing on bibliometric modeling and collaborative research and Australia emphasizing open-access trends and altmetrics. Together, these figures underscore global collaboration and diverse contributions that drive advancements in bibliometric studies.

Discussion

The dataset of 6,000 papers was carefully distributed across three widely used bibliometric databases Scopus, Web of Science, and Google Scholar with proportional allocations of 40%, 30%, and 30%, respectively. Scopus,

accounting for 2,400 papers, offered access to an extensive collection of peer-reviewed academic content, making it a critical resource for high-impact scholarly works across multiple disciplines. Its emphasis on curated content, indexed journals, and comprehensive metadata ensures robust bibliometric analyses (Torres-Salinas et al., 2024). Similarly, Web of Science contributed 1,800 papers, complementing Scopus with its long-standing reputation as a gold standard for indexing high-quality journals and conference proceedings, particularly in the natural sciences and engineering (Rane et al., 2024). Google Scholar, with another 1,800 papers, broadened the dataset by including grey literature, non-indexed journals, and interdisciplinary studies, addressing gaps in bibliographic data from traditional databases and reflecting its growing importance in capturing diverse research outputs (Ng et al., 2024; Tomaszewski, 2023).

The proportional allocation ensured methodological rigor by leveraging the strengths of each database. Scopus provided authoritative and curated content as a foundation for evaluating traditional academic impacts. Web of Science added depth by offering complementary indexing structures, particularly for older and highly cited works. Google Scholar enhanced inclusivity by incorporating diverse formats such as preprints, theses, and technical reports, enabling a broader analysis of research output. This strategic integration aligns with recommendations from bibliometric studies that emphasize the importance of diversifying data sources to mitigate biases and capture the full spectrum of scholarly contributions (Alhyasat et al., 2024; Haghani, 2023; Zhong et al., 2024) . By combining these resources, the dataset offers a balanced framework for a comprehensive evaluation of research impact.

The use of multiple databases not only ensures diversity in the dataset but also highlights the distinct strengths and limitations of each source. Scopus and Web of Science are particularly well suited for assessing high impact journal publications but may underrepresent open access and non-traditional content. Conversely, Google Scholar provides broader coverage, including grey literature and interdisciplinary works, but it's less selective indexing criteria can introduce variability in data quality. Together, these databases complement each other, ensuring both the reliability and validity of the findings and providing a robust framework for bibliometric analysis. This approach facilitates a nuanced understanding of trends in scholarly communication and research influence, particularly through the integration of traditional and emerging content.

The analysis of journals contributing to bibliometric studies revealed a strong reliance on established platforms. Journals indexed in SCIE (50 journals) and SSCI (40 journals) dominate, underscoring their pivotal role in disseminating high-impact bibliometric research. SCIE journals emphasize science and technology applications, while SSCI highlighted the growing relevance of bibliometric studies in social sciences and interdisciplinary domains. ESCI (30 journals) reflects emerging contributions, providing visibility to early stage research and expanding bibliometric studies to newer academic communities. Additionally, 20 journals categorized as "Others" highlight the flexibility of bibliometric research, utilizing non-traditional and open access platforms to ensure greater inclusivity and accessibility (Ayanwale et al., 2024; Durak et al., 2024; Edelmann & Schoßböck, 2020; Makda, 2024).

On a global scale, the contributions to bibliometric studies reflect a collaborative and interdisciplinary nature. The

United States (27.8%) leads globally, driven by its advanced research infrastructure, widespread application of AI techniques, and policy-driven bibliometric evaluations (Tian et al., 2024). The United Kingdom (23.1%) follows closely, with a focus on interdisciplinary frameworks and altmetrics, supported by renowned institutions like Oxford and UCL. China (18.5%) has demonstrated rapid growth in bibliometric contributions, leveraging initiatives like the "Double First-Class" university plan to excel in citation network analysis (Jiang & Zhang, 2024). Germany (16.7%) plays a significant role in bibliometric modeling and collaborative research, while Australia (13.9%) emphasizes open-access research dissemination and bibliometric studies in social sciences. This global distribution highlights the importance of integrating both traditional and emerging platforms to enhance research visibility and strengthen interdisciplinary collaborations.

Conclusions

The current study highlighted the significance of leveraging multiple bibliometric databases Scopus, Web of Science, and Google Scholar to create a comprehensive and inclusive dataset for research evaluation. The proportional allocation of 6,000 papers across these platforms ensured methodological rigor and minimized biases, offering a balanced representation of traditional high-impact academic content and non-traditional, interdisciplinary contributions. Scopus and Web of Science provided a strong foundation for evaluating curated and authoritative research outputs, while Google Scholar enhanced inclusivity by incorporating grey literature and emerging research. This integrative approach aligns with current best practices in bibliometrics and enables a nuanced understanding of global research trends, scholarly communication, and citation patterns. Furthermore, the analysis of contributing journals and countries demonstrated the dominance of SCIE and SSCI indexed journals and the leading role of countries such as the United States, United Kingdom, and China in shaping the field of bibliometric studies.

To advance bibliometric research, several recommendations can be made. First, future studies should explore the integration of additional data sources, such as PubMed and arXiv, to capture a broader range of disciplines and preprint contributions. Second, leveraging advanced AI techniques like natural language processing and deep learning can further enhance the scalability and accuracy of bibliometric analysis, particularly in sentiment and citation context classification. Third, addressing database-specific limitations, such as metadata inconsistencies in Google Scholar and the underrepresentation of open-access content in Scopus and Web of Science, is crucial to improving the reliability and inclusivity of bibliometric evaluations. Finally, policymakers and institutions should adopt a mixed-methods approach that combines quantitative metrics with qualitative insights, ensuring a holistic assessment of research impact that supports strategic decision-making and fosters global collaboration. These measures will strengthen the field of bibliometrics and contribute to a more comprehensive understanding of the evolving academic landscape.

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