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Application of Citation Analysis in Development of Core Chemistry Information Sources in Nnamdi Azikiwe University Library, Awka.

Angela Nkiruka Ofoedu
eu.ofoedu@unizik.edu.ng

E. S. Anaehobi
es.anaehobi@unizik.edu.ng

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By

Anaehobi E. S.
Department of Library and Information Science
Nnamdi Azikiwe University, PMB 5021, Awka.
E-mail: es.anaehobi@unizik.edu.ng

and

Ofoedu, Nkiruka Angela
University Library, Nnamdi Azikiwe University, PMB 5021, Awka
E-mail: an.ofoedu@unizik.edu.ng; naofoedu@gmail.com

Abstract

This study was carried out to develop core information sources in chemistry using citation analysis. A total of 85 theses submitted to the Department of Chemistry from 2010 to 2019 constituted the population. A bibliometric study was conducted using indicators such as types of cited sources, most cited journals, most cited books, age of cited journal and books and availability of cited journals and books in the university library. A total of four thousand, seven hundred and thirty (4,730) citations were obtained from the 85 theses. The findings of the study revealed that journal was the most cited source with 2001 (42.30%) citations. Book is the next most cited source with 1365 (28.86%) citations. The most cited journals and books were also identified. The findings of the study also showed that most of the cited books (88.46%) and journals (96.99%) were not available in the university library. Based on the findings, some recommendations were made among which are: improved funding for acquisition of current research materials in Industrial Chemistry by the Library Management. It was also recommended that Nigerian university library should use the identified frequently cited sources as a guide in the acquisition of sources in order to meet the information resource need of researchers in Industrial Chemistry.

Key Words: Citations, Citation Analysis, Citation counting, Information sources, Library and Information Science

Corresponding author's email address: an.ofoedu@unizik.edu.ng; naofoedu@gmail.com

Introduction

Chemistry is a central science that deals with all aspects of molecules, their physical and chemical properties, their composition and structure, their synthesis and use. An understanding of chemistry is necessary to all other fields of science. Within the field of science and technology, chemistry is seen as a key discipline able to impact on all facets of our lives. Chemistry has contributed enormously in enhancement of health and quality of life as well as in wealth creation for individuals and nations. According to Steven and Berhanu (2011) chemistry's contributions to human advancement need not to be seen in terms of its own core role as a physical science, but also as a "platform science" in the context of its relationships within the group of "natural sciences" that includes physics and biology. They added that Chemistry provides the basis for understanding the atomic and molecular aspects of theses disciplines and, through its interfaces with a range of pure and applied sciences, underpins the dramatic advances seen in recent decades in such diverse fields as medicine, genetics, biotechnology, materials and energy. For this reason, research in chemistry has always taken centre stage in sciences and technology domain.
Chemical research is essential to the development of new methods to address various aspect of the biological, environmental and applied science. Chemical research produce an innovative surrounding where the researcher, investors and entrepreneurs collaborations determines how successful the country becomes by translating scientific ideas into practical process and products that results to national development and sustainability (Akpoghelie, Esemedafe & Ogbuta, 2019). Thus, research in the field should not be neglected. Chemical research should be continuously strengthened to meet the nation's sustainable development goals. To achieve this, important information materials should be made available to researchers in the field of chemistry.

Availability of information sources means ensuring their presence in the libraries for immediate use (Aguolu & Aguolu, 2002). Availability and proper utilization of information resources is important in promoting research. There is no doubt that access to

journals, textbooks and other information materials contribute greatly to students' performance and quality research. Aguolu and Aguolu (2002) were of the opinion that availability should be a yardstick in measuring the state of library resources in Nigerian university libraries. They argued that the poor state of most university libraries in Nigeria in terms of availability of information sources was as a result of proliferation of universities in the country with no corresponding match to human and material resources. So many studies Gooden (2001), (Iyaro (2004), Anunobi, Okoye and James-Chima (2012) and Anaehobi and Muokebe (2014)), Flaxbart (2018) have revealed similar case of poor availability of information sources in the university libraries, more especially in the field of sciences. Gooden (2001) posited that less than half of the total journal titles owned by Ohio State University Library were needed to satisfy the research of the chemistry doctoral students. Flaxbart (2018) also observed that the trend of book citation in chemistry dissertations over the years studied was clearly downwards.

This alert requires an investigation to ascertain relevant (core) information sources in chemistry and determine their availability in Nnamdi Azikiwe University library to check if the library is meeting their statutory objectives of supporting teaching, learning and research in the field. It is however not known through research, the kinds of information sources Industrial Chemistry postgraduate students use during research as well as the availability of these sources in the university library particularly in Nnamdi Azikiwe University Awka, hence the need for this research.

Objective of the study

The purpose of this paper is to apply citation analysis in the development of core information sources for the study of chemistry using postgraduate theses submitted to Department of Chemistry Nnamdi Azikiwe University Awka from 2010 to 2019. Specifically, the paper intends to determine

1. Type of information sources cited in the postgraduate theses.
2. Most cited journals in postgraduate theses
3. Most cited books in postgraduate theses

4. Age of cited journal and books
5. To ascertain the availability of cited journals in the university library.
6. To ascertain the availability of cited books in the university library

Literature Review

Citation Analysis

Citation analysis according to Meho (2007) is defined as a branch of information science in which researchers study the way articles in scholarly fields are accessed and referenced by others. Haranda and Ladan (2013) sees citation analysis as one of the bibliometric research tools used in evaluating scholarly communication with the intent of finding or establishing links or relationships with other studies, researchers, scholars, institutions and corporations. Citation analysis is the study of the citation process in scholarly research in form of citation counting to determine the frequency of citations made to authors, journals, books and other forms of intellectual works so as to evaluate their impact. It involves counting the number of times an academic paper or author is cited and it works on the assumption that influential authors and important works will be cited more frequently than others. Thus, the analysis of citation can help in understanding scholarly communication patterns and identify major contributors and contributions (Zhao and Logan, 2002). According to Araujo (2006), the data obtained from citation analysis allow us to identify the most used document type, the most used sources, the age of literature, the most productive authors, the impact of authors and publication and so on. Some of these provide insight to various research trends that are useful in developing the library.

Thus, citation analysis may be used by librarians in selection and acquisition of important materials in the library. According to Zafrunnisha (2012), meaningful acquisition becomes possible when the quantum of citation from a particular journal or other sources is accessed by the librarian. Citation analysis, without the users' influence provides valuable insight into different kinds of material that are used by various users. Through this process,

it becomes possible to establish the citation pattern of a given discipline depending on the types of sources cited by researchers. The dominant sources could be books, journals, conference and seminar papers, theses, government documents, news publication and other kinds of research materials.

In addition, citation analysis provides information on how much impact a particular article has had by showing which other authors found the work relevant in writing their own papers (Meho, 2007). It assists in determining the core sources and through this, guides in identifying important materials required to promote research in various fields of study. Citation analysis provides a good method of in-house evaluation which librarians employ in collection evaluation and maintenance of library resources (Gooden, 2001). This helps librarians in making judicious use of limited financial sources in acquisition of unlimited information resources.

Besides, data obtained in citation analysis helps in determining the age of cited documents in order to obtain the useful life of information sources in any discipline (Gupta & Kaur, 2013). Age of a material is the length of time the information material has existed and it is usually measured in years. Age of cited sources is very important for librarians to manage their collection in an effective and efficient manner. Data obtained by analysing the age of cited sources can be used in developing preservation, weeding, storage, and journal back-file decisions as well as for interlibrary loan (Vallmitjana & Sabate, 2008). Citation analysis is, therefore, useful in various disciplines to eliminate costly or low use and unused sources, and ascertain sources needed for patron use and in determination of most active research and volume of research in a particular area of study (Ezema & Asogwa, 2012).

Use of Information Sources by Postgraduate Students

The information sources used by postgraduate students and researchers in chemistry and in the field of science in general vary. Otubelu (2003) asserted that there are variations in the citation patterns of postgraduate researchers of various departments studied in Life Sciences. His findings revealed that the Department of Biochemistry and Pharmacology

and Therapeutics used books most and also made least use of grey literature and unpublished sources respectively while the Department of Medical Biochemistry made the greater use of journals and the least use of books. According to Kimball, Stephens, Hubbard and Picket (2013) those investigators who analyzed citations across disciplines reported lower percentages of journal use for the sciences as a whole than did the investigators who analyzed citations from specific science subjects, such as biology and chemistry. David Flaxbart (2018), agreed with this finding as he revealed that the trend of book citation in chemistry dissertations over the years studied was clearly downwards. Gooden (2001) also observed that chemistry postgraduate researchers used greater percentage journal articles than monographs. However, she regrets that less than 50% of the total journal titles owned by the library studied were needed to satisfy the research needs of the chemistry doctoral students. Anaehobi and Muokebe (2014) in their finding also reported that journals and books heavily cited by the researchers in the field science studied were not available in the university library. The assumption, according to them, was that probably the students went elsewhere to get these materials. This assumption is in line with Brown, Lund and Walton (2007) who reported that for researchers the library is declining in importance as a physical place to consult journals (whether electronic or paper).

Facilitating access to journals and other information sources for a multidisciplinary field of study requires an understanding of the literature used by those researchers (Watkins & Gunapala, 2013). Analysis of citation of post graduate theses will go a long way in identifying the literature used by those researchers. Zipp (1996) indicated that the data derived from research on graduate students provide more than a valuable insight into students' research behaviour.

Several citation studies have been conducted to establish the nature and type of sources used in chemistry and in field of science in general. Very few of these studies however checked the availability of cited sources in university libraries. A few others moved further to determine the age of cited sources.

Gooden (2001) studied Citation analysis of Chemistry Doctoral theses: An Ohio State University case study. She found that out of 3704 citation generated, journal articles were cited most 85.8%, followed by monograph (8.4%) while the remaining 2.2% were to other sources. Otubelu (2003) conducted a similar study titled citation analysis of post graduate research in life sciences in University of Nigeria, Nsukka. The result revealed that out of 6480 citation obtained, journal article constitute 74.2% followed by books (15.4%), the grey literature with 9.6% and finally unpublished sources with 1.4%. The findings also revealed that most of the most frequently cited information sources were not available in the university libraries. Another study by Olatokun and Makinde (2009) titled Citation Analysis of Dissertations submitted to the Department of Animal Science, University of Ibadan, Nigeria revealed that journal was the most cited source out of 12,374 citations with 6875(55%) citations. This is followed by book and conference papers that ranked 2nd and 3rd respectively. Web resources had the lowest citations. The oldest cited item was a periodical. Fifty percent of all reference materials cited in the dissertations was less than eight years old. Conference proceeding was the most recent materials with 72% dissertations published in the last 10 years and twenty percent of books were less than 20 years. Also, Anunobi, Okoye and James-Chima (2012) in their study titled Citation analysis of Postgraduate Students as a Measure of their Resource Preference found that out of 2,350 citations generated, journal articles were cited most with 34.12 % citations, followed by monographs (21.06 %) and conference papers (14.89%). Other sources generated 29.91 %. The most cited journal was *Nigerian Journal of Animal Production* with 54 (6.73%) citations. The findings revealed that current issues of cited journals were not available in the university library. Gohain and Saikia (2014) studied Citation Analysis of PhD Theses Submitted to the Department of chemical Sciences, Tezpur University, Assam. Findings revealed that out of 10983 citations analysed journal constitute 78.83% citations, followed by books (15.57%). The next cited sources were the patient/standards/technical reports (2.20%). Seminar/conference proceedings accounted for 1.74% citations. Journal of American Chemical Society was the most preferred journal with 7.13% of journal citations. Study by Borthakur (2015) titled Citation Analysis of Theses and Dissertations in Chemistry Submitted to the LNB Library, Dibrugarh

University, revealed that out of 5145 citations, journal articles contribute the highest number of citations (82.68%). Books were second most cited source with 14.90% citations. Patents/technical reports account for 0.79% citations. Web resources, seminar/conference proceedings, PhD theses yielded 0.66%, 0.62%, and 0.33% citations respectively. Journal of American Chemical Society occupied the first rank with 3.85% citations. Saptute (2019) in his recent work; Citation Analysis of PhD Theses in Chemistry Submitted to Kavayitri Bahinanabai Chaudhari North Maharashtra University, Jalgaon found that journal were the major source of information with 81.96% citations out of 12078 citations. Citations to books were 14.39%. Patents, theses, conference proceedings and Web resources occupied 2.01%, 1.52%, 1.11% and 0.02% citations respectively. The highest citation was covered during the period of 1995-2010.

Methods

The design of the study was bibliometric research design using citation analysis method. The population of the study comprises all the 85 masters theses submitted to the Department of Industrial Chemistry, Nnamdi Azikiwe University Awka from 2010-2019 (Industrial Chemistry Departmental Catalogue, 2019). Industrial Chemistry was purposively chosen because it is a wide area of study and being one of the oldest departments, has produced a reasonable number of master students. Data were collected from citations documented as references in the theses. In order to achieve this, the researcher had to photocopy all the reference pages in the 85 masters theses submitted in the library. The researcher's designed instrument titled "Citation Analysis of Industrial Chemistry Theses Document Analysis Form (CAICTDAF)" was used to record the citations in these theses based on the research questions that guided the study. The citation was manually counted for the analysis. The researcher used the second instrument (Availability of Cited Sources Document Analysis Form (ACSDAF) to find out whether the cited sources were available in the university library catalogue. The data were analyzed using descriptive statistics of measures of central tendency, frequency distribution and percentages.

Results

Table 1: Type of Sources Cited in Industrial Chemistry postgraduate Theses

Types of sources	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	total	%
journals	72	103	193	279	215	521	56	385	41	136	2001	42.30
books	123	197	201	169	113	312	21	116	30	83	1365	28.86
E-resources	5	7	9	53	66	119	37	98	67	87	548	11.59
Conf./semin	14	12	8	23	11	42	21	32	11	8	182	3.85
Govt. pub	1	3	12	12	14	29	14	20	12	7	124	2.62
Ency/dic	12	8	9	14	11	32	10	12	3	7	118	2.46
handbooks	2	4	6	11	7	34	5	7	2	2	80	1.69
Reports	3	5	8	9	8	22	7	5	2	3	72	1.52
Theses	0	4	6	4	5	23	5	10	7	3	67	1.42
Review articles	2	3	6	5	6	18	2	11	4	4	61	1.29
Workshops	1	3	4	3	5	9	1	4	1	1	32	0.68
Manuals	0	1	2	3	4	7	2	3	2	3	27	0.57
Lect.Notes/mime	1	1	3	4	3	6	1	3	1	2	25	0.53
Newspapers	0	2	2	1	3	4	1	2	1	2	18	0.38
newsletter	0	1	1	1	0	4	0	2	0	1	10	0.21
total	**236**	**354**	**470**	**591**	**471**	**1182**	**183**	**710**	**184**	**349**	**4730**	**100**

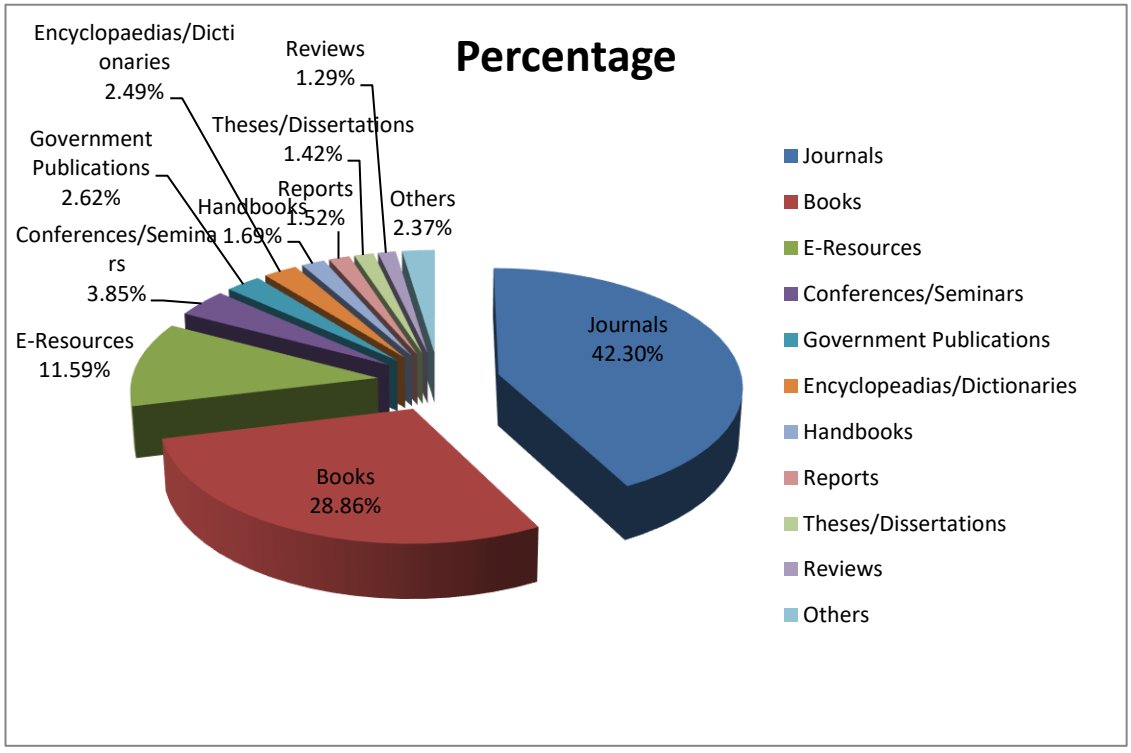

Fig 1: Pie chart showing types of cited sources.

Table 1 and figure 1 show the type of information sources cited in postgraduate theses of Department of Chemistry. It could be observed from table 1 and figure1 that the information sources used by postgraduate students of Industrial Chemistry are journals, books, internet resources, conference proceedings, seminars papers, encyclopaedias, dictionaries, Government publications, handbooks, reports, theses, dissertations, review papers, workshop articles, manuals, newspapers, mimeograph, lecture notes and newsletters.

Journal has the highest citation with 2001 (42.30%) citations. This is followed by book (monograph) with 1365 (28.86%) citations. Citations to e-resources generated 548 (11.59%) citations while conference proceedings/seminars produced 182 (3.85%) citations. This is followed by government publications with 124 (2.62%) citations. Encyclopaedias/dictionaries yielded 118 (2.49%) citations. Citations to handbooks, reports, dissertations and reviews are 80 (1.69%), 72 (1.52%), 67 (1.42%) and 61 (1.29%) respectively. While citations to workshops, manuals, newspapers, mimeograph and lecture note are 32 (0.68%), 27 (0.57%), 18 (0.38%), 13(0.28%) and 12 (0.25%) respectively. The least citations are to Newsletter with 10 (0.21%).

Table 2: Ranked List of Cited Journals ***N=4730***

S/N	Journals	No of Theses	No of Citation	% Citation
1	Journal of Chemical Society of Nigeria	27	52	2.60
2	Journal of Applied Polymer Science	33	44	2.20
3	Corrosion Science Journal	18	42	2.10
4	American Chemical Society	31	39	1.95
5	Analytical chemistry Journal	24	37	1.85
6	African Journal of Biotechnology	21	31	1.55
7	Journal of Bioresource Technology	19	27	1.35
8	Pure and Applied Chemistry Journal	16	25	1.25
9	Journal of *Renewable* Energy	18	24	1.20
10	Journal of Science Engineering Tech	21	24	1.20
11	Journal of Environmental Quality	17	23	1.15
12	Nigerian Journal of Solar Energy	19	21	1.05
13	Journal of the American Oil Chemists Soc.	16	21	1.05
14	Journal of Ethno Pharmacology	13	20	1.0

15	E journal of Chemistry	18	20	1.0
16	Journal of Polymer Science	8	20	1.0
17	Journal of Applied Electrochemistry	11	20	1.0
18	Environmental Health Perspectives	6	17	0.85
19	Journal of Polymer Degradation Stab.	14	17	0.85
20	Int'l Journal of Electrochemical Sci.	15	17	0.85
21	Nigerian Journal of Applied Science.	9	17	0.85
22	Journal of Electrochemical Society	14	17	0.85
23	Journal of Hazardous Materials	13	16	0.80
24	Journal of Material Science	11	15	0.75
25	Water, Air and Soil Pollution New York	8	15	0.75
26	Portugaliae Electrochemical Acta.	13	15	0.75
27	World journal of Microbiology Biotech.	12	14	0.70
28	International Journal of Biotech.	9	14	0.70
29	Journal of Chemical Education	11	14	0.70
30	Int'l Journal of Env. Sci. and Tech.	6	14	0.70
31	Journal of Environmental Science	11	13	0.65
32	Analytical Chemical Acta	8	13	0.65
33	Journal of Analytical Chemistry	5	13	0.65
34	Journal of Composite Science and Tech.	11	13	0.65
40	6 Journals with 12 citations	49	72	3.60
49	9 Journal with 11 citations	54	99	4.95
61	12 journals with 10 citations	65	120	6.00
75	14 journals with 9 citations	75	126	6.30
92	17 journals with 8 citations	78	136	6.80
112	20 journals with 7 citations	94	140	7.00
135	23 journals with 6 citations	96	138	6.90
160	25 journals with 5 citation	99	125	6.25
186	26 journals with 4 citations	80	104	5.20
216	30 journals with 3 citation	60	90	4.50
251	35 journals with 2 citations	44	70	3.50
288	37 journals with 1 citation	37	37	1.85
	Total		**2001**	**100**

Table 2 presents data on the ranked list of cited journals. From the table, *Journal of Chemical Society of Nigeria ranked first out of the 288 cited journals* with 52 (2.60%)

citations. The journal was cited in 27 theses. This is followed by *Journal of Applied Polymer Science* which was cited in 33 theses with 44 (2.20%) citations. *Corrosion Science Journal* which gained citation in 18 Theses ranked third with 42 (2.10%) citations. Journal of *American Chemical Society* was cited in 31 theses and has a total of 39 (1.95%) citations while *Analytical Chemistry Journal* has 37 (1.85%) citations in 24 theses. *African Journal of Biotechnology* ranked sixth with 31 (11.40%) citations in 21 theses while *Journal of Bio-resource Technology* ranked seventh with 27 (9.93%) citations in 19 theses. 37 journals have one citation each.

Table 3: Ranked List of Cited Books

S/N	Book	No of Theses	No of Citation	% Citations
1	Steroechemistry and the Chemistry of Natural products	59	102	7.47
2	Physiochemical Methods	52	84	6.15
3	Organic Chemistry by Carey	41	77	5.64
4	Analytical Chemistry	46	73	5.34
5	The Useful Plant of West Tropical Africa	57	68	4.83
6	Industrial Chemistry	38	65	4.76
7	Medical plant and Trad Medicine in Africa	29	61	4.46
8	Polymer Degradation and Stability	26	58	4.24
9	Environmental Pollution and Degradation	37	54	3.95
10	Medical Plant in Tropical West Africa	31	52	3.80
11	Pharmaceutical Basis of Therapeutics	28	49	3.58
12	Environmental Chemistry and Toxicology	39	45	3.29
13	Pharmacognosy	27	39	2.85
14	Environmental Chemistry	22	34	2.49
15	Fundamentals of Analytical Chemistry	18	31	2.27
16	Economic Botany	21	27	1.97
17	Environmental Chemistry and Toxicology	17	25	1.83
18	History of Medicine	19	24	1.75
19	The Chemical Analysis of Food	17	18	1.31
20	Introduction to Environmental Engineering	7	16	1.17
21	Principle and the Theory of Analytical Chemistry	9	14	1.02
22	The Chemistry and the use of Fire Retardant	10	13	0.95
23	The Plant Book	8	11	0.80
24	Introduction to Polymer Chemistry	9	11	0.80
25	Medical Chemistry	6	10	0.73
26	Fundamental of Organic Chemistry	4	10	0.73
27	Concise Organic Chemistry	6	10	0.73
28	Quantitative Chemical Analysis	6	9	0.65
29	Chemistry for Sanitary Engineers	4	9	0.65
30	Phytochemical Screening of Nigerian Medicinal Plants	6	8	0.58

31	The Sceptical Environment	3	8	0.58
32	Man and the Environment	5	8	0.58
33	Fundamental Concept of Environmental Chemistry	4	8	0.58
34	Synthetic Organic Chemistry	3	7	0.51
35	Higher Education Chemistry	2	7	0.51
36	Principles of Environmental Engineering	6	7	0.51
37	Basic Concept of Environmental Engineering	4	7	0.51
38	Chemical Ecotoxicology	3	7	0.51
39	Antimicrobal Chemotherapy	6	7	0.51
40	Organic Chemistry of Natural Product	3	7	0.51
41	The Theory and Practice of Primary Health	5	7	0.51
42	Environmental Engineering	2	7	0.51
43	Introduction to Hydrogeology	4	6	0.43
44	Basic Principle of Organic Chemistry	3	6	0.43
45	Principle of Polymer Chemistry	2	6	0.43
46	Principle of Instrumental Analysis	5	6	0.43
47	Advanced Inorganic Chemistry	3	6	0.43
48	Chemistry for Environmental Engineering and Science	5	6	0.43
55	7 books with five citations each	22	35	2.52
62	7 books with four citations each	19	28	2.03
71	9 books with three citations each	22	27	1.89
83	12 books with two citations each	22	24	1.68
104	21 books with one citations each	21	21	1.53
	Total		**1365**	**100**

Table 3 presents data on rank list of cited books. Out of the 104 cited books, *Stereochemistry and the Chemistry of Natural Products* ranked first with 102 (7.47%) citations. This book was cited in 59 theses. This is followed by *Physiochemical Methods* which was cited in 52 theses with 84 (6.15%) citations. *Organic Chemistry* by Carey which was cited in 41 theses ranked third with 77 (5.64%) citation. *Analytical Chemistry* appeared in 46 theses with 73 citations representing (5.34%), while *The Useful Plants of West Tropical Africa* has 68(4.83%) citations and was cited in 57 theses. *Industrial Chemistry* ranked sixth with 65 (4.76%) citations. The book *Industrial Chemistry was cited* in 38 theses. *Medicinal Plants in Tropical West Africa which* ranked seventh with 61(4.46%) citations appeared in 29 theses. *Polymer Degradation and Stability, Environmental Pollution and Degradation* and *Medical Plant and Traditional Medicine* have 58 (4.24%), 54(3.95%) and 52(3.80%) citations and were cited in 26, 37 and 31 theses respectively. Twenty one books have one citation each.

Table 9: Age of Cited Journals and Books

Age in interval	Journals	Books	Journal %	Book %	Journal cum. frequency	Book cum, frequency
2010-2019	1052	500	52.57	36.63	1052	500
2000-2009	564	281	28.19	20.59	1616	781
1990-1999	266	329	13.29	24.10	1882	1110
1980-1989	49	81	2.45	5.93	1931	1191
1970-1979	34	42	1.70	3.08	1965	1233
1960-1969	24	43	1.20	3.15	1989	1276
1950-1959	6	30	0.30	2.20	1995	1306
1940-1949	3	23	0.15	1.68	1998	1329
1930-1939	3	24	0.15	1.76	2001	1353
1920-1929	0	12	0	0.88	2001	1365
	2001	1365	100	100		

Table 10: Summary of Age of Cited Journals and Books

Age in interval	Journal & book citation	Percentage citation	Cumulative citation
2010-2019	1552	46.11	1552
2000-2009	845	25.10	2397
1990-1999	595	17.68	2992
1980-1989	130	3.86	3122
1970-1979	76	2.26	3198
1960-1969	67	1.99	3265
1950-1959	36	1.07	3301
1940-1949	26	0.77	3327
1930-1939	27	0.80	3354
1920-1929	12	0.36	3366
	3366	100	

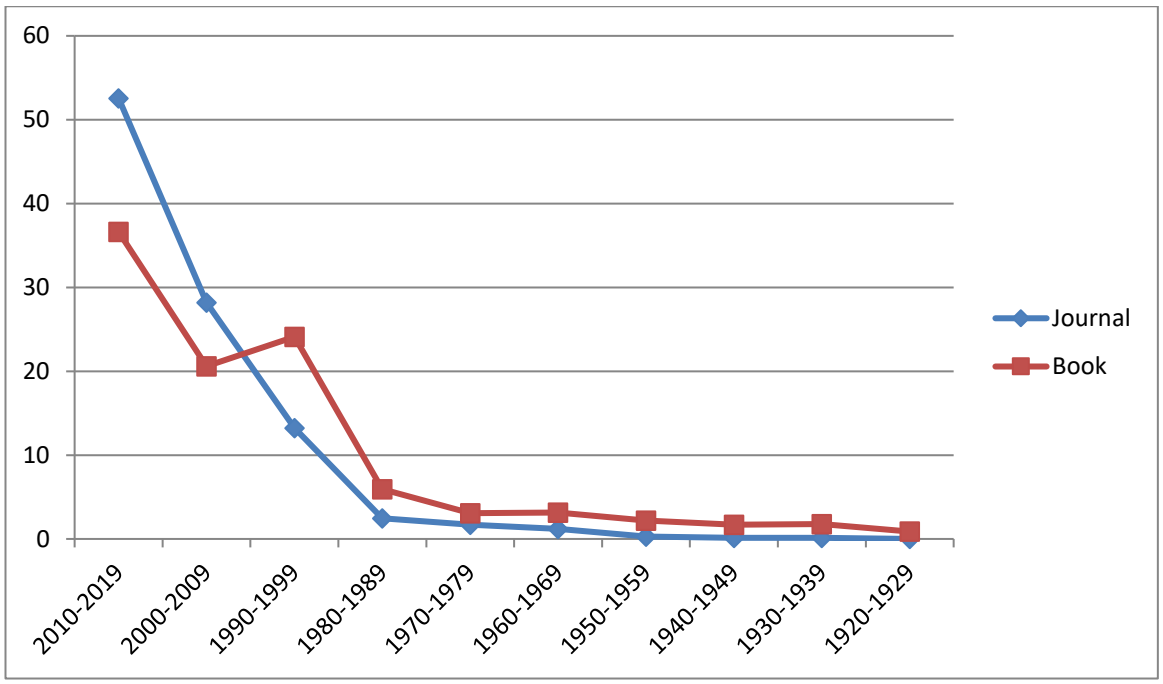

Fig. 4: A Line graph showing the age of cited Journal and Book.

It can be observed from table 9, 10 and figure 4 above that the journals and books published from 2009 to 2019 yielded the highest citation with 1552 (46.11%) citations. Journals published in the same period generated 1052 (52.57%) while books of the same age generated 500 (36.63%) citations. Books published from 1920 to 1999 generated more citations than journals published in these periods. Their citations are 584 (42.78%) and 385 (19.24%) respectively. There is no citation recorded for journals that are published in 1920 to 1925 while books of the same age yielded 12 (0.25%) citations.

In tables 10 and 11 below, 1 stands for available while 0 stands for not available

Table 10: Availability of Cited Journals in the University Library

S/N	Journals	Citation	% Citation	Availability
1	Journal of Chemical Society of Nigeria	52	2.60	1
2	Journal of Applied Polymer Science	44	2.20	0
3	Corrosion Science Journal	42	2.10	1
4	American Chemical Society	39	1.95	0
5	Analytical chemistry Journal	37	1.85	1
6	African Journal of Biotechnology	31	1.55	0
7	Journal of Bioresource Technology	27	1.35	0
8	Pure and Applied Chemistry Journal	25	1.25	0
9	Journal of *Renewable* Energy	24	1.20	1
10	Journal of Science Engineering Tech	24	1.20	1

11	Journal of Environmental Quality	23	1.15	0
12	Nigerian Journal of Solar Energy	21	1.05	1
13	Journal of the American Oil Chemists Soc.	21	1.05	0
14	Journal of Ethno Pharmacology	20	1.0	0
15	E journal of Chemistry	20	1.0	0
16	Journal of Polymer Science	20	1.0	0
17	Journal of Applied Electrochemistry	20	1.0	0
18	Environmental Health Perspectives	17	0.85	0
19	Journal of Polymer Degradation Stab.	17	0.85	0
20	Int'l Journal of Electrochemical Sci.	17	0.85	0
21	Nigerian Journal of Applied Science.	17	0.85	0
22	Journal of Electrochemical Society	17	0.85	0
23	Journal of Hazardous Materials	16	0.80	0
24	Journal of Material Science	15	0.75	0
25	Water, Air and Soil Pollution New York	15	0.75	0
26	Portugaliae Electrochemical Acta.	15	0.75	0
27	World journal of Microbiology Biotech.	14	0.70	0
28	International Journal of Biotech.	14	0.70	0
29	Journal of Chemistry Education	14	0.70	1
30	Int'l Journal of Env. Sci. and Tech.	14	0.70	0
31	Journal of Environmental Science	13	0.65	0
32	Analytical Chemical Acta	13	0.65	1
33	Journal of Analytical Chemistry	13	0.65	1
34	Journal of Composite Science and Tech.	13	0.65	0
35	Journal of Mat. Chemistry and Physics	12	0.60	0
36	Journal of Chemical and Pharm. Res.	12	0.60	0
37	American Journal of Biological sci.	12	0.60	0
38	Journal of Science of Food and Agric.	12	0.60	0
39	Organic and Bio molecular Chemistry	12	0.60	0
40	Journal of Colloid and Interface Science	12	0.60	0
41	International Journal of Physical Science	11	0.55	0
42	Journal of Oil Colour Chemical Ass.	11	0.55	0
43	New Journal of Chemistry	11	0.55	0
44	Journal of Environmental Management	11	0.55	0
45	Journal of the Science of the Total Env.	11	0.55	0
46	Journal of Environmental Monitoring	11	0.55	0

47	Angew. Chem. Int. Ed. Engl.	11	0.55	0
48	Medical Journal of Australia	11	0.55	0
49	Journal of Nutrition	11	0.55	0
50	12 journals with 10 citations	120	6.00	0
51	14 journals with 9 citations	126	6.30	0
52	17 journals with 8 citations	136	6.80	0
53	20 journals with 7 citations	140	7.00	0
54	23 journals with 6 citations	138	6.90	0
55	25 journals with 5 citation	125	6.25	0
56	26 journals with 4 citations	104	5.20	0
57	30 journals with 3 citation	90	4.50	0
58	35 journals with 2 citations	70	3.50	0
58	37 journals with 1 citation	37	1.85	0
	Total	**2001**	**100**	**9**

Table 10 presents data on the availability of cited journals in the university library. As can be observed from the table, nine journals are available in the university library. These journals include *Journal of Chemical Society of Nigeria, Corrosion Science Journal, Analytical Chemistry Journal, Journal of Renewable Energy , Journal of Science Engineering Technology, Nigerian Journal of Solar Energy, Journal of Chemistry Education, Analytical Chemical Act* and *Journal of Analytical Chemistry*. These journals ranked first, third, fifth, nine, ten, twelve, twenty nine, thirty two and thirty three positions respectively. The remaining 290 journals were not available in the university library.

Table 11: Availability of Cited Books in the University Library

S/N	Book	No of Citation	% Citations	Availability
1	Stereochemistry and the Chemistry of Natural products	102	7.47	1
2	Physiochemical Methods	84	6.15	0
3	Organic Chemistry by Carey	77	5.64	1
4	Analytical Chemistry	73	5.34	1
5	The Useful Plants of West Tropical Africa	68	4.83	0
6	Industrial Chemistry	65	4.76	1
7	Med Plant and Trad Med in Africa	61	4.46	0
8	Polymer Degradation and Stability	58	4.24	0
9	Environmental Pollution and Degradation	54	3.95	1
10	Medical Plant in Tropical West Africa	52	3.80	0
11	Phama Basis of Therapeutics	49	3.58	0

12	Environmental Chemistry and Toxicology	45	3.29	0
13	Pharmacognosy	39	2.85	0
14	Environmental Chemistry	34	2.49	0
15	Fundamentals of Analytical Chemistry	31	2.27	1
16	Economic Botany	27	1.97	0
17	Environmental Chemistry and Toxicology	25	1.83	0
18	History of Medicine	24	1.75	0
19	The Chemical Analysis of Food	18	1.31	0
20	Introduction to Environmental Engineering	16	1.17	0
21	Principle and the Theory of Analytical Chemistry	14	1.02	1
22	The Chemistry and the use of Fire Retardant	13	0.95	0
23	The Plant Book	11	0.80	0
24	Introduction to Polymer Chemistry	11	0.80	0
25	Medical Chemistry	10	0.73	0
26	Fundamental of Organic Chemistry	10	0.73	1
27	Concise Organic Chemistry	10	0.73	1
28	Quantitative Chemical Analysis	9	0.65	0
29	Chemistry for Sanitary Engineers	9	0.65	0
30	Phytochemical Screening of Nigerian Medicinal Plants	8	0.58	0
31	The Sceptical Environment	8	0.58	0
32	Man and the Environment	8	0.58	0
33	Fundamental Concept of Environmental Chemistry	8	0.58	0
34	Synthetic Organic Chemistry	7	0.51	0
35	Higher Education Chemistry	7	0.51	0
36	Principles of Environmental Engineering	7	0.51	0
37	Basic Concept of Environmental Engineering	7	0.51	0
38	Chemical Ecotoxicology	7	0.51	0
39	Antimicrobal Chemotherapy	7	0.51	0
40	Organic Chemistry of Natural Product	7	0.51	0
41	The Theory and Practice of Primary Health	7	0.51	0
42	Environmental Engineering	7	0.51	0
43	Introduction to Hydrogeology	6	0.43	0
44	Basic Principle of Organic Chemistry	6	0.43	1
45	Principle of Polymer Chemistry	6	0.43	0
46	Principle of Instrumental Analysis	6	0.43	0
47	Advanced Inorganic Chemistry	6	0.43	1
48	Chemistry for Environmental Engineering and Science	6	0.43	0
49	Polymer Science and Technology	5	0.36	0
50	Biogas System	5	0.36	0
51	Fundamental Principle of Analytical Chemistry	5	0.36	0
52	Introduction to Ceramics	5	0.36	0
53	Electrical Technology	5	0.36	0
54	Applied Clay Mineral	5	0.36	0
55	Introduction to Technology of Pottery	5	0.36	0

56	Fundamental Principle of Organic Chemistry	4	0.29	1
57	Industrial Ceramics	4	0.29	0
58	Introduction to the Chemistry of Carbon Compound	4	0.29	0
59	Chemistry and Biochemistry Herbage	4	0.29	0
60	Medical Plant of Nigeria	4	0.29	0
61	General Chemistry	4	0.29	0
62	Plant Product of Tropical Africa	4	0.29	0
63	Forest Ecology	3	0.21	0
64	Micro Biology	3	0.21	0
65	Health Benefit of Natural Plant	3	0.21	0
66	The Text Book of Polymer Science	3	0.21	0
67	Principle of Polymer Processing	3	0.21	0
68	Chemistry and Nigerian Economy	3	0.21	0
69	Polymer Alloy	3	0.21	0
70	The Science and Technology of Polymer Films	3	0.21	0
71	Nutrition Science and Application	3	0.21	0
72	Applied Polymer Science	2	0.14	0
73	Pyrolysis of Polymer	2	0.14	0
74	Practical Biology	2	0.14	0
75	Statistical Methods for the Analysis of Biochemical Data	2	0.14	0
76	Statistics for Beginners	2	0.14	0
77	General and Inorganic Chemistry	2	0.14	0
78	Fundamentals of Electrochemical Deposition	2	0.14	0
79	Chemistry of Water and Water Pollution	2	0.14	0
80	Instrumental Analysis	2	0.14	0
81	Environmental Science	2	0.14	0
82	Fundamental of Environmental Science	2	0.14	0
83	The Evolution of Chemistry	2	0.14	0
84	21 books with one citations each	21	1.53	0
	Total	**1365**	**100**	**12**

Table 11 presents data on the availability of cited books in the university library. From the table, twelve cited books are available in the university library. These books include *Stereochemistry and the Chemistry of Natural Science*, *Organic Chemistry by Carey*, *Analytical Chemistry*, *Industrial Chemistry*, *Environmental Pollution and Degradation*, *Fundamentals of Analytical Chemistry*, *Principle and the Theory of Analytical Chemistry*, *Fundamental of Organic Chemistry*, *Concise Organic Chemistry*, *Basic Principle of Organic Chemistry*, *Advanced Inorganic Chemistry* and *Fundamental Principle of Organic Chemistry.* These books ranked first, third, fourth, sixth and ninth fifteen, twenty

one, twenty six, twenty seven, forty four, forty seven and fifty six respectively. The remaining 92 books are not available in the library.

Summary of Findings

1. The findings of the study show that out of the sixteen (16) type of sources cited, journal articles yielded the highest number of citations 2001 (42.30%). This is followed by books with 1365 (28.86%) citations. E-resource ranked third with 548(11.59%) citations. Citation to other resources is significantly low with a total of 816 (17.25%).
2. Journal of Chemical Society of Nigeria was the most cited journal. The most cited book is Stereochemistry and Chemistry of Natural Products.
3. Information materials of 0 to 9 (2010-2019) years generated more citation. The mean age of cited journal is 9.13 years while the mean age of cited book is 14.67 years.
4. The findings indicate that only nine (3.01%) out of the 299 journals cited by master students of Department of Chemistry were available in the university library.
5. Out of the 104 books cited by master students of Department of Chemistry twelve (11.54%) books were available in the university library.

Discussion of findings

The result of the findings shows that Journal articles were highly cited with 2001 (42.30%) citations. This finding is in line with earlier findings of Kushkowski, Parsons and Wiese (2003); Olatokun and Makinde (2009); Anunobi, Okoye and James-Chima (2012) among others who observed that journal are the dominant source of information. The finding is also consistent with the observation that journals are the predominant source of information in the field of natural sciences. The reason may be because literature in sciences takes a shorter period of time to become outdated than in the humanities. The findings also revealed that citation to book was fairly significant with 1365 (28.86%) citations. This implies that Chemistry researchers also consider textbooks useful for scholarly research. The

finding agrees with other citation analysis studies reviewed earlier in this study. In the study conducted by Echezona, Okafor and Ukwoma (2011), books accounts for over thirty percent of the total citations generated in the study. It is equally in line with the findings of Kehinde (2012), who observed that books contributed more than twenty five percent on his study on Agricultural Economics and Extension (AEE).

Surprisingly, findings from the study show low citation to electronic resources with 548 (11.59%) citations. Moreover, there was very low 21(3.83%) citation to e-resources in the first three years out of the ten years period in the study. This is relatively low when compared with the rate at which use of e-resources is increasing. Internet World Statistics (2018) revealed that there is incredible fast evolution of the Internet from 1995 till the present time from 15 million users to 4.208 billion users. However, most of the studies reviewed showed low usage of e-resources in their findings. For instance, Kehinde's (2012) study reported that the least citation (1.49%) came from e-resources. Echezona, Okafor and Ukwoma (2011) also revealed that citation to e-resource was very low with 1.0 percent. The reason according to him was non availability of current subscriptions in the library under study.

Similarly, Conference and seminar paper was poorly used. They yielded approximately four percent of the total citation. This finding is not surprising since these information sources are not often published. Thus, they are not easily accessible to researchers even though they are vital scholarly publication. The findings also corroborate the findings of other studies. For instance, in the works of Anaehobi and Muokebe (2014) and Echezona, etal (2011), citation to conference and seminar papers account for only 6.8 and 6.9 percent of the total citations respectively. The Findings also revealed that encyclopedias and dictionaries and other information sources that are of importance to Chemistry research such as government publications, handbooks, reports, reviews, theses and dissertations received low citation.

Interestingly, a journal published in Nigeria (*Journal of Chemical Society of Nigeria* ranked first with 52 (2.60%) of journal citations. This journal was the only journal published in Nigeria out of the first ten highly ranked Journals. It is worthy to note that out of the ten highly ranked books, five belong to field of Chemistry while the rest are distributed in other related areas such as Environmental Science, Microbiology and Botany. Taking into account the authors of these core books, the findings revealed that only one out of the first ten ranked books were written by Nigerian Authors. This book is the useful plants of west tropical Africa by Sofawara A. and polymer Degradation and Stability by Okonkwo E. M. and Ebeatu A. N. It is however important to observe that citations to foreign journals and books contributed heavily in the overall citations

Findings from the study show that postgraduate students of Chemistry prefer to use recent publications since 1552 (46.11%) citations were made to journals and books less than 10 years old. This finding is in line with earlier findings of Kushkowski, Parsons and Wiese (2003); Williams and Fletcher (2006); Olatokun and Makinde (2009) who revealed that postgraduate students writing theses prefer to use current information sources. This is also consistent with the findings of Kimball, Stephens, Hubbard and Pickett (2013) who observed that science researchers cite newer publications frequently but occasionally cite older materials. It could be seen from the findings that there is decline in use of publication as they get older. The median age of journal is 9.13 years while the median age of book is 14.67 years. It is also interesting to note that the oldest cited source is a book titled *Bjerrum Inorganic Chemistry*. This book was published in 1925.

The cited journals were checked in the university library and findings revealed that only nine out of two hundred and ninety nine (299) cited journals are available in the library.

The findings also revealed that twelve out of the one hundred and four (104) books are available in the university library. The remaining 91 cited books are not available in the library. This finding is in line with earlier findings of Anunobi, Okoye and James-Chima (2012), Anaehobi and Muokebe (2014) among others

who observed that most of the core sources used by postgraduates students were not available in the university libraries.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The University Library should improve on their acquisition of current journals and books because these two resources are the major information resource used by researchers in Industrial Chemistry. They should also embark on the development of information and communication technology infrastructure required to get them connected to the internet to improve access to electronic resources which is very important to research.
2. Nigerian university library should use the identified frequently cited sources as guide in the acquisition of sources in order to meet the information resource need of researchers in Industrial Chemistry.
3. The university library should acquire more current sources in Industrial Chemistry with special preference in subscription of journals
4. University library should improve on the provision of research materials in Industrial Chemistry especially most cited journals and books. This is very important because most of the cited journals are not available in the library.

Conclusion

Research is an important activity in all fields of study. It is means through which scholars communicate their findings and it helps in development of knowledge in every field of study. Through detailed research, students develop critical thinking expertise as well as effective communication skills that are globally sought-after and incredibly beneficial. Unfortunately, the findings revealed that some of the core information sources used by postgraduate students of Industrial Chemistry are not available in the university library. Efforts should therefore be geared towards provision of current and relevant information resources needed for research in Industrial Chemistry. This will go a long way in improving the research effort of the university.

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