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Comparative Study of Citation Databases of Scopus Web of Science and Google Scholar

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Abstract
Citation analysis and various other metrics measurement tools are key components to identifying research scholarly achievement. This study presents the different types of citation analysis tools and research metrics like author-level and journal-level metrics which are useful for research scholars for their day-to-day scholarly publications. Several measures have been developed to measure author and journal impact. Based on this study the research scholars get more impressions, and they can implement their new ideas, this article also focuses on the research scholars publishing more publications in reputed journals and getting more ranking/citations based on their new ideas. As per the UGC-approved journal list, Care list, Indian Research Information Network System (IRINS), Scopus, Web of Science, Google Scholar, SJR, and other journal citation metrics and ranking tools help the research to get new knowledge. Scopus, Web of Science, Google Scholar, SJR, and other citation databases are used for citing, and hunts, allowing the researchers to discover, check, and pathway citation data year by year. This study also provides exhaustive material from popular citation databases of Web of Science, Scopus, and Google Scholar.

Keywords: *Citation Analysis, Citation Databases, Web of Science, Scopus, Google Scholar*

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I. Introduction

Research productivity in academic institutions is usually measured based on certain metrics. The various measures offer different viewpoints and have certain strengths and weaknesses. A comprehensive picture of impact for individual scholars and journals requires the use of several measures and does not completely capture all facets of impact. Authors and higher education administrators often assume that journal impact factors (JIFs) and citation counts are indicators of research quality (Dougherty & Horne, 2022). There are different tools and methods in practice to measure the impact of a journal or the individual or their scholarship. Citation analysis tools like Web of Science, Scopus, and Google Scholar are used for locating citations to produce citation-based quality evaluation measures. Citation analysis is the study of the impact and expected quality of a research publication, an author, or an academic institution based on the number of times works and/or authors have been cited by others.

II. Review of Literature

The present study focuses on citation analysis and other metrics that are essential for authors to measure the impact of research publications. The literature reviewed which is relevant to the present study is as follows:

Jie Li et al. (2010) compares the citation analysis potential of Web of Science, Scopus, SciFinder, and Google Scholar. The paper highlights methods of analysis, differences in coverage, and means of linking references of each database. Web of Science provides coverage back to 1900 and Scopus from 1996 onwards. Although Scopus and Web of Science provide wide-ranging citation reports, all databases miss linking to some references included in other databases.

Suelzer and Jackson (2022) discussed various metrics for individual authors (G-index, H-index, i-10 index), articles (iCite) and journals (journal Impact Factor, Journal Citation Indicator, Scimago h-index, SNIP, CiteScore, etc.) including strengths and weakness of each metrics. This paper also highlights the authors could make use of digital identifiers such as ORCID, and ResearcherID to overcome the problems of duplicate names, and inconsistent names which affect the impact of their publication output.

Kim and Chung (2018) reviewed different metrics such as impact factor, Eigenfactor score, and the article influence score which are used to indicate the level and influence of scholarly journals. In addition, journal metrics such as Source Normalized Impact per Paper, h-index, g-index CiteScore, and SCImago Journal Rank, are discussed. The authors pointed out that one should be cautious about relying on those quantitative measures when evaluating journals or researchers.

The research also focused on the following previous studies:

– The use and misuse of journal metrics and other citation indicators (Pendlebury, 2008)
– An author-level metrics of scholarly impact journals cited through Google Scholar Source (Mariyappa, Kumar & Narasimhamurthy, 2022)
– Web of Science as a data source for research on scientific and scholarly activity (Birkle et al., 2019)
– Comparison between Scopus & ISI Web of Science (Joshi, 2016)
– Citation metrics covary with researchers' assessments of the quality of their works (Aksnes, Piro & Fossum, 2023)
– A Comparative Study of Journals Quality based on Web of Science, Scopus and Google Scholar: A Case Study with IJP&PT (Roales-Nieto & O'Neill, 2012)
– Web of Science, Scopus, and Google Scholar: A content comprehensiveness comparison (Adriaanse, 2013)
– Scopus and Google Scholar publication profiles of Bharat Ratna C.N.R. Rao: A comparison for better assessment of individuals (Prakash & Naik, 2019).
– Review of Google Scholar, Web of Science, and Scopus search results: The case of inclusive education research (Shah, Mahmood & Hameed, 2017)
– Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories (Martín-Martín et al., 2018).
– Journal Metrics: Different from Author Metrics (Kavadichanda, 2020)
– Author-level metrics in the new academic profile platforms: The online behaviour of the Bibliometrics community (Martín-Martín, Orduna-Malea & Orduna-Malea, 2018)
– Google Scholar to overshadow them all? Comparing the sizes of 12 academic search engines and bibliographic databases (Gusenbauer, 2019).
– Citations analyses of Publications (Misra & Ravindran, 2021)

III. Objectives

The main objectives of the study are:

- To find out the importance of three citation analysis database tools such as Web of Science, Scopus, and Google Scholar for research scholars;
- To know the citation analysis potentials of Web of Science, Scopus, and Google Scholar;
- To explore the author-level and journal-level metrics significant for research scholars;
- To review the problem associated with research metrics and suggest some measures to overcome it.

IV. Methodology

The data for the study was obtained by doing a search on the popular citation databases as well as from the e-ShodhSindhu library consortia e-resources. Web of Science, Scopus, and Google Scholar are the three important citation data base selected for this study. The work was done, from June 2023 to March 2024.

V. Discussion

Research metrics are the measurement of the research impact of scholarly publications. They play an important role in impact analysis in funding evaluation, employment, and tenure decisions. The citation analysis tools that are used to analyse the citations and some important research metrics focused on in the present article are as follows:

- Comparison of Web of Science, Scopus and Google Scholar

- Author-level and article-level metrics
- Journal-level metrics and

5.1 Comparison of Citation Analysis Tools

Citation analysis is the examination of the frequency and patterns of citations in research publications. Citation databases have been developed for evaluating publications and these databases enable the authors to count citations and check which articles or journals are the most cited ones.

Table 1: Comparison of Citation analysis Tools

Name	Year	Logo	Owner	Platform	URL
Web of Science	1997	WEB OF SCIENCE	Clarivate	Journal Citation Report	https://clarivate.com/webofsciencegroup/solutions/web-of-science
Scopus	2004	Scopus	Elsevier	SCImago	https://www.scopus.com
Google Scholar	2004	Google Scholar	Google	Google Scholar	https://scholar.google.com/

Table 1 shows the comparative study of the Web of Science, Scopus, and Google Scholar. This table highlights the year of launch, its producers, the type of platform, and also its URL.

5.2 Database Type and Coverage

Table 2 describes the database types and coverage of citation analysis tools. Here in this table, we can compare all three citation analysis tools such as Web of Science, Scopus and Google scholar, their type, the different area covered, Author metrics, journal metrics their top cited publication are shown here.

Table 2: Database Type and Coverage

Description of Citation analysis tools	Web of Science	Scopus	Google Scholar
Database type	Abstract and citation database	Abstract and citation database	Bibliographic database
Disciplines coverage	Science, social science, arts, humanities	Life sciences; social sciences; physical sciences; health sciences	All subjects/Multidisciplinary
Update frequency	Daily/Weekly	Daily	Updated automatically (usually takes 6-9 months)
No. of records	79 million(core collection) 171 million (platform)	82.4 million	389 million records (2018)
Access type	Subscription	Subscription	Free
Temporal coverage	1900-present	1788-present	Unknown
Record format	csv, BibText, ASCII, RIS	csv, BibText, ASCII, RIS	csv, BibText, ASCII, RIS
Geo-spatial coverage	Worldwide	Worldwide	Worldwide
Author Metrics	h-index, Scholarly output and citation count	h-index, Scholarly output and citation count	h5-index, i-10 index, h5 - median
Journal Metrics	Impact Factor (IF), Journal Citation Indicator (JCI)	CiteScore, SJR, SNIP, SCImago H-Index	Scholar Metrics
Topcited publication	Ca-A Cancer Journal for Clinicians (286.13)	Ca-A Cancer Journal for Clinicians	Nature (IF 42.78)
Alert Service	Yes	Yes	Yes
Author Profiles	Yes	Yes	Yes

The use of Scopus and Google Scholar, in addition to WoS, helps reveal a more accurate and comprehensive picture of the scholarly impact of authors (Meho & Yang, 2007). Web of Science (WOS) retrieved the most citation results, followed by Google Scholar (GS) and then Scopus. WOS performed the best with total coverage of the journal sample population and also retrieved the most unique items compared to Google Scholar and Scopus databases (Adriaanse, 2013).

Table 3: Author-level Metrics

Author-level metrics	Developer	Year	Description
H-index	Jorge E. Hirsch	2005	The h number of published papers that have been cited at least h times.
i_{10}- index	Google Scholar	2011	The number of publications with at least 10 citations.
g-index	Leo Egghe	2006	The largest number is such that the top "g" articles received together at least g2 citations.

Table 3 gives a brief introduction to the three important Author-level metrics, such as H-Index, i_{10}- index, and g-index. It provides information on the year of development, how it is calculated, and the name of the person who developed these metrics.

Table 4 Journal–Level Metrics

Journal-level metrics	Developer	Year	Calculated based on	Calculated by
Journal Impact Factor(JIF)	Eugene Garfield	1975	Web of Science	Clarivate
Eigenfactor	Jevin West andCarl Bergstrom	2007	Web of Science	Eigenfactor
CiteScore	Elsevier	2016	Scopus	Clarivate
SCImago Journal Rank	Scimago Lab	1996	Scopus	SJR
Source normalized impact per paper (SNIP)	Henk F.Moed	2012	Scopus	Leiden University's Centre for Science and Technology Studies (CWTS)

Table 4 presents journal-level metrics, such as the journal impact factor, Eigenfactor, cite score, SCImago journal rank, and source normalized impact per publication. This section outlines essential details about these metrics, including their developers, initiation years, calculation bases, and entities responsible for conducting the calculation process.

Table 5: Calculation data source and some examples of citation indicators

Indicator	Calculation	Data source	Example
Impact Factor (IF)	Total Citations within the JCR year divided by journal articles published over the prior two years.	Journal Citation Report	Nature Science JAMA
Eigenfactor Score	Sophisticated algorithm incorporating citations from influential journals.	Eigenfactor.org	New England Journal of Medicine
Immediacy Index	Current year citations divided by current year article count.	Journal citation report	PLOSONE
Citescore	Citations within a year divided by documents published in the preceding three years	Scopus	Cell the lancet
SCImago Journal Rank (SJR)	Sophisticated algorithm relying on citation networks and the prestige of citing journals.	Scopus	American Economic Review
Source normalized impact per paper (SNIP)	Citations received within a year are divided by the anticipated based on subject area.	CWTS Leiden Ranking.	Physics reports
H-Index	The maximum value of H where H publications have received at least H citations	Google Scholar	Stephen Hawking

Table 5succinctly outlines the calculation process for journal indicators, delineating the necessary data sources and providing journal examples for enhanced clarity. It effectively elucidates how metrics such as impact factor and H-index are computed for journals, aiding users in understanding the process thoroughly.

Table 6: Overview of selected citation indicators

Indicator	Year	Subject / Discipline	Scope	Time frame
Impact Factor (IF)	1975	Multidisciplinary	International	Annual
Eigenfactor Score	2007	Biomedical, Health Sciences	Global	Annual
Immediacy Index	1989	Multidisciplinary	Broad	Annual
Citescore	2016	Various	International	Annual
SCImago Journal Rank	2007	Various	Global	Annual
Sourcenormalized impact per paper (SNIP)	2010	Various	International	Annual
H-Index	2005	Various	Individual	Continues

Different citation metrics are used, including the Impact Factor (IF), Eigenfactor Score, Immediacy Index, Citescore, SCImago Journal Rank (SJR), Source normalized impact per paper (SNIP), and H-Index for comparative study. Table 6 shows the fundamental details regarding these journal metrics including their

commencement year, subject coverage, national and international significance, and the time frame within which the calculation process is conducted.

Table 7: Issues related to citation indicators

Indicator	Issues
Impact Factor (IF)	Possible issues may arise due to differing citation practices among disciplines, self-citations, and manipulation of citation measures.
Eigenfactor Score	The intricate calculation process may obscure findings, impeding the researcher's ability to interpret and compare scores.
Immediacy Index	Possible concerns involve fluctuations stemming from publication frequency and discipline-specific citation norms.
Citescore	Challenges may occur due to uneven disciplinary coverage and differing citation practices among fields.
SCImago Journal Rank (SJR)	Possible concerns involve dependence on database coverage and variations in citation norms among disciplines
Source normalized impact per paper (SNIP)	Challenges may emerge due to inaccuracies in subject categorization and differences in citation norms across disciplines.
H-Index	Difficulties may arise from differences in citation practices across disciplines and inconsistencies in data precision.

Table 7 outlines the difficulties encountered with citation indicators, notably in Impact factor differing citation practices among the disciplines, self-citations and manipulation of citation measures are the prevalent issues. Likewise, the issues arise in H index due to variations in citation practices across fields and inconsistencies in data precision, Similarly, the Cite score faces obstacles stemming from unequal disciplinary coverage and differences in citation practices among academic fields.

Table 8: Suggestions and observation of citation indicators

Indicator	Suggestions and Observations
Impact Factor (IF)	Enhance data transparency, promote ethical citation practices, and explore alternative metrics in addition to IF.
Eigenfactor Score	Increase transparency in calculation methods, provide clear documentation, and offer user-friendly score access interfaces.
Immediacy Index	Utilize alongside other metrics for a holistic view of a journal's long-term impact.
Citescore	Improve disciplinary coverage rectify data collection and discrepancies, and ensure transparent calculation methods.
SCImago Journal Rank (SJR)	Improve methodological transparency, broaden database coverage, and validate findings by comparing with alternative metrics.
Source normalized impact per paper (SNIP)	Enhance subject classification accuracy, broaden disciplinary coverage, and maintain consistency in citation data source and methodology.
H-Index	Encourage ethical citation practices, explore field specific H-index normalization, and integrate multiple metrics for a thorough evaluation of researcher impact.

Table 8 indicates the suggestions and Observations of the indicators. In this we can observe some features of the indicators like for Impact factor, it has features such asenhancing data transparency. It also explores alternative metrics in addition to the Impact Factor.Eigen Score has increased transparency in calculation methods, immediacy index makes use of other metrics for a total view of a journal in the long run process. Cite Score has in transparency calculation methods, SCImago Journal Rank broader database coverage and authenticates findings, SNIP has maintained consistency in citation data Source and methodology, H index encourages ethical citation practices; put together multiple metrics for a systematic evaluation of researcher's impact.

VI. Conclusion

Citation analysis is crucial for Journal development. Various like the Impact Factor, Eigen-factor Score, and H –index aid in assessing journal influence. Authors aim to concisely explain these metrics, aiding scholars and users in understanding their significance. By presenting detailed yet accessible information users can navigate scholarly publishing effectively, making informed decisions about journal selection and manuscript submission. This facilitates knowledge dissemination and journal growth within the academic community.

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