CITATION ANALYSIS FOR THE MODERN INSTRUCTOR: AN INTEGRATED REVIEW OF EMERGING RESEARCH

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Abstract

While online instructors may be versed in conducting e-Research (Hung, 2012; Thelwall, 2009), today's faculty are probably less familiarized with the rapidly advancing fields of bibliometrics and informetrics. One key feature of research in these areas is Citation Analysis, a rather intricate operational feature available in modern indexes such as Web of Science, Scopus, Google Scholar, and PsycINFO. This paper reviews the recent extant research on bibliometrics within the context of citation analysis. Particular focus is on empirical studies, review essays, and critical commentaries on citation-based metrics across interdisciplinary academic areas. Research that relates to the interface between citation analysis and applications in higher education is discussed. Some of the attributes and limitations of citation operations of contemporary databases that offer citation searching or cited reference data are presented. This review concludes that: a) citation-based results can vary largely and contingent on academic discipline or specialty area, b) databases, that offer citation options, rely on idiosyncratic methods, coverage, and transparency of functions, c) despite initial concerns, research from open access journals is being cited in traditional periodicals, and d) the field of bibliometrics is rather perplex with regard to functionality and research is advancing at an exponential pace. Based on these findings, online instructors would be well served to stay abreast of developments in the field.

Keywords: Bibliometrics, informetrics, citation analysis, information technology, Open resource and electronic journals

INTRODUCTION

In an ever increasing manner, the educational field is irreparably linked to advances in information technology (Plomp, 2013). Moreover, due to the information explosion and exponential growth of scholarly knowledge, both students in higher education and faculty face an increasing educational challenge to keep pace with developments in their area of study (Varshney, 2012). At the same time, online information repositories such as open access archives, conference proceedings, and Web pages are facilitating the seismic rate of growth in scientific literature (Larsen & von Ins, 2010). The connectivity and promulgation of the knowledge base of scholarly literature serves as a barometer of the health of a discipline (Poor, 2009). To add to the complexity, particularly in recent years, cross-fertilization of academic disciplines and resultant research has significantly increased the challenge of evaluating the veracity, robustness, and generalizability of scholarship (Ruscio, Seaman, D'Oriano, Stremlo, & Mahalchik, 2012). Conversely, the majority of contemporary scholarly literature is highly specialized and, thus, evaluating the merits of research studies has become an onerous and perplexing task. This dilemma has been keenly noted by Porter (2012), "Should citations of review essays be credited to the same extent as references to original research? Are theoretical papers cited in similar ways to experimental or other empirical writing?" (p.169).

Bibliometrics—Cross-disciplinary Impact

Published research is, in essence, a discourse process. Put another way, the rationale for the accumulation of a body of scientific literature (archived in academic and professional journals) is to impart knowledge to others (the public and students), share findings with colleagues (scholars and researchers), and provide a framework for advancing knowledge and (it is hoped) ones discipline. Cited-references establish a permanent link in this discourse process. While bibliometrics proper is a subject area of study (albeit rather staid) in library and information sciences, citation analysis has captured the attention of academics and researchers from all fields and disciplines, particularly in recent years (Bar-Ilan, 2012; Harzing, 2011). Rigorous research on citation analysis has recently appeared in subject areas such as allied health (De Groote, 2012), information science (Williams & Winston, 2003), mass media & communication (Stephen, 2011), psychology (Cho, Tse, & Neely, 2012; Piotrowski, 2012), social work (Hodge, Lacasse, & Benson, 2012), human resource development (Jeung, Yoon, Park, & Jo, 2011), and management (Peng & Zhou, 2006; Podsakoff et al., 2008).

But a legitimate question remains: What's all the fuss about citations? First, and foremost, academicians and researchers are interested on the impact of their scholarship and writings. Secondly, science requires the interchange of ideas and findings which prompts interest in the "who & what" of scholarly influence. Interestingly, recent research shows that in some fields nearly 50% of cited references are less than 5 years old (Rethlefsen & Aldrich, 2013). Third, applying metrics to scientific contributions can facilitate or identify the structure of science, influential fields of research, and promising avenues of discovery (Cacioppo & Cacioppo, 2012). Moreover, vanity extends beyond the individual researcher—research institutes and universities have a vested interest in the research ranking of their institutions (Egghe, 2010). Most, if not all, disciplines have an inherent need to identify the 'core' journals, e.g., Smith (2010), and the top-cited articles (citation 'classics') in their field (Lipsman & Lozano, 2011; Stack, 2013). Identifying cited-references in books has been a perennial problem and searching options have been rather restricted. Recent research, however, has shown that Google Books appears to show promise in this endeavor (Kousha & Thelwall, 2009; Kousha, Thelwall, & Rezaie, 2011). In the contemporary educational environment, researchers seem keenly interested in the impact of e-journals on citation behavior and output (Brown, 2010; Kurtz & Bollen, 2010). Furthermore, advances in communication technology and online instruction have prompted investigatory efforts in novel areas such as the potential impact of online syllabi on citations (Kousha & Thelwall, 2008) and the impact of Twitter on initiation of citation "bursts" (see Eom & Fortunato, 2011; Eysenbach, 2011).

Research on the topic of citation analysis in the education field has been rather robust, including computer science (De Sutter & van den Oord, 2012), health education (Burtis & Taylor, 2010), business education (Amara & Landry, 2012; Urbancic, 2011), and STEM education (Greenseid & Lawrenz, 2011). Perhaps more pertinent to the current focus, research studies on citation analysis regarding different aspects of distance education and e-learning have appeared (Chen & Lien, 2011; Herring, 2010; Hwang & Tsai, 2011; Lee et al., 2005; Tuncay & Uzunboylu, 2010). With regard to online instruction, Shih, Feng, and Tsai (2008), using a cited-reference strategy, found that studies on instructional approaches, information processing, and motivation had the greatest impact on subsequent research. Another study

reported that editors from distance education journals viewed 'open access' journals quite favorably in terms of prestige (Zawacki-Richter et al., 2010). Shaffer (2011), utilizing citation analysis, investigated proficiency in graduate students' use of library research skills.

The Influence of Citation Analysis in Higher Education

The interface of bibliometrics (defined as: the study and application of indices of scholarship and scholarly influence on future research endeavors) and higher education has crystalized in recent years largely due to a) the proliferation of scholarly content (entombed mostly in journals and books), and b) the availability of cited-reference options across several relatively new database vendors, e.g., Scopus and Google Scholar (e.g., van Aalst, 2010). At the same time, there have been major innovations in the education field such as the use of computer-mediated technology, online instruction, and open access publishing (Hricko & Howell, 2006; Rudestam & Schoenholtz-Read, 2010; Vodanovich & Piotrowski, 2005). Since the intellectual foundations of education are multidisciplinary, the knowledge base of a myriad of fields is the cornerstone that informs and, at the same time, impacts scholarship and educational practices (Goodyear et al., 2009; Hart & Metcalfe, 2010). Based on this premise, intellectual exchange is a critical function of higher education and academic journals are the primary mode of communication and instruction among researchers, professors, and even advanced students. This aggregated scholarship functions as a central conduit in the creation, dissemination, and application of knowledge. Bibliometrics serves as a barometer of all these major scholarly functions (De Bellis, 2009).

At the same time, the communicative interaction with regard to scholarly knowledge is rather complex. Citation analysis is one critical approach in examining this communicative process and cited references are the hallmark in identifying citation patterns (Budd, 1990; Budd & Magnuson, 2010). In fact, citation analysis has been regarded as a valid methodology in identifying research trends in the field or in examining the rigor, prestige, and impact of individual researchers, journals, and universities (Lee, Wu, & Tsai, 2009; Tsay, 2008). Moreover, this bibliometric indicator has been relied upon in evaluating or assessing the scholarly influence of individual journals (e.g., Haas et al., 2007; West & Rich, 2012.). Scholarly "impact" indices are major criteria in the evaluation of research productivity of academic and research faculty, and the critical metric is the number of citations to a faculty member's research (Aguinis, Suarez-Gonzalez, Lannelongue, & Joo, 2012). In addition, research studies on citation analysis have examined issues such as the international impact of educational research (Vinluan, 2012; Wolhuter, 2011) and the use of electronic journals and online reference sources by graduate students (Smyth, 2011), and as a valid strategy in detecting plagiarism (Alzahrani, Palade, Salim, & Abraham, 2012).

One area of intense investigation involves the robust nature of the 'importance' of an individual citation. Accordingly, not all citations harbor the same valence or esteem, and the discussion has delineated cited reference impact as either 'popularity' (the aggregated number of citations) or 'prestige' (citations appearing in highly cited articles or top-ranked journals) (Ding & Cronin, 2011; Zhou, Lu, & Li, 2012). In this regard, novel metrics have been introduced to gauge the prestige of both citing and cited journals (Guerrero-Bote & Moya-Anegon, 2012). Some researchers have proposed using a 'weighted' formulation to determine an article's prestige (Van & Ding, 2010; Zyczkowski, 2010). Others have argued that citation indices that purport to ascribe 'prestige' are a misuse of journal impact metrics (Balaban,

2012). Furthermore, content analyses of the extant literature point to the reality that positive findings tend to be cited more than studies reporting negative results (see Fanelli, 2013).

Despite these academic debates, citation metrics are being used increasingly by educational administrators (Rodriguez-Ruiz, 2009). However, as innovative hybrids of the h-Index (e.g., h int) have been introduced in recent years (Guerrero-Bote & Moya-Anegon, 2012; Levene, Fenner, & Bar-Ilan, 2012), researchers have expressed concerns about the validity and limitations of these emerging citation metrics (Kosmulski, 2010; Schreiber, 2013; Smith, 2012), for faculty evaluation, promotion, or tenure. Moreover, educators and academics from within the field of bibliometrics have also scrutinized these citation barometers (Chang, McAleer, & Oxley, 2011). Second, the much maligned 'Journal Impact Factor' continues to be criticized in the scholarly literature (see Smeyers & Burbules, 2011), highlighting issues like the impact of 'self'-citations (Carley, Porter, & Youtie, 2013; Foo, 2009) and editorial board influence or pressure on citing their own journal so as to embellish citation counts (Campanario et al., 2006). A related concern, not frequently mentioned in the published literature, is the issue of reciprocal citations within a select, narrow circle of researchers (see Kosmulski, 2010). Interestingly, contrasting views on these issues have been noted in the information sciences field, e.g., Krell (2010).

Critical to the current discussion, researchers are well aware of the fact that educational research publications are not well represented among 'source' journals in the major databases that offer cited-reference functions and that 'Educational' journals have relatively low impact factor scores (see Togia & Tsigilis, 2006). This creates doubt about the salience and usefulness of search files like Web of Science, Scopus, and Google Scholar from instructors in the field of education (Albion, 2012).

Proliferation of Scholarship and Advances in Bibliometrics

The information age has prompted a dramatic shift in how academic knowledge is created, disseminated, communicated, archived, and retrieved (Thelwall, 2009). These advances, however, have evidenced a host of concerns with regard to the reliability, credibility, and sustainability of scholarship in the published (and online) literature (Meyer & Schroeder, 2009; Narin, Olivastro, & Stevens, 1994; Piotrowski & Perdue, 2003). Research studies of online instruction resources have been at the forefront of these concerns (e.g., Hricko & Howell, 2006). Over the past decade, bibliometric tools have emerged as an efficient and effective remedy for the filtering, evaluation, and accreditation of scholarly material (Eom, 2009; Feller, 2005; Richardson & McLeod, 2009; Wolfram, 2003). A decade ago, researchers and academicians relied on a sole bibliometric resource, i.e., Social Sciences Citation Index (n.d.), to access the scholarly literature in order to access citation reference data on subject matter, target periodicals, and author cited references (Herubel & Buchanan, 1993). The past seven years, however, has witnessed the proliferation of a number of scholarly citation databases or the introduction of 'citation' options within existing database files (see De Bellis, 2009). Moreover, these major citation databases have continued to modify and upgrade the operations and functionality of their search platforms at an accelerated pace (Harzing, 2011; Moed, 2005; Schroeder, 2007; Taris, 2006). Researchers in the field of bibliometrics have also conducted detailed comparisons of citation features in PubMed, Scopus, Web of science, and Google Scholar; database functions, including the benefits and shortcomings of each file, have been keenly analyzed (e.g., Falagas, Pitsouni, Malietzis, & Pappas , 2008; Garcia-Perez, 2010; Meho & Yang, 2007; Vaughan & Shaw, 2008).

A Note on Open-Access Research

Open-access has become a well- respected channel for publishing research findings. Recent years have witnessed a high level of research interest in examining the influence of open-access journals on the visibility level of articles published online and subsequent citation counts (Norris, Oppenheim, & Rowland, 2008). Interestingly, most analyses to date indicate that open-access articles have a higher probability of being cited than articles limited to traditional toll-access journals. Cross-disciplinary studies have confirmed this finding in the field of communication studies (Poor, 2009), biomedicine (Kim et al., 2011), anthropology (Xia & Nakanishi, 2012), information sciences (Mukherjee, 2009; Yuan & Hua, 2011), and sociology (Norris et al., 2008). Researchers have reported that the citation rate 'advantage' of open-access articles can be two-fold (see Xia, Myers, & Wilhoite, 2011). In addition, open-access have gained momentum in publishing high-quality research and some open access journals are regarded as high as their print journal counterparts (Xia, 2012). However, recent bibliometric research suggests that more refined investigatory procedures need to be implemented in examining the intricate functionality on the process of citing references in the open-access domain (Povh & Zumer, 2012).

Cross-database Comparisons

There has been lively and spirited debate on comparative analyses of the attributes and drawbacks of the major citation databases (Jasco, 2005; Schroeder, 2007). However, the Web of Science is regarded as the 'Gold Standard' or benchmark in bibliometric research (Garcia-Perez, 2011; Harzing, 2013a), although the database Scopus provides more comprehensive journal coverage in select fields (Haddow & Genini, 2010). Moreover, there has been robust research interest in empirical comparison of databases such as Web of Science, Scopus, with Google Scholar (e.g., Falagas et al., 2008; Kousha & Thelwall, 2008; Kulkarni, Aziz, Shams, & Busse, 2009; Levine-Clark & Gil, 2009). In one of the few studies examining citation-based measurements of 'education' journals, Haddow and Genoni (2009) found that Scopus outperformed Web of Science. Perhaps, this finding is a function of the fact that Scopus indexes substantially more journals from the education field than Web of Science.

It must be kept in mind that once a pool of cited references has been identified, a researcher can conduct analyses of several key identifiers or factors such as journal or type of journal, language, author(s), author affiliation or national residence, topical focus, type of article (empirically-based, review, commentary), type of methods or procedures, type of theoretical framework, measures used, or trends over time based on publication date, and research funding sources. This exemplifies the robust nature of studying citation-based data which is recognized by scholars worldwide (e.g., Aksnes & Rip, 2009; Bornmann, Schier, Marx, & Hans-Dieter, 2012; Perdue & Piotrowski, 2004). It would be informative to provide a brief overview of key studies with a focus on citation analysis across disciplines. To that end, Table 1 presents the major bibliometric topics researched in select academic fields; Table 2 summarizes several key functional aspects of major academic indexes that offer citation-based operations and data.

Table 1
Examples of Studies on Citation Analysis in Select Disciplines

Academic Fields	Study	Topical Issue
Accounting	Chan & Liano (2009)	Used citation analysis to identify top accounting journals and institutions: *Journal of Accounting Research, Journal of Accounting and Economics, Economics and Accounting Review*; University of Chicago, University of Pennsylvania, University of Michigan.
Biology	Lortie et al. (2013)	Critiqued citation analysis in that critically important articles in evolutionary biology do not necessarily receive the highest citation rates
Chemistry	Bornmann et al. (2009)	Studied the h-Index; Journal Impact Fact; 20 organic chemistry journals
Cognitive Science	Cho & Neely (2012)	Examined whether the standard H index is superior to variants of the index in establishing an individual researcher's scholarly impact in a sample of elite cognitive psychologists
Communications & Media	Chung & Park (2012)	Evaluated Web presence & citation counts; Scholars in communication
Computer Science	Franceschet (2010)	Highlighted variability in cited-references; Web of Science & Google Scholar
Criminal Justice	Telep (2009)	Identified the most cited research experiments across 6 criminology areas
Earth Sciences	Mikki (2010)	Compared Google Scholar to Web of science
Economics	Pislyakov (2009)	Compared Scopus and Journal Citation Reports for leading economics journals
Engineering	Franceschini & Maisano (2010)	Commented on h-Index, h-Spectrum; top quality engineering-management journals
Environmental Science	Vanclay (2013)	Reported that substantive 'review' articles from high impact journals tend to be cited

		most
Humanities	Eccles et al. (2012)	Discussed Webometric analysis of digitized scholarly resources
Human Sexuality	Antell (2012)	Studied the extent of coverage of LGBT studies in mainstream academic literature
Information Systems	Cabanac (2012)	Analyzed editorial board involvement across 77 leading journals
Kinesiology	Omrcen & Lescic (2011)	Compared citation analysis for English vs non-English references
Knowledge Management	Bontis & Serenko (2009)	Studied citation impact of intellectual capital journals; h-Index; g-Index
Management	Judge et al. (2007)	Determined that citation rates are a function of journal or university prestige
Nursing	Smith & Hazelton (2008)	Studied bibliometrics and citation-based research in nursing profession
Physical Therapy	Wiles et al. (2012)	Evaluated bibliometric patterns from 1945-2010 in journal: *Physical Therapy*
Physics	Radicchi & Castellano (2011)	Presented empirical data that confirmed that citation analysis, over time for a journal, is unreliable
Psychiatry	Hunt et al. (2010)	Reported that the h-Index outperformed Journal Impact Factor, over time
Psychology	Nosek et al. (2010)	Investigated citation impact & career-stage patterns of social psychology faculty

Table 2

Major Features of Databases that Offer Citation-based Data

	Web of Science	Google Scholar	SCOPUS	PsycINFO
Coverage	Extensive, but somewhat limited in the field of education, social sciences and humanities	Quite comprehensive across all fields	Very comprehensive, beyond that of SSCI/SCI	Excellent in social-behavioral sciences; limited in management and education

Journal coverage	15,000+	Quite extensive, both U.S. and foreign	18, 500+	About 2,500, but article selectivity in some journals
Rapid indexing	Quite rapid	Very rapid	Quite rapid	2-4 months, but can be longer
Books	Limited, somewhat select	Moderate, but can be selective by field	Limited, somewhat select	Inclusion is somewhat limited; behavioral & social sciences only
Conference Papers	Limited coverage	Moderate coverage; select Proceedings	Limited coverage	No coverage
Dissertations	Some coverage	Extensive coverage	Some coverage	Inclusion is limited to behavioral & social sciences
Graphic metrics	Available	Available	Available	Not included

Faculty Naivete Regarding Scholarly Databases

Survey data indicate that faculty in higher education have a myopic view of the myriad of scholarly database selections currently available (Piotrowski, Perdue, & Armstrong 2005). These authors found that instructors tend to focus on a limited number of online databases when conducting research. Unfortunately, this relative lack of orientation or competency (familiarity?) on the part of faculty regarding the nuances of scholarly database searching, let alone the complexities of citation searching, is unwittingly transferred on to students. For example, there has been abject neglect in the social sciences to remedy this state of affairs (see Piotrowski, 2007 for a discussion on this issue). This pedagogic neglect of online searching methods has continued over the past decade (Dron, 2012; Vodanovich & Piotrowski, 2001), and evidenced by recent national survey data (see Piotrowski & Vodanovich, 2004). Fortunately, investigators are now focused on the role of the student and the process of engaging in research projects. In fact, recent research has examined the comfort level of graduate students' use of Google Scholar as a research retrieval tool (Cothran, 2011).

More research on the acquisition of competency in bibliometric research methods for the novice learner is sorely needed, considering the evolving and intricate nature of the field (e.g., Bornmann et al., 2011; Franceschet, 2010; Kousha & Thelwall, 2007). There is an urgent need to discuss the fundamental operations and functions central to citation searching across select database vendors, particularly for faculty facing academic milestones like obtaining tenure, promotion, and applying for research grants.

Conclusions

If a scholar wants to identify a listing of their cited author references contained in books or book chapters, then Google Scholar-Books would seem in order. Also, in the field of Psychology, PsycNet offers a 'cited by' option that includes books/chapters, although coverage is somewhat limited (Perdue

& Piotrowski, 2003). When faculty need to document their citations found in peer-reviewed articles, then Web of Science and Scopus have comprehensive coverage of scholarly and academic journals (but limited coverage of books, dissertations, or proceedings). However, authors, in need of locating citations in 'open access' journals, appear to be limited to searching Google Scholar (Aguillo, 2012; Herther, 2010; Varshney, 2012).

Recently, Carleton, Parkerson, and Horswill (2012) concluded that all citation databases demonstrate restrictions in function and capacity, and suggest that a multi-database search strategy should provide comprehensive, optimal results. This approach is supported by prior research findings on the utility of multi-file search strategies when conducting research (Lohonen, Isohanni, Nieminen, & Miettunen, 2010; Piotrowski & Perdue, 1988; Wu, Aylward, Roberts, & Evans, 2012). Based on this review of the extant literature, "Online" educators have a functional pedagogic framework to a) utilize available citation-based features of established databases, and b) consider the limitations of more recent bibliometric tools in the field of citation analysis. With 'hands-on' experience and attention to developments in this rapidly advancing field, educators can stay abreast of the most efficacious methods needed for obtaining optimum citation analysis results across academic disciplines.

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