The Place of Citations in Today's Academy

The new science of bibliometrics

Citations are references to authors in other academic papers as acknowledgement of their contribution to a specific research area. They are mostly accrued through the publication of journal articles although they are also generated through books. The field of citation indexing is called bibliometrics and it was pioneered by Dr Eugene Garfield in 1955.

Garfield envisioned a world where information about important scientific developments could be easily retrieved by researchers. With the use of information tools, scholars could map scientific trends, assess the influence of individual papers, and, of course, trace the impact of their own work.

Garfield created the Institute for Scientific Information which is the citation index most used by the academic community today. Unlike the first issue of the Science Citation Index, produced in volume form in 1964, bibliographic information is now available on-line (www.ISIknowledge.com). The Institute for Scientific Information (ISI) includes bibliographic data on the sciences, social sciences, and more recently the arts and humanities.

Many university libraries subscribe to ISI. The most common use of the database is for retrieving journal articles. However, increasingly bibliographic data are being used as a heuristic technique for assessing scientists' work, and they are even being used by governments to evaluate whole nations' research output.

Using citations to measure quality

Many deans, department heads and recruitment committees are using citations as part of the assessment process involved in making new appointments. By going through databases like ISI, selection panels can not only discover what quality of journals an individual is publishing in, but they can also check if a candidate's work is making an impact by being cited by other researchers in their field.

Using citations as a measure of research quality is still controversial. Some assert that bibliographic data were not intended to be used as tools for measuring excellence but instead for information retrieval. Despite objections, bibliometric measures have become part of the evaluation process of academic research.

In 1986 the British government introduced the Research Assessment Exercise (RAE) which was designed to assess the quality and quantity of research being generated in UK universities. The method is quite complicated, involving, at the heart, peer review supported by substantial quantities of paper-work. Because each RAE requires enormous effort, from scholars and administrators across the sector, some faculty started to ask whether a much simpler mechanism might be to use citations analyses. Consequently there have been a range of studies over the last three assessment exercises that have compared RAE results with those drawing only from bibliometric measures. Overwhelmingly, the papers report a strong correlation between the two sets of results. A chemistry department in University X that is highly rated by the peer-reviewed RAE method is also typically a highly-cited one.

Weaknesses in citations data

A common criticism of citations data is that an author can receive citations for bad work as well as for work that is viewed as good. This happens, some argue, because authors will cite often a piece of work that is receiving criticism and, therefore, the publishing author of 'bad science' might accrue as many citations as someone publishing quality work. Of course what is considered 'bad science' mayl be hotly disputed, and these disputes themselves are part of the process of scientific development.

It is my belief that, in general, those studies that are genuinely shown to be wrong or to have been falsified will not go on to generate high numbers of citations. Of course there will always be exceptions. Papers that are repeatedly referenced negatively may generate a small bubble of citations, but it is unlikely that future work from the same author will receive a great deal of attention. Indeed, authors who write on bibliographic data, who are mostly from the field of information science, on the whole agree that citations analyses are a reliable indicator of performance over long periods of time.

Another weakness often reported with citations indexing is nationality. Language biases have been shown to exist within ISI because of the dominance of English. However, as most international journals are increasingly producing English versions, language bias has arguably become less of a problem. Nevertheless, it will undoubtedly take a number of years for language to become neutral rather than disadvantageous to authors publishing from non-English speaking nations. There are those who assert that the global dominance of English is a form of cultural imperialism. But then, academic publications tend to follow research money and the United States still has the largest research budget of any nation.

The US generates the largest quantity of academic articles and also citations. It has been claimed in the literature that preferential referencing may take place within the US; this essentially means that Americans are more likely to reference Americans. However, again, this is largely explained by of the size of the US academic market. It is usual for those who are geographically and culturally closer to be part of the same networks. Hence, they are more likely to reference each other. This is changing somewhat. Thanks to improved communications, particularly the internet, international co-authoring is now common.

Journal impact factors

There are problems with the accuracy of bibliographic data collection. Inconsistencies in methods of referencing, and inaccuracies in citation statistics, have been common. Self-citing presents another potential glitch, and this can take two forms: first, over-citing one's own work in academic papers, and, second, self-citation in articles to try to raise a journal's 'impact factor'. Journal impact factors measure the intellectual influence of journals by counting which ones are receiving the most citations (over the latest two years) by publishing authors. So for example, if the most cited work is coming from articles in 'Journal of Great Work' then this will increase the impact factor of that publication.

Academic journals are now equally keen to attain as many citations as possible. This is because ISI assign impact factors to journals and these, in turn, raise or lower their

perceived standing. ISI even goes as far as to create a quasi league table of journals using these data.

Traditionally, the status of an academic journal was built up through the reputation of editors, the editorial board, and those eminent scholars who published ground-breaking research between their covers. Of course, time and again the most influential work failed to appear in the top publications. There have been many examples of articles that become the most cited, yet that failed to be accepted by leading journals in their field. This may occur because some ground-breaking studies are at the fringes of a subject area and therefore deemed to be somewhat risky by the disciplinary stalwarts.

Although previously mentioned 'traditional' measures of journal quality still apply, these bibliographic alternatives available through ISI have not gone unnoticed.

When ISI first began to assess academic journals using this methodology, there were inconsistencies; and this is where the notion of self-citation returns. One study that looked specifically at this issue reported a significant correlation between self-citation levels and impact factor scores across six journals in the field of anaesthesia. These journals discovered that it was possible to raise their impact factor by encouraging publishing authors to cite other authors from previous issues. However, this loop has now apparently been closed, as have many loops in this somewhat infant field. Journal impact factors should, nevertheless, be applied with some caution.

Comparing citations across academic disciplines

Most important when using citations as any kind of measure of quality is recognition of the huge differences between disciplines. For example, a very highly cited social scientist (say, one of Harvard's best professors) might have a lifetime citation score of around 3,000-4,000 whereas a top molecular biologist could have a score of over 15,000-20,000. The discrepancies in citation levels across disciplines are demonstrated in the number of new cited references that appear in ISI every week. The sciences generate approximately 350,000 new cited references weekly, the social sciences 50,000 and the humanities 15,000.

Bibliometric indicators have been used more consistently across the sciences than in the humanities and social sciences. Such use is most evident in the natural and life sciences. These disciplines publish more journal articles and have a higher prevalence of co-authorship. In the social sciences, it is now quite common for there to be up to three authors attributed to an article, but any more is unusual -- whereas in the sciences, co-authors can easily extend to the tens or twenties.

Another issue that skews disciplinary comparison is the publication rhythm and turnaround times of journals. Some medical disciplines have weekly journals; in history the journals are often quarterly. The discipline of economics relies heavily on journal articles although, unlike scientific publications that tend to publish quickly, in economics it can take up to two years from the time an article has been accepted to the date of publication. The refereeing process in economics alone can be up to a year. This is not usual in the sciences.

Writing articles for journals is less common in the arts and humanities. These disciplines tend more towards publishing monographs. The culture of books and journals is somewhat different. For example, one study found that in the discipline of

sociology two distinct groups of highly cited academics co-existed -- those highly cited through journal articles and those through publishing books.

Conclusion

Finally, there has been monopoly concerns expressed about over-reliance on the Institute of Scientific Information, which is now owned by Thomson Publishing. Other sources for citations retrieval do exist, for example, Scopus, which is owned by the publisher Elsevier. And there are also small societies and independent one-man-bands that create websites with their own methods of counting citations.

One of the most interesting, though possibly unsurprising, outcomes associated with the heightened awareness of citations is the extent to which they are being used to create league tables of top scientists. In 2005 Jorge Hirsch developed an *h*-index, essentially a method of counting citations, which he uses to identify the most cited scholars in the field of physics. These top physicists are then slotted into a league table. Similar rankings exist in economics and psychology, and no doubt elsewhere. For some scholars, counting one's own citations has by repute become almost obsessional. I personally know of a physicist who checks his numbers every morning!

It could be argued that this level of citations awareness is somewhat unhealthy and overly competitive. Then again, maybe it is inevitable in a world that celebrates those who are first – to identify a fact or explain a phenomenon. It is worth mentioning at this point that for those who would like to improve their citations levels there is a very quick and easy method. Ensure that you place all your academic papers (and others) onto your web site with live links to the full text. This will not only generate a few more citaions for you, but also, and more importantly, it will get your work out to other scholars and generally disseminate your ideas more widely. This must be good for science.

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