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The Web impact of open access social science research

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Abstract

For a long time, Institute for Scientific Information (ISI) journal citations have been widely used for research performance monitoring of the sciences. For the social sciences, however, the *Social Sciences Citation Index*[®] (SSCI[®]) can sometimes be insufficient. Broader types of publications (e.g., books and non-ISI journals) and informal scholarly indicators may also be needed. This article investigates whether the Web can help to fill this gap. The authors analyzed 1530 citations from Google[™] to 492 research articles from 44 open access social science journals. The articles were published in 2001 in the fields of education, psychology, sociology, and economics. About 19% of the Web citations represented formal impact equivalent to journal citations, and 11% were more informal indicators of impact. The average was about 3 formal and 2 informal impact citations per article. Although the proportions of formal and informal online impact were similar in sociology, psychology, and education, economics showed six times more formal impact than informal impact. The results suggest that new types of citation information and informal scholarly indicators could be extracted from the Web for the social sciences. Since these form only a small proportion of the Web citations, however, Web citation counts should first be processed to remove irrelevant citations. This can be a time-consuming process unless automated.

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1. Introduction

Authors of academic journal articles use references to acknowledge prior published research, such as building upon previous discoveries, using others' methods, or drawing upon relevant theoretical insights. Citations can be valuable evidence that the cited article has made a useful contribution to the scientific enterprise (Merton, 1973). The word *impact* is often used to denote that which is represented by citation counts; an article, journal, or any other collection of work that has received many citations can be described as having a high impact in terms of influencing future work in some way. Citation impact can also reasonably be described as “scholarly impact” and “intellectual impact” and is often equated with the quality of importance of research. Although this probably tends to be true in large-scale analyses, it is not true for individual articles (Moed, 2005).

Citation analysis has been widely used to evaluate research and to identify the impact of scientific work in many areas of science (Cole, 2000; Moed, 2005). Thompson Scientific, formerly Thompson ISI and the Institute for Scientific Information (ISI), is the predominant source for impact assessment using journal citations (Wouters, 1999). Moreover, the main source of information for citation analysis in the social sciences is the *Social Sciences Citation Index*[®] (SSCI[®]), also maintained by the ISI. Although many studies have used ISI citations for research impact in the social sciences and humanities (e.g., Finkenstaedt, 1990; Glänzel, 1996; Hicks, 1999; Ingwersen, 2000; Van Leeuwen, 2006), there are still many practical limitations for using ISI citation data for monitoring impact performance in the social sciences (see Nederhof, 2006). For instance, geographic coverage biases (e.g., overrepresentation of English-language journals) are problematic when benchmarking the output of countries in the social sciences and humanities (Gingras, Archambault, Vignola-Gagne, & Cote, 2006). Moreover, the ISI database does not attempt to cover all research; it attempts to include top-quality journals, which can be a problem for research evaluation (Moed, 2005). For these reasons, some efforts have been made to design locally created social science citation indexes (Webster, 1998). Furthermore, journal articles are less important for scholarly communication in many social science and humanities disciplines; in science, publications such as books and monographs have a smaller role in research communication (Glänzel & Schoepflin, 1999; Knieval & Kellsey, 2005; Moed, 2005; Nederhof, 2006). In addition, unpublished communications such as some conference presentations, keynote talks, e-mail lists, and panel discussions can also be important avenues for social science scholars to gain reputations and establish support for their positions (Becher & Trowler, 2001).

Nederhof (2006) states the following clear case for differing methods in the basic sciences and the social sciences and humanities:

Bibliometric methods for monitoring research performance should reflect the heterogeneity in publication and citation behavior of social scientists and humanities scholars.... The citation indices used predominantly in social sciences and humanities tend to have more limitations than the SCI for most sciences (p. 89).

Every bibliometric study has some limitations, but Nederhof (2006) also suggested that a broader range of publications and indicators is needed in many social sciences and

humanities areas for bibliometric monitoring of research performance. This could include non-ISI serials, edited volume chapters, monographs, formal reports, and even information aimed at a non-academic audience.

In addition, informal scholarly sources and activities may influence scholarly work (Becher & Trowler, 2001; Crane, 1972), but they cannot be detected using traditional citation analysis techniques. The term *formal communication* is usually used to describe the published literature in a field (Meadows, 1974), including books, journals, and published conference proceedings. In contrast, *informal scholarly communication* refers to all other forms of communication, including letters, talks, and telephone calls. It is possible to use conventional research methods (i.e., observation, interviews, and questionnaires) to study informal scholarly communication patterns (e.g., Fry, 2006; Lievrouw, 1990; Matzat, 2004). Nevertheless, these methods are time consuming and impractical for large-scale studies or routine research impact evaluations. Currently, however, some informal communication is published on the Web—for example, in preprint archives, subject or university digital repositories, and e-mail discussion list archives.

As an alternative source of information, the Web contains citation data from a wide range of publication types, including non-ISI serials and informal scholarly sources that could potentially be useful for impact assessment (e.g., course reading lists, scholarly presentations, and correspondence). Thus, it is necessary to assess formal and informal impact in the social sciences based upon this wider source of information and perhaps also to understand the extent to which scholarly work is influenced by it.

There are many ways in which scientific impact could be measured on the Web, such as counting mentions of individual scholars (Cronin, Snyder, Rosenbaum, Martinson, & Callahan, 1998) or counting citations to, or mentions of, the full range of their publications. One logical extension of traditional citation analysis, however, is to count Web citations to published journal articles. Although other researchers have analyzed Web citations for the impact assessment of journal articles in the sciences (Vaughan & Shaw, 2005), in library and information science (Vaughan & Shaw, 2003), and the Dutch and French humanities (Van Impe & Rousseau, 2007), no similar research has analyzed Web citations in the wider social sciences, an important gap.

In this study, the authors analyzed sources of “unique Web/URL citations” (as defined below) from Google™ to open access journal articles in four social sciences: sociology, psychology, education, and economics. The aim was to identify whether there were significant numbers, what type of citations existed, and whether there were disciplinary differences in the results. Open access journals and the Web/URL citation method were chosen in order to get evidence of the widest possible range of types of Web citations. Overall disciplinary differences were analyzed in terms of the proportion of Web citations representing formal and informal online intellectual impact. The primary aim was to assess whether the Web contains citation data that could compliment ISI data for traditional bibliometric monitoring studies in social sciences. In particular, online non-journal citations that give useful evidence of academic impact were sought.

2. Literature review

Several previous Web classification studies have explicitly reported the proportion of citations from online academic publications, described here as *formal impact* (but also termed *research-oriented*, *research impact*, or *formal scholarly communication*), and the proportion that suggest scholarly impact in some other way, described here as *informal impact* (mainly education-related).

The early multidisciplinary study of Harter and Ford (2000) examined motivations for creating links to e-journal Web sites. They found few links equivalent to the formal citations used for impact assessment. Although they did not explicitly classify any sources of Web links as indicating informal impact, some of their Web links were from academic course reading lists.

Other Web citation impact experiments used text citations to journal articles rather than links. Vaughan and Shaw (2003) classified a sample of 854 Web citations (exact article titles in the text of Web pages) to ISI journal articles in library and information science (LIS). They found about a third to be representative of formal impact (e.g., citations from online articles). In addition, 12% of their Web citations were from class reading lists, representing wider intellectual impact. This gave the first clear evidence that the Web could yield new, useful types of non-journal citation data for impact assessment. A later study of the same field classified sources of 3,045 URL citations (mentions of exact article URLs in the text of Web pages) to articles in LIS open access journals. This study found an increased proportion—close to half of the URL citations—representing formal impact (Kousha & Thelwall, 2006). It is not clear whether these different results were due to the different data collection methods used or to changes over time. Another study by Vaughan and Shaw (2005) counted Web citations to ISI journal articles in four areas of science: biology, genetics, medicine, and multidisciplinary sciences. The percentage of Web citations indicating any kind of intellectual impact (merging citations from articles and class reading lists) was about a third for each discipline. This suggested that a smaller percentage of Web citations represents scientific impact in the sciences than in LIS and perhaps the wider social sciences.

Other online impact assessment experiments covered university Web sites rather than journal Web sites and used links rather than Web or URL citations. They are useful evidence that the Web contains impact evidence. Wilkinson, Harries, Thelwall, and Price (2003) classified 414 inter-university links from the ac.uk domain. They found less than 1% equivalent to journal citations, a much lower percentage than reported in any of the journal-related studies. Moreover, less than 2% of the Web links were from student learning material. Bar-Ilan (2004) classified 1332 Israeli inter-university links. She found that about 20% were research oriented or reflected formal impact, and 23% were educational (mainly course-related), which could indicate informal impact. In another study, she examined reasons for linking between Israeli academic Web sites based upon a classification of link types from the source and target pages, finding 28% of the links to be research oriented. She did not report the percentage for educational link creation motivations, although 13.5% of targeted pages were educational (Bar-Ilan, 2005). In contrast, Kousha and Horri (2004) classified motivations for creating 440 links from Web sites within the .edu domain to Iranian university Web sites, finding no citation-like reasons for any of these international links. These results highlight the variability in the use of links across countries and contexts.

Table 1
Summary of previous classification exercises for online intellectual impact assessment

Study	Type of Web object	Discipline or Web domain	Formal impact	Informal impact	Total impact
Harter and Ford (2000)	Links to e-journal Web sites	No specific discipline	8%	N/A	8%
Vaughan and Shaw (2003)	Web citations to journal articles	Library and Information Science	30%	12%	42%
Wilkinson et al. (2003)	Links between university Web sites	UK university Web sites	1%	2%	3%
Bar-Ilan (2004)	Links to university Web sites	Israeli university Web sites	20%	23%	43%
Kousha and Horri (2004)	International links to university Web sites	Iranian university Web sites	0%	N/A	0%
Bar-Ilan (2005)	Link target pages in academic Web sites	Israeli academic Web sites	28%	N/A	28%
Vaughan and Shaw (2005)	Web citations to journal articles	Biology, genetics, medicine, and multidisciplinary sciences	N/A	N/A	30%
Kousha and Thelwall (2006)	URL citations to e-journal articles	Library and Information Science	43%	N/A	43%

Table 1 summarizes these studies.

3. Research questions

Despite the research discussed above and the importance of informal communication for the social sciences, no previous study has investigated online evidence of scholarly impact across the social sciences. This article fills this gap. However, to narrow the scope of the investigation to a practical level, it examines only citations to refereed journal articles in the social sciences and ignores citations to other (sometimes equally valid) outputs, such as books and conference presentations. In addition, as a practical step, open access journal articles in only four social science disciplines are investigated: education, psychology, sociology, and economics. The following specific questions drove the research:

1. What are the common types of online intellectual impact (formal or informal) that can be used to assess scholarly communication in the social sciences, in terms of citations to open access, refereed journal articles?
2. Are there significant disciplinary differences between sciences and social sciences in terms of online informal impact indicators derived from open access, refereed journal articles?

4. Procedures

This article uses the same method and data set (in terms of journals) for extracting Web citations to open access (OA) journals as a previous investigation that examined the correlation between ISI citations and Google™ Web/URL citations (Kousha & Thelwall, 2007a). For the

classification of online formal and informal impact, the authors adopted a scheme previously used for science (Kousha & Thelwall, 2007b) so that the results would be directly comparable. The next section briefly summarizes the data gathering method.

4.1. *Sample selection*

The sample consisted of English-language, open access, peer-reviewed (or editor-reviewed) journals published in 2001 and covering education, psychology, sociology, or economics. Only research articles were selected, and proportional sampling was applied in each discipline so that journals with more published articles had more sampled articles. This gave 492 research articles from 44 open access journals.

For each article, “Google Web/URL citation” searches (Kousha & Thelwall, 2007b) were conducted. These found Web pages that contained either the title of the article or its URL anywhere in the page text (but not necessarily as a link). Google unique Web/URL citations were extracted, a maximum of one Web/URL citation per site. This eliminated repeated results from the same site (see Kousha & Thelwall, 2007a) and produced a list of 7942 citations. Proportional sampling was again applied to select the Google unique Web/URL citations for each OA journal. Hence, journals with more unique Google unique Web/URL citations targeting their OA articles had also more Web/URL citations in the sample. This process gave 1530 Google unique Web/URL citations to be classified.

4.2. *Classification of Web/URL citations*

For the classification process, two types of citation were important: those representing formal impact and those representing informal impact. The remaining citations were classified as “other.”

Citations were classified as indicating formal scholarly impact if they were in the reference sections of online, scientifically related documents, either full-text documents or cross-reference services. This definition is similar to formal scholarly communication (Borgman & Furner, 2002), and the concepts of research oriented (Bar-Ilan, 2004, 2005) and research impact (Vaughan & Shaw, 2005). Note that the inclusion of two categories of documents that are not necessarily formally published (e-prints and reports) means that our definition is not the same as that traditionally used for formal scholarly communication (e.g., Meadows, 1974). This decision was made because the dividing line between published and unpublished online academic documents seems to be significantly greater than that between academic documents and more informal messaging formats (see Section 6 for more discussion). Below are the subclasses used for formal scholarly impact:

- journal articles;
- conference or workshop articles;
- dissertations;
- e-prints (post-prints, preprints, or unknown scholarly documents);
- research or technical reports;

- books or book chapters; and
- cross-reference or citation index entries.

In some cases, the citing source types could not be recognized from the full-text Web documents or from further investigations of the hosting site. The e-prints classification category was used for unknown document types. As with a previous study of science (Kousha & Thelwall, 2007b), the proportion of such e-prints that were journal or conference pre-prints or post-prints could not be assessed.

Citations were classified as indicating informal scholarly impact if there was evidence that the targeted documents had been recommended by other people or otherwise mentioned in an informal scholarly communication context. For instance, Web/URL citations in a class reading list, presentation file, discussion board posting, or forum message (where people recommend articles or use them to support a discussion) were taken to indicate some kind of use and hence impact of the research. Note that current awareness Web citations were excluded, as were those that were created for reasons that did not indicate intellectual impact. The following subclassifications were used:

- presentations (i.e., conference or seminar presentation files);
- course reading lists (i.e., academic course outlines or syllabi); and
- discussion board or forum messages.

5. Findings

5.1. *The online impact of OA social science articles*

Of the 1530 sampled Google unique Web/URL citations targeting 492 research articles in 44 open access journals published in 2001 in the four social science disciplines, 289 (19%) and 166 (11%) were found to represent formal and informal impact, respectively. In other words, about 30% of the Web/URL citations reflected the online intellectual impact of open access articles in the social sciences and could therefore potentially be used for research evaluation. Recall that 1530 out of 7942 were selected citations in the sample. The total number of formal or informal impact citations for the complete set of citations was expected to be $(289+166) \times 7942 / 1530 = 2362$ for the 492 articles sampled, which is $2362 / 492 = 4.8$. In whole numbers, there were about 3 formal and 2 informal impact citations, a total of 5 per article.

Fig. 1 illustrates disciplinary differences in the proportion of the Google unique Web/URL citations, which reflect formal and informal intellectual impact. In sociology, psychology, and education, there are only moderate differences between formal and informal online impact, although there is a low overall level in psychology. In contrast, in economics the ratio of formal to informal impact is six to one. A possible explanation is differing disciplinary patterns of informal scholarly communication. Perhaps the unusually high degree of agreement in (Anglo-Saxon) economics about which research problems are important means that informal scholarly communication is less essential. In other fields, debate may be needed to stake claims to the value and validity of research areas and approaches (Whitley, 2000, pp. 119–148). Another explanation is that research outputs may be more tied to teaching, presentation, and discussion.

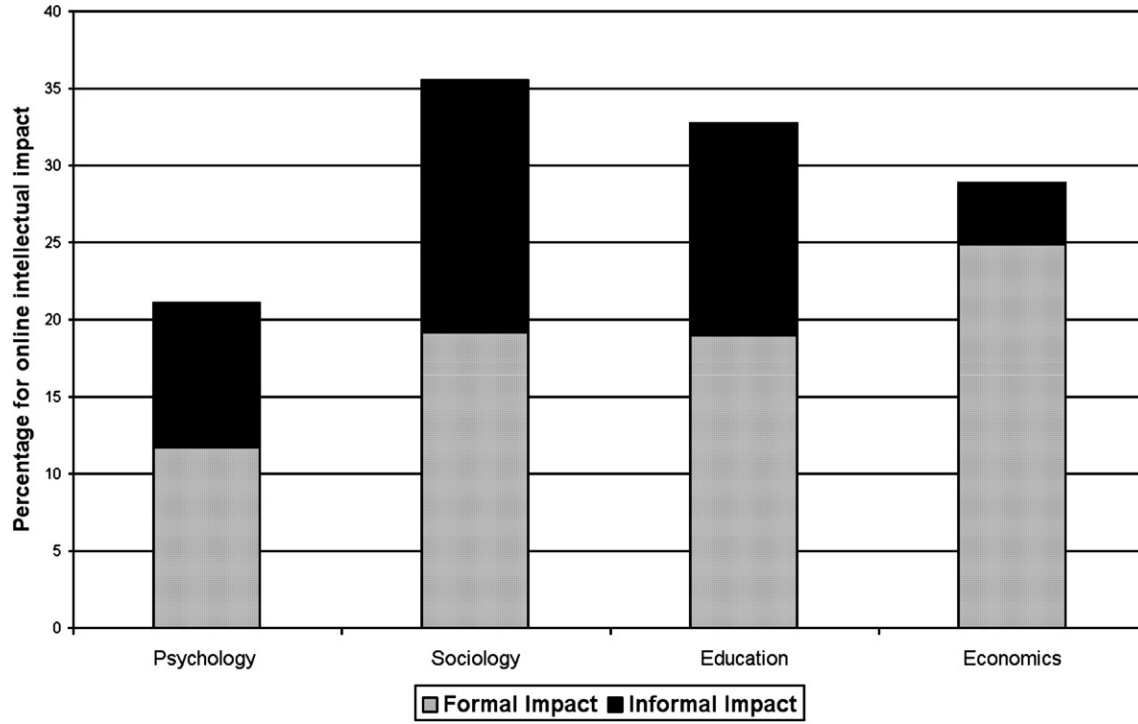


Fig. 1. Comparison between formal and informal online impact in four social sciences.

Table 2
Sources of formal impact in four social science disciplines

Source	Formal scholarly impact							
	Journal	Conference/ Workshop	Dissertation	E-print pre/post- print	Research/ technical report	Book	Cross- reference service/Web citation index	Total
<i>Discipline</i>								
Psychology	17 (4.9%)	0 (0%)	1 (0.3%)	10 (2.9%)	4 (1.1%)	1 (0.3%)	8 (2.3%)	41 (11.7%)
Sociology	12 (3.4%)	11 (3.1%)	8 (2.3%)	23 (6.6%)	5 (1.4%)	2 (0.6%)	6 (1.7%)	67 (19.1%)
Education	17 (4.1%)	15 (3.6%)	9 (2.2%)	21 (5%)	8 (1.9%)	1 (0.2%)	8 (1.9%)	79 (18.9%)
Economics	20 (4.9%)	16 (3.9%)	7 (1.7%)	22 (5.4%)	29 (7.1%)	1 (0.2%)	7 (1.7%)	102 (24.8%)
Total	66 (4.3%)	42 (2.7%)	25 (1.6%)	76 (5%)	46 (3%)	5 (0.3%)	29 (1.9%)	289 (18.9%)

In contrast, economics research might be more tied to article and research report publications, with economic information being more likely to be confidential. These disciplinary differences are discussed further in the next section.

5.2. Online social science formal impact

Table 2 shows different sources of formal impact equivalent to citations in the four social science disciplines. In both sociology and education, e-prints were most common sources of formal impact. This suggests that there is an e-print culture in some parts of the social sciences. However, recall that some e-prints have unknown document types.

In economics, the major source of formal impact was from economics reports. This suggests a particular importance for academic reports in economics. The majority of these reports were from the World Bank, the World Trade Organization, and the International Monetary Fund. Assuming that economists would agree on the value of reports prepared for these organizations, this suggests that in economics the Web could enhance the ISI as a source of impact data by including such reports. Although the ISI does index some books, presumably they would not include economics reports. Economics reports would thus be “invisible” for conventional impact assessments.

5.3. Online social science informal impact

Course reading lists (7%) were the predominant source of informal impact in the four social science disciplines. Of the four fields, it seems that lecturers in education are most willing to put outlines and syllabi of their courses online. Perhaps this springs from the special disciplinary importance in education of bridging the gap between research and teaching. This information could be used for intellectual impact assessment. In other words, good education research is more likely to be cited in many course reading lists.

Five percent of the citations in sociology were from forum or discussion board messages where people (perhaps sociologists) recommended open access articles or cited them to support a

Table 3
Sources of informal impact in four social science disciplines

Informal scholarly impact				
	Teaching	Presentation file	Forum/discussion board message	Total
Psychology	21 (6%)	0 (0%)	12 (3.4%)	33 (9.4%)
Sociology	30 (8.5%)	11 (3.1%)	17 (4.8%)	58 (16.5%)
Education	48 (11.5%)	8 (1.9%)	2 (0.5%)	58 (13.9%)
Economics	10 (2.4%)	6 (1.5%)	1 (0.2%)	17 (4.1%)
Total	109 (7.1%)	25 (1.6%)	32 (2.1%)	166 (10.8%)

discussion. This kind of information might be valued in sociology, where argumentation and ongoing discussions are perhaps more important for academic reputation building than in many other fields. The objective of the research is the humanities-like goal of building understanding and interpretation rather than establishing facts (Becher and Trowler, 2001, pp. 35–39; Fuchs, 1992, pp. 88–93). Thus, the findings again suggest that the Web can help study research impact in the social sciences. Table 3 summarizes the sources of informal impact across the four disciplines.

6. Discussion

In disciplines that depend to a significant extent on information not published in periodicals, using the ISI database for bibliometric studies can be less than ideal (Glänzel & Schoepflin, 1999). For example, in social science fields, monographs, edited volumes, and even informal discussions are valued and considered central to the dissemination of research. ISI-based investigations clearly cannot reflect research communication accurately.

This study is the first attempt to assess Web-based, open access journals in several social science disciplines for online impact assessment. About 30% of the Web/URL citations reflected the formal or informal intellectual impact of social science research and could hence be used in some way for research evaluation. This represents approximately five useful Web-based citations per article—a figure high enough to be valuable. The detailed results indicate that the Web contains a wide range of non-ISI/non-serial formal citation data that could be used for social sciences impact assessment. In economics, for instance, this study found many formal citations from economics reports, which presumably would be valued.

Perhaps the most promising result is the large proportion of Web citations representing informal impact (course reading lists, presentations, discussion messages) in social sciences

Table 4
Comparison of online impact indicators between sciences and social sciences

Disciplines	Formal impact	Informal impact	Total Google unique Web/URL citations studied
Social sciences (sociology, economics, psychology, and education)	289 (18.9%)	166 (10.8%)	1530 (100%)
Sciences (biology, chemistry, physics, and computing)	365 (23.1%)	35 (2.2%)	1577 (100%)

Table 5
Disciplinary differences in the predominant source of online impact

Science	Major source of impact	Social science	Major source of impact
Chemistry	Journal papers (5%)	Psychology	Teaching (6%)
Biology	Journal papers (18%)	Sociology	Teaching (8.5%)
Physics	E-prints (7%)	Education	Teaching (11.5%)
Computing	Conference papers (6%)	Economics	Research reports (7%)

(11%) compared to a previous online impact assessment in four hard sciences (2%) (Kousha & Thelwall, 2007b). This suggests that Web-based informal channels are more central to scholarly communication in the social sciences than in the hard sciences. Table 4 compares the impact assessment results with previous results.

Disciplinary differences seem to be an important factor in the major source of online intellectual impact (see also Kousha & Thelwall, 2007a). Table 5 shows the differing predominant sources of formal impact in the different fields. This supports previous claims that there are different contexts in which disciplines publish on the Web (Fry & Talja, 2004; Kling & McKim, 1999). Thus, studying disciplinary differences in Web citation patterns may also shed light on the strengths and weaknesses of traditional citation analysis tools in scholarly communication research.

This study's definition of formal impact included documents that had not necessarily been formally published (e-prints and reports). If these were moved to the informal impact categories so that the informal impact categories represented *all* unpublished sources, there would be more informal than formal citing sources in each subject (from Tables 2 and 3: 167 formal and 288 informal sources all together). This strengthens the claim that there is a significant proportion of useful citing sources that can be found on the Web, which would not be available in any database restricted to formal academic publications.

Finally, although the focus of the research was in all types of Web citation to social sciences research, the method used was restricted to Web/URL citations to open access journal articles. Similar research into Web citations of non-open access journal articles would be needed to assess the extent to which the findings are specific to the type of Web citation used and to open access journals. This would also assess whether the disciplinary differences identified are more related to open access journals or differing Web citation practices. An initial study based upon the Directory of Open Access Journals (www.doaj.org) showed that there were an almost equal proportion of open access journals in science and social science disciplines. However, there were fewer social sciences open access journals than science disciplines covered by the ISI. This suggests a relatively higher importance for open access journals in the social sciences and hence a relatively stronger case for using Webometric techniques to assess the impact of open access social science research.

7. Conclusion

The Web-based citation extraction method suffers from some of the same limitations as the ISI database. It identifies only citations to journal articles and not to books, book chapters, and

more informal discussions. Nevertheless, it is possible that such citations could be extracted from the Web, for example by first identifying lists of potentially citable items from course reading lists and other sources. This would require considerable extra effort. In addition, with only approximately a third of Web citations being useful for research evaluation, the necessity to filter the results is onerous. It is probably impractical for most purposes, unless it can be automated. Hence a key future research direction is the development of methods to automate or semi-automate the collection of informal citation data from the Web. Such methods would probably need to be based around developing commercial search engine searches, then processing them to filter out false and irrelevant matches and identify genres of citing documents. Successful research in this direction would open a significant new window into a range of informal uses of research. It should be extended to cope with non-open access publications, if possible, and to assess whether this extension changes the usefulness of the method. Finally, it would be interesting to explore the reciprocal phenomenon of Web sources within print journals in order to assess the extent to which Web content aids or influences research, thus extending previous exploratory research (e.g., Kim, 2000; Smith, 2004).

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