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Digital Libraries and Access to Information in Nigerian Federal Universities: The Impact of Technology Variables

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Abstract. The paper examined the impact of technology variables on access to information by undergraduates in the digital libraries of federal universities in Nigeria. The study was an empirical research which adopted *Ex-post-facto* as the design. The questionnaire was used to collect data from a sample of 1,506 respondents drawn, using a multi-stage technique, from the population of 30,121 undergraduates in addition to the entire 21 library staff of seven federal universities purposively selected from southern Nigeria. Focus group discussion and interview sessions were also used to complement the questionnaire responses. Data generated were analysed using frequency and percentages. Responses from the focus group discussion and the interview were analysed qualitatively. The findings revealed that technology variables such as system usability, interface design and content usefulness make a low impact on the undergraduates' access to information. It was recommended among others that training programs should be organised by the libraries to equip the undergraduates with the digital literacy skills required for effective access to information.

Keywords: Digital libraries; information access; technology variables; undergraduates; university library.

1. Introduction

The digital library was introduced to complement the conventional library system. It is aimed at harnessing and providing easy access to electronic information resources as well as ensuring seamless access to these resources (Chowdhury and Foo, 2012). This is because the emphasis on today's library is on its effectiveness in providing access to current and reliable information which is central for the promotion of scholarship (Igbo and Imo, 2017). A synthesis of definitions given by different authors as advanced by Igbo (2017) describes the digital library as a collection of computer-mediated information resources that are acquired, processed, stored and accessed mainly through the application of digital technologies. In the context of this study, digital libraries connote more than a collection of computer-mediated resources. The concept refers to a virtual platform/unit in the library, made up of computer systems that are connected to the web. Through these

computers and the assistance of human intermediaries (library professionals), users are able to have access to information resources electronically. In the opinion of Reitz (2004), information resources of the digital libraries are materials consisting of data and/or computer programs encoded for reading and manipulation by a computer or by using a peripheral device directly connected to the computer, such as CD-ROM drive. In addition, the resources of a digital library can also be accessed remotely via network, such as the internet. These resources are described by Appleton (2006) as electronic resources and they include online databases, newsgroup postings, e-journals, e-books, e-newspapers/magazines, electronic theses and dissertations, CD-ROMs, OPACs, e-mail, and other internet resources (Reitz, 2004; Appleton, 2005; Hardasan and Khan, 2005). These resources as outlined by the above authors constitute the scope of the information resources addressed by this study.

In the view of Millawithanachchi (2012), access to information through digital libraries depends on certain critical factors that are found to be related to digital technology, library professionals and the user. These include technology variables (usability, interface design characteristics and usefulness of the content); individual characteristics (digital literacy) and library support or organisational context (Thong *et al.*, 2002; Ramaya, 2006; Millawithanachchi, 2012). These are further synthesised and classified into technological and human variables of access to information by the researchers. However, this work is set to find out the relative impact of the technological variables on access to information by the undergraduates in Nigerian federal universities.

Technological variables are vital components that influence the functionality of the digital libraries in enhancing access to information (Millawithanachchi, 2012). In the view of Faruqi and Alam (2005), adaptation of technology in library and information services is described as the hub of digital libraries. For digital libraries to be effective and functional, it is critical for the underlying technology platform to deliver the performance and reliability required. Faruqi and Alam further contended that patrons of digital libraries expect high service levels, which requires a scalable enterprise-level technology with built-in reliability, availability, and serviceability. Hence, Millawithanachchi (2012) identified ease of use of technology, the interface design characteristics and usefulness of the content as the technology variables that have an impact on access to information in digital libraries. Further description by the above author shows that technology usability addresses issues related to how easy it is to use the technology, whether the language of the technology is easy to understand, whether the technology provides feedback for effective communication, the speed of system performance and whether there is default guidance to users. With regard to interface design characteristics, consideration is given to whether the design is user-friendly, whether the language is easy to understand, whether the screen design is good and whether the technology is easy to navigate. Furthermore, interface design is expected to address issues of visibility of the system, words, and symbols that users see on the computer screen, the layout of the displays, the menus

that users see on the visual display terminals, etc. The usefulness of the content in the view of Mutula and Ojedokun (2008) implies the relevance, adequacy and consistency of availability of information resources in the digital library system.

The preceding shows that the provision of effective access to information to users in digital libraries requires the understanding of human-computer interaction. Tsakonas and Papatheodorou (2011) have, however, proposed the "User-system-content" model of understanding the impact of technology on access to information. This model contends that digital library evaluations should be driven by easy to use technology with an interface design and content useful to the user. The technology acceptance model of Davis (1989) throws more light on the influence of technology variables on access to information. This model explains what determines users' adoption of technologies for information access. According to the theory, the intention to adopt an information system is determined by two beliefs namely, perceived ease of use and perceived usefulness. These beliefs are influenced by external variables such as design characteristics, training, computer self-efficacy and the nature of the implementation process. Perceived ease of use is defined as the extent to which a person believes that using a particular technology would be easy, while perceived usefulness is the extent to which a person believes that using a particular system would enhance his or her performance (Tsakonas and Papatheodorou, 2011). From a psychological point of view, technology acceptance is described as an individual's impression that controls his determination to use a particular technology. This rightly shows that the human aspect of implementing a digital library technology should be considered to enhance effectiveness in the application of technology to information access. The relationship of the above theory to the study is that ease of use of digital technology, the interface design characteristics and the relevance of the content are strong influences on an individual's interest and ability to use digital libraries to access information.

1.1. *Statement of the problem*

Digital libraries have indeed become a means of providing consistent and easy access to current and adequate books, journals, archives and images required for effective learning. Personal observation across some universities has shown that many students prefer to use the conventional libraries instead of digital libraries for information access. For instance, a pre-research survey made by the researchers at the University of Nigeria Nsukka, the Nnamdi Azikiwe University Awka and University of Port-Harcourt indicate that undergraduates have the problem of understanding how to use technology to access digital resources. Many cannot effectively use the internet to source for materials while many have technophobia which affects their psychological disposition in the use of digital technology. Hence, they resort to consulting past projects for their research work, either from the project section of the libraries or the departmental/faculty libraries. The above scenario implies that many undergraduates find it difficult to access accurate, relevant and timely information

which are essential for learning in the present digital environment. Many ignorantly complain of the non-availability of information in their areas of study when it is evident that these resources are available. The above situation, if not checked, can undermine research development and promotion of scholarship, which are vital drivers of national development. This inability to access information harms students' overall academic performance and extends to their performance in the world of work, participation in social life and further education. Against this backdrop, there is need to determine the relative impact of technological variables on undergraduates' access to information. Hopefully, the result of the study will help the universities' administration to assess digital libraries *vis-à-vis* their roles in facilitating effective access to information for enhanced academic performance of undergraduates. This will in turn helps to justify the financial investments made in establishing the digital libraries.

1.2. *Research questions*

The study is guided by the following research questions:

(1) To what extent do undergraduates access information resources of the digital libraries in the federal university libraries in Southern Nigeria?
(2) To what extent does technology usability influence undergraduates' access to information in the libraries?
(3) To what extent do interface design characteristics influence undergraduates' access to information in the libraries?
(4) To what extent does content usefulness influence undergraduates' access to information in the libraries?
(5) What are the challenges of undergraduates' access to information in the libraries?
(6) What are the strategies for enhancing undergraduates' access to information in the libraries?

1.3. *Research hypotheses*

The study is guided by the following null hypotheses which were tested at 0.05 level of significance:

H_{o1}. Technology usability has no significant influence on access to information by undergraduates in digital libraries.
H_{o2}. Interface design characteristics have no significant influence on access to information by undergraduates in digital libraries.
H_{o3}. Content usefulness has no significant influence on access to information by undergraduates in the digital libraries

1.4. *Review of literature*

Access to information has been identified as the predictor of user satisfaction and raison *d'être* of any digital library (Chowdhury and Foo, 2012). Studies by

Hewitson (2002), Kidd (2002), Whitemire (2002), Wijayasundara (2004), Norton (2005), Mohamed (2007), Mahmood (2009), Sharma (2009) and Swain and Panda (2009) have shown that the extents to which students generally have access to information using the digital technology is low. According to Hewitson, apart from the information that can be obtained through the internet, the actual use of other resources like e-books and databases by students is abysmally low. In support of this, Turan and Bayram (2013) assert that though students use internet resources for school assignments, the digital library was not a priority choice among sources of information because they are not aware of how to use the technology. This implies that there is a problem of under-utilisation which Mohamed (2007), Hewitson (2009), Sharma (2009), Turan and Bayram (2013) and Shopova (2014) revealed as the bane of the efforts in using digital libraries to enhance students' access to information.

Technology variables have earlier been described as vital in determining the extent to which information can be accessed in digital libraries (Millawithanachchi, 2012). Different studies conducted by Hong *et al.* (2002), Ramaya (2006) and Xie (2006), have shown that perceived usefulness, interface characteristics (terminology, good screen design and navigation clarity); ease of use and learnability of user interfaces, system performance issues (such as response time), presence of feedback mechanism (that allowed users to communicate with administrators in order to point out problems or suggest additional features) are important determinants of information access in digital libraries. However, the report of a study conducted by Peking University Library (2007) on user satisfaction indicated that digital information resources have lower rates of satisfaction due to their difficult interface. This indicates the low impact of technology on access to information.

Applications of technology to information access in the digital libraries are not without challenges. These challenges have been identified in the different studies of Luther (2000), Chowdhury (2001), Ajuwon (2003), Ojo and Akande (2005), Conway (2006), Park *et al.* (2009), Roas and Lamas (2012), Fezaa (2013), American Library Association Office for Information Technology Policy Digital Literary Task Force (2013), Magamma (2013) and Uutomi (2014) to include, lack of awareness and insufficient training in the use of computers and databases; lack of sufficient staff, lack of ICT skills by staff, insufficient training of staff, lack of subject area or technical expertise; poor technological infrastructure, frequent electricity interruption, frequent machine breakdown, low internet bandwidth/server instability, lack of technicians for maintenance of systems and variation of content due to short lifespan of digital files. The preceding implies that there are skills-related, as well as infrastructural and human resources-related challenges of using digital technology to access information.

Several strategies have been identified for meeting the challenges of information access in digital libraries. The effectiveness of digital libraries requires that the users should have a friendly user interface and the skills to navigate it (Park *et al.*, 2009). Suggestions by Sherman (2000) and Han and Goulding (2003) include the following: designing the user interface bearing the user in mind, selecting high-quality resources, training/educating the users, providing effective library support services,

increasing technology accessibility and usability, improving power supply, professional development of staff for effective functioning, and collaboration among libraries. To overcome the problem of short digital lifespan, Li and Banach (2011) identified digital preservation techniques for digital information to make them accessible over a long period. The author added that creators of digital information should be more proactive about archiving their work to ensure long term preservation of digital scholarship.

An avalanche of researches has been done on digital libraries in different parts of the world with only a few in Nigeria. Specifically, there is little or no study on the impact of technology on access to information in the Nigerian context. This research, therefore, seeks to bridge this gap.

Conceptual Framework: Figure 1 developed by the researchers is applied in the understanding of the impact of the technology variables on access to information in the digital libraries.

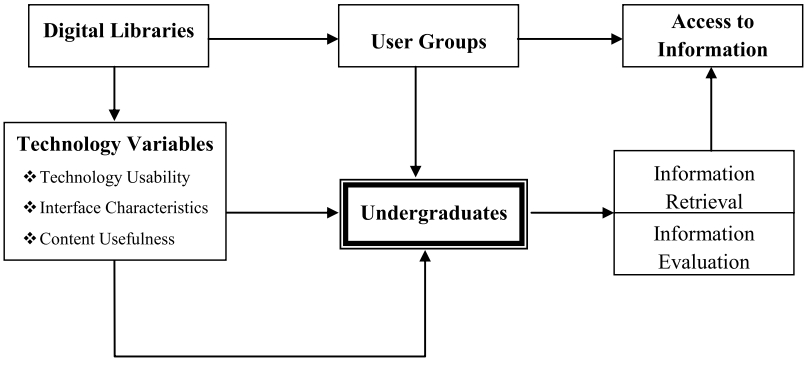

Fig. 1. Diagrammatic representation of the conceptual model of the study.

Figure 1 depicts the user-digital technology interaction, which results to access to information. This interaction is usually necessitated by the user's ability to use technology which may be self-acquired or through assistance from the organisational context. Technology variables here relate to how easy-to-use the technologies, how friendly the interface characteristics are to attract interest and how relevant the information content is in meeting information needs. The positive influence of these characteristics enables the individual user (undergraduate) to retrieve and evaluate electronic resources, resulting in effective access to information.

2. Methodology

The *ex post facto* research design was used to conduct the study. The population was made up of 50,175 subjects, composed of 50,132 registered undergraduates and 43 staff of digital library units of 13 federal universities in southern Nigeria. Southern Nigeria has a total of 17 federal universities. At the time of study, 13 of these

universities have digital libraries. The remaining four (Federal University Otuoke, Federal University, Ndufu-Alike, University of Petroleum Resources Efrun, Delta and Federal University Ekiti), were newly established, with no digital libraries as at the time of the study. The multi-stage sampling technique was used to select a sample of 1506 registered undergraduates, which represented 5% of the total number of, 30,121 undergraduates. All 21 staff of the digital library units of seven universities in Southern Nigeria, were purposely selected for this study. These universities include the University of Nigeria, Nsukka (UNN), Nnamdi Azikiwe University Awka (NAU), University of Calabar (UNICAL), University of Port-Harcourt (UNIPORT), University of Uyo (UNIUYO), University of Benin (UNIBEN) and Obafemi Awolowo University (OAU). The criteria for identifying the seven universities that made up the sample of the study was based on two basic yardsticks: functional digital libraries (universities that were using digital library platform to serve users) as at 2017/2018 session and availability of all the three broad fields of study, namely, Arts/Humanities, Science/Technology and Social Science. However, the University of Lagos and the University of Ibadan were not involved in the study. Although they offer courses in the broad fields of study, pre-research survey revealed that they do not use digital library platform to serve users as at the time of the study. The other four universities (the Federal University of Technology Owerri, Federal University of Technology Akure, University of Agriculture Abeokuta and Michael Okpara University of Agriculture Umudike) are specialised institutions. Some of them have functional digital libraries, but none offers courses that cover the broad areas of study. Also, the use of a 5% baseline in determining the sample size of the undergraduates is in line with the recommendation advanced by Uzoagulu (2011) which prescribes that for a population of up to 10,000 the minimum sample size of 5% should be appropriate.

The major instrument used for data collection was a 49-item questionnaire titled "Technological Variables and Access to Information Questionnaire (TAIQ)". The questionnaire was trial-tested using 20 undergraduates in Ahmadu Bello University in the North Central geopolitical zone of Nigeria. The internal consistency of the instrument showed overall reliability of 0.93, indicating that the instrument was reliable for the study.

The data collection exercise lasted for four weeks. The researcher engaged the services of seven Research Assistants, one in each of the universities involved in the study. They assisted in the distribution and collection of the questionnaire. These personnel were briefed by the researchers on the process of distributing and checking of the completed questionnaire to ensure a high percentage of returns and usability of the instrument for data analysis. The semi-structured interview for librarians working in the digital libraries was conducted by the researchers through personal visits to the respective seven federal university libraries. Participation in the interview was not restricted to the heads of the digital library units. Every staff who was involved in assisting the undergraduates in making use of the digital libraries was involved in the interview. Out of the 21 staff of the digital library units that were supposed to be interviewed, six were unavailable for the interview. The interview

was thus conducted with 15 of them which represented 71% of the total. The specific numbers of digital library staff that were available during the period of the visit for the interview in the respective university libraries were as follows: UNN (5), NAU (3), UNIBEN (1), UNIPORT (2), UNICAL (2), OAU (1) UNIYO (1).

Also, the researchers had group interaction with the undergraduates in the various university libraries through focus group discussion sessions. This was guided by the schedules prepared for that purpose. The group in each university was made up of a total of 12 participants which comprised of four participants from each of the three major fields of study. The selection of the discussants in each field of study was randomly done to ensure equal representation of the participants in each field of study. The discussion was conducted on a round table seating arrangement with the principal author as the moderator and the co-author as the recorder of the proceedings. Seven sessions of discussion were held, one in each of the university libraries with the undergraduate students who visited the libraries to read.

The data collected were analysed using frequency and percentages, mean and standard deviation for the respective research questions, while regression analysis was used to test the null hypotheses stated at 0.05 level of significance. Out of the 1506 copies of the questionnaire distributed, 1375 (90%) were returned, of which 1274 (85%) were found useful for the analysis. The data from the focus group discussion and the interview schedule were analysed qualitatively as indicated in Appendices A and B, respectively.

3. Results

This section presents the results of the data collected and analysed for the study. The presentation contains the analysis of the demographic details of the respondents, research questions formulated and the stated hypotheses for the study. The results are presented as follows.

3.1. *Demographic characteristics of the respondents*

The demographic data of the respondents indicate that 694 (54.5%) were males while 580 (45.5%) were females. Concerning the year of study, 415 (33.0%) were first-year students, 354 (27.8%) were second-year students, 267 (21.5%) were third-year students while 238 (18.7%) were final year students. Also, 360 (28.3%) were students in the field of Arts/Humanities, 525 (41.2%) were from Science/Technology and 389 (30.5%) were from Social Sciences.

3.2. *The extent of undergraduates' access to information resources in the digital library system*

The undergraduates were requested to assess the extent to which they access information resources in the digital libraries of their universities. The items were presented on a 4-point rating scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE) and No Extent (NE) as indicated in Table 1.

Table 1. Descriptive statistics of the extent of undergraduates' access to information in the digital libraries.

$N = 1274$

S/N	Information resources	VHE	HE	LE	NE	Mean	SD
1	Resources in online databases like AGORA, OARE, DOAJ, SCOPUS, etc.	75 (5.9)	208 (16.3)	340 (26.7)	651 (51.1)	1.77	0.93
2	Electronic books	152 (11.9)	262 (20.6)	404 (31.7)	456 (35.8)	2.09	1.02
3	Electronic journals	167 (13.1)	199 (15.5)	415 (32.6)	493 (38.7)	2.03	1.03
4	Electronic newspapers/magazines	125 (9.80)	308 (24.2)	315 (24.7)	526 (41.3)	2.03	1.02
5	Newsgroup postings	103 (8.1)	328 (25.7)	401 (31.5)	442 (34.7)	2.07	0.96
6	Electronic theses and dissertations	100 (7.8)	297 (23.3)	401 (31.5)	476 (37.4)	2.02	0.96
7	Electronic mail	225 (17.7)	330 (25.9)	331 (26.0)	388 (30.5)	2.07	1.02
8	Resources in CD—ROMs	139 (10.9)	201 (15.8)	424 (33.3)	510 (40.0)	1.98	1.00
9	Resources in online public access catalogues (OPAC)	159 (12.5)	316 (24.8)	329 (25.8)	469 (36.8)	2.13	1.05
10	Resources in institutional repositories	149 (11.7)	279 (21.9)	359 (28.2)	487 (38.2)	2.07	1.03
11	Resources found using search engines like Google, Yahoo, etc.	476 (36.7)	376 (29.5)	237 (18.6)	194 (15.2)	2.90	1.06
12	Resources in websites	363 (28.5)	252 (19.8)	304 (23.9)	355 (27.9)	2.49	1.17

Source: Researchers: Data in Table 1 shows the mean responses of the undergraduates on the extent to which they access information in the digital libraries. The items mean scores show that the majority of the identified resources have a low rate of access as their mean scores are below the criterion mean (2.50). Only resources found using search engines like Google, Yahoo were accessed highly by the respondents with a 2.90 mean score. Other resources like online databases, electronic books, electronic journals, electronic newspapers/magazines, electronic theses and dissertations, electronic mail, CD-ROMs, OPAC, institutional repositories and websites attracted low percentage responses indicating that their level of access was generally low. The focus group discussion revealed that the general opinions held by the undergraduates correspond with the views of the library staff. The result confirmed that undergraduates do not make good use of the digital library facility to access information because they have not mastered how to use them. The inference to be made here is that access to information resources of the digital libraries is generally low.

The respondents were directed to indicate their level of agreement on the influence of technology usability on their access to digital information in the libraries. As shown in Table 2, the options were strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD) as shown in Table 2.

Data in Table 2 show that the usability of technology makes a low impact on access to information. Ease of use of digital technology attracted a low mean score of 2.42. The same pattern of responses was generated on the items on "provision of feedback for effective communication" (2.39) "how easy to learn is the technology"

Table 2. Descriptive statistics of influence of technology usability on undergraduates' access to digital information in the libraries.

S/N	Usability of technology	SA	A	D	SD	Mean	Standard deviation
1	The digital technology is easy to use	258 (20.3)	319 (25.0)	399 (31.3)	298 (23.4)	2.42	1.06
2	The use of technology is easy to learn	256 (20.1)	250 (19.6)	306 (24.0)	462 (36.3)	2.24	1.14
3	The technology provides feedback for effective communication between the user and the administrator	231 18.1	384 30.1	314 (24.6)	345 (27.1)	2.39	1.07
4	The system takes too much time to perform a task and this gets one frustrated	385 (30.2)	422 (33.1)	336 (26.4)	131 (10.3)	2.83	0.98
5	The system has an in-built/default guidance that gives clear instructions to the user	228 (17.9)	369 (29.0)	425 (33.4)	252 (19.8)	2.45	1.00

(2.24) and "the presence of in-built guidance that gives clear instruction to users" (2.14). A positive mean response of 2.83 was scored by the item that states that the system takes too much time to perform a task and this further supports the fact that technology usability does not exert a positive influence on the undergraduates' access to information. The submission made by the discussants across the universities indicated that there was a low level of access to digital resources as a result of challenges related to difficulty in the use of technology, an opinion which the staff concurred to during the interview. Specifically, the discussants at the University of Nigeria, Nsukka stated thus: "the mode of operation of the digital library is not yet clear", "We do not have the skills to manipulate the technology". The general opinion of the discussants across the universities is that they still prefer to use library print resources, lecture notes and personal books because they find it difficult to apply digital library technology for effective access to information. The inference to be made here is that the technology makes a low impact on undergraduates' access to information in the digital libraries.

Table 3 shows that usability of technology has significant influence on undergraduates' access to information resources in the digital libraries ($\beta = 0.951$, $t = 110.031$, $P < 0.05$). This is also supported by the significant of the F — statistic as revealed in the above table ($F = 12, 106.73$, $P < 0.05$). Further, the R^2 value of 0.905 indicates that the usability of technology contributes 90% to undergraduates' access to information resources in the digital libraries, while the remaining 10% may be due to other factors (Table 3).

Data from Table 4 show that interface design characteristics do not have influence on undergraduates' access to information. This is evidenced by the low

Table 3. Regression analysis of undergraduates' mean response on the influence of technology usability on access to digital information in the libraries.

Model	Unstandardised coefficients		Standardised coefficients	t	Significance**
	B	Std. error	Beta		
Constant	−0.271	0.023	—	−11.559	0.000
Content usefulness	0.976	0.009	0.951	110.031	0.000

Notes: $F = 12106.728$**,
$R = 0.951$,
$R^2 = 0.905$,
Adj. $R^2 = 0.905$,
SEE = 0.30391,
**$P < 0.05$ (or significant at 0.05).

mean scores attracted by the items. The item on "the friendliness of the interface design" scored 2.38, "easy to understand system terminology/language" scored 2.24, while the item on "easy to understand and clear instructions of the navigation" scored 1.95, and the screen design outlook scored 1.88 (Table 4).

Table 5 shows that interface design characteristics have a highly significant influence on undergraduates' access to information resources in digital libraries ($\beta = 0.986$, $t = 212.320$, $P < 0.05$). This is also supported by the significant of the F — statistics revealed in the above table ($F = 45079.874$, $P < 0.05$). Furthermore, the R^2 value of 0.973 indicates that the interface design characteristics contribute 97% to undergraduates' access to information resources in the digital libraries, while the remaining 3% may be due to other factors (Table 5).

In Table 6, all the items attracted low mean scores. This ranges from 2.10 on the item on "consistency of availability information resources", 2.08 on the "relevance of the information content" to 1.85 on "adequacy of the information content". All these indicate that for the undergraduates in this study, the information content of the digital libraries has not influenced their access to information (Table 6).

Table 7 shows that content usefulness has highly significant influence on undergraduates' access to information resources in the digital libraries ($\beta = 0.990$,

Table 4. Descriptive statistics of undergraduates' response on the influence of interface design characteristics on access to information in the digital libraries.

S/N	Interface design characteristics	SA	A	D	SD	Mean	SD
1	The interface design is user-friendly	146 (11.5)	469 (36.8)	385 (30.2)	274 (21.5)	2.38	0.95
2	The system terminology/language is easy to understand	256 (20.1)	250 (19.6)	306 (24.0)	462 (36.3)	2.24	1.14
3	The technology has good screen design	142 (11.1)	143 (11.2)	407 (31.9)	582 (45.7)	1.88	1.00
4	The technology is easy to navigate with clear instructions	102 (8.0)	230 (18.1)	446 (35.0)	496 (38.9)	1.95	0.94

Table 5. Regression analysis of relationship in undergraduates' mean response on the influence of interface design characteristics on access to digital information in the libraries.

Model	Unstandardised coefficients		Standardised coefficients	t	Significance**
	B	Std. error	Beta		
Constant	0.018	0.011		1.676	0.094
Content usefulness	1.003	0.005	0.986	212.320	0.000

Notes: $F = 45079.874$**,
$R = 0.986$,
$R^2 = 0.973$,
Adj. $R^2 = 0.973$,
SEE = 0.16328,
**$P < 0.05$ (or significant at 0.05).

Table 6. Descriptive statistics of undergraduates' response on the influence of content usefulness on access to digital information in the libraries.

	Content usefulness	SA	A	D	SD	Mean	SD
1	The information content of the digital library is relevant to my needs	257 (20.2)	297 (23.3)	306 (24.0)	413 (32.4)	2.08	1.06
2	The information content is adequate to satisfy my needs	91 (7.1)	196 (15.4)	421 (33.0)	566 (44.4)	1.85	0.93
3	There is the consistency of availability of information resources in the system	127 (10.0)	269 (21.1)	479 (37.6)	399 (31.3)	2.10	0.96

$t = 249.486$, $P < 0.05$). This is also supported by the significant of the F — statistics revealed in the above table ($F = 62243.266$, $P < 0.05$). Furthermore, the R^2 value of 0.980 indicates that the interface design characteristics contribute 98% to undergraduates' access to information resources in the digital libraries, while the remaining 2% may be due to other factors.

Table 7. Regression analysis of relationship in undergraduates' mean response on the influence of content usefulness on access to information in the digital libraries.

Model	Unstandardised coefficients		Standardised coefficients	t	Significance
	B	Std. Error	Beta		
Constant	0.082	0.009		9.039	0.000
Content usefulness	1.023	0.004	0.990	249.486	0.000

Notes: $F = 62243.266$**,
$R = 0.990$,
$R^2 = 0.980$,
Adj. $R^2 = 0.980$,
SEE = 0.13948,
**$P < 0.05$ (or significant at 0.05).

From a list of challenges of access to information in the digital libraries, the respondents were asked to indicate their level of agreement or disagreement with these challenges. Their responses are as indicated in Table 8.

Table 8. Descriptive statistics of undergraduates' response on the challenges of access to information in the digital libraries.

$N = 1274$

S/N	Challenges	SA	A	D	SD	Mean	SD
1	Technology interface not user-friendly	379 (29.7)	340 (26.7)	277 (21.7)	278 (21.8)	2.64	1.12
2	Library support services not satisfactory to users	383 (30.1)	448 (35.2)	221 (17.3)	222 (17.4)	2.78	1.06
3	Lack of librarians who are experts/trained in digital search services	298 (23.4)	340 (26.7)	321 (25.2)	315 (24.7)	2.64	1.02
4	Slow internet access/limited internet connectivity	327 (25.7)	419 (32.9)	294 (23.1)	234 (18.4)	2.66	1.05
5	Poor ICT infrastructure in the library	360 (28.3)	384 (30.1)	249 (19.5)	281 (22.1)	2.65	1.11
6	Frequent interruption of power supply	340 (26.7)	297 (23.3)	257 (20.2)	379 (29.7)	2.47	1.18
7	Students' lack of digital literacy skills as a result of lack of training	362 (28.4)	354 (27.8)	292 (22.9)	266 (20.9)	2.64	1.10
8	Frequent breakdown of computer systems	337 (26.5)	294 (23.1)	390 (30.6)	253 (19.9)	2.56	1.08
9	Delay in effecting repair of breakdown system	321 (25.2)	390 (30.6)	268 (21.0)	295 (23.2)	2.58	1.10
10	Difficulty in using digital technology	251 (19.7)	383 (30.1)	375 (29.4)	265 (20.8)	2.49	1.03
11	Digital content not always permanent in the system	281 (22.1)	435 (34.1)	320 (25.1)	238 (18.7)	2.6	1.03
12	Digital content not always adequate/relevant to satisfy user's needs	315 (24.7)	385 (30.2)	340 (26.7)	234 (18.4)	2.61	1.05
13	Computer technology was not easily accessible to users most times	355 (27.9)	363 (28.5)	287 (22.5)	268 (21.0)	2.63	1.10

Source: Researchers: Data in Table 8 above indicate that all the identified factors were rated as challenges of access to information due to their high positive percentage ratings. The item with the highest rating is, library support services not satisfactory to users with mean score 2.78. This is followed by the challenges of slow internet access (2.66), poor ICT infrastructure (2.65), and technology interface not user-friendly (2.64), Lack of librarians who are experts/trained in digital search services (2.64), lack of digital literacy of students as a result of lack of training (2.64), and computer technology not easily accessible (2.63). Other challenges include "non-permanence of digital content", "lack of expert librarians in digital information services", "delay in repair of systems" and "frequent interruption of power supply". Challenges identified by the discussants which correspond to those of the library staff during the interview include the following: students' general lack of awareness of the kinds of e-resources available, inaccessibility of computers to students, lack of dedicated internet access to the libraries, out-datedness of work stations and digital library hours of operation not accommodating to students' lecture schedule. The staff further identified students' irresponsibility in diverting the purpose of the computer technology to accessing social networking sites and pornographic contents. They added that careless students engage in trying their hands to manipulate the systems to configure some programs and this often results to system breakdown.

3.3. *Strategies for enhancing of access to information in the digital libraries*

The respondents were required to indicate their level of agreement/disagreement with a list of strategies using the options strongly agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) as shown in Table 9.

Table 9. Descriptive statistics of undergraduates' response on the strategies for enhancing of access to information in the digital libraries.

$N = 1274$

S/N	Strategies	SA	A	D	SD	Mean	SD
1	The system designers should ensure that the technology interface is user-friendly	621 (48.7)	348 (27.3)	107 (8.4)	198 (15.5)	3.09	1.09
2	Providing library support services that will assist users in the use of technology by the library administration	633 (49.7)	374 (29.4)	106 (8.3)	161 (12.6)	3.16	1.03
3	Improving users digital literacy skills through training and instructions by the librarians	583 (45.8)	271 (21.3)	113 (8.9)	307 (24.1)	2.89	1.22
4	The library should select high-quality resources that will match the user's information needs	611 (48.0)	321 (25.2)	135 (10.6)	207 (16.2)	3.05	1.11
5	Technology accessibility and usability should be ensured by the library administration	633 (49.7)	295 (23.2)	148 (11.6)	198 (15.5)	3.07	1.11
6	The libraries should engage in the professional development of staff through training and retraining for effective service delivery	636 (49.9)	324 (25.4)	81 (6.4)	233 (18.3)	3.07	1.14
7	Improved electricity supply by providing an alternative source of energy should be ensured by the university administration	647 (50.8)	345 (27.1)	113 (8.9)	169 (13.3)	3.15	1.05
8	Ensuring long term preservation of digital resources to ensure the longevity of the resources and avoid loss of content by the library	609 (47.8)	317 (24.9)	153 (12.0)	195 (15.3)	3.05	1.10
9	Employing technical experts for proper maintenance of the system by the university administration	641 (50.3)	355 (27.9)	110 (8.6)	168 (13.2)	3.15	1.05
10	Frequent maintenance and upgrade of computer systems by the systems technical experts	661 (51.9)	307 (24.1)	107 (8.4)	199 (15.6)	3.12	1.10
11	Improving internet access by increasing the bandwidth through subscriptions by the university administration	627 (49.2)	219 (17.2)	191 (15.0)	237 (18.6)	2.97	1.18

Source: Researchers: Data in Table 9 above indicate a high level of acceptance of all items that are related to strategies for improving access to information resources in the digital libraries. The most important strategy is "providing library support services that will be satisfactory to the users by the library administration" (3.16). This is followed by "improved electricity supply by providing an alternative source of energy" (3.15), "employing technical experts for proper maintenance of system by the university administration" (3.15), "frequent maintenance and upgrade of computer systems by the systems technical experts" (3.12), and "ensuring that the technology interface is user-friendly" (3.09), "engaging in professional development of staff through training and retraining for effective service delivery" (3.07), "ensuring technology accessibility and usability by the library administration" (3.07), "selecting high quality resources that will match users' information needs" (3.05), and ensuring the long term preservation of digital resources for longevity and to avoid loss of content" (3.05). Others include, "improving users digital literacy skills through training and instructions by the librarians" and "ensuring improved internet access". Also the opinion shared by the discussants which are congruent with the submissions made by the library staff identified the following as additional strategies: awareness creation to enlighten students about the nature of e-resources available, provision of enough computers for free access by students, up-grading of internet access in the universities to ensure seamless access by all at any location, provision of dedicated internet access to the library and up-grading of work stations for faster performance and introduction of two work shifts in the digital library units to accommodate students' lecture schedule. The inference to be made from the above findings is that the various library administrations have an enormous role to play in ensuring the high-quality performance of the digital libraries as all the identified strategies are mostly administrative.

The results of the focus group and the interview are presented as an attachment. See Appendices A and B, respectively.

4. Discussion of Findings

The findings on the extent to which information resources are accessed by the undergraduates in the digital libraries show that with the exception of resources found using search engines like Google and Yahoo, other resources like online database, e-books, e-journals, e-theses and dissertations, CD ROM resources, OPACs and institutional resources, have low access rates. This could explain why the focus group discussants across the universities asserted that they prefer library print materials, personal books, lecture notes and departmental handbooks to digital library resources. The above finding is in consonance with the discoveries of Hewitson (2002), Kidd (2002), Whitemire (2002), Wijayasundara (2004), Norton (2005), Mohamed (2007), Mahmood (2009), Sharma (2009) and Swain and Panda (2009) which have shown that the extent to which students generally have access to information using digital technology is low. The finding also corroborates the findings of Hewitson (2002) and Turan and Bayram (2013) which show that apart from the information that can be obtained through the internet, the actual use of other resources like e-books, databases, institutional repositories, etc. by students is abysmally low. This shows that students have a general knowledge of the internet, which could be as a result of their frequent exposure to mobile phones but not necessarily as a result of the introduction of the digital libraries. This exposure also gives them a high level of mastery of the use of search engines for accessing university websites and social networking sites.

Similarly, the findings on the extent to which technology variables enhance access to information in the digital libraries by undergraduates indicate that technology usability, interface design and usefulness of content did not exact positive influence in enhancing undergraduates' access to information in the digital libraries. This finding corresponds with the finding made by Peking University Library (2007) on user satisfaction which indicated that OPAC display and navigation of e-resources both have lower rates of satisfaction due to their not-easy-to use interface. It should however, be pointed out that all the hypotheses tested indicated that technology variables (usability, interface design and content usefulness) have a significant influence on access to information. The negative responses from the respondents (see Tables 2, 4 and 6) could be attributed to human factors as indicated by their response to the challenges of access to information in digital libraries. These factors have inherently masked the positive effect of technology variables on access to information. The above issues are pointers to the need for a study on the human ergonomics of the impact of technology variables to digital access to information. The interview and focus group reveal that students lack the necessary technological skills to make use of the digital library and this situation explains why technology interface was difficult to use. This position could have affected their submission that

the content is not useful. It is only when they are able to manipulate the technology that they can assess the content.

The results show that all the items of challenges are accepted as factors that hinder undergraduates from having effective access to information in the digital libraries. The greatest challenge is that library support services are not satisfactory to users. It is a well-known fact that information professionals have a critical role to play in promoting access to information with the use of technology. In a situation where the user finds it difficult to manipulate the system, either because of the complexity of the technology or lack of digital skills, there is need for the intervention of a professional who is knowledgeable and skilful in digital information service to bridge the gap. The finding corroborates the position taken by Chowdhury (2001), who states that the absence of human intermediaries who should play a major role in online search services is a major problem of information search/access in a digital environment. The finding on lack of trained librarians for digital information services corroborates the findings of the American Library Association Office for Information Technology Policy Digital Literary Task Force (2013) that identified lack of sufficient staff/staff skill, lack of subject area or technical expertise and training as some of the challenges faced by digital libraries in ensuring information access. It is not enough to engage in huge economic spending in the course of establishing the digital library system without ensuring the availability of librarians who are skilful service delivery experts to drive the system and ensure its sustainability. The findings on slow internet access/limited internet connectivity, frequent interruption of electricity supply, non-accessibility of computer technology, delay in effecting repair of breakdown systems and poor ICT facilities correspond to the findings of Luther (2000), Aguolu and Aguolu (2002), Park *et al.* (2009), Roas and Lamas (2012), Fezaa (2013) and Uutomi (2014) who in different studies identified the problem of poor technological infrastructure as widening the digital gap between the developed and developing countries. Considering the opinions of the discussants on lack of awareness, it is necessary to note that the introduction of innovation requires massive sensitisation for its acceptance and subsequent utilisation. Problems with the opening hours of the libraries are indicative of the flaws of the library support services. Ideally, users should access digital information/services such as e-mail services, chat services, instant messaging, video conferencing/webcam services, etc. any time anywhere without necessarily coming to the physical library. The absence of this is an indication that the digital libraries in Nigerian universities are not yet operating in conformity with global standards. The prevailing existence of social networking and pornographic sites has been a distractive force that diverts the attention of youths today from using technology to engage in meaningful academic exercise. This is made worse by the activities of over-zealous students who would always like to try to manipulate the technology to suit their selfish purposes, thereby causing damages to the system, indicating user-induced challenges that distort the operations of the digital libraries.

The strategies highlighted for improving access to information in the digital library in the present study corroborate those identified by Han and Goulding (2003). The authors identified providing effective library support services, training/educating the users, designing the interface knowing the user, selecting high quality resources, increasing technology accessibility and usability, improving power supply and professional development of staff as the strategies for achieving improvement in the use of the digital libraries for information access. Also, the finding on the preservation of digital resources as a strategy conforms to the opinion of Li and Banach (2011), who prescribed that creators of digital information should take proactive measures to ensure long term preservation of digital information. This would help to ensure long term availability/access to a particular online information source. On the overall, it is believed that if adequate arrangement for library support services is put in place, the staff would be well trained to offer the required professional services to users; there would be effective advocacy and sensitisation about the potentials of the digital libraries, user training would be ensured, there would be effective collaboration among different libraries for sharing of resources and in fact the entire system would be functioning appropriately. The suggestions made during the focus group with undergraduates and the interview with the staff show that awareness creation is very important as it would go a long way in getting the users to know what is available to decide whether it is relevant to their needs or not. Also, the suggestion by the discussants on running shift duties in the digital libraries is very important but it cannot be an effective solution so long as the libraries are not offering online information services to users. The digital library is synonymous with a virtual library, paperless library or libraries without walls. Above all, today's libraries are no longer regarded only as a place but also as space and as such users are supposed to have seamless access to information services. This, in other words, means that users should be able to have access to information from these libraries even from the comfort of their homes. This would go a long way in helping the undergraduates to make effective use of the digital libraries for maximum benefits.

5. Conclusion and Recommendations

The achievement of the major objectives of teaching, learning and research in any academic institution depends so much on access to adequate, timely and useful information. Undergraduates particularly depend on this type of information to consolidate their learning experiences in the classroom. Due to economic challenges, the university library is no longer able to meet up with the basic responsibility of acquiring and providing access to adequate information required by the teeming population of users. In the present ICT dispensation, the development of the digital libraries is seen as a vital answer to the information access challenges facing university libraries because of it allows for diverse kinds of rich information resources that are available on the web. Despite this potential, it has been found that undergraduates still find it difficult to make maximum use of the digital library

system to access information relevant for problem-solving. This is largely due to challenges linked to the human factors of application of digital technology to access information.

Based on the foregoing, it is thus recommended that the administration of the various university libraries should employ library professionals who have the requisite skills to provide support to users of the digital libraries for effective access to information. The administration should also engage the services of technical experts, ensure the availability of adequate technology infrastructure through maintenance and upgrade, and improve the electricity supply by providing alternative sources. In addition, the university administrations who are the major funders of the digital libraries should ensure that the procured computer technologies are designed in an easy to use manner to enable undergraduates make maximum use of the resources of the digital libraries.

References

Aguolu, CC and IE Aguolu (2002). *Librarians and Information Management in Nigeria*. Maiduguri: Ed-Linform Services.

Ajuwon, GA (2003). Computer and internet use by first-year clinical and nursing students in a Nigeria Teaching hospital. *BMC Medical Informatics and Decision making*, 3(4), 112–154.

American Library Association, Office for Information Technology Policy, Digital Literary Task Force (2013). Digital literacy, libraries and public policy. Available at http://www.districtdispatch.org/wp-content/. Accessed on 20 September 2012.

Appleton, L (2006). Perceptions of electronic library resources in further education. *The Electronic Library* 24(5), 619–634.

Chowdhury, GG (2001). Digital library services: Present and future. *Journal of Documentation (JDOC)* 58(3), 258–283.

Chowdhury, G and S Foo (2012). *Digital Libraries and Information Access: Research Perspectives*. London: Facet.

Conway, P (2006). *Preservation in the Digital World*. Washington DC: Council on Library and Information Science. Available at http://www.clir.org/pubs/abstract/Pub. 62.html. Accessed on 28 January 2015.

Davis, FD (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly* 13(3), 319–340.

Faruqi, KK and M Alam (2005). *Library Information Systems and e-Journal Archiving*. Delhi, India: Authors Press.

Fezaa, BA (2013) An exploratory study of the benefits and inhibitors of digital libraries in Iraq. Master's Degree thesis, Edith Cowan University Perth, Western Australia.

Han, L and A Goulding (2003). Information and reference services in the digital library. *Information Services and Use*, 23, 251–262.

Hardasan, S and M Khan (2005). Impact and use of e-resources by social scientists in the National Social Science Documentation Centre. *The Electronic Library*, 27(1), 117–133.

Hewitson, A (2002). Use and awareness of e-information services by academic staff of Leads Metropolitan Universities: A qualitative study. *Journal of Librarianship and Information Science*, 34(1), 34–52.

Hong, W, JYL Thong, W Wong and K Tam (2002). Determinants of user acceptance of digital libraries: An empirical examination of individual differences and systems characteristics. *Journal of Management Information System*, 18(3), 97–124.

Igbo, HU (2017). Impact of technological and human variables on undergraduates' access to information in the digital libraries of federal universities in southern Nigeria. PhD Thesis, Department of Library and Information Science, University of Nigeria, Nsukka.

Igbo, HU and NT Imo (2017). Electronic information resource sharing among university libraries in southern Nigeria: Opportunities and challenges. *African Journal of Libraries, Archives and Information Science*, 27(1), 77–91.

Kidd, T (2002). Electronic journal usage statistics practice. *Serials*, 6(1), 11–17.

Li, Y and M Banach (2011). Institutional repositories and digital preservation: Assessing current practices at research libraries. *D-Lib Magazine*, 17(5/6), 23–28.

Luther, J (2000). *White Paper on Electronic Journal Usage Statistics*. Washington DC: Council on Library and Information Resources.

Magamma, M (2013). Digital reference service in engineering college libraries: A case study of Visakhapatnam. *E-Library Science Research Journal*, 1(10), 1–10.

Mahmood, K (2009). Gender, subject and degree differences in university students' access, use and attitudes toward ICT. *International Journal of Education and Development Using Information and Communication Technology (IJEDICT)*, 5(3), 206–216.

Millawithanachchi, US (2012). Electronic resources usage by post-graduates at the University of Colombo: Identifying the critical success factors. *Annals of Library and Information Studies*, 59, 153–163.

Mohamed, HK (2007). Use of ICT based resources and services in special libraries in Kerala. *Annals of Library and Information Studies*, 54, 23–31.

Mutula, SM and AA Ojedokun (2008). Digital libraries. In *Information and Knowledge Management in the Digital Era: Concepts, Technologies and African Perspectives*, LO Aina, SM Mutuala and MA Tiamiyu (eds.). Ibadan: Third World Information Services, pp. 101–121.

Norton, L. (2005). Building attitudes: How a technology course affects pre-service teachers' attitudes about technology. Available at http://www.math.byu.edu/Ifrancis/tims-page/attituudesite.html. Accessed on 3 March 2013.

Parent, I. (2012). Libraries — A force for change: Inspiring surprising empowering. *IFLA Journal*, 38(4), 322–328.

Park, N, R Roman, S Lee and E Ching (2009). User acceptance of a digital library system in developing countries: An application of the technology acceptance model. *International Journal of Information Management*, 29, 196–209.

Peking University Library (2007). Peking University Library. Available at *www.lib.pku.edu.cu/portal/index.jsp*. Accessed on 6 June 2010.

Ramaya, T. (2006). Interface characteristics, perceived ease of use and intention to use an online library in Malaysia. *Information Development*, 22(2), 123–128.

Reitz, JM (2004). *Dictionary for Library and Information Science*. Nest Port: Libraries Unlimited.

Sharma, C (2009). Use and impact of e-resources at Gobing Singh Indraprastha University (India). *Electronic Journal of Academic and Special Librarianship*, 10(1). Available at http://lu.com/odlis/index.cfm. Accessed on 26 February 2013.

Sherman, C (2000). Reference Resources on the web. *Online*, 24(1), 52–56.

Shopova, T (2014). Digital literacy of students and its improvement at the university. *Journal of Efficiency and Responsibility in Education and Science*, 7(2), 26–32.

Swain, DK and KC Panda (2009). Use of e-resources in business school libraries of an Indian State. *The Electronic Library Journal*, 27(1), 74–88.

Thong, JYL, W Hong and KY Tam (2002). Understanding user acceptance of digital libraries: What are the roles of interface characteristics, organizational context-and individual differences? *International Journal of Human-Computer Studies*, 57, 215–242.

Tsakonas, G and C Papatheodorou (2011). An ontological representation of the digital library evaluation domain. *Journal of American Society for Information Science and Technology*, 62(8), 1577–1593.

Turan, F and O Bayram (2013). Information access and digital library use in university students' education: The case of Ankara University. *Procedia-Social and Behavioral Sciences*, 73, 736–743.

Uutomi, WE (2014). Evaluation of digital reference services in academic libraries in Namibia. Master's Degree Thesis, Department of Library and Information Science Sweetish School of Library & Information Science, Namibia.

Uzoagulu, AO (2011). *A Practical Guide to Writing Research Project Reports in Tertiary Institutions*, 2nd edn. Enugu: Cheston Ltd.

Whitemire, E (2002). Disciplinary differences and undergraduates' information-seeking behavior. *Journal of American Society for Information Science and Technology*, 53(8), 631–638.

Wijayasundara, DN (2004). The importance of information literacy skills in e-learning. Available at www.wseas.us/e-library/conferences/2013/Brasov/.STAED-50.pdf. Accessed on 6 August 2014.

Xie, H (2006). Evaluation of digital libraries: Criteria and problems from the user's perspective. *Library and Information Science Research*, 28(3), 433–452.