Editors' Update

Your network for knowledge

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H-index: measuring an author's impact

With such a vast amount of scientific data at its disposal, Elsevier is constantly searching for new ways to collect, organize and interpret it all. That's where bibliometrics comes in. Bibliometrics measures the performance of a collection of articles, whether defined by a researcher, a collection of select articles, a journal, an institute, and so on. The results can then be used to identify trends, evaluate a researcher's performance or provide documentation when processing funding and grant applications.

Adopted by Scopus, the largest abstract and citation database of peer-reviewed literature and Web sources, the h-index is one of the latest additions to Elsevier's range of bibliometric tools. The h-index is a single simple metric that editors can use to evaluate the impact of a particular author over the past decade. The h-index, or highly cited index, was developed in 2005 by the physicist Professor J. Hirsch of the University of California at San Diego as a new way to measure the impact of an author's research articles. Unlike other measurement tools, which tend to examine a specific journal's impact, the h-index looks only at the individual author's work. It rates a scientist's performance based on the number of citations each of their articles has received over its lifetime.

How does the h-index work?

The h-index is calculated as follows: a scientist has index h if h of their n papers have at least h citations each, and the other (N-h) papers have no more than h citations each. An example of this would be: Professor X has an h-index of 29 if 29 of his 185 papers have at least 29 citations each and the other 154 (185-29) papers have fewer than 29 citations each.

The h-index puts an author's career into context, enabling editors to evaluate authors and groups of authors within a specific subject area. "The h-index is part of the growing body of indices that tries to measure scientific information," says Dr. Lisa Geijtenbeek-Colledge, Publishing Information Manager at Elsevier. "The h-index can be applied to anything, but the original idea was that it would measure the impact of a scientist. It does that by looking at all of the citations that their publications have received in their lifetime and then in effect measures the average of the number of citations that an article published by that scientist has received."

Citation data are collected by indexing databases, and the two major ones are Elsevier's Scopus and Thomson Scientific's Web of Science. Both tools index articles and record the references given at the end of the articles. These results are then used to measure scientists' impact upon their field. Of course, this assumes that their impact can be measured by the number of citations their papers receive, which Geijtenbeek-Colledge believes is "fair because citations usually reflect the fact that their peers have read their papers and considered them relevant enough to be referred to in their own work."

A new way of looking at research

While other bibliometric indices already exist, the h-index represents a new direction for these measurements. Most ranking systems to date have only evaluated authors by measuring the impact of the journal in which the scientist has published. While that may be a fair way to assess these authors in some cases, in other cases it may not be very accurate, since it looks only at the average performance of all the articles in the journal in question. According to Geijtenbeek-Colledge, "Any individual paper published in that journal could have performed much better or worse than the average of all the papers in that journal. So it's not really fair to say that a scientist's influence in the field is directly related to the impact of the journal he or she's published in. The h-index

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looks just at their own papers and the citations their own papers have received. I think it's a much fairer and more accurate measurement of a scientist's influence on their field."

The h-index has proven to be an especially valuable tool for editors, as it provides a simple method of gaining information on a scientist's body of work. Editors will often receive suggestions for a scientist whose work they are unfamiliar with to serve on an editorial board. A quick check of the h-index will give the editors a basic measure of how many papers that scientist has published and whether they are interesting enough to be cited. Some editors also use the h-index as a useful means of comparison when carrying out assessments for grant applications.

> "The h-index is a simple metric editors can use to evaluate the impact of a particular author over the past decade."

How reliable is the h-index?

One way of measuring how successful the h-index is in evaluating scientists is to see whether its results match the opinions of internationally renowned scientists in a particular field. A study published in *Scientometrics* (1) in 2005 looked at the h-indices of young post-doctoral researchers who applied for a biomedical fellowship. Those awarded the fellowship had a higher h-index than unsuccessful candidates, indicating that the h-index could be considered a reasonable measure of quality.

Still, like any bibliometric tool, the h-index has advantages and disadvantages. Among its benefits are that it takes into account both the productivity of a scientist and the quality of a scientist's articles and so can distinguish between truly influential scientists and those who just publish numerous papers (as well as the one-hit wonders).

But with these advantages come some drawbacks. One is that the h-index is not affected by several very highly cited papers which are often considered to be the ones that primarily affect a scientist's influence in a field, thereby sometimes giving a somewhat misleading measure of a particular author's true impact on the field. In addition, the h-index does not decrease with time, so it cannot be used to detect declining research output or retirement. Having said this, the Scopus h-index implementation includes articles published per year and cites received per year to address this shortcoming.

Defining the citation period

Scopus has references for articles from 1996 onwards as this was proven to be sufficient for the majority of current literature research needs. For the h-index, this means that works published prior to 1996 will only have a citation count if they were cited by papers published after 1996. However, for the purposes of grants and funding, most application forms require no more than 10 years worth of information. The Scopus h-index enables users to limit the time for the h-index anywhere between one and 10 years. This may result in a reduction in h-index for authors who were active before 1996, as some of their key papers might not be counted. "We have had some queries from scientists concerned about this cutoff, especially if they've had a long career and some of their early papers are not counted," says Geijtenbeek-Colledge. "We still believe that for the vast majority of cases, the more recent articles are sufficient to make a fair judgment of a scientist's impact and relevance, rather than something they published 20 or 30 years ago."

Ultimately, there can be no one measurement that will satisfy every situation. The h-index was conceived as a complement to the other indicators currently available, not as a replacement for them. And as the ever-growing field of bibliometrics shows, authors and editors are always on the lookout for new and innovative ways to measure scientific research.

References:

(1) Bohrmann, L. and Daniel, H.D. (2005). Does the h-index for ranking of scientists really work? *Scientometrics*, 65, 391-392.

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