University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Library Philosophy and Practice (e-journal) | Libraries at University of Nebraska-Lincoln

11-2-2009

Citation Analysis of Doctoral Works Submitted to the Department of Animal Science, University of Ibadan, Nigeria

Wole Michael Olatokun
Africa Regional Centre for Information Science (ARCIS), University of Ibadan, Nigeria, woleabbeyolatokun@yahoo.co.uk

Follow this and additional works at: http://digitalcommons.unl.edu/libphilprac

Part of the Library and Information Science Commons

Olatokun, Wole Michael, "Citation Analysis of Doctoral Works Submitted to the Department of Animal Science, University of Ibadan, Nigeria" (2009). *Library Philosophy and Practice (e-journal)*. Paper 300.
http://digitalcommons.unl.edu/libphilprac/300

Library Philosophy and Practice 2009

ISSN 1522-0222

Citation Analysis of Doctoral Works Submitted to the Department of Animal Science, University of Ibadan, Nigeria

Wole Michael Olatokun

Olayinka Makinde

Africa Regional Centre for Information Science (ARCIS)
University of Ibadan, Nigeria

Introduction

Citation refers to the list of references to other works in a published work. "Referring" means mentioning in the proper context and giving an explicit bibliographical statement in a list of references. Older articles are then cited by or will receive a citation from the newer one (Rousseau, 2008). Citations acknowledge the existence of related literature (Coleman, 2004). They help communicate specialist knowledge (Leydesdorff, 1998). Merton (2000) observes that citations provide peer recognition that is central scholarly system of science and other fields. Typically, citation shows that a relationship exists between the work of an author and the previous works done in that field. Isaac Newton referred to this relationship when he said, "If I have seen further, it is by standing on the shoulders of giants" (Merton, 1968). Authors contribute to existing knowledge and demonstrate that they are current with activity in their fields (Aina, 2006). Citation analysis looks at citation practices (Leydesdorff, 1998). Citation analysis helps determine the competitive position of authors and can help identify useful journals (Aina, 2006). Citation analysis may be viewed as a collaborative effort that can promote the quality of scholarly research (Rousseau, 2008). Citation analysis is also a way to understand users. Studying references cited by faculty publications shows the sources most commonly used and valued locally (Curtis, 2005).

Meho (2007) has observed that citation analysis is actually a branch of information science in which researchers study the way articles in a scholarly field are accessed and referenced. Citation analysis was developed to identify core articles, authors, or journals in a field. Citation analysis has been used beyond information science for scholarly analysis and evaluation. Johnson (2000) points out that citation studies reveal much about scholarly communication and can guide collection development in academic libraries. Garfield (1983) notes that citation analysis is used to study the journals as well as the people and work of science. Citation analysis of different subjects are based on a literary model of scientific process (Garfield, 2004). Based on this model, citation analysis has been carried out in a variety of ways (Johnson, 1996). Garfield (2004) has observed that scientific work is represented by the papers published to report it, and the relationships between works are represented by references. Smith (1981) suggests that citation analysis of theses and dissertations can have implications for both collection development and user services. She cautions librarians that citation does not imply quality or importance. It is a controversial methodology because it does not represent all the possible needs or uses for information (Haycock, 2004). Though valid criticism of citation analysis exists, several authors have shown that citations correlate with other methods of collection analysis, including impact factors, circulation statistics, in-house use, and user surveys (Tsay 1998, Blecic, 1999, and Fuchs et al., 2006).

Governments, funding agencies, and tenure and promotion committees may use citation to evaluate the quality of work (Meho, 2007). Citation measures have emerged from studies of citation databases. These include Journal Impact Factor and Relative Impact Factor. Meho (2007) also observes the growing number of Web citation tools, including download counts, link analysis, and page ranking, as well as Web Citations, and Hirsch's "h-index." Not everyone agrees that citation analysis is the best way to judge validity of scientific claims (Meho, 2007). The applicability of ISI citation databases outside the natural sciences has been questioned, because these databases contain few books, proceedings, or other kinds of documents (Russell and Rousseau, 2002).

Today, bibliometrics and scientometrics make extensive use of citations to assess quality and trace patterns of scholarly communication (Borgman and Furner, 2002; Wouters, 1989). A number of researchers have used citation analysis to look at the subject focus of postgraduate students and determine their journal needs (McCain and Bobick, 1981; Momoh 1996). It is against this background that this study does citation analysis of doctoral theses (2000-2007) of the Department of Animal Science, University of Ibadan, Nigeria.

The department is one of seven under the Faculty of Agriculture and Forestry. It was founded in 1967. As of 2006, the department had produced 182 PhDs. Departmental faculty engage in research in animal science and agriculture in general.

The objectives of the study are:

- identify the most cited sources in the doctoral theses in the Department of Animal Science.
- investigate the age of cited items in the doctoral theses in the Department of Animal Science.
- determine citation patterns among animal science disciplines.
- determine the most frequently cited journals in animal science.
- examine the extent of use of journals from non-animal science disciplines by doctoral students
- determine the subject areas with the highest number of projects submitted to the department of animal science.
- examine patterns of citation and co-citation in the doctoral theses in the Department of Animal Science.

Previous Studies

Olatokun and Makinde (2009) studied master's theses in animal science and found that journals were the most used reference materials, and that poultry nutrition and agricultural biochemistry and nutrition were the most frequent topics. Labonte (2005) used citation analysis to determine if a science-engineering library was meeting the needs of an interdisciplinary group of faculty. The study was aimed at developing a core list of journals and identifying journals that should be added to the collection. The three most recent publications of each faculty member (published within the last five years) were analyzed using *Science Citation Index* . Results indicated that the library subscribed to 98 percent of the journals in which faculty members are published or cite frequently. Williams and Fletcher (2006) performed a citation analysis on materials used by graduate students in engineering and found that journals (38 percent), conference papers (19 percent), and books (18 percent) were the most heavily used formats, with books aging more slowly than other formats.

Shi and Wang (2005) counted and analyzed citations to create several lists. The study discusses the importance of interdisciplinary journals and is used for guiding collection development decisions. Waugh and Ruppel (2004) did an analysis of dissertations, theses, and graduate research papers to determine core serials in the discipline, and provide collection guidance. Gooden (2001) carried out a citation analysis of chemistry doctoral dissertations as a way of determining material use. Rethlefsen (2007) did a citation analysis to describe the information needs of a state public health agency. Rethlefsen and Wallis (2007) performed a citation analysis on public health citation patterns to determine

the publication types cited most often in public health as well as the most heavily cited journal titles. Stern (2004) used graphs to show how many citations a group of journal articles related to ecological economics received during 1989-2003. Pouris (2007) reported the results of an investigation to identify disciplinary strengths and international standing of higher education institutions in South Africa.

Method

The research is a descriptive study. Two major sources of data used were theses submitted for the Doctor of Philosophy (PhD) degree in the Department of Animal Science, University of Ibadan, Nigeria from 2000-2007, and the database of MPhil/PhD theses in the same department. The study population was the total population of theses submitted within the coverage period of the study. In all, forty-two doctoral theses were analysed.

Data Collection

Each thesis was examined and citations extracted from the reference section. The method of data collection was document extraction through content analyses. Data extracted included year of project submission, year of cited work, year of the oldest materials cited, number of citations, most cited year (mode of occurrence), title of project work, volume of project work, type of cited journal, journal type cited and years cited. The citations in were broken into eight categories: journals (serials other than monographic series and conference proceedings), books, conference papers, web resources and technical reports and standards (including government technical reports). Others were government documents (state, federal and foreign), theses and dissertations, and miscellaneous (patents, personal communications, product literature, software and software manuals, university extension documents, unpublished materials, and others).

Analysis

The data extracted were entered into a spreadsheet. Frequency distributions charts, graphs, and measures of central tendency (mean, mode, and median) were obtained. The spreadsheet data was later imported into Statistical Package for Social Sciences (SPSS) for hypotheses testing using correlation, ANOVA, Independent Samples T-test, and chi-square tests.

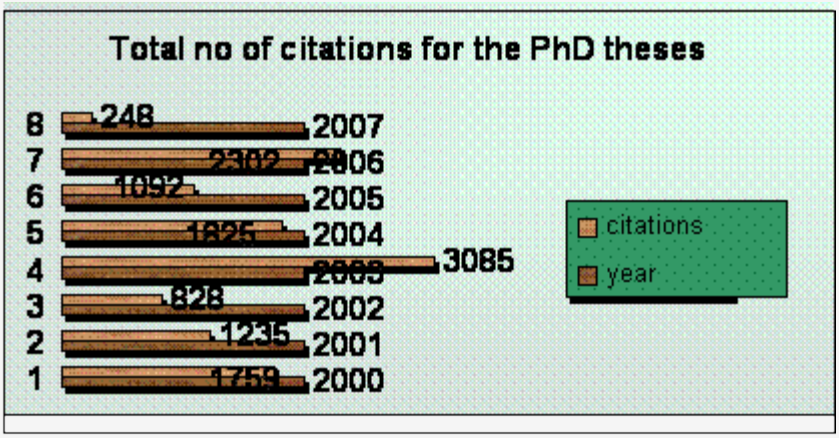
Distribution of Citations in all Projects

A total of 10,578 items were cited. Table 1 shows the distribution of types of material cited.

Table 1: Distribution of Citations in PhD projects

Materials Referenced	Journals	Books	Conference Papers	Web Resources	Technical Reports & Standards	Government Documents	Theses & Dissertations	Miscellaneous	Total
Number of Reference and %	6,278 (59.90%	1,914 (18.09%)	1,006 (9.51%)	36 (0.34%)	208 (1.97%)	269 (2.54%)	351 (3.32%)	516 (4.88%)	10,578 (100%)

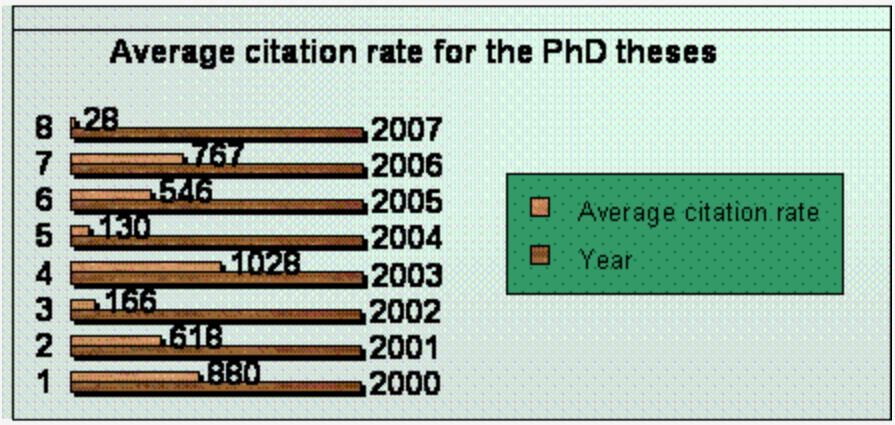
Table 1 shows that citations to journals alone accounted for nearly 60 percent of the total citations. Previous studies confirm that journals are the most cited reference material, with other formats varying widely (Patterson, 1945; Coile, 1969; Rieb, 1993; Musser and Conkling, 1996; Kim, 2002; Kushkowski et al., 2003; Williams & Fletcher, 2006).



Source: Researcher's data collection, March-July 2008

Figure 1: Total of all Citations by Year

Figure 1 shows that the highest number of citations was in 2003 followed by 2006 and the lowest number of citations was in 2007. 2004 had the highest number of theses submitted (14), but is ranked third in number of citations. The real citation rates can be obtained from Figure 2 below, which were obtained by finding average citation rates of all theses.



Source: Researcher's data collection, March-July 2008

Figure 2: Average Citation rate in the theses

Year 2003 tops the chart while 2007 had the lowest citations. The distribution of citations in the theses was unsymmetrical or skewed.

Distribution of Citations by Year

Table 2: Distribution of Citations by Year (2000-2007)

Type of Reference Materials/Year	2000	2001	2002	2003	2004	2005	2006	2007
Journals	253	195	904	488	2243	257	457	1481
Books	98	54	358	121	696	78	131	378
Conference Papers	43	67	144	85	332	30	71	234
Web Resources	0	0	3	0	5	13	3	12
Technical Reports & Standards	11	15	27	17	79	3	19	37
Government Documents	8	12	23	18	101	11	11	78
Theses & dissertations	22	21	49	37	101	4	40	84
Miscellaneous	23	20	69	40	238	12	40	74
Total Citations	458	384	1577	806	3795	408	772	2378
Number of theses	2	2	5	3	14	2	3	9
Average Citations	229	192	315	269	271	204	257	264

Table 2 shows that journals had highest values in all years. The largest number of citations to journals was 2,243 in 2004.

Distribution of Citations by Type of Material

Cited material was grouped into eight categories: journals, books, conference papers, web resources, technical reports and standards, government documents, theses and dissertations, and miscellaneous. The highest overall citation to journals was in 2004, with 2,243 citations, followed by 1,481 in 2007.

Table 3: Citations by Type and Year

Year/ ormat	Journals	Books	Conference Papers	Miscellaneous	Theses & Dissertations	Government Documents	Technical Reports & Standards	Web Resources	Total
2000	253	98	43	23	22	8	11	0	458
2001	195	54	67	20	21	12	15	0	384
2002	904	358	144	69	49	23	27	3	1577
2003	488	121	85	49	34	18	17	0	806
2004	2243	696	332	238	101	101	79	5	3795
2005	257	78	30	12	4	11	3	13	408
2006	457	131	71	40	40	11	19	3	772
2007	1481	378	234	74	84	78	37	12	2378
Total	6278	1914	1006	516	351	269	208	36	10578

Journals and textbooks were the most cited sources, with journals being cited more than any other material. Web resources were the least cited material.

Age of Citations

Age is the length of time material has existed, measured in years. In this area, percentages were used to describe items to make the data more meaningful.

Table 4: Age of Materials

	Age of oldest Item (years)	50% of items less than (years)	80% of items less than (years)	10 years oldor less (%)	5 years old or less (%)
All Formats	69	9	15	64	52
Books	69	10	21	60	49
Conference	42	6	16	70	55
Journals	69	8.5	18	63	52

The oldest reference materials were a journal (*Journal of Biological Chemistry*) and a book (*Quantitative Clinical Chemistry*), both cited in 2000 and both 69 years old. Half of all citations were less than nine years and 80 percent within the last 15 years.

Journal Citation Distribution

Table 5: Top Twenty Cited Journals

Rank	Journal Titles	Number of Citations
1	Journal of Animal Science	897
2	Journal of Nutrition	743
3	Animal Feed Science and Technology	326
4	Poultry Science	301
5	Journal of Agriculture and Food Chemistry	160
6	Journal of Agricultural Science	152
7	British Journal of Nutrition	105
8	Nigerian Journal of Animal Production	101
9	Journal of Science, Food and Agriculture	95
10	Journal of Dairy Science	90
11	Journal of Animal Production	88
12	British Poultry Science	79
13	Journal of Food Science and Technology	77
14	World Poultry Science Journal	49
15	Journal of Agricultural Chemistry	49
16	Journal of Applied Biotechnology	48
17	British Veterinary Journal	45
18	Indian Journal of Animal Science	47
19	Applied and Environmental Microbiology	47
20	American Journal of Clinical Nutrition	46

Journal of Animal Science (JAS) was the most cited journal, with a total of 897 citations, found in 24 PhD theses. The probability of finding a thesis that cited JAN article is 0.6000, indicating high citations and the visibility of JAS in the theses. The highest citation by any individual to JAS was 70, in 2002. Citations to *Journal of Nutrition* ranked second on the list of most cited journals with 743 citations. This

was found in 27 theses and the probability of finding a thesis that cited a JON article is 0.6750. The highest citation by any individual to JON is 56, in 2007 by a male student. *Animal Feed Science and Technology* (AFSTJ) was ranked third, with a total of 326 citations. This was found in 21 theses and the probability of finding a thesis that cited AFSTJ article is 0.5250. The highest citation by any individual to AFSTJ is 38, which occurred in 2002. The least cited journal was the *American Journal of Clinical Nutrition* with a total of 46 citations.

Areas of Study

Table 6: Areas of Study in the Theses

Field/Year	2000	2001	2002	2003	2004	2005	2006	2007	Total
Animal Breeding & Genetics	0	0	1	0	1	0	0	0	2
Monogastric Nutrition	1	0	0	1	3	0	1	2	8
Agricultural Biochemistry & Nutrition	1	1	2	2	3	0	0	3	12
Animal Products & Meat Science	0	0	0	0	1	0	0	0	1
Animal Production	0	1	0	0	0	0	0	1	2
Ruminant Nutrition	0	0	2	0	3	0	1	3	9
Animal Physiology	0	0	0	0	1	2	0	0	3
Poultry Nutrition	0	0	0	0	1	0	0	0	1
Forage Production & Management	0	0	0	0	1	0	1	0	2
Total	2	2	5	3	14	2	3	9	40

Agricultural biochemistry and nutrition was the area of study most researched between 2000 and 2007, with 12 theses (30 percent) submitted during this period. This was followed by ruminant nutrition with 9 theses (23 percent).

Citation Pattern among Animal Science Sub-fields

Table 7: Citation Pattern among Animal Science sub-fields in the theses

Field/Format	Journals	Books	Conference Papers	Web Resources	Technical Reports & Standards	Government Documents	Theses & Dissertations	Misc.
Animal Breeding & Genetics	233	100	36	1	3	6	10	37
Monogastric Nutrition	1399	290	136	0	44	33	55	130
Agricultural Biochemistry & Nutrition	2281	616	332	6	39	72	110	157
Animal Products & Meat Science	72	48	7	0	6	23	6	6
Animal Production	179	44	43	1	10	10	5	11
Ruminant Nutrition	1212	493	314	12	81	93	133	114
Animal Physiology	426	135	58	20	4	24	14	21
Poultry Nutrition	282	75	40	0	10	9	4	25
Forage Production & Management	194	113	40	2	11	9	14	17

Journals were also the most cited materials for different animal science sub-fields. Books came in second and Web resources were the least cited, with zero citations for monogastric nutrition, animal products and meat science and poultry nutrition, although but not the least cited for animal physiology (20 citations).

Patterns of Co-citation

A co-citation analysis was carried out to investigate relationships among authors as listed in the thesis bibliographies. It was assumed that the more two authors were co-cited, the closer the relationship between them. Twenty-one authors were chosen from three doctoral theses with a number of references well above three hundred. The authors were also chosen based on three other reasons: highly cited in the project bibliographies, publish within the same subject area, and chosen from serial references (specifically journals) in the bibliographies. The 21 authors chosen for co-cited author analysis in this study are presented in Table 8.

Table 8: Selected authors for co-citation analyses

Ansah, G. A.	Gerdner, F. A.	Lilli,R.	Sunder, M. L.	Zylobica	Bermudez, A. J.	Heywang, B. W.
Martin, P. A.	Tortuero, F.	Chand, D.	Ikpi, A. E.	Njike, M. C.	Udedibi, A. B. I.	Douglas, C. R.
Jeffrey, A. E.	Obioha, F. C.	Veltman, J. R.	Fasuyi, A. O.	Keshavarz, K.	Parson, C. M.	Williams, W. P.

Table 9 shows the table obtained based on factor analysis of the listed authors in the theses.

Table 9: Values of Component Matrix for Co-citation of 21 Authors

Name/Component	1	2	3	4	5	6		7
Ansah		-.616						.405
Bermudez	-.640							
Chand				.486		-.539		
Douglas	-.551				.566			
Fasuyi			-.483	.554				
Gerdner				-.493		-.426		
Heywang	-.731							
Ikpi		.552						-.423
Jeffrey			.797	.516				
Keshavarz						.448		
Lilli			.684				-.452	
Martin	.620							
Njike	.555	.566						
Obioha	.661							
Parson	.459	.482						
Sunder		.765						
Tortuero								
Udedibi	.414	.410			.621	-.652		

Veltman		-.543	.443					
Williams					.434			.433
Zylobica				-.576				

Authors on the same factor were usually mentioned together. The power of factors diminishes to the right, and loadings below 0.4 were suppressed. Figure 8 displays doctoral co-citation maps consecutively for the listed 21 authors. The figures gave a multidimensional scaling routine in author co-citation analysis based on an algorithm used by SPSS-10 to create visual display maps from proximity matrices, so that the underlying structure within a set of objects could be studied.

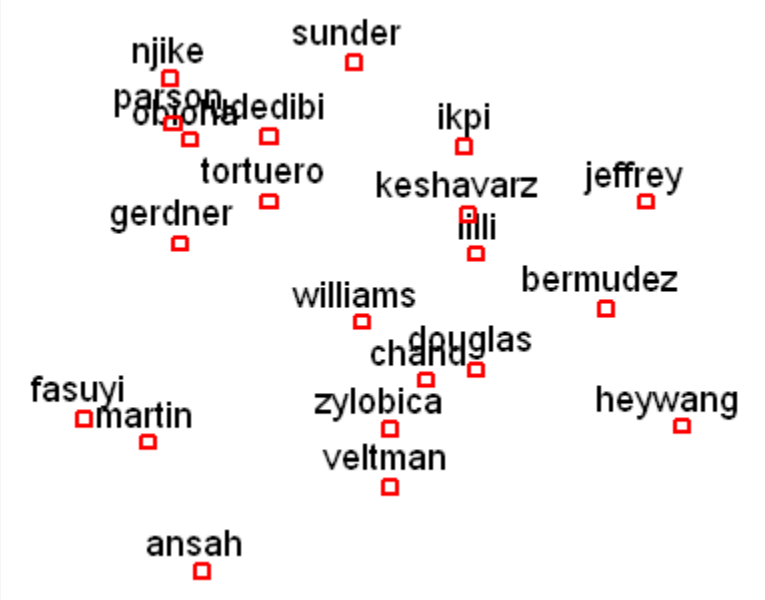


Figure 8: Author Co-citation Map (ACM) of the 21 Authors

Parson and Obioha were the authors having the strongest level of co-citation. Njike and Heywang had their nodes farthest apart, with a co-citation profile correlate at -.731. Also, similar statements hold for other far-distant pairs on the map. However, that two authors are rarely or never co-cited, and have negatively correlated profiles, need not imply that citers have consciously judged them dissimilar. It may simply imply that possible relationships between their works have not yet been perceived.

Discussion

Findings revealed that the citation formats used in the doctoral theses include journals, books, conference papers, web resources, technical reports and standards (including government technical reports) and government documents (comprising state, federal and foreign government documents). Others citation formats used were theses and dissertations and miscellaneous reference materials (comprising patents, personal communication, product literature, software and software manuals, university extension documents, unpublished materials, and others). This classification of citation formats is in line with the formats that have been extensively used in various works on citation analysis. Among them are Williams and Fletcher (2006) that divided the reference materials (formats) of their citation study into eight groups. This study actually strongly builds on Williams and Fletcher's citation analysis to relate it to the animal science discipline. Johnson (2000) and Gooden (2001) also carried out a citation study in which five groups were clearly identified. This study improved on and added to these groups since animal science as an agricultural discipline utilizes myriads of reference materials.

The most cited source was journal accounting for more than half of the total citation to reference sources. Web resources citations were the lowest. A reason one could adduce for this is that the doctoral students of animal science were yet to appreciate the importance of the indication of web resources referencing in their projects or that they had little or no access to internet facilities or lacked basic information literacy skills needed to use the facilities. However, there were pointers that some reference materials must have been sourced from the internet but were wrongly passed for other formats. This escalated some other citation formats. Nevertheless, there were indications that this will increase with time. Other reference materials or citation formats apart from books and conference papers that ranked second and third respectively were moderately used in the theses. Many studies in citation analyses buttress the finding from this study that journals are the most used materials in any research field judging from the fact that they point to currency of research works (Gooden, 2001; King, 2006; Rethlefsen and Wallis 2007; Johnson, 1996). Bradford 's law of scatter also applies in this study with 13 journals accounting for half of the journals citations in the theses examined. This kind of user-data implications should be considered in evaluating journals. Therefore, the Bradford 's zone of few journals accounting for many citations was confirmed by the findings from this study. So also was a confirmation of Bibliographic law of concentration which stipulates that the trails of literature of any one discipline concerns, in large part, of the cores of the literature of all their disciplines and that all other disciplines combined produce a multidisciplinary literature core for all of science that consists of no more than 1000 journals.

In the theses, the topics most popular include: Agricultural biochemistry and nutrition (ranked first with 12 PhD theses), Ruminant nutrition (ranked second with 9 PhD theses) and Monogastric nutrition (ranked third with 8 PhD theses). Animal products and Meat science and Poultry nutrition both tie up as the least popular topics. These rankings could help in research funding and development of areas of specialization as well as in developing and refocusing on areas that were least researched. This points and reflects on Pouris (2007) assertion that the application and usage of citation analyses can be a useful tool in the evaluation of academic research and as a result could be used to know the variability in least and most popular topics in order to attract funds for research development. Furthermore, findings also revealed that the oldest cited items were a journal (Journal of Biological Chemistry) and a book (Quantitative Clinical Chemistry) each aged 69 years. Eighty percent of books were less than 21 years which supports Musser and Conkling's (1996) recommendation, that books should not be placed in storage as quickly as other citation formats because of a lasting referral to them. Johnson (2000) also observed in his work that age of cited works was much less diverse but in this study age of reference materials were much more diverse. This agrees with Williams and Fletcher (2006) that much diversity was experienced in ages of materials used in their study. In addition, the most cited journals were Journal of Animal Science, Journal of Nutrition, Animal Feed Science and Technology, Poultry Science and Journal of Agriculture and Food Chemistry in that order. They could thus be regarded as core animal science journals. These most frequently cited journals were actually agricultural journals which is in line with the fact that any research discipline tend to cite more from the journals that are from the core area of that discipline (Aina, 2006; Williams and Fletcher, 2006; Gooden, 2001; Johnson, 1996; Izah, 1996).

Findings equally revealed that virtually all the fields of study dwindled in terms of shifting foci of study except agricultural biochemistry and nutrition and ruminant nutrition that reasonably rose through the years. Ruminant nutrition could be weakly considered as the new focus in the doctoral theses, with the study having as high as three theses submissions in the last year of the coverage period of this study. The word ‘weakly' was used because the project works of these sub fields experienced steady fluctuations during the coverage period of this study. Citation analysis of the different sub-fields have shown that there would always be changing or shifting focus of study areas because of student discretion, faculty area of specialization, available project supervisors and funding (Labonte, 2005; Rethlefsen, 2007).

Animal science as an agricultural science discipline is an area that extensively makes use of a wide range of science journals ranging from medical sciences, life sciences, mathematics, engineering (especially agricultural engineering), food sciences, veterinary sciences and even social sciences.

Findings showed that close to 20% of the journals identified were found to be core animal science journals. The remaining 80% ranged among the other sciences including few additions from other areas of study apart from the sciences. Thus, it can be said that animal science uses more journals that are not core animal science journals. However, this study reveals that the core animal science journals account for the bulk of the citations in the discipline's bibliographies. This is in line with the findings of Garfield (1975) that agricultural scientists used and cited the same hard core of frequency cited basic research journals used by all other research workers in the life sciences. This was Garfield 's argument when he stated emphatically that an agricultural citation index is embedded in science citation index. This study shows that about 80% of the total journals cited were actually from the basic sciences.

Although online sources was least used in all the cited reference materials, nevertheless the use of web resources in animal science research as seen in the theses is on the rise especially with the adoption and use of information communications and technologies (ICTs) in all spheres of human endeavour especially research. This corroborates Aina (2006) finding that the web was the least source used in the project works of information scientists he surveyed. However, Williams and Fletcher (2006) had a contrary result in their study of master students of engineering. The web was ranked fourth behind journals, conference papers and books in an eight-group classification of reference materials used in engineering. Web usage from various citation analyses carried out might simply indicate that its thorough utilization would be discipline independent and would also anchor on the promotion of ICT utilization by institutions and governments. The result of this study might also show a degree of inadequacy and inaccuracy in that, some of the journals cited could have been electronic journals that were passed for published journals instead of web journals that should be a web source before its publication.

Finally, findings showed that all animal science disciplines cite journals extensively but citations were highest in the animal nutrition and biochemistry sub-field. Also, zero citation was recorded to web resources in the sub-field of monogastric nutrition, animal products and meat science and poultry nutrition. Other reference materials display a reasonable level of variability in their citation patterns. These variations concur with Williams and Fletcher (2006) and Aina (2006) that indicated that different sub fields of a discipline will utilize varying degrees of reference materials pointing to their varying citation patterns and this might also be discipline specific.

Conclusion

This study updates and expands on previous citation analysis studies that focused on agricultural science, especially those completed by Garfield (1975) and Izah (1996). This study analysed citation from 40 doctoral theses submitted to the department of animal science of Nigeria 's premier University, University of Ibadan between 2000 and 2007. Although, much citation analysis studies have not been done in the field of animal science in Nigeria with the search of the literature, nevertheless this study had its pivot on several citation analysis works that have been carried out in other fields (both related and unrelated fields). This study discovered that most of the cited sources were journals-well over 50% of the total citations for PhD works were to journals. The results support previous findings that journals are the most commonly cited format. This confirms that animal science PhD projects are not in isolation of similar works elsewhere. Consequently, this study should stimulate useful discussion among scientists and research managers about publication strategies and research directions. Also this study is useful in identifying journals worthy of closer examination by librarians that are expected to be familiar with local needs as this study has generously pointed out the core journals needed for research in animal science. Another striking agreement of this study is that only about 12 to 13 titles were needed to cover 50% of the journal citations. Lal and Panda (1996), Edwards (1999) and Gooden (2001) found similar results in citation analyses of journals in plant pathology (an agricultural discipline), polymer science and chemistry respectively. This points to the fact that this study could serve as a user study with implications for both collection development and user services design.

This study also has serious implications on calling for the construction of citation indexes that will be web based at different levels especially institutional level being narrowed down to departmental level

to ease citation practices of students, the academia and researchers. These citation indexes will also facilitate citation analysis study that entails manual and painful counts. This will save the rigorous and time-wasting exertions as encountered in this study during the process of data collection. The index will help to correct the anomalies of the ISI's databases that cites more of North America's journals especially that of United States of America thus contributing to the low impact factor of our local journals. At least, this will boost our local citations towards achieving international visibility and influence. Also, local citation indexes will help to locate background sources and information for postgraduate students and researchers. Evaluation of how development and advancement have developed over the years can also be measured using this local citation indexes thus leading to an easy measure of most significant research and the most influential researcher on a national basis. Also in terms of citation practice, this study with its discoveries of variations in citations and its rule of application calls the more for the formulation of a detailed and comprehensive theory of citation that will foster the ideologies entrenched in the field of citation and it will brings into focus the "best-practice principle" in citation. Future studies could focus on ascertaining the implications of collection of reference materials to project and article referencing, instruction in classes and outreach.

References

Aina, B. T. (2006). *Citation and subject analysis of projects of Africa Regional Centre for Information Science, University of Ibadan, 1992-2005 (A Master's Thesis).* Africa Regional Centre for Information Science (ARCIS): University of Ibadan.

Blecic, D. D. (1999). Measurements of journal use: An analysis of the correlations between three methods. *Bulletin of the Medical Library Association 87* (1): 20-5.

Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. *Annual Review of Information Science Technology 36*: 3-72.

Coile, R. C. (1969). Periodical literature for electrical engineers. *Journal of Documentation 8* (4): 209-226.

Coleman, A. (2005). Instruments of Cognition: use of citations and Web links in online teaching materials. *Journal of the American Society for Information Science and Technology 56*(4): 382-392.

Curtis, D. (2005). *E-Journals: A how-to-do-it-manual for building, managing, and supporting electronic journal collections* . New York: Neal-Schuman.

Edwards, S. (1999). Citation analysis as a collection development tool: A bibliometric study of polymer science theses and dissertations. *Serials Review 25* (1): 11-20.

Fletcher, C. L., & Williams, V. K. (2006). Materials used by master's students in engineering and implications for collection development: A citation analysis. Available: http://www.ist1.org/06-winter/refereed1.html .

Fuchs, B. E., Thomsen, C.M., Bias, R. G., & Davis, D. G. (2006). Behavioral citation analysis toward collection enhancement for users. *College and Research Libraries 67* (4): 304-24.

Garfield, E. (2004). Citation analysis as a method of historical research into science. Available: www.garfield.library.upenn.edu/ci/chapter7.pdf

Garfield, E. (1983). *Citation indexing: Its theory and application in science, technology and humanities* . Philadelphia: Wiley. Available: http://www.garfield.library.upenn.edu/ci/title.pdf

Garfield, E. (1975). What is the literature cited by agricultural scientists: A case study in literature dispersion. Report Presented at the World Congress of Agriculture Librarians and Documentalists, Mexico City.

Gooden, A. M. (2001). Citation analysis of chemistry doctoral dissertations: An Ohio State University case study. *Issues in Science and Technology Librarianship* (Fall). Available: http://www.istl.org/01-fall/refereed.html

Haycock, L. A. (2004). Citation analysis of education dissertations for collection development. *Library Resources & Technical Services 48* (2): 102-6.

Izah, M. (1996). Pattern of citation in *Journal of Agricultural Extension* , 1981-1992. *Library Focus 13& 14* : 105-15.

Johnson, B. (1996). Citation analysis of the Texas Tech University's Statistics Faculty: A study applied to collection development at the university library. Available: http://libres.curtin.edu.au/libre6n3/johnson.htm .

Johnson, B. (2000). Environmental impact: A preliminary citation analysis of local faculty in a new academic program in environmental and human health applied to collection development in an academic library. *Library Philosophy and Practice 2* (2). Available: http://unllib.unl.edu/LPP/johnson.html

Kim, M. (2002). Citation patterns of Korean physicists and engineers: Differences by type of publication source and type of authorship. *Scientometrics 55* (3): 421-436.

King, C. (2006). Citation analysis. Microsoft Students 2007 (DVD). Redmond WA: Microsoft Corporation.

Kushhowski, J. D., Parson, K. A., & Wiese, W. H. (2003). Master's and doctoral theses and dissertations: Analysis and trends of a longitudinal study. *Portal: Libraries and the Academy 3* (3): 459-479.

Labonte, K. B. (2005). Citation analysis: A method for collection development for a rapidly developing field. *Issues in Science and Technology Librarianship* (Summer)

Lal, A., & Panda, K. C. (1996). Research in plant pathology: A bibliometric analysis. *Library Science 33* (3): 135-147.

Leydesdorff, L. (1998). Theories of citation? *Scientometrics 43* (1): 5-25.

McCain, K., & Bobick, J. E. (1981). Patterns of journal use in a departmental library: A citation analysis. *Journal of the American Society for Information Science 32* (4): 257-267.

Meho, L. I. (2007). The rise and rise of citation analysis. *Physics World* 20(1). Available: http://www.sis.indiana.edu/faculty/meho/PhysicsWorld.pdf

Merton, R. K. (2000). On the Garfield input to the sociology of science: A retrospective collage. In Cronin, B., & Atkins, H. (Eds.). *The Web of knowledge: A Festschrift in honor of Eugene Garfield* (pp. 435-448). Medford, NJ: Information Today.

Merton, R. K. (1968). The Matthew Effect in Science. *Science 159* (5 January 1968, No. 3810): 56-63.

Merton, R. K. (1979). *The sociology of science: An episodic memoir* . Carbondale: SIU Press.

Momoh, O. M. (1996). Subject analysis of postgraduate theses in library, archival and information science at Ahmadu Bello University, Zaria. *Library Focus 13&14* : 105-15.

Musser, L. R., & Conkling, T. W. (1996). Characteristics of engineering citations. *Science and Technology Libraries 15* (4):41-49.

Olatokun, W.M., & Makinde, O. (2009). Citation analysis of dissertations submitted to the Department of Animal Science, University of Ibadan, Nigeria. *Annals of Library and Information Studies 56* : 117-128.

Patterson, A. M. (1945). Literature references in industrial and engineering chemistry for 1939. *Journal of Chemical Education 22*: 514-515.

Pouris, A. (2007). The international performance of the South African Academic Institution: A critical assessment. Available: http://www.che.ac.za/

Rethlefsen, M. L. (2007). Citation analysis of Minnesota Department of Health official publications and journal articles: A needs assessment for the RN Barr Library. *Journal of the Medical Library Association 95* (3): 260-266.

Rethlefsen, M. L., & Wallis, L. C. (2007). Public health citation patterns: An analysis of the *American Journal of Public Health* , 2003-2005. *Journal of Medical Library Association 45* (4): 408-415.

Rieb, H. (1993). Citation analysis: A case study of Korean scientists and engineers in electrical and electronics engineering. Proceedings of the American Society for Information Science Annual General Meeting, 30: 165-171.

Rousseau, R. (2008). *Social information systems: Emerging technology and applications for searching the web effectively* . Goh, D., & Foo, S. (Eds.). Hershey (PA): Information Science Reference (IGI Global): 13, 252-267.

Russell, J., & Rousseau, R. (2002). Bibliometrics and institutional evaluation. In: *Encyclopedia of Life Support Systems* (EOLSS). Part 19-3: Arvantis, R. (Ed.). Science and Technology Policy.

Shi J., Shi, G., & Wang Z. Y. (2005). A local citation analysis in China: From Wuhan University faculty in surveying and mapping. *Journal of Academic Librarianship 31* (5): 449-455.

Smith, L. C. (1981). Citation analysis. *Library Trends 30* (1): 83-105.

Stern, D. (2004). Citation analysis of ecological and environmental economics. *Ecological Economics 50* : 261-292. Available: www.rpi.edu/~stern/citations.html

Tsay, M. (1998). The relationship between journal use in a medical library and citation use. *Bulletin of the Medical Library Association 86* (1): 31-9.

Waugh, C. A., & Ruppel, M. (2004). Citation analysis of dissertation, theses, and research paper references in workforce education and development. *Journal of Academic Librarianship 30* (4): 276-284.

Williams, V. K., & Fletcher, C. L. (2006). Materials used by masters' students in engineering and implications for collection development: A citation analysis. *Issues in Science and Technology Librarianship* (Winter). Available: http://www.istl.org/06-winter/refereed1.html

Wouters, P. (1989). *The citation culture* . Doctoral thesis, University of Amsterdam. Available: http://garfield.library.upenn.edu/wouters/wouters.pdf