Relevance of Library Collections for Graduate Student Research: A Citation Analysis Study of Doctoral Dissertations at Notre Dame

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This study focused on determining the extent to which collections of the Hesburgh Libraries of Notre Dame met the needs of graduate students. This study data (2005–2007) consisted of a citation analysis of 248 dissertations and focused on the following questions: What were the graduate students citing in their dissertations? Did the library own the cited items? How did the disciplines compare in their citation patterns? The data showed that over 90 percent of the 39,106 citations were to books and journals. The libraries owned 67 percent of the items graduate students cited in their dissertations. The libraries owned 83 percent of the Arts & Humanities, 90 percent of the Engineering, 92 percent of the Science, and 75 percent of the Social Sciences sources in the top 1,000 most cited titles, indicating a need for funding for further development of Social Sciences collections in the Hesburgh Libraries.

The University of Notre Dame is a private Catholic university, founded in 1842, and located in Notre Dame, Indiana. The Graduate School, established in 1918, offers thirty-two masters' and twenty-five doctoral degree programs.[1] Professional degrees are administered separately by the School of Architecture, the Law School, and the College of Business. During the period studied (2005–2007), the Graduate School enrolled, on average, 1,951 students annually. Roughly 68 percent of these graduate students were Ph.D. students. On average, 41 percent and 24 percent of the doctoral students enrolled were female and international students, respectively. Doctoral students enrolled as percent of the total number of graduate students varied by discipline as follows: Engineering (93%), Science (98%), Humanities (62%), and Social Science (48%).[2]

The first mention of a "college library" at Notre Dame was in 1869, when it contained 7,000 volumes. The collection grew and was relocated several times until a new separate library building for the university library was built and dedicated in 1917, which coincided with the start of the Graduate School in 1918. By 1920, the library collection had grown to over 100,000

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volumes. The current library system, the Hesburgh Libraries, has one main library building and nine branches with over three million monographs and 45,000 serials, a $22 million budget and 60 library faculty members. The University of Notre Dame is a member of the Association of Research Libraries (ARL).[3] This study focused on Notre Dame's graduate students' doctoral dissertations in Science, Arts and Humanities, Social Sciences, and Engineering. Dissertations produced by students in the professional schools of architecture, law, and business were excluded.

Citation analysis is a very powerful tool that demonstrates the researchers' pathways toward, and support for, their final conclusions. "Citations are signposts left behind after information has been utilized and as such provide data by which one may build pictures of user behavior."[4] Items cited in students' dissertations show the resources they used in their dissertation research and writing. Studies in library and information science and other disciplines have used citation analysis as a way to examine various issues related to research and researchers' information-seeking behavior. Researchers in library and information science use citation analysis to identify and assess user needs; determine patterns of author usage of sources; tally and rank referenced materials; and develop library collections for different disciplines based on identified needs and usage counts.

The objective of this study was to find out the extent to which the collections of the Hesburgh Libraries of Notre Dame met the needs of the graduate doctoral student population. This was done using citation analysis of the doctoral graduate students' dissertations and focused on the following questions: What were the doctoral graduate students citing in their dissertations? Did the library own the cited items? How did citation patterns differ among academic disciplines?

Literature Review

Analysis of citation data can be used to create core journal lists, which can be used to make collection decisions in support of research and teaching. However, errors arise from mistakes made in the citations. For example, names of authors, titles of articles, and journal titles are often listed incorrectly and inconsistently in published works. The problem this creates in terms of analyzing data is duplication of entries in datasets, which might underestimate or overestimate use. Notwithstanding possible methodological problems, citation analysis is a valuable tool for librarians and libraries in making decisions about collection development, collection maintenance, library services, and library budget considerations.[5]

A number of studies have used citation analysis specifically for collection development and creating core lists (Wilder; Kelsey and Diamond; Burright et al.; Waugh and Ruppel; Pancheshnikov; Nabe and Imre; Ralston et al.; and Gao et al.).[6] Yet other studies have focused merely on assessing the match between the library collection and the citation patterns of graduate students or other patrons (Smith; Fuchs et al.; Pancheshnikov; and Wilson and Tenopir).[7] Knight-Davis and Sung looked at changes in students' citation patterns over time.[8] Other studies have dealt with citation patterns per se (Gooden; Sam and Tackie; Kuruppu and Moore; and Cox);[9] comparing citation patterns in different disciplines (Sinn);[10] and testing Bradford's Law of Scattering (Tonta and Al).[11] Last, some researchers have studied faculty publications (Kelsey and Diamond; Burright et al.; Wilson and Tenopir; Pancheshnikov; and Ralston et al.).[12]

In terms of sample size, Kuruppu and Moore had the largest number of dissertations and total citations of all the studies reviewed.[13] The longest time frame sampled was the study by Sinn covering a 23-year period between 1980 and 2002.[14]

There have been a variety of sampling strategies used in these types of studies. One strategy was to select all documents (dissertations, theses, journal articles,

and/or research papers) within a particular time frame. This strategy was used by Burright et al. on neuroscientists at the University of Maryland;[15] Cox on graduate theses at Indiana University School of Dentistry;[16] Tonta and Al using masters' theses and doctoral dissertations produced at Turkey's Hacettepe University Department of Librarianship;[17] Waugh and Ruppel's study based on research papers, theses, and dissertations produced by graduate students in the Workforce Education and Development (WED) department at Southern Illinois University, Carbondale;[18] Sinn's using mathematics and statistics dissertations produced at Bowling Green;[19] Nabe and Imre in their study on biology dissertations at Southern Illinois;[20] Pancheshnikov's study on literature citations in faculty publications and student theses at the University of Saskatchewan; [21] and Ralston et al. in their study at the Indiana University School of Medicine.[22]

Another strategy was to take a sample of the documents from a specified time frame. A third option was to sample a certain number of citations out of the total number of citations found in the documents fitting a particular selection criterion. Some studies have used a combination of strategies. Among those using the second and/or third strategy was Gooden, who sampled chemistry dissertations produced and housed in the Science & Engineering Library at Ohio State University;[23] Knight-Davis and Sung, who used a sample of Eastern Illinois University undergraduate student portfolios;[24] and Gao et al., who sampled dissertations from library and information science, biology, photogrammetry and remote sensing, and stomatology at Wuhan University.[25] Others, such as Smith, used a random sample of theses and dissertations produced at the University of Georgia by the education, arts and humanities, sciences, and social sciences disciplines;[26] Fuchs et al. did a "classic bibliographic citation analysis" on dissertations produced in civil engineering and educational psychology at the University of Texas at Austin;[27] and Sam and Tackie examined usage of different formats of materials in dissertations produced in the Department of Information Studies at the University of Ghana, Legon.[28] In their citation analysis, Kuruppu and Moore used half of the dissertations emanating from nine agriculture and biology subject disciplines at Iowa State University.[29]

Most of the studies reviewed made no specific mention of computer programs used for data entry, including, for example, Smith; Tonta and Al; Sam and Tackie; Kuruppu and Moore; and Pancheshnikov.[30] There were studies that used a spreadsheet or database (Waugh and Ruppel; Fuchs et al.; and Knight-Davis and Sung).[31] Other studies used Microsoft Access (Burright et al.; Sinn; and Ralston et al.)[32] or Microsoft Excel (Haycock; Cox; Gao et al.; Nabe et al.; and Wilson and Tenopir).[33]

Methodology

This citation analysis study focused on dissertations authored by doctoral graduate students at the University of Notre Dame for a three-year period from 2005 to 2007. A Notre Dame Faculty Research Program grant funded this study. Because the grant period was 2008, the dissertations studied were for the most recent three years preceding that year: 2005, 2006, and 2007. The library owns print copies of all Notre Dame dissertations and electronic copies of most Notre Dame dissertations completed in recent years. For this study, only those dissertations for which the library had an electronic copy were used. Thus, the study examined the 248 dissertations that were produced in 2005, 2006, and 2007. The dissertations were produced in nineteen departments, with the most (26 apiece) coming out of Biological Sciences, Chemical & Biomolecular Engineering, and Electrical Engineering. All electronic copies of dissertations are accessible from the library's Web site in the Electronic Theses & Dissertations (ETD). From the ETD, a PHP script was used

to capture bibliographic data about the dissertations, including dissertation title, dissertation author, author's department, page length, and year of the dissertation.

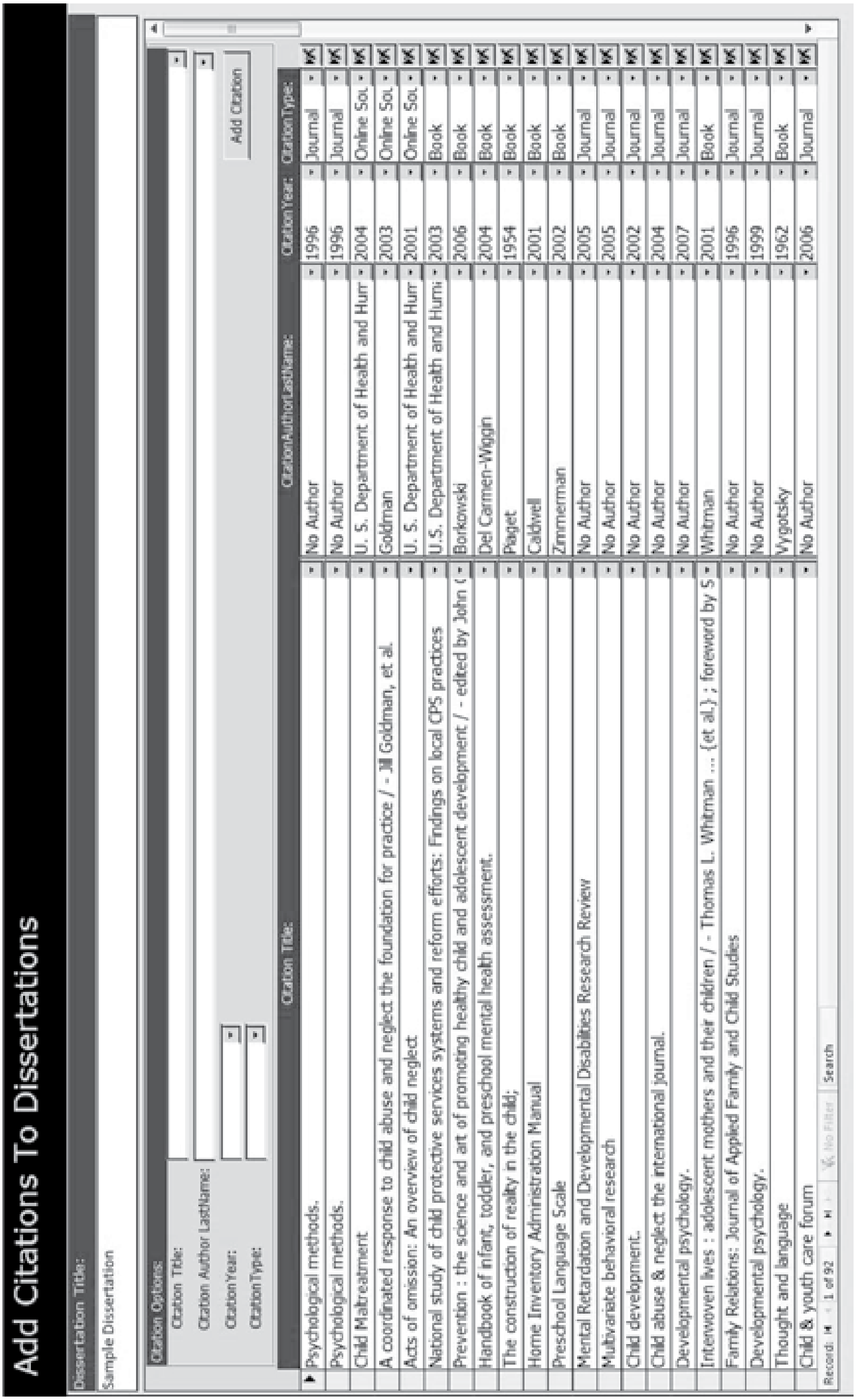
For each dissertation, every bibliographic reference cited in the dissertation was entered into a database. Specific forms (see figure 1) were created in a Microsoft Access database to make it easier to collect bibliographic data, including citation title, citation author (for nonserial sources), citation year, and citation type. Visual Basic for Applications (VBA) code was added to the forms to compare the data being entered against preexisting entries to eliminate redundancy and to standardize the form fields. In cases where a record was found to already exist in the database, it was linked to the newly entered citation. Where there was no match for a newly entered citation, a new record was created. To expedite the process of data entry, autocompletion was also used. In the event that the person doing data entry needed to edit or delete an entry, a subform allowed for that. The researcher, along with five research assistants, gathered bibliographic data from the references cited in each dissertation, including citation title (cited publication), citation author, citation year, and citation type (such as journal or newspaper). This information was entered into the Access database. In total, 39,106 citations were entered, which translated into 27,652 discrete citations. In other words, the 39,106 figure represented the total corpus of citations collected whereas the 27,652 figure represented a grouping of unique items, those items that shared the same title, year, citation type, and author (for books). Grouping is explained more fully later in this section.

The researchers checked the data for accuracy by comparing and correcting each reference gathered using additional bibliographic data from the library's online catalog. For every cited reference, researchers manually searched the catalog to determine whether the library owned a copy of the cited source. If a cited item was not found in the catalog, an attempt was made to validate the original citation. To ensure that the library did not own a correctly cited item and that the citation was correct, a verification of its existence was done (by searching WorldCat, for instance). This process, in essence, eliminated citation errors made by dissertation authors. Ownership of an item meant that the library had a subscription, either print or electronic to the full text of the cited source. So, for example, links to electronic books and open access journals would also be considered "owned." Ownership status was determined at the time of the study in 2008, that is, whether the library currently had subscriptions to the items that the graduate students had cited in their dissertations completed in 2005, 2006, and 2007. Researchers did not collect "point in time" data due to time and financial limitations.

Finally, the data were cleaned to eliminate any redundancies that may have been created using a variety of techniques. Redundancies in collected data were partly attributable to dissertation authors' use of abbreviations or acronyms of source titles. Cleanup methods included using an algorithm to compare string distance, Access queries (such as title within title and initial article), and spell-check. Researchers corrected items within the database after reviewing the reports and making necessary adjustments. A duplicate records search was done to remove duplicate records, and the database was updated accordingly. These steps were repeated until all redundancy checks and queries returned no errors.

Collected citations were classified in two different ways based on the bibliographic data and disciplines. There were three groups based on the bibliographic data: Group 1 contained the 27,652 discrete citations mentioned previously in this section and included items that shared the same year, title, type, and author. Year was included in this first group so that, for example, the same

FIGURE 1
Sample Data Entry Form



Add Citations To Dissertations

Dissertation Title:
Sample Dissertation

Citation Options:
Citation Title:
Citation Author LastName:
Citation Year:
Citation Type:
Add Citation

Citation Title:	CitationAuthorLastName:	Citation Year:	Citation Type:
Psychological methods.	No Author	1996	Journal
Psychological methods.	No Author	1996	Journal
Child Maltreatment	U. S. Department of Health and Hum	2004	Online Sou
A coordinated response to child abuse and neglect the foundation for practice / - Jill Goldman, et al.	Goldman	2003	Online Sou
Acts of omission: An overview of child neglect	U. S. Department of Health and Hum	2001	Online Sou
National study of child protective services systems and reform efforts: Findings on local CPS practices	U.S. Department of Health and Hum	2003	Book
Prevention : the science and art of promoting healthy child and adolescent development / - edited by John (	Borkowski	2006	Book
Handbook of infant, toddler, and preschool mental health assessment.	Del Carmen-Wiggin	2004	Book
The construction of reality in the child;	Piaget	1954	Book
Home Inventory Administration Manual	Caldwell	2001	Book
Preschool Language Scale	Zimmerman	2002	Book
Mental Retardation and Developmental Disabilities Research Review	No Author	2005	Journal
Multivariate behavioral research	No Author	2005	Journal
Child development.	No Author	2002	Journal
Child abuse & neglect the international journal.	No Author	2004	Journal
Developmental psychology.	No Author	2007	Journal
Interwoven lives : adolescent mothers and their children / - Thomas L. Whitman ... {et al.} ; foreword by S	Whitman	2001	Book
Family Relations: Journal of Applied Family and Child Studies	No Author	1996	Journal
Developmental psychology.	No Author	1999	Journal
Thought and language	Vygotsky	1962	Book
Child & youth care forum	No Author	2006	Journal

Record: 1 of 92 No Filter Search

journal, from two different years, was seen as two discrete (separate) sources. Group 2 contained 18,942 discrete citations and included those items that shared the same title, type, and author. In this second group, all journals with the same title, even if they were from different years, were seen as one source. In essence, Group 2 allowed for a more valid comparison between journal titles and other materials than Group 1 did. Group 3 contained 11,278 discrete citations and varied by only identifying the cited items owned by Notre Dame's libraries. For citations referring to books, author data were collected to distinguish between books with the same title. Author data were not collected for journal references because the journal at large, as opposed to each individual article contained within the journal, was the focus of this citation analysis.

The second way the data were classified was in groupings by discipline. There were four groups created and classified by discipline: Arts and Humanities, Engineering, Science, and Social Sciences (see table 1). Table 1 also shows the descriptive data for the dissertations in each disciplinary group. Additionally, all data in the bibliographic and disciplinary groups were subjected to a weighted index. Weighting was used to ensure that an individual dissertation citing an item an inordinate number of times would not bias the results. In other words, weighting was done in recognition of the fact that one publication with numerous citations to a particular source would create an imprecise ranking order. So, weighting was used to get a true measure of which items were being cited the most by different graduate students, in general, and by discipline. The weighted index formula from the Waugh and Ruppel study was used.[34] This weighting formula ranked items in order of those cited the most times by the greatest number of graduate students. All the data collected and processed was then analyzed using the Statistical Package for the Social Sciences (SPSS).[35]

Results

The average length of dissertation overall was 196.9 pages. History dissertations were the longest with an average page length of 426.3 pages, and psychology dissertations were the shortest with an average page length of 83.6 pages. The longest dissertation in this study was from Civil Engineering & Geological Sciences with 813 pages, while the shortest one was from Mathematics with 39 pages. On average, there were 0.83 citations per page (total number of pages divided by the total number of end references in the bibliography) overall, 1.23 citations per page in Biological Sciences, and 0.30 citations per page in Medieval Studies (see table 1).

The average age of citations overall was 19.1 years. The mean age of citation sources by discipline was as follows: Arts & Humanities (33.4 years), Engineering (11.4 years), Science (10.8 years) and Social Sciences (15.7 years). On average, graduate students in the departments of History and of History and Philosophy of Science tended to cite older material, 43.3 and 43.2 years, respectively. However, graduate students in the department of Computer Science & Engineering cited relatively newer (7.1 years old) materials (see table 1).

Of the 39,106 total citations, 55.2 percent were journal citations and 36.8 percent were book citations (see table 2). Classification groups [Group 1 (same year, title, type, and author), Group 2 (same title, type, and author) and Group 3 (same title, author, and type and owned by Notre Dame's libraries)], all showed that books and journals were the most frequently cited types of materials as follows: Group 1 (46% journals, 44% books), Group 2 (64% books, 22% journals), and Group 3 (66% books, 31% journals) (see table 3).

Classification groups based on disciplines also showed that books and journals were the most frequently cited sources, accounting for 96 percent, 78 percent, 92 percent, and 88 percent of all

TABLE 1
Number and Characteristics of Dissertations Used by Department and Disciplinary Areas

Discipline	Department	Number of Dissertations	Dissertation Length			Total Citations	Average Citations per Page	Average Citation Age
			Average	Longest	Shortest			
Arts and Humanities	History	9	426.3	706	310	3,547	0.98	43.3
	Theology	16	336.9	506	226	4,693	0.81	24.5
	History & Philosophy of Science	2	293.0	308	278	580	1.00	43.2
	English	12	277.0	487	177	2,893	0.90	29.4
	Philosophy	6	235.8	404	182	771	0.48	14.7
	Medieval Studies	1	233.0	233	233	65	0.30	30.7
Arts & Humanities		**46**	**321.4**	**706**	**177**	**12,549**	**0.85**	**33.4**
Engineering	Civil Engineering and Geological Sciences	15	231.5	813	96	1,810	0.66	12.7
	Chemical and Biomolecular Engineering	26	180.7	427	99	4,440	0.96	11.8
	Computer Science and Engineering	9	173.3	246	120	978	0.63	7.1
	Electrical Engineering	26	147.2	237	80	2,175	0.59	11.3
	Aerospace and Mechanical Engineering	16	137.4	243	98	1,273	0.61	14.0
Engineering		**92**	**171.3**	**813**	**80**	**10,676**	**0.68**	**11.4**
Science	Chemistry and Biochemistry	11	198.1	272	130	2,025	0.95	10.2
	Biological Sciences	26	166.2	442	97	5,018	1.23	8.9
	Physics	22	160.7	285	55	2,125	0.64	16.1
	Mathematics	9	102.2	152	39	301	0.39	14.9
Science		**68**	**161.1**	**442**	**39**	**9,469**	**0.86**	**10.8**
Social Sciences	Political Science	12	288.2	507	186	2,525	0.78	20.3
	Sociology	5	242.4	414	155	1,076	1.00	13.7
	Economics	6	178.7	299	71	1,045	1.00	13.1
	Psychology	19	83.6	131	51	1,766	1.13	13.0
Social Sciences		**42**	**174.5**	**507**	**51**	**6,412**	**0.87**	**15.7**
TOTAL		**248**	**196.9**	**813**	**39**	**39,106**	**0.80**	**19.1**

TABLE 2
Citation Type by Frequency and Percentage

Citation Type	Frequency	Percent
Journal	21,597	55.2%
Book	14,406	36.8%
Conf. Proc.	856	2.2%
Online Source	601	1.5%
Dissertation	361	0.9%
Paper	258	0.7%
Report	238	0.6%
Other	206	0.5%
Newspaper	121	0.3%
Thesis	78	0.2%
Manuscript	73	0.2%
Magazine	69	0.2%
Conf. Presentation	52	0.1%
Computer Program	29	0.1%
Manual	26	0.1%
Patent	24	0.1%
Admin. Materials	16	0.0%
Presentation	15	0.0%
Mimeograph	13	0.0%
Course Notes	10	0.0%
E-mail	8	0.0%
Preprint	8	0.0%
Speech	5	0.0%
Poster	4	0.0%
Computer File	4	0.0%
Newsletter	4	0.0%
Lecture	4	0.0%
Poll	3	0.0%
Interview	3	0.0%
Document	3	0.0%
Electronic Device	2	0.0%
Video	2	0.0%
Map	2	0.0%
Project Summary	1	0.0%
Image	1	0.0%
Memorandum	1	0.0%
Testimony	1	0.0%
Radio broadcast	1	0.0%
Total	39,106	100.00%

the citations in Arts and Humanities, Engineering, Science, and Social Sciences dissertations, respectively. The most frequently cited types of materials by discipline were: Arts & Humanities, books (73%) and journals (23%); Engineering, journals (64%) and books (14%); Science, journals (78%) and books (14%); and Social Sciences, journals (46%) and books (42%). When examined at a departmental level, the same pattern emerged where journals and books were the most cited items across all departments, except in Computer Science & Engineering, where conference proceedings were the most frequently cited (32%), followed by journals (31%), online sources (14%), and books (11%). Two departments, while maintaining the journals and books pattern, had citation types in third place that were notable. The third most highly cited items in Electrical Engineering were conference proceedings (14%) and in Economics were papers (11%).

Further analysis, using the weighted index, indicated the most cited titles overall. Of the top twenty most cited titles overall, the journals of *Science* and *The Journal of Biological Chemistry* appeared most frequently (see table 5). There was an average of 4.9 citations to *Science* (for the year 2000), for 29 dissertations, which was 11.7 percent of all the dissertations.

To apply the weighted index to the data in the disciplinary groups, the weighting formula was adjusted to limit analysis to those dissertations within each group, as follows: Group Weight = $(T/G) \times C$ (where T = number of graduate students citing each item within the disciplinary group; G = number of dissertations in that disciplinary group, and C = number of times the item was cited in that disciplinary group). In terms of the number of dissertations in each disciplinary group, there were 46 in Arts and Humanities, 92 in Engineering, 68 in Science, and 42 in Social Sciences.

TABLE 3
Unique Citation Types by Bibliographic Grouping

Citation Type	Group 1*		Group 2**		Group 3***	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Journal	12,771	46%	4,236	22%	3,444	31%
Book	12,131	44%	12,131	64%	7,492	66%
Conf. Proc.	630	2%	505	3%	117	1%
Online Source	557	2%	548	3%	17	0%
Dissertation	342	1%	342	2%	0	0%
Paper	248	1%	239	1%	22	0%
Report	230	1%	230	1%	7	0%
Other	200	1%	196	1%	10	0%
Newspaper	101	0%	84	0%	83	1%
Thesis	74	0%	74	0%	21	0%
Manuscript	72	0%	72	0%	0	0%
Magazine	62	0%	51	0%	32	0%
Conf. Presentation	51	0%	51	0%	1	0%
Computer Program	27	0%	27	0%	0	0%
Patent	24	0%	24	0%	0	0%
Manual	24	0%	24	0%	0	0%
Presentation	15	0%	15	0%	0	0%
Admin. Materials	15	0%	15	0%	0	0%
Mimeograph	13	0%	13	0%	0	0%
Course Notes	9	0%	9	0%	1	0%
Email	8	0%	8	0%	0	0%
Preprint	8	0%	8	0%	0	0%
Speech	5	0%	5	0%	1	0%
Poster	4	0%	4	0%	26	0%
Computer File	4	0%	4	0%	0	0%
Newsletter	4	0%	4	0%	1	0%
Lecture	4	0%	4	0%	2	0%
Poll	3	0%	3	0%	0	0%
Interview	3	0%	3	0%	0	0%
Document	2	0%	2	0%	0	0%
Electronic Device	2	0%	2	0%	0	0%
Video	2	0%	2	0%	0	0%
Map	2	0%	2	0%	1	0%
Project Summary	1	0%	1	0%	0	0%
Image	1	0%	1	0%	0	0%
Memorandum	1	0%	1	0%	0	0%
Testimony	1	0%	1	0%	0	0%
Radio broadcast	1	0%	1	0%	0	0%
Total	27,652	100%	18,942	100%	11,278	100%

*Group 1 = same year, title, type, and author; ** Group 2 = same title, type, and author; and ***Group 3 = same title, type, and author and owned by Hesburgh Libraries

TABLE 4
Types of Citations by Department and Disciplinary Areas

Discipline	Department	Journal	Book	Conf. Proc.	Online Source	Dissertation	Paper	Report	Newspaper	Other	Total N
Arts & Humanities	History	13%	81%	0%	0%	2%	0%	0%	1%	2%	3,547
	English	16%	81%	0%	1%	1%	0%	0%	1%	1%	2,893
	Medieval Studies	22%	77%	0%	0%	2%	0%	0%	0%	0%	65
	History and Philosophy of Science	22%	75%	1%	0%	2%	0%	0%	0%	0%	580
	Theology	29%	69%	0%	0%	1%	0%	0%	0%	0%	4,693
	Philosophy	37%	54%	1%	0%	1%	5%	0%	0%	2%	771
	Average for Arts & Humanities*	23%	73%								
Engineering	Aerospace and Mechanical Engineering	59%	22%	9%	1%	2%	4%	2%	0%	3%	1,273
	Electrical Engineering	62%	15%	14%	3%	2%	0%	1%	0%	3%	2,175
	Civil Engineering and Geological Sciences	78%	14%	2%	1%	1%	0%	2%	0%	2%	1,810
	Computer Science and Engineering	31%	11%	32%	14%	1%	0%	5%	0%	5%	978
	Chemical and Biomolecular Engineering	88%	9%	0%	1%	0%	0%	0%	0%	1%	4,440
	Average for Engineering*	64%	14%								
Science	Mathematics	51%	34%	4%	2%	3%	0%	1%	0%	6%	301
	Physics	74%	13%	1%	6%	3%	0%	1%	0%	3%	2,125
	Biological Sciences	94%	5%	0%	0%	0%	0%	1%	0%	0%	5,018
	Chemistry and Biochemistry	95%	3%	0%	0%	0%	0%	0%	0%	1%	2,025
	Average for Science*	78%	14%								
Social Sciences	Political Science	25%	67%	0%	1%	0%	1%	1%	0%	4%	2,525
	Sociology	51%	42%	0%	1%	2%	0%	1%	0%	3%	1,076
	Economics	41%	31%	0%	6%	0%	11%	1%	2%	6%	1,045
	Psychology	68%	29%	0%	0%	0%	0%	0%	0%	2%	1,766
	Average for Social Sciences*	46%	42%								
	Overall Average	55%	37%	2%	2%	1%	1%	1%	0%	2%	
	*Averages are provided only for journals and books										

TABLE 5
Most Frequently Cited Items for All Dissertations

	Title	Year	Dissertation	Weighted Index	% of all Dissertations
1	Science	2000	29	4.9113	11.69%
2	Science	2002	26	4.7177	10.48%
3	The Journal of Biological Chemistry	2004	17	2.8790	6.85%
4	Science	2001	21	2.7097	8.47%
5	The Journal of Biological Chemistry	2003	17	2.6048	6.85%
6	Nature	2002	16	2.3871	6.45%
7	The Journal of Biological Chemistry	2001	15	2.3589	6.05%
8	Science	1999	19	1.9153	7.66%
9	Proceedings of the National Academy of Sciences of the United States of America	2000	18	1.8871	7.26%
10	The Journal of Biological Chemistry	1999	18	1.8871	7.26%
11	The Journal of Biological Chemistry	2002	16	1.8710	6.45%
12	Proceedings of the National Academy of Sciences of the United States of America	2001	14	1.6371	5.65%
13	Nature	2001	16	1.6129	6.45%
14	Journal of the American Chemical Society	2004	14	1.5806	5.65%
15	Nature	1999	16	1.5484	6.45%
16	The Journal of Physical Chemistry B	2004	10	1.5323	4.03%
17	Science	1997	17	1.5081	6.85%
18	The Journal of Biological Chemistry	2000	13	1.3629	5.24%
19	Journal of the American Chemical Society	2003	12	1.3548	4.84%
20	The Journal of Physical Chemistry B	2002	12	1.3548	4.84%
21	Science	1998	16	1.3548	6.45%
22	Proceedings of the National Academy of Sciences of the United States of America	1999	16	1.3548	6.45%
23	The Journal of Biological Chemistry	1996	16	1.3548	6.45%
24	Proceedings of the National Academy of Sciences of the United States of America	2002	14	1.2984	5.65%
25	Applied Physics Letters	2001	13	1.2056	5.24%

The data in tables 6, 7, 8, and 9 show the top twenty most frequently cited items by discipline with the weighted index and the group weighted index. In Arts & Humanities, the top twenty most frequently cited items were overwhelmingly religious sources. In Engineering, *Science*, *The Journal of Physical Chemistry B,* and *Applied Physics Letters* were the most frequently cited items. In Science, several issues of *The Journal of Biological Chemistry* were cited most frequently. In Social Sciences, psychology sources, such as *Child Development,* were cited most frequently.

In this study, library ownership meant that the library had either a print or an electronic copy of a particular cited item. Of the 27,672 unique materials cited (Group 1), Hesburgh Libraries owned 18,461, or 67 percent. The weighted index was applied to determine which items were the top 1,000 cited overall. Of the top 1,000 items cited overall, Hesburgh Libraries owned 93 percent. When the group weighted index was applied to the top 1,000 citations by the various disciplinary groups, library ownership was as follows: Arts & Humanities (83%), Engineering (90%), Science (92%), and Social Sciences (75%) (see table 10).

Discussion and Conclusions

Results of this study show that the University of Notre Dame owns 67 percent of the materials Notre Dame graduate students cite in their dissertations. To get a more accurate assessment of their actual needs, however, a weighted index was applied. Of the top 1,000 citations overall (using a weighted index), library ownership rose to 93 percent. Further breakdown by group shows some variation in ownership and access by the different disciplines, with Science faring the best (92%), followed by Engineering (90%), Arts & Humanities (83%), and Social Sciences (75%).

Smith (2003), in her study of University of Georgia graduate student theses and dissertations, reported an 87 percent overall ownership and the following percentages of ownership by disciplinary group: Social Sciences (93%), Science (89%), and Arts & Humanities (80%).[36] The major difference between the Georgia statistics and Notre Dame's is the much lower library ownership (75%) of materials cited by the Social Sciences graduate students. Elsewhere, studies at the University of Texas-Austin found that the library owned 84.9 percent of the materials cited in graduate student theses and dissertations for education psychology students.[37] The Notre Dame figure of 90 percent library ownership of materials cited by Engineering graduate students is, however, comparatively much higher than that reported by Fuchs et al., who found that the library owned 71.2 percent of what University of Texas-Austin civil engineering students were citing.[38] The gap in ownership of materials at Notre Dame, cited by students in the physical sciences as compared to ownership of materials cited by students in the social sciences, might be attributable to differences in internal library budgetary allocations or to differences in endowments for particular subjects. Although endowments are generally restricted by donor preferences, other sources of funding can be administratively reallocated as is deemed necessary.

Age of the most cited materials in this study differed from findings in other studies on graduate student citations. In a citation analysis of Chemistry and Chemical Engineering dissertations, Vallmitjana and Sabate found that the mean age of citations was 14 years.[39] The mean age of citations for Notre Dame's most comparable group, Science, was 10.8 years. The Texas-Austin educational psychology student citations were, on average, 13.7 years old, whereas the Notre Dame's Social Sciences group citations averaged 15.7 years. However, the mean age of cited items by the civil engineering students in the Fuchs et al. study, at the University of Texas-Austin,[40] was comparable to Notre Dame's Engineering group (11.34 vs. 11.4 years, respectively).

TABLE 6
Top 25 Citation Items for Arts and Humanities Disciplines

Citation Title	Year	Total Citations	Number of Dissertations Citing this Reference	Disciplinary Group Weighted Index	Overall Weighted Index
Anchor Bible dictionary / David Noel Freedman, editor-in-chief; associate editors, Gary A. Herion, David F. Graf, John David Pleins ; managing editor, Astrid B. Beck.	1992	12	5	1.30	0.24
Cosmos Crumbling: American Reform and the Religious Imagination / Robert H. Abzug.	1994	6	6	0.78	0.15
The Democratization of American Christianity / Nathan O. Hatch.	1989	6	6	0.78	0.20
Exile: Old Testament, Jewish, and Christian Conceptions / edited by James M. Scott.	1997	11	3	0.72	0.13
American national biography /general editors, John A. Garraty, Mark C. Carnes.	1999	9	3	0.59	0.11
From revelation to canon: studies in the Hebrew Bible and Second Temple literature / by James C. VanderKam.	2000	13	2	0.57	0.10
The political unconscious: narrative as a socially symbolic act / Fredric Jameson.	1981	5	5	0.54	0.10
Without God, without creed: the origins of unbelief in America / James Turner.	1985	5	5	0.54	0.10
Catholicism and American freedom: a history / John T. McGreevy.	2003	5	5	0.54	0.10
The William and Mary Quarterly.	2002	11	2	0.48	0.09
The Dead Sea scrolls: fifty years after their discovery : proceedings of the Jerusalem Congress, July 20-25, 1997 / edited by Lawrence H. Schiffman, Emanuel Tov, and James C. VanderKam.	2000	7	3	0.46	0.08
Philosophical perspectives	2000	10	2	0.43	0.08
The Community of the Renewed Covenant: the Notre Dame Symposium on the Dead Sea Scrolls / edited by Eugene Ulrich and James VanderKam	1994	5	4	0.43	0.08

(continued)

TABLE 6 *(continued)*
Top 25 Citation Items for Arts and Humanities Disciplines

Citation Title	Year	Total Citations	Number of Dissertations Citing this Reference	Disciplinary Group Weighted Index	Overall Weighted Index
The Catholic Biblical quarterly	1981	5	4	0.43	0.08
Encyclopedia of the Dead Sea scrolls / Lawrence H. Schiffman, James C. VanderKam, editors in chief	2000	6	3	0.39	0.07
Persia and Torah: The Theory of Imperial Authorization of the Pentateuch /James W. Watts, editor	2001	9	2	0.39	0.07
The Gospel of Luke / Luke Timothy Johnson ; Daniel J. Harrington, editor	1991	4	4	0.35	0.06
Historiography and Self-Definition: Josephus, Luke-Acts, and Apologetic Historiography	1992	4	4	0.35	0.06
America's God: from Jonathan Edwards to Abraham Lincoln / Mark A. Noll	2002	4	4	0.35	0.06
Journal for the Study of the Pseudepigrapha	1988	4	4	0.35	0.06
A Greek-English lexicon / compiled by Henry George Liddell and Robert Scott	1996	4	4	0.35	0.06
Honor & Slavery : Lies, Duels, Noses, Masks, Dressing as a Woman, Gifts, Strangers, Humanitarianism, Death, Slave Rebellions, The Proslavery Argument, Baseball, Hunting, and Gambling in the Old South /Kenneth S. Greenberg	1996	4	4	0.35	0.06
Cradle of the Middle Class: The Family in Oneida County, New York, 1790–1865 / Mary P. Ryan	1981	4	4	0.35	0.06
Making the American Self: Jonathan Edwards to Abraham Lincoln / Daniel Walker Howe	1997	4	4	0.35	0.06
The Chronicler as Author: Studies in Text and Texture / edited by M. Patrick Graham & Steven L. McKenzie	1999	16	1	0.35	0.06

TABLE 7
Top 25 Citation Items for Engineering Disciplines

	Citation Title	Year	Total Citations	Number of Dissertations Citing this Reference	Disciplinary Group Weighted Index	Overall Weighted Index
1	Science	2002	16	10	4.52	4.72
2	The Journal of Physical Chemistry B	2004	35	8	3.80	1.53
3	Science	2000	12	8	3.78	4.91
4	Applied Physics Letters	1999	27	9	2.93	1.17
5	Science	1999	14	10	2.89	1.92
6	Applied Physics Letters	2001	19	10	2.68	1.21
7	The Journal of Physical Chemistry B	2002	20	9	2.61	1.35
8	The Journal of Physical Chemistry B	2005	21	8	2.28	0.93
9	Applied Physics Letters	2003	15	9	1.96	1.16
10	Journal of the American Chemical Society	2004	12	8	1.83	1.58
11	IEEE transactions on information theory	2001	22	6	1.67	0.65
12	Science	1997	9	6	1.66	1.51
13	The Journal of Physical Chemistry B	2001	16	8	1.57	0.69
14	Journal of the American Chemical Society	2003	12	6	1.57	1.35
15	Journal of Chemical Physics	2004	13	8	1.55	0.80
16	Applied Physics Letters	2000	13	8	1.41	0.65
17	Applied Physics Letters	2002	13	7	1.41	0.73
18	Nature	1999	8	4	1.39	1.55
19	Science	1998	7	6	1.22	1.35
20	The Journal of Physical Chemistry B	2003	11	6	1.20	0.73
21	Journal of the Electro-chemical Society	2005	21	5	1.14	0.42
22	Science	2001	5	4	1.14	2.71
23	Applied Physics Letters	2005	13	7	1.13	0.45
24	Applied Physics Letters	2004	10	6	1.09	0.60
25	Journal of Applied Physics	2004	10	7	1.09	0.56

TABLE 8
Top 25 Citation Items for Science Disciplines

	Citation Title	Year	Total Citations	Number of Dissertations Citing this Reference	Disciplinary Group Weighted Index	Overall Weighted Index
1	Science	2000	30	21	12.79	4.91
2	Science	2002	29	16	11.09	4.72
3	The Journal of Biological Chemistry	2004	42	17	10.50	2.88
4	The Journal of Biological Chemistry	2003	37	16	9.25	2.60
5	Science	2001	27	17	8.34	2.71
6	The Journal of Biological Chemistry	2001	37	14	8.16	2.36
7	Nature	2002	31	12	7.29	2.39
8	The Journal of Biological Chemistry	2002	29	16	6.82	1.87
9	The Journal of Biological Chemistry	1999	24	16	6.35	1.89
10	Proceedings of the National Academy of Sciences of the United States of America	2000	23	16	6.09	1.89
11	Proceedings of the National Academy of Sciences of the United States of America	2001	26	12	5.35	1.64
12	The Journal of Biological Chemistry	2000	26	13	4.97	1.36
13	The Journal of Biological Chemistry	1996	20	15	4.71	1.35
14	Nature	2001	19	13	4.47	1.61
15	Proceedings of the National Academy of Sciences of the United States of America	1999	18	13	4.24	1.35
16	Proceedings of the National Academy of Sciences of the United States of America	2002	18	10	3.71	1.30
17	The Journal of Biological Chemistry	1998	18	11	3.44	1.05
18	Nature	2000	18	12	3.44	1.00
19	Journal of the American Chemical Society	2004	16	6	3.29	1.58
20	Science	1997	13	11	3.25	1.51
21	Science	1999	11	9	3.07	1.92
22	Nature	1999	13	10	3.06	1.55
23	Science	1994	13	11	3.06	1.16
24	Proceedings of the National Academy of Sciences of the United States of America	1996	16	11	3.06	0.94
25	Proceedings of the National Academy of Sciences of the United States of America	1998	17	11	3.00	0.87

TABLE 9
Top 25 Citation Items for Social Sciences Disciplines

	Citation Title	Year	Total Citations	Number of Dissertations Citing this Reference	Disciplinary Group Weighted Index	Overall Weighted Index
1	Parenting and the child's world : influences on academic, intellectual, and social-emotional development / {edited by} John G. Borkowski, Sharon Landesman Ramey, Marie Bristol-Power	2002	12	6	1.71	0.29
2	Child development	1984	9	7	1.50	0.25
3	Child development	2000	6	6	0.86	0.20
4	Interwoven lives : adolescent mothers and their children / Thomas L. Whitman ... {et al.} ; foreword by Sharon Landesman Ramey	2001	6	6	0.86	0.15
5	Developmental psychology	1997	6	6	0.86	0.15
6	Child development	1994	7	5	0.83	0.14
7	Child development	2003	7	5	0.83	0.14
8	Child development	2005	7	5	0.83	0.14
9	Parenting, science and practice	2004	6	5	0.71	0.12
10	Child development	2002	6	5	0.71	0.12
11	Psychological methods	1996	7	4	0.67	0.11
12	Psychological bulletin	1990	5	5	0.60	0.10
13	Journal of Personality and Social Psychology	1986	5	5	0.60	0.10
14	Multivariate behavioral research	1990	5	5	0.60	0.10
15	After virtue : a study in moral theory / by Alasdair MacIntyre	1981	3	3	0.21	0.10
16	Nature	1999	3	2	0.14	1.55
17	Nature	2001	2	1	0.05	1.61
18	Science	1998	2	1	0.05	1.35
19	Nature	2002	1	1	0.02	2.39
20	Nature	1998	1	1	0.02	0.90
21	Science	1991	1	1	0.02	0.40
22	IEEE transactions on information theory	1999	1	1	0.02	0.23
23	The democratization of American Christianity / Nathan O. Hatch	1989	1	1	0.02	0.20
24	Proceedings of the National Academy of Sciences of the United States of America	1990	1	1	0.02	0.12
25	Nature	1993	1	1	0.02	0.10

TABLE 10
Hesburgh Libraries' Ownership of Cited Items by Disciplinary Group*

Group	Citations	Owned	% Owned	% Top 1,000 Cited Items Owned **
Arts and Humanities	10,818	7,297	63	90
Engineering	7,032	4,395	67	83
Science	5,369	4,093	76	92
Social Sciences	5,185	3,378	65	75
Overall	27,652	18,461	67	93

* There were 752 citations that were in more than one group, 702 of which were owned.

** Weighted index was applied.

The most frequently cited types of materials overall were books (55%) and journals (37%); and by discipline were: Arts & Humanities, books (73%) and journals (23%); Engineering, journals (64%) and books (14%); Science, journals (78%) and books (14%); and Social Sciences, journals (46%) and books (42%). The Notre Dame findings are comparable to the findings in the study of theses and dissertations by Smith at the University of Georgia. That study found book and journal citation patterns were as follows: All Disciplines, books (48%) and journals (38%); and Arts & Humanities, books (71%) and journals (19%).[41] The Burright study of neuroscience faculty and graduate students' work showed that cited references in their publications were 82 percent from journal articles and 8 percent from books,[42] which is similar to Notre Dame's Science group, journals (88%) and books (7%). Notre Dame's Science group citation pattern is also comparable to Kuruppu and Moore's study of agriculture and biology dissertations at Iowa State, which reported that student citations were 80.5 percent journals and 10.5 percent books.[43]

The effect of electronic access on citation patterns has been studied by Smith (2003). She found that citations to Web sites were nonexistent in the 1991 theses and dissertations but were 3.5 percent of the citations in the 2001 set of theses and dissertations. There was also a clear shift from the use of ERIC microform to the electronic version of ERIC in the education theses and dissertations.[44] Other research on undergraduates found that students cited more Web sources and fewer books than they had three years previously.[45] It is difficult to measure through citation analysis precisely how big of an impact electronic access has had on researchers because researchers do not necessarily acknowledge that they used an electronic version. The effect of electronic materials on library ownership has also been studied by Smith (2003) at the University of Georgia. Smith found that the library owned more monographs and fewer periodicals in 2001 than it did in 1991, a finding that surprised her.[46] Further analysis on Notre Dame dissertations will involve selecting dissertations, from a point in time before electronic access became the norm, to compare citation patterns and ownership statistics to those dissertations that were used in this study.

In conclusion, citation analysis gives the library researcher a deeper look into the user's research patterns and library research needs, which should be important in recommending materials for selection and deselection. A previous study of graduate students at Notre Dame found that students identified materials relevant to their research by searching a database or reading an article or book and that, if the library did not own an item, 64 per-

cent of them would try to get it through interlibrary loan.[47] Although this citation analysis study was conducted on Notre Dame's graduate student population, the findings should be relevant to librarians elsewhere in developing collection development policies and in thinking about budgeting for different user populations.

The findings in this study indicate a need for additional funding for further development of the social sciences collections in the Hesburgh Libraries of Notre Dame to support graduate student research (theses and dissertation writing) and publication endeavors at the university. The marked difference in library ownership of materials cited by graduate students in the physical sciences versus those in the social sciences can be addressed through library budgetary increases and/or adjustments. Since this study focused on graduate students from various departments and colleges at Notre Dame, it should be a fairly accurate indicator of their current and future needs and, therefore, impact decisions regarding collection development funding. It will enable those involved in collection development to provide and maintain high-quality collections for graduate students. This is not to suggest that libraries should have comprehensive collections to be useful to graduate students. Comprehensive collections are impractical because of funding hardships in libraries. There are other ways to support graduate student research: for example, ordering unowned materials through interlibrary loan, assuming this is more cost-effective than purchasing a particular item. Using data such as that collected through citation analysis to drive collection strategies and to develop quality collections is a better approach than striving for comprehensive collections. Ultimately, developing and maintaining a high-quality library collection is paramount in meeting graduate student needs.

Notes

1. "About Notre Dame," University of Notre Dame, available online at http://nd.edu/aboutnd [accessed 16 September 2010].

2. "Fact Book," University of Notre Dame Institutional Research, available online at www.nd.edu/~instres/home3/fact_book.shtml [accessed 10 October 2010].

3. "Chronology of Notre Dame Libraries," Hesburgh Libraries, available online at www.library.nd.edu/about/history/timeline.shtml [accessed 16 September 2010].

4. Linda Smith, "Citation Analysis," *Library Trends* 30 (1981): 83–106.

5. Thomas E. Nisonger, "Journals in the Core Collection: Definition, Identification, and Applications," *The Serials Librarian* 51 (2007): 51–73.

6. See Stanley J. Wilder, "A Simple Method for Producing Core Scientific and Technical Journal Title Lists," *Library Resources & Technical Services* 44 (2000): 92–96; Paul Kelsey and Tom Diamond, "Establishing a Core List of Journals for Forestry: A Citation Analysis from Faculty at Southern Universities," *College & Research Libraries* 64 (2003): 357–77; C. Keith Waugh and Margie Ruppel, "Citation Analysis of Dissertation, Thesis, and Research Paper References in Workforce Education and Development," *The Journal of Academic Librarianship* 30 (2004): 276–84; Marian Burright, Trudie Hahn, and Margaret Antonisse, "Understanding Information Use in a Multidisciplinary Field: A Local Citation Analysis of Neuroscience and Cognitive Science Research," *College & Research Libraries* 66 (2005): 198–210; Yelena Pancheshnikov, "A Comparison of Literature Citations in Faculty Publications and Student Theses as Indicators of Collection Use and a Background for Collection Management at a University Library," *The Journal of Academic Librarianship,* 33 (2007): 674–83; Jonathan Nabe and Andrea Imre, "Dissertation Citations in Organismal Biology at Southern Illinois University at Carbondale: Implications for Collection Development," *Issues in Science & Technology Librarianship* 55 (2008); Rick Ralston, Carole Gall, and Frances A. Brahmi, "Do Local Citation Patterns Support Use of the Impact Factor for Collection Development?" *Journal of the Medical Library Association* 96 (2008); 374–78; Shi-Jian Gao, Wang-Zhi Yu, and Feng-Ping Luo, "Citation Analysis of PhD Thesis [*sic*] at Wuhan University, China," *Library Collections, Acquisitions, & Technical Services* 33 (2009): 8–16.

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Cristina Thomsen, Randolph Bias, and Donald Davis. "Behavioral Citation Analysis: Toward Collection Enhancement for Users," *College and Research Libraries* 67 (2006): 304–24; Pancheshnikov, "A Comparison of Literature Citations," 674; Conception Wilson and Carol Tenopir, "Local Citation Analysis, Publishing and Reading Patterns: Using Multiple Methods to Evaluate Faculty Use of an Academic Library's Research Collection," *Journal of the American Society for Information Science & Technology,* 59 (2008): 1393–1408.

8. Stacey Knight-Davis and Jan S. Sung, "Analysis of Citations in Undergraduate Papers," *College & Research Libraries* 69 (2008): 447–58.

9. See Angela M. Gooden, "Citation Analysis of Chemistry Doctoral Dissertations: An Ohio State University Case Study," *Issues in Science and Technology Librarianship* 32 (2001), available online at www.istl.org/01-fall/refereed.html [accessed 16 September 2010]; Joel Sam and S.N.B. Tackie, "Citation Analysis of Dissertations at the Department of Information Studies, University of Ghana, Legon," *African Journal of Library Archives and Information Science* 17 (2007): 123–32; Pali U. Kuruppu and Debra C. Moore, "Information Use by PhD students in Agriculture and Biology: A Dissertation Citation Analysis," *portal: Libraries and the Academy* 8 (2008): 387–405; Janice E. Cox, "Citation Analysis of Graduate Dental Theses References: Implications for Collection Development," *Collection Management* 33 (2008): 219–34.

10. Robin N. Sinn, "A Local Citation Analysis of Mathematical and Statistical Dissertations," *Science & Technology Libraries* 25 (2005): 25–37.

11. Yasar Tonta and Umut Al, "Scatter and Obsolescence of Journals Cited in Theses and Dissertations of Librarianship," *Library & Information Science Research* 28 (2006): 281–96.

12. Kelsey and Diamond, "Establishing a Core List of Journals for Forestry," 357; Burright, Hahn, and Antonisse, "Understanding Information Use in a Multidisciplinary Field," 198; Wilson and Tenopir, "Local Citation Analysis, Publishing and Reading Patterns," 1393; Pancheshnikov, "A Comparison of Literature Citations," 674; Ralston et al., "Do Local Citation Patterns Support Use of the Impact Factor for Collection Development?" 374.

13. Kuruppu and Moore, "Information Use by PhD Students in Agriculture and Biology," 391.

14. Sinn, "A Local Citation Analysis of Mathematical and Statistical Dissertations," 29.

15. Burright et al., "Understanding Information Use in a Multidisciplinary Field," 202.

16. Cox, "Citation Analysis of Graduate Dental Theses References," 225.

17. Tonta and Al, "Scatter and Obsolescence of Journals," 285.

18. Waugh and Ruppel, "Citation Analysis of Dissertation, Thesis, and Research Paper References," 279.

19. Sinn, "A Local Citation Analysis of Mathematical and Statistical Dissertations," 29.

20. Nabe and Imre, "Dissertation Citations in Organismal Biology."

21. Pancheshnikov, "A Comparison of Literature Citations," 674.

22. Ralston et al., "Do Local Citation Patterns Support Use of the Impact Factor for Collection Development?" 374.

23. Gooden, "Citation Analysis of Chemistry Doctoral Dissertations."

24. Knight-Davis and Sung, "Analysis of Citations in Undergraduate Papers," 448.

25. Gao et al., "Citation Analysis," 10.

26. Smith, "Assessing Collection Usefulness," 346.

27. Fuchs et al., "Behavioral Citation Analysis," 307.

28. Sam and Tackie, "Citation Analysis of Dissertations," 126.

29. Kuruppu and Moore, "Information Use by PhD Students in Agriculture and Biology," 391.

30. See Smith, "Assessing Collection Usefulness," 346; Tonta and Al, "Scatter and Obsolescence of Journals," 285; Sam and Tackie, "Citation Analysis of Dissertations," 126; Kuruppu and Moore, "Information Use by PhD Students in Agriculture and Biology," 391; Pancheshnikov, "A Comparison of Literature Citations," 675.

31. See Waugh and Ruppel, "Citation Analysis of Dissertation, Thesis, and Research Paper References,"279; Fuchs et al., "Behavioral Citation Analysis," 307; Knight-Davis and Sung, "Analysis of Citations in Undergraduate Papers," 448.

32. See Burright et al., "Understanding Information Use in a Multidisciplinary Field," 202; Sinn, "A Local Citation Analysis of Mathematical and Statistical Dissertations," 29; Ralston et al., "Do Local Citation Patterns Support Use of the Impact Factor for Collection Development?" 375.

33. See Laurel A. Haycock, "Citation Analysis of Education Dissertations for Collection Development," *Library Resources & Technical Services* 48 (2004): 102–06; Cox, "Citation Analysis of Graduate Dental Theses References," 225; Gao et al., "Citation Analysis," 10; Nabe and Imre, "Dissertation Citations in Organismal Biology"; Wilson and Tenopir, "Local Citation Analysis, Publishing and Reading Patterns," 1394.

34. Weight = $(T/N) \times C$ (where T = number of graduate students citing each item, N = number of dissertations in this study, and C = number of times the item was cited). Waugh and Ruppel, Citation Analysis of Dissertation, Thesis, and Research Paper References," 280.

35. Julie F. Pallant, *SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS* (Sydney, Australia: Allen & Unwin, 2007).
36. Smith, "Assessing Collection Usefulness," 352.
37. Fuchs et al., "Behavioral Citation Analysis," 317.
38. Ibid.
39. Nuria Vallmitjana and L.G. Sabate, "Citation Analysis of Ph.D. Dissertation References as a Tool for Collection Management in an Academic Chemistry Library," *College & Research Libraries* 69 (2008): 72–82.
40. Fuchs et al., "Behavioral Citation Analysis," 311.
41. Smith, "Assessing Collection Usefulness," 348.
42. Burright et al., "Understanding Information Use in a Multidisciplinary Field," 204.
43. Kuruppu and Moore, "Information Use by PhD Students in Agriculture and Biology," 393.
44. Smith, "Assessing Collection Usefulness," 354.
45. Philip M. Davis and Suzanne A. Cohen, "The Effect of the Web on Undergraduate Citation Behavior 1996–1999," *Journal of the American Society for Information Science and Technology* 52 (2001): 309–14.
46. Smith, "Assessing collection usefulness," 354.
47. Jessica Kayongo and Clarence Helm, "Graduate Students and the Library: A Survey of Research Practices and Library Usage at the University of Notre Dame," *Reference & User Services Quarterly* 49 (2010): 341–49.