

**INFOMETRIC ANALYSIS OF SELECTED MASTERS DEGREE THESES IN
COMPUTER SCIENCE FOR COLLECTION DEVELOPMENT AT THE FEDERAL
UNIVERSITY OF TECHNOLOGY LIBRARY, MINNA BETWEEN 2008-2014**

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Abstract

Infometrics plays a crucial role in library collection development. It uses quantitative methods to measure and assess scientific publication outputs. It applies mathematical and statistical techniques to books and other media, recognising significant works in various disciplines and identifying future research directions. This study analysed citations from 20 selected master's theses in Computer Science that were submitted to the Federal University of Technology, Minna, between 2008 and 2014. Using a bibliometric research design and total enumeration sampling, data was collected through three document extraction templates covering key study objectives. The study examined collaboration patterns, document types, and chronological distributions of cited references. Findings revealed that 53.9% of cited references were multidisciplinary. Journals (52%) and books (18%) were the most cited document types. Additionally, the cited references were current and relevant to the research topics at the time of citation. The study recommends that university library management address budgetary constraints by investing in multidisciplinary pertinent publications to Computer Science. Furthermore, library acquisition and collection development committees should prioritise purchasing more scientific journals, ensuring an optimal balance between journals and other document types in their collections.

Keywords: Collection Development, Infometrics, Citation analysis, University Libraries, Computer Science, Masters' Theses

Introduction

Library collections are the bedrock for services provided to the community where the libraries are situated and eternal assets to the library. Maidabino & Zainab (2016) cited Akinola (2020), who identified the aim of a modern university library as largely to provide access to both

print and non-print collections. This makes it necessary to develop a balance between ownership and access to information or knowledge. To meet this purpose, there is a need for in-depth analysis of various categories of library collections. This can be viewed from the number of access to the level of popularity and impact of information resources. Collection development is a planned and systematic development of the collections based on the objectives of the library. These objectives could be stated in documents relating to how to achieve them (Daniel, 2019). Kaur and Kuar (2017) defined collection development as a process of identifying and analysing content and citations in various kinds of library collections to meet researchers' academic and research needs in a recognised faculty or disciplines. University libraries are structured to promote access and fast retrieval for clientele and are staffed by librarians and other personnel trained to provide impeccable services to quench users' information needs.

Informetrics provides quantitative data, such as citation analysis, journal impact factors, and trends in academic publishing, which can inform collection development decisions. For example, the citation count of a journal can influence whether the university library continues to subscribe to it or if a new resource is worth acquiring. Informetrics can be used to evaluate the usage and impact of resources within the collection, which is valuable for collection development. By analysing how often materials are used or cited, university libraries can make data-driven decisions about which resources should be retained, discarded, or replaced. Infometric techniques and tools have been adopted in the mapping of world research and analysing top papers (Yuan & Sun, 2020); identifying macro-level collaboration networks and visualisation with Essential Science Indicators (Yang *et al.*, 2020); analysing scientific collaboration (Jabeen *et al.*, 2019) and analysis of art exhibit reviews (Wang and Ho, 2018).

The presence of infometric activities in university libraries is driven by a desire for a redefinition and widening of the professional roles and services of academic librarians and libraries within the university because, hitherto, librarianship focuses on the acquisition and organisation of its collections, searching and retrieving information for the library patrons. University libraries have also increasingly focused on the development of knowledge and services related to scholarly communication, other than the search and retrieval of academic information. By analysing metrics such as cost-per-use (for electronic resources or journals), collection developers can assess the cost-effectiveness of resources in relation to their impact or

usage for postgraduate research activities, especially master's degree theses. Informetrics can provide insights into whether an item offers sufficient value based on its usage data and infusing such data into collection development processes correlate them with the environmental aspects such as users' demands, needs, and expectations, the information world, fiscal plan, history, and trends of the collections.

Statement of Research Problem

University libraries are entrusted with managing bibliographic collections that aim to provide relevant and up-to-date information, as well as access and supply services to their users. However, many libraries acquire information resources with limited awareness of current trends in user information needs, particularly the research requirements of postgraduate students. This challenge is compounded by the financial constraints faced by academic libraries, including insufficient funding for collection development, limited space for resource storage, rising costs of library materials, and the presence of outdated resources within their collections. The application of informetrics as an essential tool for collection development becomes critical in this context, as it provides evidence-based insights into publications and citations that can guide effective decision-making in resource acquisition. This study identifies the lack of sufficient inquiry into the role of informetrics in supporting collection development and knowledge-based production, especially in the context of postgraduate research, such as master's theses. There is a need for a comprehensive study on how informetrics can be utilised to enhance collection development strategies and address the evolving needs of users in academic libraries.

Research Questions

1. What are the collaboration patterns of cited references to support collection development at the Federal University of Technology, Minna?
2. What are the forms of cited references to aid collection development at the Federal University of Technology, Minna?
3. What are the chronological distributions of cited references to support collection development at the Federal University of Technology, Minna?

Literature Review

In creating a distinction between information organisation and management, early scholars such as Shiyali Ramarita Ranganathan and Alan Pritchard propounded different scientific approaches (Bilson, 2022). Infometrics, hitherto known as bibliometrics, have piqued the interest of numerous researchers in other fields of study. Infometric analysis, which is the method of assessing the status and trends of a particular research field and providing ideas and directions for future research, has been adopted by libraries of various types to boost their collection development processes. Collection development, according to Sanjay (2016), focuses on a variety of routines connected to the procedures and policies of identifying, selecting, acquiring, managing and possibly evaluating library collection. These policies and procedures involve the constitution of a selection team, which has the users, the library staff and subject experts in the fold. Explaining the need for infometric studies for relevant collection development, Anyaobi *et al.* (2019) explained that knowledge is increasing rapidly, and the need to identify the growth of knowledge, core authors and most productive journals in a field becomes imperative for future collection development librarians and researchers. Collection development plays a pivotal role in identifying the strengths and weaknesses of any field, which helps in making the right decisions and developing policies. Libraries can employ quantitative measurements such as citation analysis to investigate the productivity and impact of their collections for collection building and research engagements (Reyes-Gonzalez *et al.*, 2016).

Knowledge is the pivotal tool through which institutes/departments/organisations in universities are able to fulfil their tasks and carry out their activities to achieve their goals efficiently (Abualoush *et al.*, 2018). Interestingly, a worthy research ground is the university, which provides fertile ground for diverse knowledge acquisition and research production. However, in lieu of the enormous size of literature that serves as information carriers for this knowledge in their various physical forms and steady growth, university libraries and their parent institutions are faced with the mandate of acquiring relevant, current and highly ranked research outputs with limited funds and exorbitant costs of research output databases for the users of their library especially postgraduate students in their research endeavours.

Postgraduate education in the university includes postgraduate diplomas, master's degrees or their equivalent and doctoral degrees (Padro, 2018). Amidst escalating government pressure

for universities to enhance productivity and transparency, a significant portion of focus gravitates towards policy matters, organisational intricacies, and the administration of postgraduate research programmes. This entails addressing concerns surrounding completion rates, programme quality, supervision effectiveness, students' performance and the overall cost-effectiveness of postgraduate education. The foregoing has necessitated delving into both the theoretical underpinnings and practical aspects of postgraduate research endeavours. This involves acknowledging emerging insights and challenges in research and teaching, as well as gathering insights into the experiences of postgraduate research students (Kamkam *et al.*, 2020). Efforts have been made to ensure that Master's theses continue to serve their primary purpose as a medium for conveying various forms of information to researchers, supervisors, librarians, scientists, and scholars. It motivates post-graduate students and supervisors in universities to produce more scholarly research and contributions from various theses in higher institutions. Kaur (2019) stated that university educators have been actively discussing the necessity of postgraduate education to cultivate diverse sets of literacy practices that extend beyond students' academic disciplines.

The discipline of computer science is the body of knowledge and practices used by computing professionals in their work. This field is also known as computer science and engineering, computing, and informatics. (Denning, 2017). The profession contains various specialities such as computer science, computer engineering, software engineering, information systems, domain-specific applications, and computer systems. Computer science degrees are very popular in institutions worldwide, and their proliferation in different universities has resulted in the production of rankings for classifying programmes according to their prestige and quality.

University libraries bid to build useful collections that will provide good returns for their financial investments through the assessment of specific subject support for various disciplines in their domains. The elements of description used for these assessments are contained in these published media, such as citations, keywords, titles, authors, institutions, core titles, forms, collaboration and chronological patterns to perform science evaluation research using bibliometric techniques (Gutiérrez-Salcedo *et al.*, 2018). In other words, infometric analysis can provide an overall examination and quantitative viewpoint of a particular research topic

supported by a large amount of literature on the topic. Subsequently, university librarians have used citation counts to study the adequacy of their collections as a result of the yearly escalating costs of information resources, as well as their proliferation, have mandated libraries to review their collection development strategies to manage the acquisition budget effectively (Yeoh and Kaur, 2018). Identifying these trends in postgraduate research titles in specific disciplines, such as computer science, via infometric tools provides reliable assessment data and information to enhance decision-making in collection management in university libraries, which enriches postgraduate research works.

Methodology

The research design employed for this study was a bibliometric research method that measured quantitative and qualitative changes in collections of books and other library media. The population of the study included all the masters' theses in computer science covering the period 2008 -2014, spanning seven (7) years. These are theses arranged and documented in the library at the time of conducting the research. Twenty (20) master's theses covering the stipulated years were submitted to the library and adopted using the total enumeration sampling technique. The instruments used in data collection were document extraction templates for extracting data from the theses.

Presentation of Results and Analysis

Research Question 1: What are the collaboration patterns of cited references to support collection development at the Federal University of Technology, Minna?

Table 1: Collaboration patterns of cited references to support collection development

S\N	Collaboration Patterns			No of citations per thesis (%)
	Single Discipline (%)	Interdisciplinary(%)	Multidisciplinary(%)	
M.Thesis 1	1	16	28	45
	2.2	35.5	62.2	100
M.Thesis 2	10	30	20	60
	16.7	50	33.3	100
M.Thesis 3	1	15	33	49
	2.1	30.6	67.3	100

M.Thesis 4	2	6	36	44
	4.5	13.6	81.8	100
M.Thesis 5	5	5	29	39
	12.8	12.8	74.4	100
M.Thesis 6	9	29	40	78
	11.5	37.2	51.3	100
M.Thesis 7	2	16	11	29
	6.9	55.2	37.9	100
M.Thesis 8	25	14	25	64
	39.1	21.9	39.1	100
M.Thesis 9	5	10	25	40
	12.5	25	62.5	100
M.Thesis 10	28	3	10	41
	68.3	7.3	24.4	100
M.Thesis 11	14	-	3	17
	82.4		17.6	100
M.Thesis 12	12	16	25	53
	12.6	30.2	47.2	100
M.Thesis 13	8	2	26	36
	22.2	5.6	72.2	100
M.Thesis 14	7	10	30	47
	14.9	21.3	63.8	100
M.Thesis 15	2	8	40	50
	4	16	80	100
M.Thesis 16	7	8	6	21
	33.3	30.1	28.6	100
M.Thesis 17	21	14	16	51
	41.2	27.5	31.4	100
M.Thesis 18	10	10	22	42
	23.8	23.8	53.4	100
M.Thesis 19	7	3	26	36
	19.4	8.3	72.2	100
M.Thesis 20	5	10	25	40
	12.5	25	62.5	100
Total	181(20.5)	225(25.6)	475(53.9)	881(100)

Table 1 investigated the pattern of collaboration in the cited references. The patterns of collaboration of cited references in computer science masters theses are single discipline publications, interdisciplinary publications and multidisciplinary publications. The Table revealed that the multidisciplinary pattern of collaboration were more with the statistics of 475 which represent 53.9 percent of the total cited publications. This was followed by an interdisciplinary pattern of collaboration with 225 (25.6%) and single discipline was the least

with 181(21%) respectively. This means that the collaborative pattern favoured in computer science was multidisciplinary in nature.

Research Question 2: What are the forms of the cited references at the Federal University of Technology, Minna?

Table 2: Forms of the cited references

S/N	Forms of Cited References										No of citations
M.Theses	Newsletters (%)	Newspapers (%)	Workshop Reports (%)	Books (%)	Journals (%)	Web resources (%)	Seminar reports (%)	Audiovisuals (%)	Conference papers (%)	Unpublished publications (%)	
1	-	2 (100)	-	11 (6.9)	4 0.9	24 (18.2)	-	-	2(2.7)	2(2.4)	45
2	-	-	-	1 (0.6)	47 10.3	9 (6.8)	1	-	2(2.7)	-	60
3	-	-	-	10 (6.3)	30 6.6	5 (3.8)	-	-	4(5.4)	-	49
4	-	-	-	6 (3.4)	32 7.0	2 (1.5)	-	-	2(2.7)	2(2.4)	44
5	-	-	-	2 (1.3)	19 4.2	8 (6.1)	-	-	9(12.2)	1	39
6	1 (8.3)	-	-	3 (1.8)	53 11.6	5 (3.8)			9 (12.2)	7(16.7)	78
7									29		
8				14 (8.8)	32 7.0	10 (7.6)				8(19.0)	64
9				9 (5.7)	15 3.3	11 (8.3)				5(11.9)	40
10				18 (11.3)	22 4.8	-		-	-	1(2.4)	41
11				12 (7.5)	4 0.87	1 (0.8)			-	-	17
12				3 (1.9)	29 6.3	10 (7.6)			8 (10.8)	3(7.1)	53
13				14	16	6			-	-	36

S/N	Forms of Cited References										No of citations
M.Theses	Newsletters (%)	Newspapers (%)	Workshop Reports (%)	Books (%)	Journals (%)	Web resources (%)	Seminar reports (%)	Audiovisuals (%)	Conference papers (%)	Unpublished publications (%)	
14	1 (8.3)			5 (3.1)	3.5 (4.5)	23 (11.4)	15		-	3(7.1)	47
15	1 (8.3)			5 (3.1)	5.0 (3.1)	17 (6.1)	8		13(17.6)	6(14.3)	50
16	4 (33.3)			11 (6.9)	-	-			6 (8.1)	-	21
17	-			2 (1.3)	40 (8.8)	3 (2.3)			6 (8.1)	-	51
18	-			10 (6.3)	21 (4.6)	6 (4.5)			3(4.1)	2(4.8)	42
19	3 (25.0)	-	3 (100)	5 (3.1)	20 (4.4)	-	-	-	5(6.8)	-	36
20	2 (16.7)	-	-	11 (6.9)	20 (4.4)	-	-	-	5(6.8)	2 (4.8)	40
Total	12 (1.4)	2 (0.2)	3 (0.3)	159 (18)	457 (52)				74 (8)	42 (5)	881

Table 2 shows the forms of cited references in the master's theses studied. The forms of referenced documents are newsletters, newspapers, workshops, books, journals, web resources, seminar reports, audiovisuals, conference papers and unpublished works. Table 2 revealed that journals were the most used form of cited references as they were mostly referenced with a total number of 457, which represents 52 per cent. Books were next in line as the forms of referenced documents, with 159 (18%) followed by web resources, pulling 132(15%). Conference papers and unpublished publications trailed behind, with 74(8.4%) and 42(5%) as the forms of referenced documents, respectively. The least were newsletters with 12(1%), workshop reports with 3(0.3%), newspapers 2(0.2%) and seminar reports with 1(0.1%) respectively. This means

that forms of documents cited in computer science postgraduate research works were mainly journals. The preference for journals is due to their nature as academic publications whose frequency of appearance translates to recent and accurate information in specific fields of study and are mostly used by scholars in the scientific field of knowledge.

Research Question 3: What are the chronological distributions of the cited references to support collection development?

Table 3: Chronological distributions of the cited references

S/N	Period of citation	Journals (%)	Books (%)	Online sources (%)	Conferences (%)	Unpublished documents	Newsletters (%)	Newspapers	Workshops	Reports	Seminars	Other	Total
1	1980 - 1985	10 (2.2)	3 (1.9)	-	-	-	-	-	-	-	-	-	13(1.5%)
2	1986- 1990	18 (3.9)	1(0.6)	3(2.8)	-	-	-	-	-	-	-	-	22(2.5%)
3	1991- 1995	10 (2.2)	4 (2.5)	10 (7.6)	3(4.1)	-	3(25)	-	-	-	-	-	30(3.4%)
4	1996- 2000	30 (6.6)	9 (5.7)	13(9.8)	5 (6.8)	2(4.9)	4(33.3)	-	-	-	-	-	63(7.2%)
5	2001- 2005	44 (9.6)	65 (40.1)	10 (7.6)	8 (10.8)	12(29.3)	1(8.3)	2 (100)	2	-	-	-	144(16%)
6	2006- 2010	145 (31.2)	50 (31.4)	46 (30.3)	23 (31.1)	17(41.5)	2 (16.7)	-	1(100)	-	-	-	284(32%)
7	2011- 2014	200 (43.8)	27 (16.9)	50 (37.9)	35 (47.3)	10 (24.4)	2 (16.7)	-	-	-	1(100)	-	325(36.9%)

Table 3 reveals the chronological distributions of cited references. This was divided into five-year intervals based on the oldest and most recent years of publication of the cited references. Table 3 revealed that publications produced between 2011- and 2015 are the most referenced, with a total number of 325 representing 36.9 per cent. Publications produced in

2006-2010 are next in line with 284(32%) and followed by 2001-2005 with 144(16%). 1996 - 2000 and 1991-1995 have the total number of cited references 63(7.2%) and 30(3.4%), respectively. The least cited references were produced in 1986-1990 and 1980-1985, with 22(2.5%) and 13(1.5%). This means that the cited references in the master's theses were mainly produced between 2011 and 2014.

Discussion of findings

The results of these analyses showed an important concentration of master degree theses in Computer Science in accordance with the research questions.

The study showed that the collaboration patterns of cited references in the masters degree theses are single discipline, interdisciplinary and multidisciplinary. This aligned with Bradford's Law of Scattering(1934); Khiste and Paithankar (2017) stating that document on a given subject is distributed (scattered) according to a certain mathematical function so that a growth in papers on a subject requires a growth in the number of journals/information sources. The implication of this finding with regard to collection development is that is that collaboration patterns enable university libraries extend their acquisition policy beyond publications published in a single discipline but recognize the laws of scattering where the feet of publications in one discipline are dipped in the roots of other disciplines. It also assists in no small measures to solve issues relating to low budgets. This finding also provides evidence based data for libraries during accreditation exercises when challenged about not providing only core computer science based resources.

The forms of documents revealed that journals are mostly cited in matsers' degree theses in computer science. The preference for journals is due to their nature as academic publications whose frequency of appearance translates to recent and accurate information in specific fields of study and mostly used by scholars in the scientific field of knowledge. This finding shares the same view with Kolle *et al.* (2017) in a study that revealed 4025 articles published in journals were cited against 1750 in books and 618 conference papers. Also, Ruhula (2023) also shared the view that university libraries have also increasingly focused on development of knowledge and services related in scholarly communications such as journals and conference proceedings. This

finding has created a clear path for libraries/ libraries in their acquisition policy which is tailored towards providing collections that meet users' demands.

Also, the study revealed geometrical growth of cited publications in proportion to their year of publication in an ascending order. This shares the view that recent publications are regularly published in the field of sciences and responsible for the tendency of their publications going obsolete unlike in the humanities and social sciences. This is because as new knowledge are emerging; they are more in use than old ones. The finding agrees with Guo *et al.* (2019) that 60% of the total cited journals and books by postgraduate scholars in their studies were slightly few years from the submission of their theses. This implies that postgraduate research scholars do not use documents that are obsolete and this will serve as a guide for libraries in the process of collection development when acquiring or weeding library collections.

Conclusion

Informetrics plays a vital role in collection development by providing quantitative insights into resource usage, research trends, and the performance of scholarly materials. Through data-driven approaches, university libraries can ensure their collections remain current, relevant, and aligned with their users' needs.

Recommendations

1. University library management can solve the age-old issue of low budgetary allocations by investing in publications that are multidisciplinary yet relevant to Computer Science. This will enable them to cover many fields with few quality multidisciplinary publications.
2. Library acquisition/collection development committees should include in their collection development policy a provision for the purchase of more journals in the sciences at a slightly raised ratio to other forms of documents.
3. Collection Development committees should take cognisance of the penchant for obsolescence of scientific publications within a few years of their production and, therefore, acquire information resources that do not go out of use as quickly as possible.

4. Also, the study indicated that most journals cited in Computer Science master degrees were multidisciplinary in nature across disciplines. Acquisition/Collection Development policy should encourage more multidisciplinary and interdisciplinary journals to be included in their collections. This has become a reality due to the law of scattering of journals.
5. Finally, the study recommends that acquisition/collection development committees should make provision for high-ranking journals such as the Institute of Electrical and Electronics Engineers (IEEE), Communications of the ACM, ACM Computing Survey, Pattern Recognition, and Springer in their collections pending when other research findings might state otherwise.

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