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The value of bibliometric measures



Is e-publishing affecting science?

As the world of publishing continues its relentless march towards the electronic medium, researchers in various fields are trying to understand what this means for science – specifically, how this is affecting citation patterns and reader behavior.

While some recent research based on citation data has indicated that the availability of online journals is narrowing science, experts in the field of reader behavior dispute this claim. Studies into reader behavior suggest that the use of online journals has instead broadened scholarship and may be driving a new “information democracy”.

In July 2008, sociologist James Evans reported in *Science* the results of a study showing that online journal access has led to an increasing concentration of citations of fewer, more recent articles across a narrower range of journals (1). Evans argues that browsing through print journals used to lead to more serendipitous discoveries of knowledge, while the era of online access has resulted in rapid consensus-building and preferential attachment.

“What our data shows is not a tendency towards an increasingly exclusive and elitist scientific system, but rather one that is increasingly democratic.”

However, in the accompanying editorial, Carol Tenopir at the University of Tennessee in Knoxville offers a different perspective. Tenopir, with longtime collaborator Donald W. King, has studied reader behavior in the online journal environment for many years. Their findings suggest that the number of older articles read by researchers has increased in the ten years that coincide with the advent of online journals, as have the number of different journals they use (2).

Online journals broaden reading

Tenopir says: “I do not dispute Evans’ findings, but my research leads me to conclude that e-journals are broadening reading, and therefore science.” Tenopir and King’s latest longitudinal work has been accepted for publication in *Aslib Proceedings* (3).

She suggests that their different conclusions could be due to the fact that they are actually studying different phenomena: “Evans is looking at citation patterns, while we study reading patterns. Scientists read journal articles for many purposes, not just research and writing, but also for teaching, current awareness and so on. Only readings that are for research within their discipline are likely to result in citations. Even then, scientists read many more articles than they eventually cite.”

Tenopir continues, “there are many motivations to cite, including signaling what is the most important or best of the whole body of what the scientist has read. Our surveys on readings show a steady increase in the number of reported readings and a broadening in the number of journal titles from which at least one article is read. Papers found by searching are more likely to be for research, and are often found in the broad range of e-journal titles held by the scientists’ university library. Readings for current awareness are more likely to be found by browsing through personal print subscriptions.

“Evans credits our earlier demonstration of increased searching as a factor in the narrowing of citations, but this seems unlikely. Finding more articles through searching is almost certainly a factor in the broadening of the sources of reading and thus citation.”

Citations spreading further

Meanwhile, a new study to be published in the *Journal of the American Society for Information Science and Technology* was recently posted to the pre-print server arXiv by Vincent Larivière, Yves Gingras and Éric Archambault (4). Using more than 25 million papers and 600 million citations, they

show that the concentration of article and journal citations has been decreasing over time.

According to their research, the percentage of papers that receive at least one citation has been increasing since the 1970s. At the same time, the percentage of articles needed to account for 20%, 50% and 80% of the citations received has been increasing, and the Herfindahl-Hirschmann Index – the concentration index used by Evans – has been steadily decreasing since the beginning of the last century.

“Taken together, these results argue for increasing efficiency of information retrieval in an online world, and the information democracy that this entails,” says Larivière. “The scientific system is increasingly efficient at using published knowledge. What our data shows is not a tendency towards an increasingly exclusive and elitist scientific system, but rather one that is increasingly democratic.”

Towards a democracy of citations

In another paper preceding that of Evans, Larivière, Gingras and Archambault also contradict the claim that the age of cited

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literature is decreasing (5). In Larivière's view, "Evans' conclusions reflect a transient phenomenon. The best example of this can be seen in the field of astrophysics, where the authors did observe a decline in the average age of cited literature at the beginning of the open access movement in the 1990s. However, by the beginning of the 2000s, when almost 100% of the papers were available, the average age started to rise again and has not stopped since."

In fact, while online publishing may have initially narrowed science, as online searching becomes more efficient and researchers learn how to use this wealth of data to greater effect, they are certainly browsing through and reading, if not actually citing,

a wider range of materials. In time, we may well see reading and citations broaden further as researchers come across a wider range of readings in the online world.

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Research trends



Women in science – perception and reality

As gender equality in science moves further to the forefront of policy agendas, we are seeing more discussion on the perceived challenges facing women in research careers. But what is the reality of the relative output and quality of the science produced by men and women?

In a 2003 EU report entitled *Gender and Excellence in the Making*, the EU Commissioner for Research asserted that "the promotion of gender equality in science is a vital part of the European Union's research policy," and called for public debate informed by research into the mechanisms by which this inequality has emerged (1). Part of the problem can be encapsulated in terms of two apparent conundrums: the Productivity Puzzle and the Impact Enigma (see box).

New research challenges long-held perceptions

Against this backdrop of perceived gender differences, recent research has cast doubt on the validity of the underlying assumptions about

productivity and impact (2). An analysis of the published research of 254 Spanish Ph.D. graduates showed no statistically significant gender differences in output (or lack thereof), degree of collaboration or citations per article. The individuals analyzed came from a range of scientific disciplines, but all were awarded their doctorates between 1990 and 1995, and so were of a similar scientific "age", suggesting that previous differences in output and impact were artifacts of a skewed distribution of women across academic grades.

In keeping with this, a study of radiation oncologists at US academic institutions showed that the [h-index](#) (determined for each individual in Scopus) was lower for women than men (mean 6.4 versus 9.4), but that when the results were adjusted for academic ranking, the gender differential almost disappears.

Gender and productivity

Elba Mauleón and Maria Bordons of the Institute for Documentary Studies on Science and Technology (IEDCYT)

A puzzle and an enigma

The Productivity Puzzle is the phenomenon whereby women publish fewer articles than men. This observation has been confirmed repeatedly over recent decades, and several reasons have been put forward to explain it. These include sociobiological factors, such as the need for women to balance career with family obligations, and sociopolitical factors, such as systematic gender bias in the process of peer review for journal publication and competitive grant funding.

The Impact Enigma stems from the observation that women have higher citation impact (citations per article) than men. It has been suggested that this might be because women have a publication strategy that emphasizes quality over quantity or that they participate more in collaborative work, resulting in more robust study design and execution.

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