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**Nigerian university websites: A webometric analysis****Williams E. Nwagwu**

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**Abstract**

*Using the AltaVista search engine, data on web links was collected randomly from 1000 selected web pages of 30 Nigerian universities to study the pattern and frequency of outlinks and inlinks. The websites have a total of 44,567 links, representing an average of 45 links per page. Of these, 81.2 % were inlinks from Nigerian university websites to other websites, while 18.8% were outlinks from other websites to Nigerian university websites. The first-generation universities have a higher percentage of links by target web pages (52.6 %) than the others, which returned below 50% of the web pages as target pages. The web pages of Nigerian universities did not target other Nigerian university web pages. Also, the websites seem to link more with non-academic websites than with academic websites. The result shows that there exists a general low-level of utilization of the Web for sharing and disseminating of information produced by Nigerian universities.*

**Keywords**

*Nigerian universities; Websites; Webometric analysis; World Wide Web; Link analysis*

**Introduction**

Since its birth in 1991, the Internet-based hypertext system, World Wide Web (Web), has become a complex and very large repository of documents in the form of hyperlinked web pages. The Web is now known to be the richest source of information - and misinformation - ever known to man ([Björneborn](#), 2004). This technology has bestowed diverse institutions, especially educational, never-before capabilities that defy the constraints of time and distance ([Tang & Thelwall](#), 2004). The hyperlinks between sites in the same or different universities are a rich source of information about the content and use of the Web by the universities, a medium for scholarly publications as well as publicity and credit to higher educational institutions.

There are both academic and non-academic purposes of universities' use of the Web; universities link themselves as well as governments, non-governmental organizations and

the private sector. These links serve purposes ranging from providing digital repositories to attracting new projects. In terms of research, academic websites can be used to announce the existence and promote the achievements of scholars, researchers, research groups, departments and institutes. They can also disseminate research findings, either by hosting digital repositories, open-access journals, online conference papers, or by publishing article abstracts, summaries, and data sets. Universities also advertise themselves to prospective students and clients, as well as staff and other interest groups. Historically, the adoption of the Web in the universities was to foster the ease and speed with which knowledge is disseminated among academic institutions ([Björneborn, 2004](#)).

Unlike many universities in the United States of America and Europe which adopted the technology when it was developed in 1991, preliminary results in this present study shows that the first evidence of web links to Nigerian universities was in the year 2000 although efforts to connect to the Web might have started before 2000. But there is not yet evidence of any studies conducted to examine web linking despite significant interest expressed by the Nigerian National Universities Commission to understand the pattern and structure of web use by Nigerian universities. Studies examining the level of linking by university websites have been conducted in other countries Australia, Canada, China, Iran, and the United Kingdom, and the findings have shown that relationships exist between the level of linking by university websites and activities in the universities, for example, the level of research and the scientific productivity of the universities ([Thelwall, 2002b, 2002c, 2002d; Thelwall & Harries, 2003a; Qiu, Chen, & Wang, 2004; Payne & Thelwall, 2004; Noruzi, 2005](#)). Such studies have shown that web link analysis could be used in scientific enquiry about a university's activity and its productivity, providing a rich source of information, which has helped in the tracing of scholarly activities and patterns of information use in higher education ([Thelwall, 2004](#)). This information can be useful in planning and setting targets for ICT development in these institutions. Studying the link relationships of Nigerian university websites could contribute to our understanding of the patterns of relationships between Nigerian universities, and between the universities and other organizations in and outside Nigeria. By extension, this study gives some highlight regarding pattern of use of modern technologies by Nigerian universities in sharing information with other universities and stakeholders.

## **The Evolution of Universities in Nigeria**

The history of universities in Nigeria dates back to 1948 with the establishment of the University College, Ibadan, affiliated to the University College London. Since then, the birth of other universities was spurred by an ever-growing need for tertiary education. These universities are now grouped into five generations namely: first, second, third, fourth and fifth generations. The first generation universities were established with the birth of the University of Ibadan in 1962 from the University College Ibadan. The second generation universities were established between 1970 and 1985 to meet the manpower need of reconstruction challenges aftermath of the civil war as well as global increase in industrialization. A need for a shift in orientation from broad based university education to specialized education motivated the birth of the third generation universities, which focused on technology and agriculture. The universities in these first three generations are fully funded and owned by the federal government. During Nigeria's second republic (1979-1983), the question of even spread of educational opportunities for all Nigerians became prominent in the political agenda of politicians, and this stimulated the birth of 19 fourth generation universities, which were state-owned. The fifth generation universities which consist of mainly private and mission universities and a few state owned universities were established during the third republic which took off in 1999.

These five generations of universities have witnessed different levels of growth, at manpower, infrastructural and technological levels according to the capability and vision of their owners. Sixty five universities were accredited by the Nigerian Universities Commission as at June 2006, but only 37 of them have websites, but not all the websites of the universities are operational, or use a common domain - faculties, departments and other facilities of most of the universities have websites which do not directly link their university websites. A cursory observation shows that the level of usage of the Web varies with the universities according to their generations. In some of the universities, only the home pages are functional, with minimal or non-existence of linkages. All the first generation universities have active web domains while eight of the universities in the second generation and six of the third generation universities have active web domains. Also, only five of the fourth generation and five of the fifth generation universities have active web domains. The rest of the universities either do not have any websites or have websites that are not active.

The Web is one of the available avenues open to the universities to provide information for purposes ranging from advertisement of their activities, admission processing, information dissemination to staff and students, teaching and research. However there is yet no understanding about how Nigerian universities use the Web to achieve these purposes or how the various circumstances of the universities influence their pattern of use of the web. According to [Internet Archives](#), the first index of web pages from a Nigerian University website was that of University of Ibadan in 1999, closely followed by Obafemi Awolowo University.

This study is intended to analyze selected Nigerian university websites in order to understand the pattern of linkage among them as well as the frequency of outlinks and inlinks of Nigerian university websites. In pursuing this objective, we are interested in establishing the links by the universities according to their generations, a strategy adopted in view of several studies that show that older and larger institutions are most likely to have a better infrastructural and technological advantage than the smaller and younger ones.

## Literature Review

Several studies have been conducted on link analysis in general and link analysis on university websites in particular. Studies of web research attempt to characterize the use of the Web through content and structural analysis of a sample of web documents obtained by web crawlers. These researches make use of information derived from hyperlinks, the individual web servers log files or search engines' log files ([Thelwall, 2004](#)). However, due to the rapid rate of development of the web, the need for continuous research to revalidate findings on the Web is imminent as findings tend to quickly become redundant and outdated. Worth noting is the increasing sophistication of the tools used in the conduct of web research especially the search engine's algorithms which allows for more comprehensive and accurate analyses.

Link analysis involves an analysis of the total number of links to a web page, the link of the websites that are linking to that page, the text used in the links to that page and the topic of the page that links to that page. Simply put, link analysis means that on the Web, entities are connected together, and one wants to know why, what and how of these connections. Web links are potential indicators and generators of trust ([Davenport & Cronin, 2000](#)) with a page that is the target of many being more likely to contain useful information than one that is not ([Thelwall, 2002c](#)). For Nigerian universities therefore, link analysis would mean examining the pattern of the links with each other's websites as well

as with university and non-university institutions within and outside Nigeria. The characteristics of this linkage tell us so much about the activities of the universities.

Not only are web resources in different languages and forms, but also, the creators of these resources belong to various groups and interests. These differentiating factors do not however hinder the use of the infrastructure; instead it introduces an even wider variety to the resources available in the Web in the form of text converter and translator software. Presently the Web is seen as an important source of information with the advantage that the Internet conquers geographic and other forms of boundaries, despite the existence of technological barriers ([Thelwall](#), 2002).

Research studies have been intense in the recent years seeking an understanding of the web, especially its hyperlinks, as a new information source, and in designing methodologies to extracting useful information from them. One of the first large-scale web studies was conducted by a Berkeley university research group INKTOMI which examined various characteristics of web documents obtained by the INKTOMI crawler in 1995 ([Larson](#), 1996). Their study examined the use of web tags and the growing use and rapidly changing nature of the web. Their finding also noted that despite the fact that the use of the Web is growing to almost double its size in one month since 1995, most of the popular documents found in the first search had disappeared by the second search, a month later. This finding confirms the volatile nature of the Web as a documents reservoir because once created the documents can easily cease to exist within a very short period of time.

## Link Analysis of University websites

The initial development of the Web was as an 'intranet' for researchers affiliated to the European Research Centre for Nuclear Physic (CERN), to facilitate information sharing through easy access to online publishing and browsing ([Björneborn](#), 2004). Ever since, universities have always been active users of the Web and they have, in turn, been sources of interest to web researchers, especially in Information Science, who use data generated from the web use in understanding different phenomena about the Web. Commenting on the use of the Web by universities, [Werf-Davelaar](#) (2006) aptly described the need for universities to utilize the infrastructure:

*It serves individual researchers and research units to raise their profile and present themselves to the community on campus and beyond, but gradually, as web publishing becomes an accepted medium for information dissemination, it serves other goals as well. It serves to speed up the communication of research results and to reach specific target groups and larger audiences in an effective manner. It raises pertinent questions about access to scholarship and the business models of traditional publishing ([Werf-Davelaar](#), 2006, p.1).*

Early web analyses conducted on universities include research on the content and structure of web documents in 1995 ([Bray](#), 1996). Bray observed that the most visible documents in his sample of study consisted of homepages of well known universities, organizations and companies while top luminous sites were dominated by web indexes such as that of Yahoo. He also observed an uneven connectivity pattern of the web, a finding that [Broder et al.](#) (2000) validated in their study of web structure conducted between May 1999 and October 1999 with two AltaVista crawls of over 200 million pages and 1.5 billion links. The study found that the Web is not as connected as previously thought with only about 28% of the web pages being 'strongly connected'. This finding differed with that of [Albert et al.](#) (1999) in their research into the structure of Notre Dame University website, which conjured that in the whole web, the average hyperlink based distance between any two pages at random, was 19 reflecting a strong connectedness.

Several studies have been conducted on links to university websites. [Qiu, Chen, & Wang](#) (2004) conducted studies on websites of 98 Chinese universities with the aim of determining whether backlinks count and Web Impact Factor (WIF) of websites associate with the comprehensive ratings and the research ratings for universities in Mainland China. Using different WIF counts to aggregate the total website, the number of faculty members and the number of colleges/departments, their findings showed that total backlinks counts and external backlinks count has significant correlation with university rating especially when using the number of colleges / departments in calculating the WIF. They argued that the method of using the total aggregate of websites in calculating WIF does not fit universities with too many pages and too few pages while using faculty WIF does not have significant correlation with general ratings and research ratings of the universities studied.

[Björneborn](#) (2004) in his doctoral thesis on small world link structures across academic web space, studied data generated from 109 UK universities. He developed a conceptual framework and empirical methods to identify whether and how small-world phenomena emerge in link structures across an academic web space and determine what micro-structure activities and elements contribute to the cohesiveness of the macro-structures across an academic web space. The findings indicated that UK academic websites showed small-world properties with a high clustering coefficient and a low characteristic path length of 3.5 between reachable websites. He further observed that computer science related sub-sites might be important cross-topic connectors in an academic web space with about 46% of sub-sites providing or receiving transversal links in the study.

[Tang and Thelwall](#) (2003) in their study of pattern of linking to 89 US academic departments from three disciplines (chemistry, psychology, and history) observed the regional differences among international inlinks and URL domain and differences between the proportion of national and international inlinks to more than 23 departments from each discipline. Their findings provided significant evidence of an association between traditional research productivity and online visibility, measured by international inlinks to the US university departments, while the analysis of regional sources of links to departments showed only a little variation by discipline. However one area in which clear disciplinary difference did emerge was in the comparison of the proportion of national to international links. In trying to understand why websites from different academic subjects interlink, [Thelwall, Harries and Wilkinson](#) (2003) took a sample of 586 linked pairs of domains with different subjects, grouped by the type of relationship between the source and target page. They found that over a third of the links formed a scholarly connection between similar subjects, but in 8% of cases, dissimilar subjects also have a scholarly connection. Also higher education teaching links were seen to form an extensive cross disciplinary network, accounting for 19% of links while 12% of links targeted non subject specific general resources. The result suggest that mapping disciplinary collaboration on the Web should be feasible but that process and topic identification in academic web would both be helped by the prior removal of key higher education teaching and general popular general pages from the data set.

Different researches have also examined the relationship between aggregates of links to a university's website and the target university's productivity indicating the possibility of a correlation between linking pattern of a university and its scholarly productivity. [Thelwall and Harries](#) (2003a), using the United Kingdom as a case study and measuring scholars' quality in terms of university wide average research ratings, tried to determine whether higher rated scholars produce higher web impact sites. Their findings showed that universities with higher rated scholars produce significantly more websites but those websites only marginally reflect a higher online impact measured from their domain alternative document models (ADM) inlink count. This finding reflects that there is no evidence that higher rated scholars produce significantly higher impact web content, only



that they produce more. Also, in another study, [Thelwall](#) (2004) examined universities in UK, Australia and China and observed that:

*A recent survey of a random collection of links between UK university websites found over 90% were related in some way to scholarly activities, but that less than one percent were equivalent to formal citations. It was concluded that counts of academic Web links will be merging a range of predominantly academic factors but do not admit a simple rationalization. These findings suggest, however, that links may be a valuable potential source of information about scholarly use of the Web. ([Thelwall](#), 2004 p.127).*

[Harries et al.](#) (2004) studied hyperlinks between academic websites, and observed that, like citations, web links can potentially be used to map disciplinary structures and identify evidence of connections between disciplines. Using three disciplines -Mathematics, Physics and Sociology, they observed that links within a discipline were different in character to links between pages in different disciplines.

[Thelwall](#) (2002a) addressed the issue of the best metric for extracting information from collections of web links focusing on the best possible domain to count backlinks from. Using British universities, he calculated WIFs from several different source domains - .edu, .ac.uk and .uk domains and the entire web. His findings show that all four areas produce WIFs that correlate strongly with research ratings, but that none produce incontestably superior figures. He also observed that WIF was less able to differentiate in more homogenous subsets of universities although positive results are still possible.

## **Nigerian Universities and the Web**

The use of the Web is still at its developmental stage in Nigerian universities. With Internet connectivity in Nigeria standing at a mere 750,000 subscribers in 2004 ([CIA: The World Fact Book](#), 2005), there has been a growing need for the expansion of access to the Internet especially to educational institutions in Nigeria. For example, in 2001, Nigeria was a signatory to the New Partnership for Africa's Development (NEPAD) E-school Africa Project, which aims to network 600,000 African schools to the Internet via satellite ([www.foundation-development-africa.org](http://www.foundation-development-africa.org)). Also in 2001 the University of Iowa in collaboration with the National Universities Commission (NUC) established the WIDERNET project aimed at training and equipping networking operators in 14 participating universities ([www.widernet.org/TechTraining/report12mo.htm](http://www.widernet.org/TechTraining/report12mo.htm)). The Macarthur Foundation in 2001 provided the University of Ibadan, Bayero University, Ahmadu Bello University and University of Port-Harcourt with \$480,000 grants to develop their information technology system. These projects provided the foundation upon which Internet connectivity and subsequently web linking expanded in Nigerian universities.

Poor Internet access in Nigeria results from a combination of factors including low level of access to the computer and low networking, low telecommunication infrastructures, and poor overall utilities provision, especially power supply. According to [Ogunsola](#) (2005), research works on the Internet in Nigerian universities are very few. [Jagboro](#) (2003) studied the utilization level of the Internet by post graduate students in Obafemi Awolowo University for academic research purposes and found that the Internet ranked fourth with 17.26% of the students using the facility as against 70% observed in another study at Carnegie Mellon. [Ehikhamenor](#) (2003) studied the use of Internet by Nigerian scientists in 10 universities and observed that scientists in Nigeria still heavily depend on printed information sources and that while 64% of them have computers at their disposal; only 50.4% have any form of access to the Internet. Studies on the use of the Web are not available.

## Methodology

### The study area and data collection

This study was carried out on Nigeria, a country with over 125 million population and more than 65 universities as at 2005. A sample survey design was adopted to study a population of web pages harvested from links to Nigerian university websites covering the period starting from 1<sup>st</sup> January 2000 to 31<sup>st</sup> December 2005. Archival data were sourced from the Web using the AltaVista search engine; the search engine was selected based on its suitability relative to other search engines ([Thelwall, 2002a](#); [Qiu, Chen, & Wang, 2004](#)).

The search was restricted to HTML pages only since HTML is the tool that provides the primary medium for linking on the Web. To retrieve the total linked pages of a website, the Boolean search statement, we utilized the following command, link: www.xxx.yyy.zz, with the syntax, WWW representing the World Wide Web, xxx represents the domain name of the university (example *ui* for University of Ibadan), "yyy" represents the sub-top level domain (example *.edu*) while "zz" represents the top-level domain (example *.ng*).

The study examined the websites of Nigerian universities as indexed by AltaVista. Web pages instead of the directory (ADM) have been found to be more effective in analyzing links ([Payne & Thelwall, 2004](#); [Thelwall & Wilkinson, 2005](#)). The cumulative queries for the population of the study returned a total hit of 2300 web pages from the 37 universities that have active websites as at 30<sup>th</sup> May 2006, with a total of 1176 web pages being identified as accessible, and this then constituted the population studied. Table 1 shows the number of pages indexed by AltaVista distributed by universities.

**Table 1: Distribution of web pages found and indexed by AltaVista**

University Name	Generation	Total web pages found	Total web pages indexed	Active web pages
University of Ibadan	1	795	621	304
Obafemi Awolowo University	1	515	401	130
University of Lagos	1	56	46	31
University of Nigeria	1	13	13	12
Ahmadu Bello University	1	13	12	2
Bayero University	2	227	153	140
University of Benin	2	201	188	169
University of Port-Harcourt	2	20	18	18
University of Jos	2	11	10	9
University of Uyo	2	10	5	4
University of Maiduguri	2	2	2	2
Usman Dan Fodio University	2	2	2	2
University of Ilorin	2	1	1	1
Abubakar Tafawa Balawa University	3	39	39	15
Federal University of Technology, Yola	3	27	27	27
Federal University of Technology Akure	3	19	19	19
Nigeria Defence Academy, Kaduna	3	20	20	18

Federal University of Agriculture Abeokuta	3	17	15	15
Federal University of Technology Minna	3	8	3	3
Rivers State University of Science & Technology	4	122	100	81
Lagos State University	4	8	8	8
University of Ado Ekiti	4	4	4	4
Olabisi Onabanjo University	4	2	2	2
Abia State University	4	1	1	1
ABTI American University	5	66	65	62
Covenant University	5	63	63	61
Cetep University	5	16	16	16
Lead City University	5	2	2	1
Igbinedion University	5	1	1	1
Benson Idahosa University	5	19	19	19
<b>Total</b>		<b>2300</b>	<b>1876</b>	<b>1176</b>

A proportional sampling technique was used in the selection of universities based on the five generations grouping. One thousand web pages constituting a sample size of 81.3% of the total number of active web pages were selected. To ensure that web pages from all the generations of universities were represented, the following formula was used:

$$\frac{\text{Number of indexed web pages in each generation of university} \times 1000}{\text{Total web pages from all universities}}$$

Table 2 shows the result.

**Table 2: Selection of sample using proportional sampling technique**

<b>Generation of universities</b>	<b>Active web pages indexed</b>	<b>Number of web pages selected</b>	<b>% of total web pages sampled</b>
1 <sup>st</sup>	479	407	40.7
2 <sup>nd</sup>	345	294	29.4
3 <sup>rd</sup>	97	82	8.2
4 <sup>th</sup>	95	81	8.1
5 <sup>th</sup>	160	136	13.6
<b>Total</b>	<b>1176</b>	<b>1000</b>	<b>100%</b>

Proportional sampling was further used in determining the number of web pages from each university in a generation using the formula:

$$\frac{\text{Number of indexed web pages in a university's website} \times \text{Number of web pages Selected}}{\text{Total indexed web pages from the university's generation}}$$

The web pages so generated were then arranged alphabetically and systematic sampling was used to select the specific web pages for data collection based on every *n*<sup>th</sup> page where *n* was calculated as follows:

$$\frac{\text{University sample size}}{\text{Total active pages in university website}}$$



The web pages selected using the above formulas were also grouped on a year-by-year basis. Only the exact web pages that are selected in the cumulative search for each university website were recognized as usable for a particular year. The year-by-year search using Web Archives yielded a total of 1,382 web pages as indicated in Figure 1 below.

**Figure 1. Distribution of indexed web pages by generation of universities and years**


Figure 1. Distribution of indexed web pages by generation of universities and years

Figure 1 shows clearly the years in which the Web crawlers located the universities on the Web. University of Ibadan and Obafemi Awolowo University - first generation universities- joined first in 2000; University of Benin of the second and Rivers State University of Science and Technology of the fourth generations joined in 2002. The first of the third generation universities -Abubakar Tafawa Balewa University - joined in 2003, while the first of the fifth generation universities namely ABTI American University joined last in 2004. For purpose of further comparison, we also selected the top ten universities in each of the variable categories, while reference is made to other universities not in the top ten, when necessary. The list of the web pages in the universities was developed and ranked in descending order of magnitude to arrive at the top ten.

Data generated was organized by generation of the universities and by the top ten universities and analyzed descriptively using simple frequency counts to understand the general distribution and trends. To accommodate the instability of searches using a commercial engine, all data used were downloaded within the period specified and stored in .txt format. The number of links per page as well as the numbers of such links that are directed to other websites was then counted. The results were tabulated in an Excel spreadsheet and further analysis was carried out using SPSS.

One of the limitations of this study is the general observation that web crawlers do not cover the whole web because they use different algorithms in determining the links to nodes, and find only the websites that meet their indexing criteria ([Vaughan & Thelwall, 2004](#)). Another limitation was the inability to determine the depth of linking that the search engine harvested since the advanced search feature of the AltaVista search engine does not provide for such information. This limitation hindered the precise determination of the level of linking engaged in by the websites. Also, search engine results have been noted to be very unstable over time with the same query generating different results over a very short period of time ([Rousseau, 1997](#); [Smith, 1998](#); [Vaughan & Thelwall, 2004](#)). To minimize such fluctuations in search results, the data used in this study were harvested within a finite and short period of time. However, [Thelwall & Harries \(2003b\)](#) have observed that despite these limitations, web information retrieved by a web crawler represents a meaningful object of any study. Another limitation is restricted to this paper; namely, we could not make inferences on the sample of data we generated for economy of space, an activity we undertake in another paper.

## Results

Out of a sample of 1000 web pages examined, 40.7% of the pages were from the first generation universities, 29.4% from the second generation, 8.2% from the third generation, 8.1% from the fourth generation and 13.6% from the fifth generation. The top 10 universities account for 87% of the total number of web pages, and the distribution is shown in Table 3. From the table, we observe a disparity in share of number of web pages between universities at the top of the table (for example, University of Ibadan with 25.8%) and those at the bottom (for example, Federal University of Technology Akure with 1.6%). It is, however, interesting that the top ten universities is not dominated by first and second-generation universities, but contains even fifth generation universities.

**Table 3: Distribution of web pages in the top 10 universities**

University Name	Generation	Web pages	% of total web pages
University of Ibadan	1	258	25.8
University of Benin	2	144	14.4
Bayero University	2	119	11.9
Obafemi Awolowo University	1	111	11.1
Rivers State University of Science & Technology	4	68	6.8
ABTI American University	5	53	5.3
Covenant University	5	52	5.2
University of Lagos	1	26	2.6
Federal University of Technology, Akure	3	23	2.3
Federal University of Technology, Yola	3	16	1.6

The first generation universities reflected a higher percentage of linking by target web pages (52.6 %) relative to the other generations which returned below 50% of their web pages as target pages - second: 27.9%; third: 40.2%; fourth, 25.9% and fifth, 14.4%. Hence, the first generation university websites are more visible to other websites than the websites of other generations of universities. Table 3 also shows that the second and fifth generation universities have a higher number of source pages generated than the older universities despite. The overall picture also reflects a higher percentage of source pages (62.9%) compared to target pages (37.1%).

The 1000 web pages had 44,567 links representing an average of 45 links per page. Out of this number, 36,194 links (81.2% of the total links) were inlinks while 8,373 (18.8%) were outlinks as shown on Table 4. The distribution shows a descending order of number of inlinks from the first generation of universities to the fifth generation. Figures 1 and 2 show that the websites of all the generations have a relatively low number of outlinks from a high number of source pages. Also, the websites have a relatively high number of inlinks from a low number of target pages. This pattern of linkage indicates that Nigerian universities generate low number of links in their web pages.

**Table 4: Distribution of links on web pages by generation of universities**

Generation	Inlinks	%	Otlinks	%	Total links %
1 <sup>st</sup>	14081	86.17	2259	13.83	16340
2 <sup>nd</sup>	10000	81.73	2235	18.27	12235
3 <sup>rd</sup>	5977	84.94	1060	15.06	7037
4 <sup>th</sup>	4157	82.45	885	17.55	5042
5 <sup>th</sup>	1979	50.57	1934	49.43	3913
<b>Total</b>	<b>36194</b>	<b>81.21</b>	<b>8373</b>	<b>18.79</b>	<b>44567</b>

**Figure 2: Distribution of links by generation of universities**


Table 5 shows the top 10 universities by the number of inlinks to their university websites. It can be observed that universities from the first three generations showed high inlinks (77.86%) relative to the total links (99.57%). Also only one university in the fourth

generation was ranked in the top ten while none of the fifth generation was ranked in the top ten.

**Table 5: Distribution of inlinks by top ten universities**

Name of University	Ranking	Inlinks	% of inlinks to total link	Total links
University of Ibadan	1	5392	77.86	6925
Obafemi Awolowo University	1	5115	90.13	5675
University of Benin	2	4725	84.37	5600
University of Lagos	1	3085	95.86	3218
Rivers State University of Sci. & Tech.	4	3055	79.83	3827
Abubakar Tafawa Balawa University	3	2583	99.57	2594
Bayero University	2	2079	62.62	3320
University of Port-Harcourt	2	1923	99.32	1936
Federal University of Agriculture, Yola	3	1728	96.27	1795
Federal University of Technology Akure	3	1301	86.73	1500

Table 6 shows the universities by the number of outlinks from their university websites. Unlike the inlinks, the five generations of university had an even distribution of outlinks with two universities from each generation. The distribution also shows the ratio of outlinks to total links with the lowest ratio coming from Obafemi Awolowo University, Ile-Ife (9.87%) and the highest from Federal University of Technology, Yola (95.94%). However, only three of the universities namely Federal University of Tech (95.94%), ABTI American University (87.86%) and NDA (55.20%) have over 50% of their total links as outlinks. This indicates that most universities' web pages create fewer links than they receive, especially considering that these universities posted more web pages than they received, as was shown in Figures 1 and 2. It is also observed that five of the universities namely University of Ibadan; Obafemi Awolowo University, Ile-Ife; University of Benin; Bayero University, Kano and Rivers State University of Science & Technology, which appeared in the top 10 inlinking universities list were also among the top 10 outlinking universities.

**Table 6: Distribution of outlinks by top ten universities**

Name of University	Ranking	Outlinks	% of outlinks to total links	Total links
University of Ibadan	1	1533	22.14	6925
Bayero University	2	1241	37.38	3320
University of Benin	2	875	15.25	5600
Rivers State University of Sci & Tech	4	772	20.17	3827
ABTI American University	5	753	87.86	857
Covenant University	5	650	36.27	1792
Obafemi Awolowo University	1	560	9.87	5675
Federal University of Technology	3	521	95.94	543
Benson Idahosa University	5	300	30.54	982

Nigeria Defence Academy	3	260	55.20	471
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In identifying which universities are connected through these outlinks, we examined the source pages to identify self links, links pointing to other pages in the same websites and links pointing out to other websites. Table 7 shows the distribution of outlinks by types, and indicates that in all the generations, self-links were dominant - ranging from 76.96% to 97.96% of the total percentage of links. Percentage of links pointing out to other websites was highest for the third generation universities (19.81%), and was lowest for the fourth generation of universities (0.11%). This indicates that, on the average, only 6 (5.6%) links to other websites were created by a university for every 100 links. Page self-linking was highest for the second-generation universities (18.97%) but was lowest for the fifth generation (1.34%) with an average of 9 self-links for every 100 links per page.

**Table 7: Distribution of outlinks by types**

Generation	Outlinks	Page self-links	%	Website self-links	%	Links to other websites	%
1 <sup>st</sup>	2259	97	4.30	2012	89.07	150	6.63
2 <sup>nd</sup>	2235	424	18.97	1720	76.96	91	4.07
3 <sup>rd</sup>	1060	149	14.06	701	66.13	210	19.81
4 <sup>th</sup>	885	17	1.93	867	97.96	1	0.11
5 <sup>th</sup>	1934	26	1.34	1890	97.73	18	0.93
<b>Total</b>	<b>8373</b>	<b>713</b>	<b>8.51</b>	<b>7190</b>	<b>85.88</b>	<b>470</b>	<b>5.61</b>

To determine which domains were of interest to Nigerian university websites, we examined the types of domains to which these outward links pointed to (Table 8). It can be observed that most of the links were directed at commercial websites (67.45%) followed by links to organization websites (22.13%), educational websites (5.53%), government websites (3.40%) and .net websites (1.48%). This shows that the rate of linking of Nigerian universities to other university websites is very low, assuming that most universities use the .edu TLD (top-level domain).

We also examined the academic or non academic distribution of the target pages to the universities. Table 8 shows a trend in all the generations namely a higher linking from non-academic websites (69.3%) compared to linking from academic websites (30.7%).

**Table 8: Distribution of outlinks by target domain**

Generation	.edu	%	.com	%	.net	%	.org	%	.gov	%	Total
1 <sup>st</sup>	0	0	148	31.49	0	0	2	0.43	0	0	150
2 <sup>nd</sup>	20	4.26	21	4.49	7	1.49	27	5.74	16	3.40	91
3 <sup>rd</sup>	0	0	135	28.72	0	0	75	15.96	0	0	210
4 <sup>th</sup>	0	0	1	0.21	0	0	0	0	0	0	1
5 <sup>th</sup>	6	1.28	12	2.55	0	0	0	0	0	0	18
<b>Total</b>	<b>26</b>	<b>5.53</b>	<b>317</b>	<b>67.45</b>	<b>7</b>	<b>1.49</b>	<b>104</b>	<b>22.13</b>	<b>16</b>	<b>3.40</b>	<b>470</b>

## Discussion and conclusion

The results show that there is a relatively lower than expected level of inlinks to Nigerian university websites, as only 37.2% of the 1000 pages examined were target pages. But there was a higher level of inlinks from the first generation universities (52.6 %) while the fifth generation universities showed the least inlinks (15%). The top ten universities

consist of universities from all the generations with four of the five first generation universities namely University of Ibadan (1<sup>st</sup>), Bayero University Kano (3<sup>rd</sup>), Obafemi Awolowo University (4<sup>th</sup>) and University of Lagos (7<sup>th</sup>) being ranked in the top ten. The only first generation university that is not ranked in this category is University of Nigeria, Nsukka. Only two of the fifth generation universities (ABTI American University and Covenant University) and two of the fourth generation universities (Federal University of Technology, Federal University of Technology) commanded places in the top ten classes. Viewed from another perspective, seven of the federally owned universities made the top ten while only one state university and two private universities were in the top ten categories.

Furthermore, Nigerian universities generate low number of links in their web pages as well as having low interuniversity links for the sharing of web resources. With an average of 9 self-links for every 100 links on a page overall, page self-linking was highest for the second-generation universities (18.97%), but lowest for the fifth generation (1.34%). Also, we observe that the rate of linking to university websites was very low, with only the second and fifth generations of universities having .edu TLD type of links. Furthermore, Nigerian university websites seem to connect more with non-academic websites than they do with academic websites, a result that has implications for a likelihood of low level of use of the Web for knowledge dissemination and sharing both between Nigerian and other universities. Closer examination of these web pages reveal that no Nigerian university's web pages targeted other Nigerian universities, showing that Nigerian universities do not interlink, contrary to the findings of [Björneborn](#) (2004) that universities within close proximities tend to relate more with themselves than with others farther away from them.

The results seem to suggest that lecturers, students and other stakeholders in the universities in Nigeria do not use the Web. The true picture would rather be that the use of the Web is not properly organized and managed. For instance, while the universities have websites, different departmental websites in the same universities do not link the Web through their university websites. Furthermore, web users in the university do not link through their university portals just as most of the email addresses of the web users are not linked to the university websites. This might account for the low return of links by Nigerian universities.

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