

Collaboration clusters, interdisciplinarity, scope and subject classification of library and information science research from Africa: An analysis of Web of Science publications from 1996 to 2015

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Abstract

This study investigated the trends in the scope and subject classifications of library and information science research from authors that are affiliated with institutions in Africa. Library and information science journal articles and conference proceedings from the 54 African countries that were published between 2006 and 2015 and indexed in the Web of Science were retrieved for the study. After the removal of non-relevant articles and articles that were not available online, the library and information science publications were classified based on subject and scope. Results from the analysis of author keywords, country of affiliation, subject and scope classification were also visualized in network maps and bar charts. Frequency analysis shows that though computer science had the most profound influence on Africa's library and information science research, its influence came to prominence in 2004. Furthermore, North African countries exhibited features that are different from the rest of Africa; they contributed most on core computer classifications while other African countries focused more on the social science-related aspects of library and information science. Unlike other regions in Africa, the North African countries also formed a dense collaboration cluster with strong interests in subjects that are conceptual and global in scope. The collaboration clustering analysis revealed an influence of some colonial languages of as a basis for forging strong collaboration between African and non-African countries. On the other hand, African countries tend to collaborate more with countries in their regions. Lastly, human computer interaction and library and information science history subject classifications were almost nonexistent. It is recommended that further studies should investigate why certain subject classifications are not well represented.

Keywords

Africa, collaboration clusters, library and information science, LIS research, research assessment, research collaboration, scientometrics

Introduction

A firm grasp of library and information science (LIS) research overview in Africa is crucial to the understanding of the trend and direction of research as well as appreciating the past efforts of African scholars in the domain. Unlike the western world in which researchers and their works easily receive prominence, the majority of African authors and their works languish in the back waters of academic recognition. This assertion and its associated cause and effects have been discussed in several works of both African and non-African authors (Asubiario, 2019; Confraria and Godinho, 2015; MacGregor, 2008; Nwagwu, 2007; Onyancha, 2009, 2013; Tijssen, 2007).

The discussions on the causes of the above are not within the scope of this study but while it is important to address

the cause(s) of this imbalance, it is equally necessary to correct some of its effects by providing insights into Africa's intellectual exploits on various fronts. Prominence is not the only positive outcome of such effort, but it reflects the many other practical benefits that can begin to manifest once policy planners, publishers, grant donors, librarians and other critical stakeholders have a better understanding of the research interests, and future directions of LIS scholars in Africa. Three possible benefits accruing from this kind of effort are: first, on the academia front, such analyses have the benefits of revealing the most interesting research

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subjects, identifying research gaps, as well as areas needing more attention from scholars and practitioners alike. Similarly, it is also possible that there is a need for capacity building in certain LIS areas. Second, a depth of understanding of what has been done in the field “could establish systematic coordination for selection of topics for research to avoid duplication of (research) effort” (Naseer and Mahmood, 2014). Lastly, although Ocholla (2008) noted ten years ago that LIS was a budding discipline in Africa, there is a need for more recent study to investigate the trend in LIS research emanating from Africa. For instance, the classification which aims to understand the biases of research emanating from LIS scholars in Africa can expose possible topics that may be ignored, and thereby recommend relevant subject areas that LIS research in Africa could focus on. It could also call for the content analysis of LIS curricula, as the LIS education in Africa is a likely reflection of the LIS research. Furthermore, knowledge of the perspective about the dispersion of subjects in the LIS field from Africa may reveal the need for capacity building in certain LIS areas. To achieve these benefits, it becomes necessary that researchers undertake periodic and frequent studies that cover the analysis of research interests within LIS, scope, (country/institutional) collaboration patterns, frequency of national/institutional outputs, inter/multi-disciplinary patterns, etc. Several critical stakeholders such as grant donors, policy planners, information professionals as well as researchers would find such analysis useful to their works.

Specifically, the aims of the study include to:

1. investigate the subject areas of LIS research from Africa and observable changes over 20-year period of 1996–2015,
2. investigate the pattern of interdisciplinarity of LIS research from Africa,
3. find out if there are differences in subject areas in LIS research from the different African countries across the years; and
4. find out the collaboration clusters in Africa’s LIS research

Literature review

Subject classification and coverage

Several scholars have written on the research landscape of African scholars in the subject domain of LIS from diverse perspectives, foci and timeframes. Studies have also reported on how such scholarship has contributed to the world body of knowledge in general. Apparently, as the LIS field differentiated into emergent research areas in the course of time, research focus equally diverged into smaller fields such as scientometrics, bibliometrics, altmetrics, informatics, webometrics, library studies, etc. From a historical perspective, Onyancha and Minishi-Majanja (2017) discussed the trends and future of LIS

education in Sub-Saharan Africa. The authors discussed the changes in nomenclature of LIS programs, proliferation of LIS schools, changing curricula, personnel and infrastructure deployment and other issues that have contributed to the evolution of LIS education and manpower development across the region from colonial era to modern times. Through a content analysis of nearly four decades of African research, they also provided insights into the socio-cultural and technological factors that spurred the growth and changes in the subject coverage of LIS within the region. The issue of transition in subject coverage and curricular evolution also received attention from Nalumaga (2016) in which they discussed the adoption of iSchool perspectives among LIS schools in Africa. Nalumaga x-rayed the varying stages of awareness and/or willingness of LIS schools in Sub-Saharan Africa to adopt the iSchool innovation but concluded that the shift has been significantly slow as most schools and administrators have differing motivations and expectations of the paradigm.

While some studies have provided overviews from national and/or institutional perspectives, a few others gave their investigation a continental focus. Continental studies, including that of Alemna (1996; 2001) provided a decade long summary of LIS research in the *African Journal of Library, Archives and Information Science (AJLAIS)* between 1990–1995 and 1996–2000 respectively. These studies were interested in the patterns shown across the years according to status of the authors, gender, most popular subjects, country of origin and types of research. While traditional LIS subjects such as classification and cataloguing received lesser attention in the last half of the decade, the first half showed a dominant interest in information technology, publishing and records management among LIS African scholars. This development showed an improvement on the findings of Aina and Mooko (1999: 177) who had suggested that “top researchers in the continent neglected substantial areas such as publishing, rural information and records management”. Increased interests in information technology reported between 1990–1995 and 1996–2000 must have reflected the curiosity of researchers in the then emerging World Wide Web and increasing popularity of technological hardware in Africa.

Alemna’s (1996, 2001) findings equally highlighted an evolution of subject interests among researchers from the previous decade (1985–1989) whose areas of focus had been heavily inclined towards different aspects of “librarianship”, as suggested by Aina (1994). Although the *AJLAIS* used by Alemna (1996; 2001) is a long-running journal with considerable recognition across the continent (Aina and Mooko, 1999), using this singular journal as a source to birth these analyses was just too narrow and as such is a major constraint on the generalizability of their findings. More than a decade later, Onyancha (2013) provided a similar analysis of impacts of LIS research on the

world's general pool of knowledge, evidenced by their citation patterns between 1986 and 2006.

In a recent analysis, Asubiaro (2019) explained how "collaboration type, (co-)authors' roles, place of publication and other factors" affect the amount of citations received by African LIS works between 1996 and 2015. A major finding of this study showed that although LIS research accounted for only 0.5% of total research output in the continent, there was significant and consistent increase in output along the years – a similar position to Alemna (2001) – and attributable to the increase in the number of LIS schools in the region (Onyancha, 2018). It was also revealed that South Africa and Nigeria were the most prolific nations in LIS research, also consistent with an earlier study by Aina and Mooko (1999).

On a lower scale of coverage, several authors have reported their findings from sub-regional, national or institutional perspectives. Such narrower studies serve as comparative bases for examining convergence and/or differences in the research interests of scholars in the different parts of the continent as well as giving contexts to the peculiar factors that might be shaping research efforts in those places. For instance, Ocholla et al. (2012) compared a decade-long research track (2000–2009) of academic librarians from East Africa as indexed in the LISA database. Their findings revealed the behind the scenes factors (such as the publish or perish push, career growth, etc.) that account for the low contribution and poor visibility of academic librarians in LIS literature across the region.

Collaboration within and among countries

The crucial issue of collaborations between LIS scholars in Africa has also received tremendous attention from researchers in the field as it is seen by many as an effective tool to gauge the integration of LIS school curricula and the similarities in the interests of researchers as well. Ocholla (2008) investigated the status and challenges of collaboration in LIS education and training in Africa and pointed out that although most of the continent's LIS schools were based in anglophone nations, collaborations amongst them were still low and largely informal. The study also reported that among the challenges confronting LIS education, student enrolment and funding rank highest. Onyancha and Maluleka (2011) explained how the pattern of academic collaborations among Sub-Saharan African countries is reflected in the citation impacts. They concluded that geographical and language proximities were crucial determinants of who collaborated with who.

With the advantage of giving some more detailed findings, works describing sub-national collaborations provide insights into peculiar situations in each country. Oyewusi (2012) carried out a content analysis of a foremost Nigerian journal, the *Nigerian School Library Journal* to provide a trends of LIS research in the country between 1979 and

2010 and found that the collaborations among the Nigerian researchers were relatively low, with most of the works being written by single authors. They also reported that a majority of the researchers used survey methodology, historical strategies, literature review and case studies, in that order. Likewise, by analysing the growth and trend in of academic librarians' research output in Nigeria between 2000 and 2018 using articles found on the LISTA database, Okeji (2019) showed that collaboration between authors led to an improvement in the output rate among the subjects.

From a Ghanaian perspective, Owusu-Nimo and Boshoff (2017) gave an insight into the patterns, motives and roles of different authors in LIS research collaborations in Ghana. While collaborations among fellow Africans were low, international cooperation with non-African authors were rife and this resulted in most of Africa's LIS papers having non-African authors, the study found out. From the east of Africa, Kwanya (2018) surveyed the publishing patterns of Kenyan LIS authors on Google Scholar and reported that their perceived low publishing performance could be traced to a number of socio-economic and technological disadvantages, such as poor funding, underdeveloped scholarly communication skills, heavy teaching workloads amongst others. Down south, Maluleka, Onyancha, and Ajiferuke (2016) explored the inherent factors influencing research collaboration in LIS schools in South Africa. In addition to highlighting the factors militating against research collaboration in the country, their findings showed a significant and increase in single- and multi-authored publications between 1991 and 2012. These national studies are however too narrowed for their findings to reflect the wider picture of what is really happening on the continental scale.

Finally, the focus of literature overview among scholars by and large has been on articles and proceedings. Book reviews constituted a negligible part of the discourse as evident from literature, consistent with an observation that journals constitute the major medium for reporting research findings in Africa (Aina and Mabawonku, 1997).

Although the studies discussed above treated African LIS literature from different perspectives, through a multi-perspective approach our study aims to string together these factors into a coherent analysis that provides insights into the subject coverage, research interests, collaboration patterns, scope and trends while providing an understanding of the timeline for the changes in these factors. Our study also provides robust and updated understanding of the state of the LIS research in Africa, the areas of concentration of research, the scope of research.

Research trends across the world

To put the review of African LIS literature in a proper context, we take a look at the trends in LIS scholarship in

other parts of the world. Ivanović and Ho (2014) conducted a bibliometric analysis of 501 highly cited articles indexed on the WoS category of Information Science and Library Science between 1900 and 2012. They found out that the years between the 1990s and the 2000s recorded the highest publications of highly cited journal articles on the database amounting to around 37% and 40% of the dataset respectively. This increase they felt was tied to drastic growth rate journals in the LIS field from 1900 to 2010. *MIS Quarterly* led the pack of 37 journals that published these top articles. They also revealed that the world's leading institutional producers are situated in the United States. This part was corroborated by Ahmad et al. (2019) and Sin (2011).

Ahmad and colleagues presented an analysis of world-wide LIS literature that was published between 2003 and 2017 and indexed on the ISI WoS database. USA (with Canada, England and Spain distantly behind) had the highest number of publications (40%) among all countries considered, while Mike Thelwall from the UK was the most prolific author within this period. They also suggested that developing countries lagged way behind those of their developed counterparts. Sin (2011) equally revealed that the United States was the dominant producer, with Canada and the UK alternating in second position among the nations contributing to LIS research worldwide. Papers from high-income nations have higher odds of being more cited and this may account for why no African country was among the 19 countries that made the top 10 nations discovered in the analysis. Other factors (such as international collaboration, number of authors, publication year, etc.) were also significant determinants in the citation patterns of LIS papers. Sin was conducting a bibliometric study of 7489 papers found in six LIS journals that were published between 1980 and 2008.

Across Asia and Oceania, Malaysian and Singaporean librarians were the most prolific within the years 2011 and 2016 according to a study on research productivity in ASEAN countries (Ramos-Eclevia et al., 2018). The authors also noted that librarians in the region were now becoming more active in scholarly communications. Wilson et al. (2011) equally reported a growing record of collaborated authorship among Australian librarians since the late 1990s.

In the aspect of LIS education, Abdullahi and Kajberg (2004) organized a survey of over 60 LIS schools in the USA, Canada and Europe to analyze the topics on which LIS professionals are being trained as a reflection of these schools' adaptation to international and technological trends. The study found out that although most of the LIS programs in the USA, Canada and Europe are equally interested in international issues, European curricula showed more "internationalization" than those found in North America. Though relatively dated, this study prepares a grounded context in which we can evaluate present

realities in the LIS training in these regions. Years later, Mole et al. (2016) critically reviewed the state of LIS education, the challenges and the future and argued that LIS education was in dire need of "re-engineering" in order to meet the industrial needs of the evolving knowledge societies. Similarly, Virkus (2015) and Borrego (2015) suggested that although European LIS schools have been adapting their curricula in response to the current trends and developments, the developments have been slow and disproportionate on a country basis, thus hindering cross-European collaborations.

Methodology

Record of LIS articles of the 54 African countries from 1996 to 2015 was collected from the WoS using the search strategy that was described in Asubiaro (2019). Five of the WoS citation indexes, namely, the Science Citation Index Expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), Arts and Humanities Citation Index (AandHCI), Conference Proceedings Citation Index-Science (CPCI-S), and Conference Proceedings Citation Index-Social Science and Humanities (CPCI-SSH) were searched using this query: AD=(South Africa OR Nigeria OR Ghana OR Kenya OR Botswana OR Tanzania OR Uganda OR Ethiopia OR Senegal OR Zambia OR Benin OR Zimbabwe OR Malawi OR Namibia OR Guinea OR Mauritius OR Mozambique OR Niger OR Sierra Leone OR Mali OR Angola OR Lesotho OR Liberia OR Gambia OR Seychelles OR Algeria OR Burkina Faso OR Burundi OR Cape Verde OR Cameroon OR Cent Afr Republ OR Chad OR Comoros OR DR Congo OR Djibouti OR Cote Ivoire OR Congo OR Egypt OR Equatorial Guinea OR Eritrea OR Gabon OR Guinea-Bissau OR Madagascar OR Morocco OR Congo Republic OR Sao Tome and Principe OR Rwanda OR Somalia OR Swaziland OR Sudan OR Togo OR Tunisia OR Western Sahara) AND PY=(1996-2015) AND SU=(Information Science and Library Science).

The search returned 2331 publications which included journal articles, book reviews, books, book chapters, conference proceedings, letters, meeting abstracts, corrections, items about individuals, news items, preprint, biographical items, editorial items and reviews. Only journal articles and conference proceedings, 1848 in number, were considered for the analysis. The dataset containing conference proceedings and journal articles were cleaned by removing six publications with missing and untraceable addresses. Afterwards, the titles, abstracts and/or full texts of the articles were read to identify items that were classified wrongly in LIS. Articles that were considered irrelevant to LIS were therefore removed; only 1587 were found suitable for further analysis after data cleaning.

Unit of analysis included the country of affiliation of authors, the scope of the study and subject classification of the articles. The country of affiliation was extracted from

the records that was obtained from WoS. The scope was classified into six categories; institutional, national, African, non-African, global and not applicable. The scope of an article was marked “institutional” if the article focused on an institution. The scope was marked “national” if the focus was beyond an institution but within an African country. The focus was marked “African” if the article’s focus was beyond one African country; this could be two or more African countries or the whole of Africa. The scope was considered “non-African” if the article focused on a non-African institution(s) or country(ies). Lastly, the scope was marked “not applicable” if the article was conceptual, an opinion piece, systems design or implementation, a review without a geographical scope. For instance, a bibliometric article focusing on a university in Africa was considered “institutional” in scope, whereas if the article focused on a country or more than one institution in a country in Africa, the scope was considered “national”.

A subject area classification scheme was created for the study from subject area classifications that were published in Pettigrew and McKechnie (2001), Kim and Jeong (2006) and Tuomaala et al. (2014). Literature search showed that different subject classification schemes for LIS has been used in similar studies; none of the existing schemes was found suitable on its own and it became necessary to create a new scheme. The three subject classification schemes which were used for creating our scheme were considered robust and they complemented each other; subject areas which were missing in some were covered in others. The subject classification schemes are displayed on Table 1. The subject category for “use and adoption of information technology” was included because it was conspicuously missing in the previous subject categories. The “use and adoption of information technology” subject area is a very important area of research in information science as it deals with the sociological aspect of information technology research. The scheme included 15 subject categories, eight of them were directly created from at least one of the three previous subject categories while six subject categories were modifications of relevant subject categories from the earlier classifications.

Clustering, link strengths and visualizations of country networks based on co-occurrence or collaboration were done with the VOSviewer software (van Eck and Waltman, 2010). Interdisciplinarity in this study is basic and was defined as the location of the articles in other WoS subject categories. In other words, the number of times LIS research overlaps with other disciplines (WoS category in this study) is a measure of its interdisciplinarity. The results of frequencies are presented on tables and charts. The articles were allocated to subject categories by the first author by considering the primary subject of the article. Subjects of articles were allocated by reading the titles alone, otherwise the abstracts were read. In cases where the titles and abstracts did not provide enough information

to allocate the subject, the full text was retrieved, if the full text is unavailable, the article was removed. This procedure was followed for the scope annotation as well. Considering conference proceedings and journals articles alone for this study is considered a limitation. However, research articles form the core of (cited) literature in LIS (Tuomaala et al., 2014). Research articles (journal articles alone or with conference proceedings) are the main data sources for many recent research articles on LIS research (e.g. Asubiaro, 2019; Kim and Jeong, 2006; Pettigrew and McKechnie, 2001). Though WoS and Scopus are the biggest and most popular data sources for bibliometric studies, studies such as Mongeon and Paul-Hus (2016) have reported that they are both biased against disciplines such as social sciences, arts and humanities and all languages but English. Similarly, Nwagwu (2005), while making a case for the creation of an index database for publications from Africa, posited that publications from Africa are underrepresented in the WoS, Scopus and all other scientific databases. With the problem of the availability of an online index database for publications from Africa still existing, WoS was chosen as data source for this study because its classification feature which makes it easy to retrieve LIS as a subject area is an advantage over Scopus. Lastly, considering publications that were written in English alone was also considered a limitation.

Results

The result of subject classifications distribution is presented on Table 2. The result shows that “use and adoption of information technology” (22.39%), “development and design of information technology” (12.77%) and “knowledge and information resource management” (10.31%), “human information behavior” (8.19%) and “library services” (7.62%) are the most popular areas of research among LIS researchers from Africa. These top five most popular subject classifications accounted for 61.28% of the publications. On the other hand, subject classifications such as “HCI/interface design” (0.25%) and “LIS history” (0.13%), are almost non-existent, while “information organization” (1.76%) and “library management” (1.76%) are the least popular research areas. This is an indication that the LIS research in Africa overemphasizes a few research areas.

Author keywords

Table 3 presents the top 20 most occurring keywords of the 3151 author keywords in Africa’s LIS for the period of 20 years. The keyword further provides an insight into the research interests of LIS researchers in Africa. The result shows that Nigeria, South Africa, Africa, Botswana and Kenya are the most frequently occurring countries/continent in the author keywords. Knowledge management, academic

Table 1. Library and Information Science Subject Classification Scheme.

	Our scheme	(Pettigrew and McKechnie, 2001)	(Kim and Jeong, 2006)	(Tuomaala et al., 2014)
1	Information organization: Indexing/abstracting/cataloging and classifications	Indexing/abstracting/cataloging and classifications		Information storage and retrieval
2	Information storage and retrieval	Information retrieval	Information retrieval	Information storage and retrieval
3	Development, design and implementation of information technology (IT)	Information technology (including www, cd-rom, gis, systems)	Internet System	
4	Use and adoption of IT			
5	HCI/interface design	HCI/interface design		
6	Bibliometrics	Bibliometrics	Bibliometrics	Analysis of LIS
7	Information policy	Information policy		
8	Design and delivery of library services and programs	Library services (design and delivery of services and programs)	Information service	Library and information-service (Landl) activities
9	Library management (human resources, fiscal, planning)	Library management (human resources, fiscal, planning)	Library management	
10	Scholarly communication and publishing	Scholarly communication and publishing	Scholarly communication	Scientific and Professional communication., Publishing
11	LIS history	History		LIS History
12	Human information behavior	Human information behavior	Information seeking and use	Information seeking
13	LIS education and pedagogy	Education and pedagogy	Education	Education in LIS
14	Knowledge and information resource management		Resource management	
15	Others (including general IS and IS research, LIS professionals)	Other (including general IS and IS research)	Professionals General LIS	Professions Methodology, Other LIS topics

Table 2. Subject classification of LIS in Africa.

		Frequency (n=1587)	Percentage (%)
1	Information organization	28	1.76
2	Information storage, preservation and retrieval	85	5.36
3	Development and design of information technology	203	12.79
4	Use and adoption of information technology	353	22.24
5	HCI/interface design	4	0.25
6	Bibliometrics	114	7.18
7	Information policy, privacy and laws	90	5.67
8	Library services	121	7.62
9	Library management	28	1.76
10	Scholarly communication and publishing	72	4.54
11	LIS history	2	0.13
12	Human information behavior	130	8.19
13	LIS education and pedagogy	70	4.41
14	Knowledge and information resource management	164	10.33
15	Others (including general IS and IS research)	123	7.75

libraries, libraries, university libraries and Internet are the top five frequently occurring terms in the author keywords. To have an insight into the evolution of LIS research in Africa using the author keywords, the 20-year period was split into quarters of five years; 1996 to 2000, 2001 to 2005, 2006 to 2010 and 2011 to 2015. Results of the top 20 most

frequently occurring keywords are presented on Table 4. Except for year 1996 to 2000 which had sparse data to generate the top 20 keywords, the top 20 most occurring keywords were obtained for every other quarter. With the 141 keywords which appeared at least five times, a visualization map presented in Figure 1 was created.

Table 3. Distribution of author keywords and total link strength in Africa's LIS.

S/N	Keyword	Occurrences	Total link strength
1	Nigeria	127	519
2	South Africa	106	471
3	Knowledge management	55	221
4	Academic libraries	52	232
5	Libraries	50	249
6	Africa	50	247
7	University libraries	43	171
8	Internet	42	177
9	e-government	33	158
10	Developing countries	32	140
11	Information literacy	28	126
12	Information management	26	119
13	Botswana	25	97
14	Librarians	23	104
15	Communication technologies	22	85
16	Information	20	85
17	Kenya	19	91
18	Records management	19	84
19	Universities	19	83
20	Information services	19	82

It is also shown that the influence of computer science in LIS research in Africa increased over the years, as there was just one computer-related author keyword – “computer networks” among the first six most frequently occurring author keywords in the first five years. In the second five years (2001 to 2005), there was an increase to six of the 20 top most frequently occurring author keywords which were computer-related- “Internet”, “telecommunications”, “information technology”, “communication technology”, “library automation” and “digital divide”. However, there was an emergence of new keywords which suggests an evolutionary trend in the Africa's LIS. These keywords include “open access” and “social media”; these are also computer-related; however it is noteworthy that the phenomenon described by these keywords occurred as a result of the development of IT. There was also an increase in the focus on subject-knowledge management. From 1996 to 2005, there were two knowledge management-related keywords – “knowledge management” and “information management”. From 2006 to 2015, there were six knowledge management-related keywords like knowledge management”, “information management”, “records management” and “knowledge sharing”.

Interdisciplinarity

Frequency of co-occurrence of the “Information science and library science” along with other WoS categories was obtained to give an insight into the influence of

other disciplines on Africa's LIS research. The result of the analysis is displayed on Table 5. Table 5 shows that Computer sciences WoS categories are the most frequently occurring, followed by Business, Management and Economics.

Yearly trends

Table 6 presents the number of articles that were analyzed per year and the productivity of the LIS researchers from Africa. While the productivity column contains the number of LIS publications that were retrieved from the WoS before data cleaning, papers analyzed column contains the number of articles after cleaning. More insight is given into the yearly trend in Figure 2 with the visualization of the subject classification per year. Table 6 shows that there is a yearly increase in the number of articles that are produced per year. The focus is on Figure 2 which reveals some patterns in the subject classifications of the LIS publications. The Figure shows that the “others” classification was the most popular subject classification before 2004, followed by LIS education and bibliometrics. From 2004 to 2015, the pattern changed, as “use and adoption of information technology” and “design and development of ICT”, computer-related classifications became the most popular, followed by “information behaviour”, “bibliometrics” and “knowledge management”. Between 2004 and 2015, a decline in the “others” and “LIS education” classifications was also recorded.

National and regional influence and collaborations

Insight into the productivity of the African countries shows that 36 African countries contributed at least five times. Table 7 shows the top 20 prolific African countries, based on LIS researchers' contributions. South Africa, Nigeria, Morocco, Botswana and Egypt were the most prolific countries. Similarly, based on the total link strength of the collaboration network, South Africa, Nigeria, Kenya, Ghana, Uganda and Tanzania were the most collaborative African countries. Similarly, a list of the top 10 most frequently non-African countries that collaborated with the African countries is presented on Table 8. USA, France, England, Malaysia and Canada were the most productive collaborating partners of the African countries. On the other hand, USA, France, England, Germany and Denmark collaborated with the highest number of African countries.

The collaborating network provides some insight into the pattern of collaboration and influence of collaborating entities. The collaboration network map of the African and non-African countries is presented on Figure 3. The result shows eight clusters which are highlighted by the colors of the network; the clusters are presented on Table 9 below. Collaboration between the most prolific in Africa and in

Table 4. Most frequently occurring keywords in the first, second, third and fourth 5 years.

S/N	1996–2000		2001–2005		2006–2010		2011–2015	
	Keyword	Frq. N=70	Keyword	N=229		N=1031		N=2292
1	Libraries	5	Internet	19	Nigeria	44	Nigeria	64
2	Interlending	5	Nigeria	17	South Africa	26	South Africa	64
3	Document supply	4	South Africa	15	Knowledge management	26	Academic libraries	39
4	Computer networks	2	Libraries	10	e-government	22	Africa	29
5	Information services	2	Africa	7	University libraries	16	Libraries	23
6	Third world	2	Telecommunications	7	Africa	14	Knowledge management	22
7			Knowledge management	7	Communication technologies	14	University libraries	22
8			Information services	6	Botswana	13	Information literacy	17
9			Information technology	5	Knowledge sharing	12	Librarians	15
10			Developing countries	5	Libraries	12	Kenya	14
11			Botswana	5	Information literacy	11	Internet	14
12			Information	5	Internet	11	Information management	13
13			University libraries	5	Developing countries	10	evaluation	12
14			Communication technologies	5	World Wide Web	10	Ghana	12
15			Information management	4	e-learning	9	e-government	11
16			Academic libraries	4	Universities	9	Social media	11
17			Library automation	4	Information management	9	Open access	11
18			User studies	4	Higher education	8	Information	11
19			Digital divide	3	Academic libraries	8	Records management	11
20			Information society	3	Information society	7	Tanzania	11

the world, talking about the collaboration between South Africa and the United States. The thickness of the connecting line between two countries explicates the strength of the collaboration (36) between the two countries. The thickness of the connecting line between South Africa and the United States is the broadest. Next to the strength in collaboration between South Africa and USA is Nigeria-USA with total link strength of 11, Germany-South Africa 9, Morocco-France 8, South Africa-Netherlands 8, Kenya-USA 7, England-South Africa 7, France-Algeria 11. The strongest collaboration strength existed between African countries and foreign countries. The strongest collaboration between two African countries existed between Botswana-South Africa 8, Nigeria-South Africa 9, South Africa-Tanzania 7, Nigeria-Malaysia.

Subject classification of the top 10 African countries

This section provides insight into the results of the productivity of the African countries that were displayed on Table 6

in the preceding section. This section therefore provides information on the LIS subject classifications of publications of the African countries. The subject classification of LIS research of the top 10 most prolific African countries is visualized in Figure 4 below. Figure 4 which shows the subject classifications of publications of the African countries, reveals that North African countries of Tunisia, Morocco and Egypt concentrated on the “design and development of IT” while “use and adoption of IT”, was consistently the most popular in all the countries but Morocco and Tunisia. The North African countries focused more on the hard LIS subject classifications such as “design and development of IT”, “information storage and retrieval”. Similarly, the small contribution on the “HCI/interface design”, computer-related classifications from the LIS collections from Africa emanated from Egypt and Morocco.

Scope

This section provides insight into the scope of the publications by LIS researchers in Africa. While Figure 5 is an

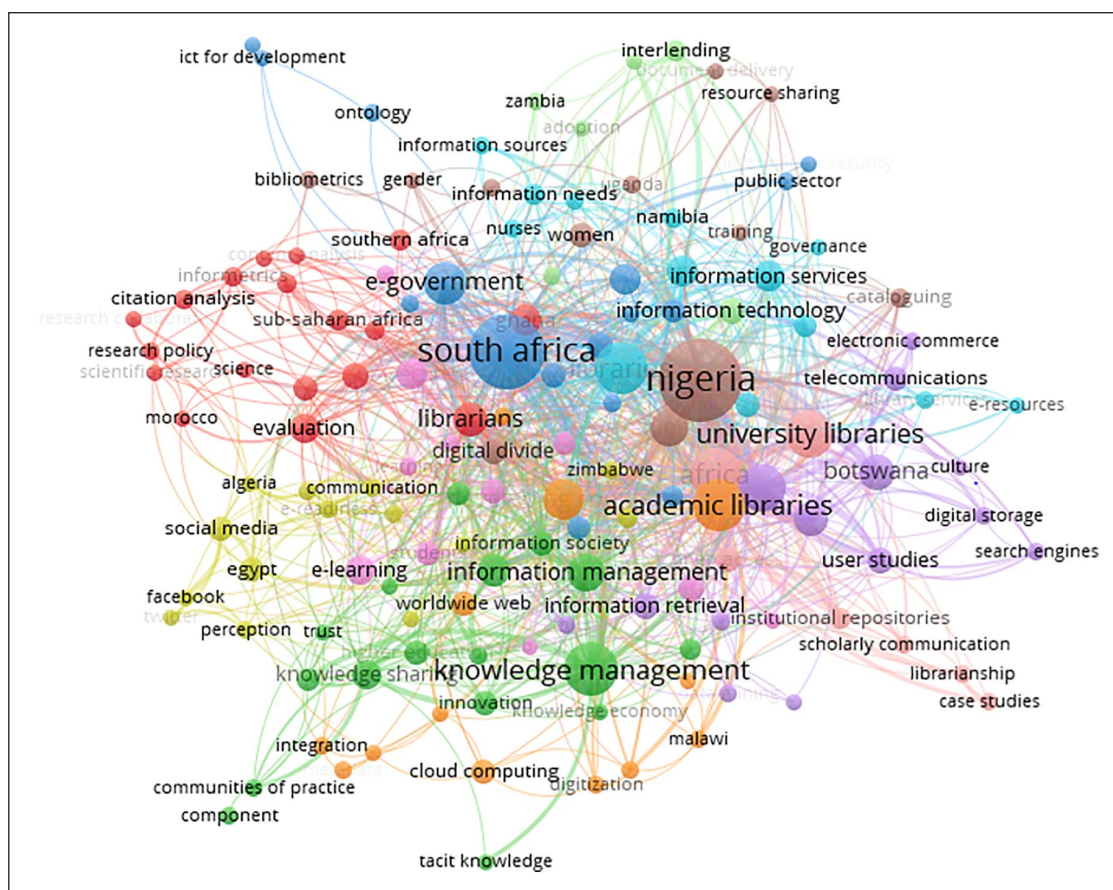


Figure 1. Visualization map of the author keywords.

aggregate of the scope of LIS research in Africa, Figure 6 gives more insight into the scope of LIS research in the top 10 most prolific countries in Africa. Figure 5 shows that articles of national scope had more proportion than others. Same observable trend in the collaboration network and subject classifications in the preceding sections continues in this section. For instance, the North African countries – Morocco, Tunisia and Egypt produced more publications in the “not applicable” scope.

Discussion and implication of findings

First, analysis of the subject classifications reveals some trends that give insight into the subject areas of LIS research in Africa. The five most popular subject classifications accounted for over 60% of the LIS research from Africa, while the four least most popular research areas accounted for about 4%. This indicates that LIS research from Africa overconcentrates on a few subject areas at the expense of others. This implies that LIS researchers in Africa are either skilled in the few subject areas they concentrate on or they lack the resources to play in the areas they ignore. This is corroborated by Ajiferuke (2011: 182) that listed “lack of appropriate informetrics skills, inaccessible data collection

sources, and unaffordable analytical tools” as the barrier to the participation of LIS researchers in Africa in bibliometric studies. Interdisciplinarity of LIS requires training and curriculum that captures the requisite skills. For instance, research areas such as “HCI/interface design” and “design and implementation of information technology” require some computer programming skills, bibliometrics requires quantitative analysis skills, “LIS history” requires some qualitative skills. Though content analysis of 29 LIS schools curricular in 18 anglophone Sub-Saharan African countries revealed that ICT intensive courses such as HCI, Operating System, Local Area Network, Applications Software and Artificial Intelligence form a significant part of their curricula (Minishi-Majanja and Ocholla 2004), LIS research does not reflect same level of ICT inclination. This observation suggests there is a need to find out the effect LIS curriculum in Africa’s LIS schools on research. The trends recorded in this study could reflect the differences in teaching and research interests among Africa’s LIS researchers, though it has been observed that most (LIS) researchers conduct research in their areas of teaching. It is also important to find out the availability of tools, laboratories, software and supports for ICT intensive research in the African universities. Perhaps, the unavailability of research tools explains why

Table 5. Influence of other disciplines on Africa's LIS.

Rank	Web of Science categories	Number of occurrences
	Information science and library science	1587
1	Computer science-information systems	350
2	Computer science	137
3	Computer science – theory and methods	110
4	Management	100
5	Business	66
6	Computer science – interdisciplinary applications	55
7	Business and economics	55
8	Telecommunications	52
9	Public administrations	40
10	Communications	39
11	Education and educational research	30
12	Social issues	24
13	Social sciences – interdisciplinary	20
14	Computer science – hardware and architecture	17
15	Social sciences, Biomedical	13
16	Health care sciences and services	12
17	Medical informatics	11
18	Psychology	11
19	Computer science – software engineering	10
20	Multidisciplinary sciences	8

Table 6. Yearly trends in productivity.

	Year	Productivity	Papers analyzed Frequency (n=1587)	Percentage
1	2015	238	205	12.89
2	2014	226	178	11.19
3	2013	188	139	8.74
4	2012	199	144	9.06
5	2011	162	110	6.92
6	2010	135	97	6.10
7	2009	131	80	5.03
8	2008	205	133	8.36
9	2007	158	96	6.04
10	2006	104	55	3.46
11	2005	78	51	3.21
12	2004	74	31	1.95
13	2003	77	46	2.89
14	2002	64	32	2.01
15	2001	36	18	1.13
16	2000	61	35	2.20
17	1999	42	30	1.89
18	1998	48	37	2.33
19	1997	44	28	1.76
20	1996	61	42	2.64

LIS researchers in Africa ignore certain research areas, as it appears the ignored areas require special research tools, while the areas they concentrated on require common research tools. For instance, HCI research requires the use of simulation laboratories which may not be available in African universities. Similarly, “information organization” research and training may require the use of the most up-to-date cataloging and classification tools such as the access to Resource Description and Access (RDA) database, Dewey Decimal Classification (DDC) schemes and Library of Congress subject headings (LCSH) and classification (LCC) schemes which may not be available in Africa's LIS schools. The results in this study may not reflect a problem in the LIS research structure, but they do reveal the interests of Africa's LIS research. However, it is necessary to find out the reasons for the lopsided research structure in future studies.

The popular subject classifications of LIS articles from Africa as observed in this study are somewhat different from studies such as Pettigrew and McKechnie (2001); Kim and Jeong (2006); Blessinger and Hrycaj (2010) and Atkins (1988) that covered LIS globally. First, LIS subject classifications in the earlier studies included a good number of HCI and LIS history studies which are almost nonexistent in Africa's LIS. Second, unlike this study, which found out otherwise, the earlier studies reported that, “information retrieval” and “bibliometrics” were two of the five most popular subject classifications in LIS. This suggests that LIS in Africa has created a unique niche, different from the global LIS outlook. LIS research globally is technologically inclined with studies from areas such as HCI and information retrieval; the results of this study suggest that the technological mix is missing in Africa. HCI and information retrieval areas are information technology-intensive research areas which requires expertise in computer programming, statistics and computer engineering.

Yearly trends found in this study are comparable to earlier studies on LIS research in Africa. Consistent with the present study, social science-related and general LIS areas dominated LIS research between 1990 and 1995 (Aina and Mooko, 1999; Alemna, 1996, 2001). On the other hand, while this study reported that computer-related subject areas became popular after 2004, Alemna (2001) reported otherwise, as it noted that “information technology”, was the most popular subject classification in Africa's LIS between 1996 and 2000. Though there are important LIS subject areas that are being ignored, the implication of the changes observed in the keywords analysis shows some dynamism in LIS in Africa. One of the changes is from the narrow research front to more diverse and rich research areas. In the first quarter, for instance, the keywords suggested the general LIS research area only was the focus, whereas this changed gradually in the second quarter as there were new prominent keywords which suggest focus on newer and broader research areas of user studies,

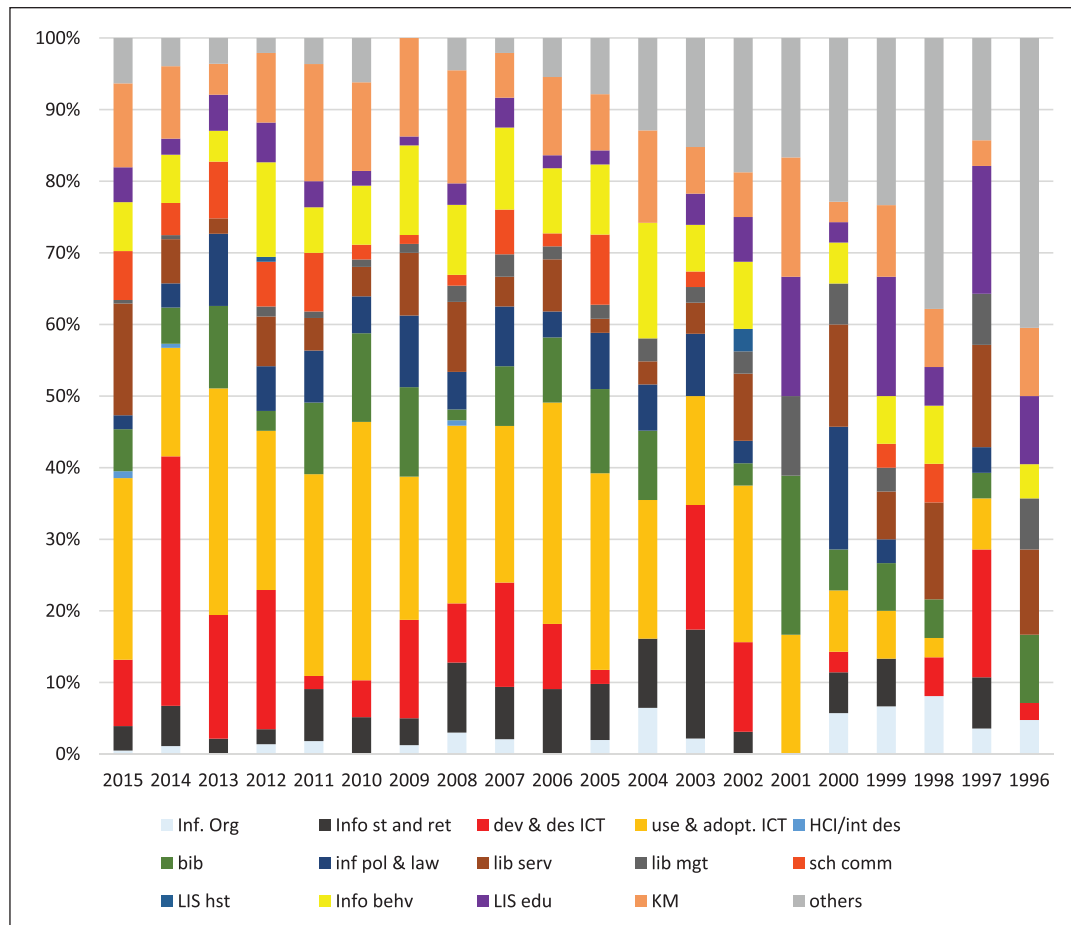


Figure 2. Yearly trend in the distribution of Africa's LIS subject classifications.

Table 7. Productivity of the top 20 African countries.

S/N	Countries	Occurrence	Total link strength
1	South Africa	721	183
2	Nigeria	295	55
3	Morocco	85	14
4	Botswana	89	15
5	Egypt	67	20
6	Ghana	67	19
7	Tunisia	35	9
8	Kenya	38	23
9	Uganda	42	21
10	Tanzania	33	21
11	Ethiopia	22	13
12	Zambia	20	10
13	Algeria	21	11
14	Malawi	18	11
15	Namibia	18	9
16	Zimbabwe	17	7
17	Benin	9	3
18	Senegal	9	6
19	Cameroon	8	4
20	Swaziland	7	7

Table 8. Non-African countries' contribution to Africa's LIS.

	Country	Number of occurrences	Total link strength
1	USA	87	126
2	France	30	48
3	England	29	37
4	Malaysia	13	16
5	Canada	11	19
6	Germany	11	30
7	Netherlands	11	11
8	Norway	9	11
9	Denmark	6	23
10	Saudi Arabia	6	6

knowledge management, information technology and academic libraries. The subsequent quarters consolidated these changes and dynamism.

Although an earlier study showed that LIS research in Africa draws theoretical grounding from computer science or the social sciences (Nalumaga, 2016), the changes observed in the present study after 2004 could be explained

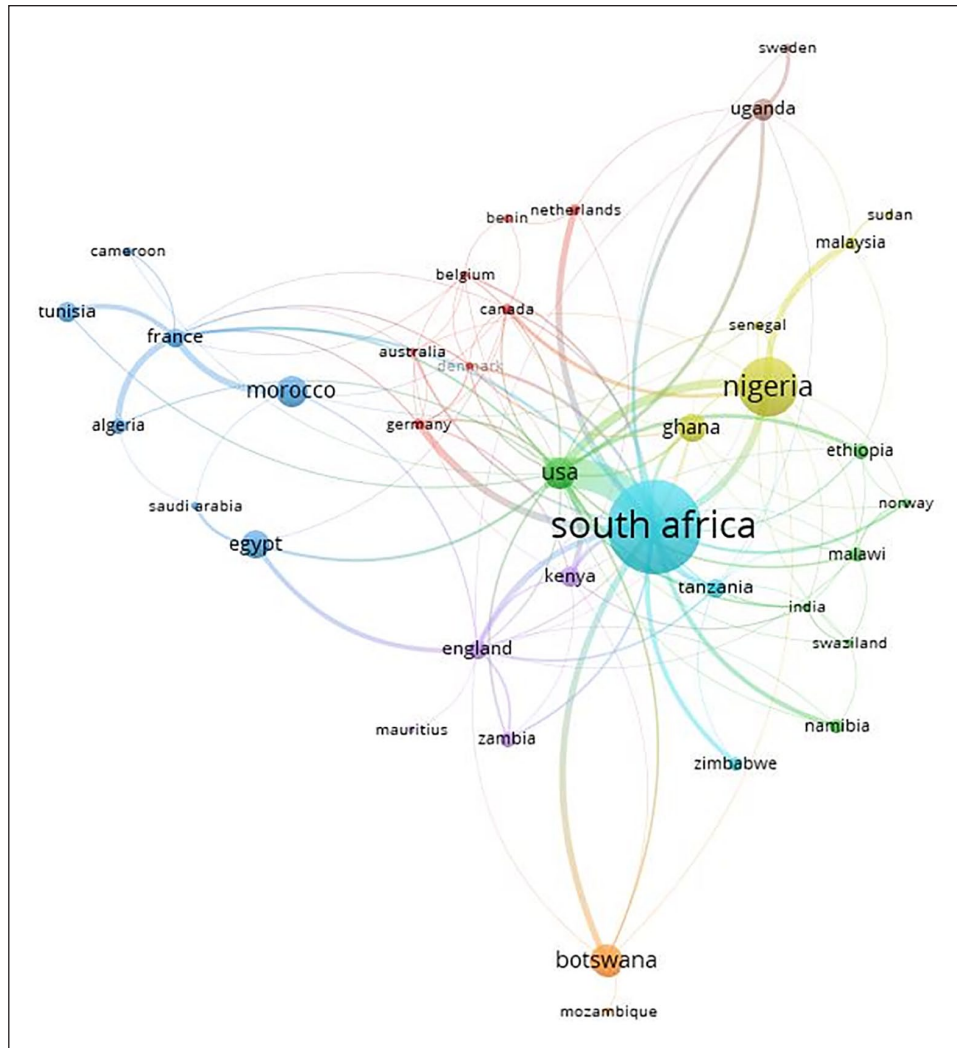


Figure 3. Visualization network map of the collaborations between African and non-African countries.

Table 9. Clusters based on the collaboration between countries.

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
Australia	Ghana	Algeria	India	England	South Africa	Botswana	Sweden
Belgium	Malaysia	Cameroon	Namibia	Mauritius	Tanzania	Mozambique	Uganda
Benin	Nigeria	Egypt	Swaziland	Zambia	Zimbabwe		
Canada	Senegal	France	Tanzania	Kenya			
Denmark	Sudan	Morocco	Ethiopia				
Germany		Saudi Arabia	Malawi				
Netherlands		Tunisia	USA				

as a reflection of the movement of LIS in Africa from the traditional to the more technologically-focused approach. As noted in Nalumaga (2016), only one LIS school in Africa officially embraced the iSchool technology-focused approach, while there were indications that others made some changes. Most of the changes occasioned by LIS schools in Africa towards ICT-driven curricula were

inspired by demands of the job market, and a strategy to survive global competition. This position is not much different from that of other studies which have posited that there are gradual changes in Africa's LIS education and curricula towards ICT (Onyancha and Minishi-Majanja, 2017). With all the discussion around changes in LIS training and curriculum in Africa towards ICT, this study shows

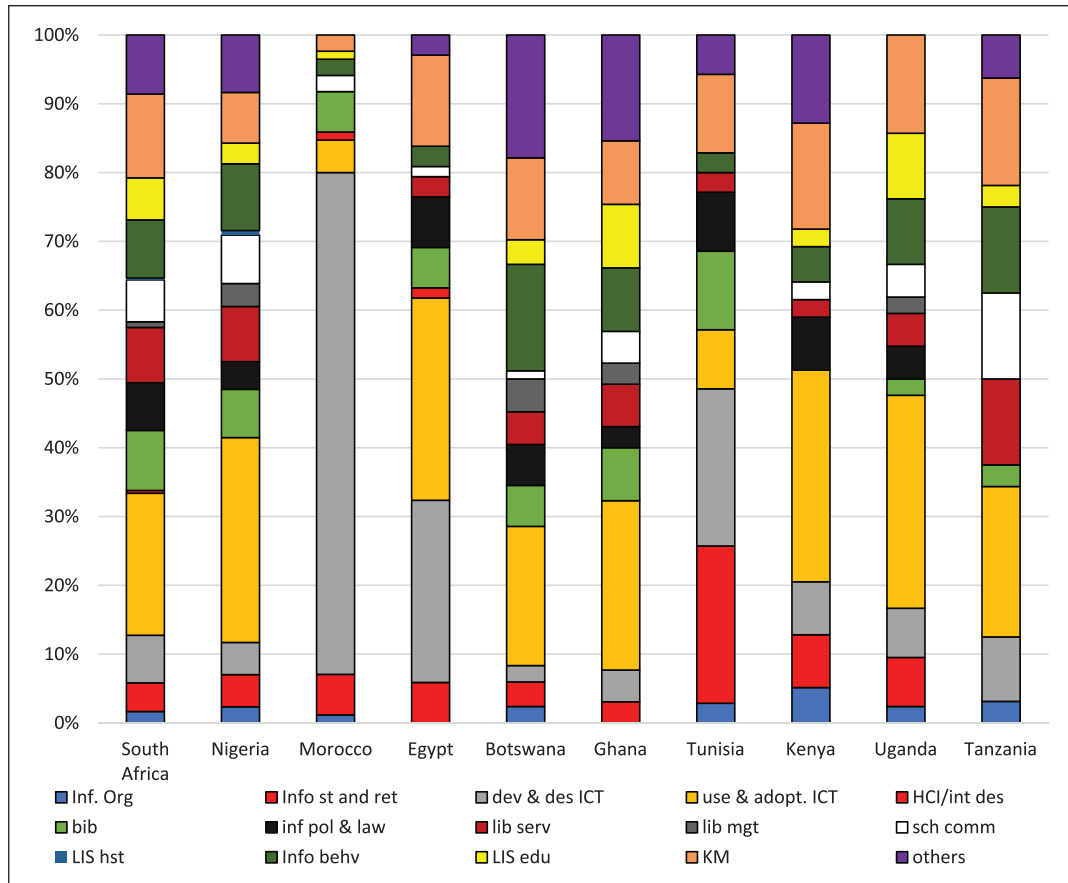


Figure 4. Distribution of the subject categories of the top 10 African countries.

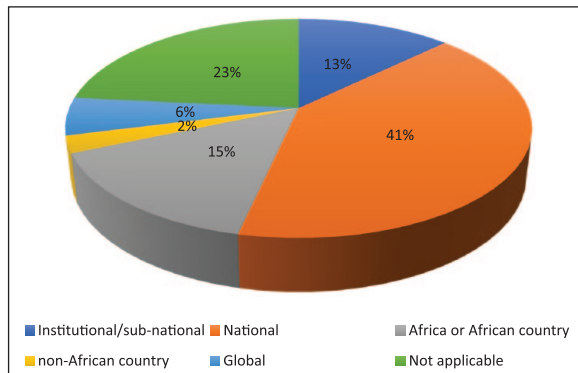


Figure 5. Scope of the LIS research.

that the LIS research in Africa takes comfort in the social sciences study of ICT, except for the North African countries that are really ICT or information systems focused. At face value, the aggregated results indicated that LIS in Africa is influenced mostly by the computer science discipline; however, with further scrutiny into which countries contributed what, it was revealed the North African countries were the ICT pros. As observed in the subject classification of the top 10 African countries, apart from the

North African countries where development and design of ICT is most prominent, subject areas such as the use and adoption of ICT are the most prominent.

Contributions of countries show the same trends as were recorded in earlier studies such as Adams et al. (2014), Asubiaro (2019), Onyancha (2018), Pouris and Ho (2014) where South Africa, Nigeria and Egypt are the most prolific countries. Similarly, a list of the top 10 non-African countries that collaborated with the African countries is the usual roll call of the North American and European research superpowers (Adams et al., 2014). The strongest collaboration strength between two countries existed between African and foreign countries; this shows the stake of the foreign countries in Africa's research. On the other hand, it shows that Africa countries' stake in each others' research is less significant relative to that of foreign countries. This is consistent with the finding of Onyancha and Maluleka (2011) which posited that African countries' contributions to each other's knowledge production through collaboration is negligible.

Country trends provide more insight into the areas of concentration of African countries in LIS. The North African countries focused more on the hard LIS subject classifications such as "design and development of IT",

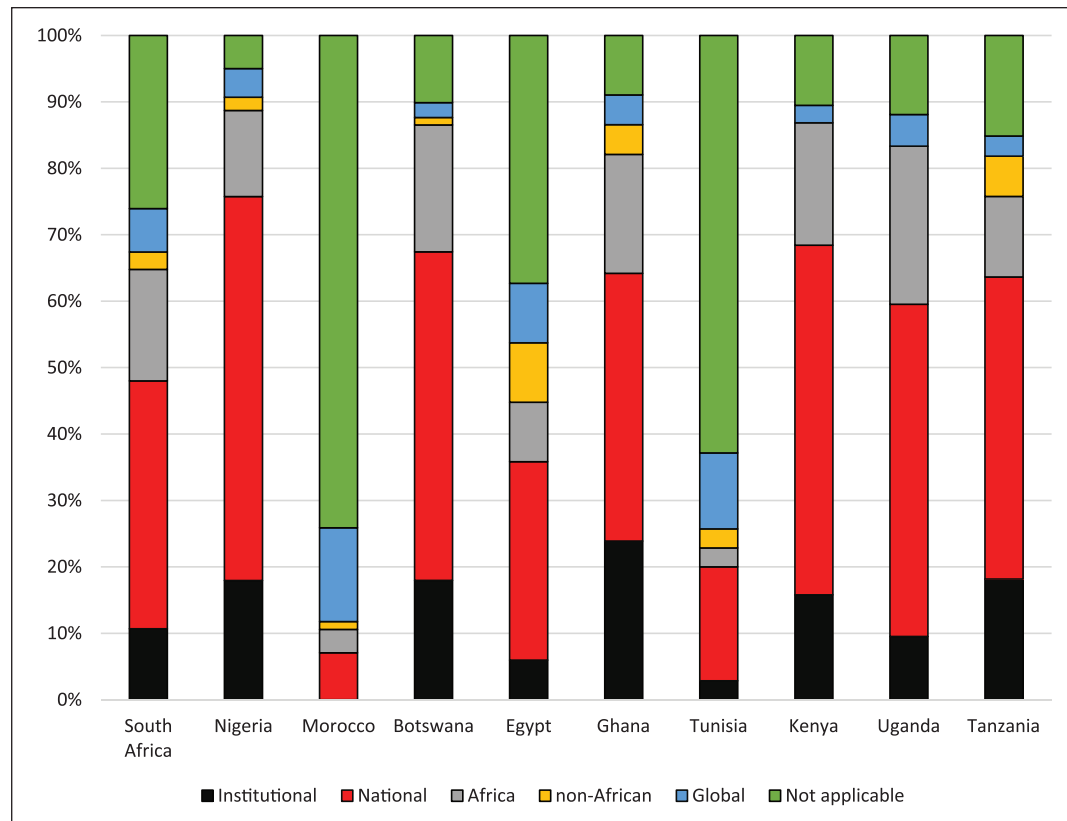


Figure 6. Scope distribution by countries.

“information storage and retrieval”. Similarly, the small contribution on the “HCI/interface design” emanated from Egypt and Morocco, two North African countries. Other African countries exhibited different feature as they concentrated more on the social science-related aspects of LIS such as “use and adoption of IT”, “knowledge management” and others.

It is evident from this study that LIS researchers in Africa are mostly interested in local problems. The analysis of the scope of LIS articles in Africa shows that most of the articles (55%) are either institutional or national in scope. Solving local problems before considering problems in other parts of the world is a good trend. However, there is a need to also contribute to global issues. This could explain one of the reasons why research from Africa is less cited, though this assertion needs to be verified by research. As observed earlier, the North African countries – Morocco, Tunisia and Egypt were different; most of their publications fell in the category “not applicable” and they accounted for the majority of the articles in this category in Africa.

Certain patterns were observed from the collaboration analysis which could explain the rationale behind collaborations in Africa. First, collaboration between the most prolific in Africa and in the world: South Africa and the United States. This suggests that the most prolific

countries collaborate with each other. Secondly, collaborations network shows the influence of the language of the colonial powers. Like the country trends, North African countries – Algeria, Morocco, Tunisia and Egypt, (all Arabic-speaking countries), France and Cameroon belong to a collaboration cluster (see Table 8). From the visualization map on Figure 3, France is the center of the cluster with Tunisia, Algeria, Morocco and Cameroon. The visualization map shows that Egypt had the least connection with the cluster and collaborated more with England, Saudi Arabia, Canada and the United States. Tunisia, Algeria, Morocco and Cameroon were colonized by France and have a good number of French speakers. On the other hand, Egypt was colonized by England (Great Britain); this likely explains its collaboration with English-speaking non-African countries. Earlier studies on collaboration in Africa have revealed a similar pattern which shows the influence of colonial powers in Africa’s science as African countries collaborate more with the foreign countries that colonized them. Regardless of discipline, countries that were colonized by France collaborated more with France e.g. Benin, (Mêgnigbêto, 2013) Cameroun (Boshoff, 2009), Tunisia (Adams et al., 2014), Morocco (Adams et al., 2014), Senegal (Adams et al., 2014; Mêgnigbêto, 2013) and Algeria (Adams et al., 2014); on the other hand, countries that were colonized

by Britain collaborated more with England and the United States e.g. Nigeria (Adams et al., 2014; Asubiaro, 2018), Ghana (Adams et al., 2014; Mègnigbèto, 2013), Egypt (Adams et al., 2014), South Africa (Adams et al., 2014; Sooryamoorthy, 2009a, 2009b, 2017), Kenya (Adams et al., 2014). Lastly, there is a growing pattern of regional collaborative clustering among the African countries. This is somewhat like the observation of Adams et al. (2014) that recognized the North African collaboration cluster as the strongest in Africa and others which are not exactly clear-cut.

Recommendations and conclusion

This study investigated the trends in the collaboration clusters, scope and subject classifications of LIS research in Africa by analyzing LIS journal articles and conference proceedings of the 54 African countries that were published between 1996 and 2015 and indexed on the WoS. This study shows that though computer science had the most profound influence on Africa's LIS, 2004 was a watershed moment as focus on computer-related classifications started to increase. This study also shows that North African countries exhibited features that are different from the rest of Africa; the North African countries contributed most of core computer classifications while others focused more on the social science-related aspects of LIS. Secondly, the North African countries formed a strong collaboration cluster with interest in conceptual, and information technology design and implementation problems. The collaboration mapping and clustering depicted some influence of language of colonial masters as a basis for forging strong collaboration between African and non-African countries. On the other hand, African countries tend to collaborate more with countries within their region. Analysis shows that LIS research in Africa is weak in the following research areas: "LIS history", "HCI/interface design" "information organization" and "library management". Likewise, LIS research in Africa has low contributions in conceptual, systems design and studies that have global scope.

It is recommended that LIS research and education stakeholders in Africa should create a curriculum that is all-round and will include the technology-related subjects including computer programming, natural language processing, bibliometrics, machine learning, database and data sciences which are otherwise alien to the traditional LIS. It is important that LIS in Africa incorporates these computer-related skills in the curriculum so that future research LIS in Africa will reflect a more robust outlook. Secondly, these computer-related skills are needed for creating LIS tools, proof of LIS concepts or theories, implementation of ideas and library software. Consequently, there is a need to provide the laboratories and tools needed for LIS research. Universities in Africa can purchase tools and create

laboratories through consortia. The model of acquiring access to educational and research resources through consortia in Africa has proved successful in many instances. For instance, the South African National Library and Information Consortium (SANLiC) which is saddled with the responsibility of acquiring electronic resources for South African universities has proved that this model works in Africa. Additionally, the Committee of Vice Chancellors (CVC) in Nigeria was also able to purchase access to WoS, Elsevier and Springer databases for its member universities, which was otherwise unaffordable for individual public universities in Nigeria.

It is also recommended that the budding regional collaboration clusters among the African countries should be encouraged. For instance, the budding collaboration clusters in the Western and Southern African countries should be strengthened while other regions should endeavor to create research collaboration clusters. These clusters can integrate into a strong Africa-wide collaboration network. The North African collaboration network that is strong in the computer-related subjects and tech-savvy can complement the rest of Africa's social science-focused LIS through collaboration.

Suggestions for further research include a current comprehensive content analysis of LIS curricula in LIS schools across Africa to understand the robustness of LIS training in Africa. Secondly, this study could also be replicated using data from other databases such as Google Scholar, Scopus and Library and Information Science Abstracts (LISA).

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Oluwole Martins Badmus is a PhD student in the Information Science program at the University of Western Ontario. His research interest covers social media analytics, library automation, disaster and crisis communications. He is currently working on his thesis that seeks to highlight critical contextual factors in information flow patterns on social media during hurricanes.