
Citation analysis of faculty publication: beyond *Science Citation Index* and *Social Science Citation Index*

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When evaluated for promotion or tenure, faculty members are increasingly judged more on the quality than on the quantity of their scholarly publications. As a result, they want help from librarians in locating all citations to their published works for documentation in their curriculum vitae. Citation analysis using *Science Citation Index* and *Social Science Citation Index* provides a logical starting point in measuring quality, but the limitations of these sources leave a void in coverage of citations to an author's work. This article discusses alternative and additional methods of locating citations to published works.

Citation analysis is used to evaluate relationships between a published source and the references appearing in other works that cite the original source. The listing of references in publications is a convention among scientists for giving credit or recognition to the value of previous work. Citation analysis therefore is based on criteria acknowledged within the scientific community for measuring the contribution of a given work to the advancement of knowledge [1]. Citation analysis is facilitated by citation indexing, which provides a means of tracking the cited references.

Systematic analyses of journal citations first became available when Eugene Garfield, who proposed the concept of journal citation analysis in 1955, began publishing *Science Citation Index (SCI)*, which now covers journals going back to 1945, and *Social Science Citation Index (SSCI)*, which began coverage in 1966 [2-4]. Online SCISEARCH goes back to 1974, while SOCIAL SCISEARCH begins in 1972. In *SCI* and *SSCI*, a citation is defined as "when one document (A) mentions or refers to another document (B)" known as the source document, and a citation index is defined as "an alphabetic list, by first author, of items cited in references from footnotes or bibliographies of a source article" or document [5].

Citation analysis has been applied to many research issues. These include analysis of citations related to a particular subject [6], professional discipline [7], country [8], journal title [9], medical decision making [10-11], comparisons of research output [12], impact

of research funds [13], influence of new and original ideas on a discipline [14], most-cited titles from a specified journal title [15], most-cited journal titles or journal impact [16], and most-cited author or author impact [17]. Journal impact analysis also is conducted yearly and reported in the *Journal Citation Report* of both *SCI* and *SSCI* [18-19].

Garfield suggests that citation analysis can be used by librarians to help manage journal collections, make journal acquisition and elimination decisions, and plan subscription budgets. He also suggests that citation analysis can help editors assess how well they are meeting a journal's stated objectives, publishers monitor their competitors and identify opportunities for new journals, authors decide where to publish, and information analysts track major bibliometric trends. This paper discusses an additional application: how citation analysis can assist in the completion of a faculty member's curriculum vitae for submission for promotion in faculty rank or application for tenure [20]. Citation analysis using the concept of author impact provides evidence that a faculty member has published works of quality and importance, not just a large quantity.

BACKGROUND

The curriculum vitae

A curriculum vitae long has been required for faculty members applying for promotion or tenure. The curriculum vitae is a comprehensive, organized outline

that records the faculty member's professional qualifications and activities [21-23]. It includes information about educational background, work experience, membership in organizations, offices held, presentations, publications, honors, awards, and community service. In contrast, a resume usually summarizes career objectives, education, qualifications, and work experience. A resume is focused or tailored to fit a specific purpose and thus is usually short, just two or three pages in length [24-26]. A curriculum vitae, in contrast, may be 50 to 100 pages in length.

Faculty evaluation

Faculty usually are evaluated for promotion and tenure based on their contributions to teaching, research, and service [27]. Promotion involves moving up in rank from instructor to assistant professor, to associate professor, and finally full professor. Tenure means the expectation or guarantee of continued appointment and employment until the faculty member chooses to leave, provided duties are fulfilled [28]. Teaching includes classroom and clinical instruction. Research includes grants received and projects completed. Service includes clinical practice, membership on university and college committees, and participation in professional and community organizations related to the faculty member's profession. Some universities or colleges also review administrative duties in the evaluation process.

Of the three major areas, research is often the most important [29]. Publications are the chief measure of the research and scholarship completed by faculty members [30-32]. Until recently, the listing of publications on the curriculum vitae was considered sufficient. However, concern has been expressed by faculty committees on promotion or tenure that a long list of publications is of little scholarly value if they did not contribute substantively to the body of knowledge in a subject area. Faculty evaluators wanted proof that the publications were adding to the knowledge base, not just to the volume of literature on a library shelf or in an electronic database [33-34]. One way to demonstrate value or worth is to document the number of times a particular faculty member's publication has been cited by other authors.

CITATION INDEXES

Clearly the primary source for citation analysis is *SCI* or online *SCISEARCH* or *SSCI* or online *SOCIAL SCISEARCH*. Although these tools are valuable, they have limitations in the area of health care. Among these constraints are the limited coverage of journals, approximately 4,500 titles in *SCI* and 2,400 in *SSCI*; limited coverage of some health care professions, such as the allied health fields; limited coverage of foreign-language journals; and citation to the primary author

only. In addition, citations to monographs, chapters in books, conference proceedings, meeting abstracts, pamphlets, audiovisuals, and other nonjournal formats are available only if the item is published or discussed in an indexed journal. An additional problem, not unique to *SCI* and *SSCI*, is that authors choose to cite one source rather than another due to various factors such as nationality, persuasiveness, timeliness, and information [35-36]. These reasons do not necessarily reflect quality.

A major gap in citation indexing is the set of the references used in textbooks. Textbooks usually summarize previously published works as opposed to publishing original works as do journals. Thus, textbooks generally are not included in citation analysis. Yet textbooks often are excellent sources of citations to useful publications, because textbook authors generally are very knowledgeable about the subject matter and therefore list quality source material. Although some promotion and tenure committees may choose to focus their evaluation on original research and its contribution in journals, the fact remains that major textbooks influence the knowledge base of many potential scholars. Hence, an author cited in a textbook should be given some measure of credit.

Of further concern is the bias built into citation indexes as a function of the journals covered. The emphasis on multidisciplinary journals means that many subject-specific journals are not included. For example, if a faculty member teaches anatomy, then the evaluation for promotion and tenure is based on publication of articles in anatomy journals. If only two or three anatomy journals are included in the citation analysis, then the impact of other anatomy journals is difficult to evaluate. The problem is compounded if only one journal in a subject area is included in the citation analysis.

Furthermore, journals tend to be selected for citation analysis based on the number of times they are cited in other journals. Journals not cited frequently in other journals tend not to be selected for inclusion in the citation database. These less-cited journals are not necessarily of poor quality, especially if they are new; they simply may have some characteristic, such as content, language, or limited distribution, that reduces the number of citations by other sources. When a large number of journals in a given subject area do not meet the criteria for inclusion in a citation analysis, then that field is underrepresented in the citation database. This problem is characteristic of the allied health professions, with the possible exception of physical therapy.

OTHER SOURCES OF CITATIONS

Given the limitations of published sources of citation analysis, a faculty member or clinician in a teaching

hospital may request assistance from a librarian in documenting citations for the faculty member or clinician's publications. The librarian may suggest several documentation techniques.

The first is actually a "housekeeping" task—reviewing the publications listed on the curriculum vitae to ensure accuracy and completeness of citations. A common problem in curriculum vitae is inaccurate, incomplete, or missing information on publications. In particular, it is important to be sure that all authors of an article are listed and are in the same order as in the article; that all titles are complete; and that the year, volume number, and pages are present and correct. Listing all authors is important, because they are fellow professionals familiar with the faculty member's work and therefore are likely to cite the faculty member's publications in their articles or monographs. This concept of familiarity will be addressed shortly. A list of publications should include abstracts published in conference proceedings, abstracts published in scientific journals, book reviews, pamphlets, brief articles in nonscientific publications, letters to editors, editorials, audiovisual items, and software programs, in addition to the more conventional full-length articles published in scientific journals, chapters in books, textbooks, and other monographs. Unpublished works, such as a master's thesis or doctoral dissertation, also should be listed, especially if these documents are listed in *Master's International Abstracts* or *Dissertation Abstracts*. A listing in either or both databases makes citing these items quite easy.

The next step is to exhaust all possibilities using *SCI* or *SSCI*. This process includes using the primary author's name in searching for any publication in which the patron or client's name appears, regardless of whether the patron or client is the lead author. This process is vital if the patron or client is a junior author, because *SCI* and *SSCI* cite only the primary or senior author.

After the citation system has been exhausted, it is useful to conduct a complete search in major databases, such as MEDLINE, EMBASE, BIOSIS, Health, or CINAHL, using as a keyword each person who appears as a primary or coauthor in an article in which the client's name appears. The rationale for this technique is that authors tend to quote works with which they are familiar. Once a person has worked on one or more papers with a second person, the former is likely to be familiar with the latter's work and include references to it when appropriate, even though the second person is not an author of the paper. Therefore, all works of any person who has been a primary author or coauthor with the client are good leads for citations. Of course, the journals covered in *SCI* or *SSCI* can be eliminated quickly, because authors appearing in those journals already have been identified

(unless the articles appeared during a time when the journal was not covered in *SCI* or *SSCI*). The focus should be on journals not included in the citing process.

A fourth approach is to ask the client to identify the primary subject area in which he or she usually publishes. Knowledge of the client's particular interests helps in organizing the task of locating past and future citations. For example, does the client usually publish in the subject area of cardiac surgery, orthopedic physical therapy, or nursing theories? The curriculum vitae can provide useful clues as to the subject area(s) in which the client most often publishes. A list of publications in that subject area should provide a starting point for identifying possible sources of citations.

The faculty members should identify not only their area of interest but also a list of journals and types of textbooks or monographs that publish in these areas and are known to be indexed. The librarian can assist in the process by performing literature searches in databases containing information on the subject area. These searches are most helpful if the output is sorted by title, so that titles with the highest rate of publication on the subject can be identified. The Brandon/Hill lists for the small medical library, allied health, and nursing are helpful [37–39]. Also useful are the subject lists of journals in the *Index of Journals Indexed in Index Medicus*, *EMBASE List of Journals Indexed*, *Nursing & Allied Health (CINAHL) Database Search Guide*, and *Journal Citation Reports* for both *SCI* and *SSCI* [40–44].

For nurses, the *Nursing Citation Index (NCI)* may be helpful as an additional source for nursing topics [45]. The *NCI* provides citation information for books, journal articles, theses, and other published and unpublished documents. However, its short publication history, 1986 to 1990, limits its usefulness. An example of its use is given by Johnson [46].

Two databases that often are overlooked are *Master's International Abstracts* and *Dissertation Abstracts*. Their broad base provides potential citations to many publications on a curriculum vitae, especially if the client serves on committees for master's and doctorate candidates. Once again, the concept of familiarity comes into play, perhaps influencing a student to cite the client's works.

The online databases SERLINE and CATLINE are also helpful in locating possible sources of citations. As always, the librarian should be careful to understand the context in which the keyword or phrase is used, because so many terms have multiple contexts and meanings. An example is the word *rehabilitation*, which can refer to the rehabilitation of criminals (criminology), psychosocial rehabilitation (psychology), vocational rehabilitation (counseling), and medical rehabilitation (physical medicine). Titles

containing the word *rehabilitation* are not always indicative of their focus. The context must be ascertained through examination of the contents. Occasionally, this task may be facilitated by an article summarizing many of the sources in a given field, such as medical rehabilitation [47].

The subject list of journals or monographs identified through the various indexing sources should be augmented with any titles known to the client or librarian but not indexed in any of the databases searched. New titles and journals published in another language are examples of possible additions. Foreign publications are especially important if the faculty member started his or her career in another country.

Chapters in textbooks present a special challenge, because few databases covering biomedical subjects include chapters in textbooks. Again, knowledge of the subject area and of authors who write about the subject is important in identifying textbooks to explore. The Brandon/Hill lists and the American College of Physicians list for internists can provide useful starting points [48-51]. However, the client must provide guidance regarding other possible sources of textbooks and monographs, such as a list of textbooks students are required to buy. With these methods, it is easy to compile a long list of textbook and monograph titles, but, unless time is unlimited, priorities need to be set to keep the task within a reasonable time frame. Citations found in widely used textbooks are most desirable, so they should be examined first.

Finally, a single summary list of sources should be compiled from all the sources, including databases, published lists, and personal knowledge. The summary list should provide a sound foundation for locating citations to the client's works.

As the librarian may surmise, visual inspection of references is the primary means of identifying citations after standard database sources have been exhausted. Neither the client nor the librarian is likely to have time to view all potential sources. A list of priorities may limit the task, but extra help can be useful. The client may want to enlist the assistance of paid staff or students hired specifically to look at references in selected journals, serials, or monographs.

PLANNING AHEAD

In addition to retrospective citation analysis, the librarian can assist the faculty member in planning ahead to facilitate continued documentation of cited works. The summary list of journals, other serials, and monographs made during the original search for citations is a good starting point. Several additional suggestions also can be made.

The first suggestion is for authors to place copies

of all their new publications in files as soon as they become available in print. For publications such as textbooks, copies of the title and verso pages should be sufficient for the file, but a copy of the entire book should be maintained in the author's collection. For book chapters, journal articles, abstracts, summaries of conference proceedings, and other small publications, a complete copy should be kept on file, in case it needs to be submitted as documentation along with the curriculum vitae. An electronic file of each work may be maintained instead of the print copy, assuming the file is such that paper copies can be printed out readily if needed. Not all faculty review committees are ready to accept electronic files; many still insist on seeing a printed version as it appeared in published final form.

The librarian also may suggest that the faculty member note and mark any citation to his or her work while reading current journals and double-check any citations to older journals as they are used for new or continuing projects. The same technique applies to chapters in textbooks, monographs, or other publications, including dissertations, pamphlets, and popular or nonscientific magazines. If the faculty member owns the publication, the citation can be marked permanently with a bookmark for future reference.

Third, the librarian can suggest that a file be started containing the citations as they are located. For journals, the page with the citation should be photocopied as well as the beginning page of the article. The ending page also may be copied if it is not the page on which the citation appears. For books, the same information should be copied plus the title page and possibly the verso page (to identify the year of publication if it does not appear on the title page). For chapters, the first and last page of the chapter should be copied as well as the page on which the citation appears and the book's title and verso pages. A similar approach can be applied to abstracts, summaries of presentations in conference proceedings, and pamphlets. If reprints are available, a copy should be placed in the file.

A fourth suggestion is for the faculty member to update the curriculum vitae at least once a year. A good time for this task is whenever the faculty member receives his or her annual review. The yearly update reduces the chances of forgetting a publication or encountering difficulty in locating a copy. If the file of citations is maintained throughout the year, then the update can be done by a secretary, saving the faculty member time for other projects.

Finally, the librarian may want to provide the client with a checklist of the suggestions made in this article together with a list of any other special assistance the librarian is prepared to offer. Such a checklist is especially important for young faculty members. If fac-

ulty members begin keeping a file of all activities that need to be recorded on their curriculum vitae early in their professional careers, then they can save much time and effort when they prepare to submit documentation of their productivity for promotion or tenure evaluations.

SUMMARY

Citation analysis has become important to faculty members being reviewed for promotion or tenure. Citation of a faculty member's publications is a means of demonstrating the quality of publication. In other words, citations suggest that the publication is contributing to the knowledge base on a particular subject and not just adding to volume or quality. The *SCI* and *SSCI*, though excellent sources, have limitations.

In view of these limitations, faculty members may need the assistance of librarians to find other means of identifying citations to published works. This article describes some additional sources and methods for citation analysis and suggests ways the faculty member can keep track of new citations as they appear in literature. Finally, it is suggested that the librarian provide a checklist to the faculty member to facilitate the development and updating of the curriculum vitae and the filing of copies of publications and citations to publications. These files can be invaluable if documentation is needed as part of a portfolio submitted by a faculty member being considered for promotion and tenure.

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