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Author-level metrics: Its impact on scholarly output evaluation among various publication metrics

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Abstract

Publication metrics indicate the visibility and reach of a research publication. The metrics can be at article-level, author-level, and journal-level to measure the scholarly output and its impact.[1] Bibliometrics is the use of statistical methods to analyze various publications mostly used in the field of library and information science; whereas, scientometrics is the sub-field concerned with the science of metrics for the measurement and analysis of scholarly publications.[2,3] Readers are not always well informed about the various publication metrics, and use them without knowing how to interpret them, their strength and limitations.[4,5]

The Internet has revolutionized the dissemination, visibility, and impact of documented evidence available on the Web. The author-level metrics (ALmetrics) provides a measure for the research output of an individual author.[6] It summarizes and aggregates the impact of an author's publications by using metrics like h-index (Hirsch-index[7], calculated from the number of articles N by an author that have each received at least N citations), i10-index (measures the number of publications with at least 10 citations, Google Scholar), g-index (an improvement of h-index by giving more weight to highly-cited articles), e-index (differentiates between scientists with similar h-indices but different citation patterns) and others.[8]

The h-index (proposed by J.E. Hirsch in 2005) is a well-accepted metric to assess the scientific impact of an individual author and/or institution due to its simplicity for cumulative research output to indicate a number of papers (h) with at least h citations, e.g. h-index 9 means that among all publications by an author, 9 publications have at least 9 citations each.[9,10] Various other new additions are proposed to complement the h-index to minimize its shortcomings in calculations of the index due to co-authors, self/collaborative citation, publication age, publication count, etc.[11] The h-core is a contextualized evaluation considered more useful.[12] Combination of newer variants help complement and eliminate some of the limitations of h-index, for example, R-index (to measure citation intensity of h-score) and AR-index (to include the age of publications).[13,14] The w-index is another simple and useful improvement to the h-index to assess the integrated impact of a researcher's work.[15] The rh-index (robust h-index) adds value for the self- and collaborative citation.[16]

Other author-centered metrics are p-index (popularity index) to measure the number of a given author's publications; the pp-index (publication popularity index) to calculate the total number of non-repeating authors that have cited a given publication at least once; the ap-index (author popularity index) for a total number of other authors that have cited any publication written by a given author at least once. These popularity indexes are alternative to the h-index which incorporate the number of different citations and eliminate the repeating citing authors, self-, and duplicated citations.[17] Author metrics influence the popularity of a journal, for example, the journal popularity index (jp-index), which means N-authors that have at least once cited a paper in a journal. The journal popularity factor (jp-factor or JPF) equals the sum of the pp-indices of all papers divided by the total number of papers in that journal. To overcome multiple citations and manipulations of the jp-index, each author is counted up only once no matter how many papers he/she has cited from that journal, and thus only new and different authors can raise the jp-index.[17] The widely known impact factor (IF) popularized by SCI journals is a measure of Journal Impact Factor (JIF) which is based on citation number, i.e., the number of citations in a given year divided by the number of published articles in the previous two years. The JIF (or simply, IF) is more of an evaluation for the ranking and prestige of the journal rather than a measure for individual article or author's output.[1,18]

The IF was pioneered by Eugene Garfield of the Institute for Scientific Information (ISI) which also developed the Science Citation Index (SCI) and is now acquired by Thomson Reuters Web of Science (WoS, previously the Web of Knowledge).[18] The SCI impact factor of WoS is maintained by Clarivate Analytics (previously the Intellectual Property and Science business of Thomson Reuters).[19,20] The Eigenfactor (EF) score indicative of journal- and author-level index incorporates both the number of citations and their quality by assigning weights to the source of the citations. The EF scores of SCI journals citation report interpret a journal's importance to the scientific community and the score depends on the size of the journal, i.e., the number of articles published.[21,22] The Article Influence Score (AIS) indicates whether each article in the journal has an above-average (score >1) or below-average (score <1) influence. The AIS = EF x 0.01 / number of articles in the journal. Similar to EF the AIS is also influenced by the size of the journal.

Other well-known and broader competing citation indexes that have emerged in recent years are Scopus and Google Scholar.[4,5] The Scimago Journal Rank (SJR) provides field-weighted citation depending on the field, quality, and reputation of the journal from more countries and more languages to improve the scientific visibility for the multidimensional performance of Journals and Nations.[1,21,23] It also provides journal h-index for the number of articles (h) that have been cited at least (h) number of times, for example, a journal with an h-index of 40 means it has published 40 articles that have been cited at least 40 times each.[1,21] The alternative metrics or 'altmetrics', different to the author level metrics- ALmetrics, are used for article-level metrics to demonstrate the impact and ranking of newly-published articles online, for example, the academic search engines like Google Scholar.[24-27] The various filters can be used to make sense of the vast amount of scholarly literature quickly without having to wait for a minimum of 2 y required to calculate IF (or JIF) calculated as the sum of the citations in a given year (e.g. 2021) divided by the sum of "citable" publications in the previous two years (i.e. during 2019+2020).[1,24,28] The IF (JIF) also lacks transparency and reproducibility and has a potential for manipulation in the calculation because the 'citable' items are not linked to specific articles in the journal.[28] This requires caution while using publication metrics. Metrics should not be used as proxies for research quality or its impact and requires the use of both qualitative (i.e. expert opinion) alongside the quantitate number of metrics.[28,29]

The CiteScore from Scopus is considered more transparent as it is based on the number of citations to documents by a journal over 4 y, divided by the number of the same document types and published in those same four years.[28] For a particular year it is calculated monthly to reveal how the metric builds up as citations accumulate. Source Normalized Impact per Paper (SNIP) is a measure for the ratio of a source's average citation per paper and the citation potential which can be used to compare journals in different subject fields.[28,30] The citation potential varies between subject fields within a discipline and is generally higher in basic science than applied or clinical journals, and journal which covers emerging topics than those with well-established areas.[30] This partially explains why and how publication from authors of basic science discipline elevate the metrics of top publications, for example, 'Nature', 'Science', 'Cell' etc.[31]

Citation counts are based on the metrics calculated to represent how many times a publication has been cited by another publication. The source of citations depends on the citation networks that connect to publication/s it cites or is cited by other publication/s. Thus, the citation number for a publication varies according to citation networks.[32]

The author metrics linked to the academic profile platforms provide an important dimension and visibility, for example, the Google Scholar Citation[33] which computes the total number of 'citations' received by the article, the ResearchGate[34] which calculates the article reads, and the ImpactStory which records 'online mentions' of publication with a DOI added to the ORCID profile of an author.[6] These bibliometric indexes analyze how many articles are published by an author, the number of citations from those articles, and the visibility of research output by that author.

A balanced approach for the evaluation of research output by an author and its quality assessment is needed. The Declaration on Research Assessment (DORA) initiative provides a set of recommendations for institutions, publishers, organizations that supply metrics, and also for the researchers. The general recommendation from DORA suggests that the quality of individual research articles and assessment of individual researchers should not be based on JIF as a surrogate measure to determine their research contribution to hire, promote, or fund and need to assess research on their merits and the journal in which the research is published.[21,35] The IF or other metrics measure the journal's impact rather than an individual author, and so the author or institution should be cautious.

The over-reliance on numbers of metrics may be biased for the actual scientific contribution. The recent controversies over hydroxychloroquine for COVID-19 involving publication metrics of French physician and microbiologist Didier Raoult was more a politics and public manipulation of science, pharmaceutical patent rights, and conspiracy theories.[36,37] For example, an author with 20 articles that are each cited 100 times will score an h-index of 20, but another person with 20 articles each cited only 20 times will also have the same h-index.[7,36] Simply going with the numbers, Didier Raoult has more than twice the h-score than Albert Einstein, and that does not mean the quality of work published and impact on science.[38]

Over-reliance on scientometrics as a measure to quantify the characteristics and features of scientific research publications has fueled the unhealthy environment for incentives and promotion of 'publish or perish' culture.[3,39] The 'acknowledgment index' is a new tool that is used to analyze the citation index and to further the impact of the contribution of acknowledged individuals or organizations to the scientific work.[40-42] A low citation metric may be simply due to non-English publication, or a new field generating fewer citations, or when the work is mainly published in books.[8]

Publication metrics with a high value generally show a high impact of research on the subject

field. All stakeholders should be familiar with the various publication metrics, and their limitations while evaluating the scholarly output of a researcher. The contents of the publication and not only the name of a journal or its metrics should be used to judge a researcher. The academic success of a researcher should be viewed with caution because the different publication metrics used for citation counts give different results, and thus in addition to the journal name and metrics of the journal, the author level metrics should be considered while evaluating the impact of an individual researcher.

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