

DIGITAL PRESERVATION STRATEGIES FOR LONG-TERM ACCESSIBILITY OF COLLECTIONS IN ACADEMIC LIBRARIES IN NORTH-CENTRAL, NIGERIA

By

BASSEY, Kelly¹ and Prof. Angela Okpala²

wealthbassey@icloud.com

¹National Assembly Service Commission, ²National Open University of Nigeria

+2347039121595 and +2348136260702

Abstract: *The study investigated the digital preservation strategies for long-term accessibility of the collections in academic libraries in North-central, Nigeria. Three research objectives guided the study. The study adopted survey research design. The population of the study was 400 librarians in university libraries in North-central, Nigeria. The sample size of the study stood at 136. Multi-stage sampling procedure was adopted to stratify the university into Federal, State and Private universities. Questionnaire and observation checklist served as instruments for data collection. The data collected for this study was analysed with the use of descriptive statistics. Descriptive statistical tools in form of percentages, frequency, mean and standard deviation was used to answer the research questions. The findings of the study revealed among others that storage media used to preserve digital collections in academic libraries in North-central, Nigeria was high with the highest mean score of 3.13 on the library use computers in the preservation of digital collections. In conclusion, the study shed light on the digital preservation strategies employed by university libraries in North-central, Nigeria, and offers valuable insights for ensuring long-term access to digital collections. The study made recommendation based on the findings which include: the management of university libraries in North-central, Nigeria should provide adequate digital collections such as e-newspapers, research data, e-seminar papers, e-theses and dissertations and e-magazines in order to enhance access to digital resources by users timely and remotely. This increases the library's reach and supports research and learning, allocate adequate funding for digital preservation initiatives and provide regular monitoring and evaluation of digital preservation strategies necessary to ensure their effectiveness.*

Keywords: Academic libraries, Digital collections, Digital preservation strategies, Long-term accessibility

Introduction

The advent of Information and Communication Technology (ICT) has fundamentally transformed how library collections are maintained in libraries and information centers. This technological shift has significantly improved information accessibility, reduced processing times, and lowered operational costs. Educational institutions, including universities, polytechnics, colleges of education, and monotechnics, can now not only store vast amounts of information but also quickly access data from diverse sources. ICT has empowered academic libraries to fulfill their core

mission of acquiring, preserving, and disseminating information. Academic libraries serve as vital components within higher education, providing information in various formats to support the teaching, learning, and research goals of their parent institutions. Omeluzor et al. (2017) assert that an academic library is a well-established and organized division of an institution, tasked with providing relevant and current library collections that cater to the information needs of its users. The primary goal of an academic library is to procure information resources in diverse formats and fields of human knowledge, then to process, organize, disseminate, and provide access to these resources.

Academic libraries are established primarily to assist tertiary institutions in their academic endeavors, aligning with and promoting their institutional vision (Grigar & Pisarski, 2024). The information resources available in these libraries exist in both print and non-print formats. Print materials encompass books, maps, theses, journals, conference papers, handbooks, and dictionaries, among others. Non-print formats include online databases, e-books, e-journals, and resources found on websites and other digital storage media. Shimray and Ramaiah (2018) specify that digital information resources include online databases and e-journals, implying that digital resources are accessible via computer networks. Therefore, the preservation of these digital resources is crucial for ensuring their long-term availability and utility.

Preserving information resources, whether print or digital, within a library context aims to ensure their survival, usability, and accessibility for the longest possible duration. Common preservation methods in libraries, such as refreshing, migration, cloud storage, binding, lamination, scanning, and photocopying, facilitate continuous access and use for library patrons. The objective of resource preservation in libraries is to enable ongoing access, utilization, and easy retrieval of information for current and future use, while also safeguarding these resources against potential threats for as long as feasible (Lavoie, 2021). Without effective digital preservation of information resources in academic libraries, digital access would yield minimal or no resources for users to conduct research, teaching, and learning activities.

Digital preservation encompasses the processes and activities designed to stabilize and protect digital resources and publications, ensuring they remain retrievable, readable, and usable over time. Hazarika (2020) defines digital preservation as the conservation of all digital materials, whether they originated in digital form (e.g., emails, websites, video games, electronic files) or

were digitized from analog sources. Digital preservation involves maintaining objects as close to their original state as possible until they are no longer required. Unlike the preservation of physical media like paper or microfilm, digital objects necessitate specialized equipment for migration, conversion, storage, retrieval, and transmission, making it a continuous and ongoing endeavor.

Digital preservation strategies for information involve implementing robust backup and redundancy systems to protect digital content from accidental deletion, hardware failures, or other forms of data loss (Matusiak, 2017). The long-term digital preservation of library collections is a complex undertaking, largely due to the dynamic nature of Information and Communication Technology (ICT) and its associated devices. This aligns with Keakopa's assertion in Matlala (2019) that the long-term preservation of digital records remains an unresolved issue, influenced by the impact of ICT applications on record-keeping practices. Challenges in digital preservation of library collections can include a lack of knowledge, insufficient trained personnel, inadequate funding, technological obsolescence, and the inherent fragility of storage media. Therefore, implementing effective digital preservation strategies within academic libraries is crucial for overcoming these obstacles. Robust strategies are essential to guarantee the future accessibility and integrity of digital library collections. It is within this context that this study aims to identify the digital preservation strategies for long-term accessibility of collections in academic libraries in North-Central, Nigeria.

Statement of the Problem

With the rapid progression of technology, many academic libraries have transitioned from physical, paper-based collections to digital formats. This significant shift offers numerous benefits, including enhanced accessibility, improved search capabilities, and greater cost-efficiency. However, it also introduces new challenges concerning the preservation and long-term availability of digital library collections. Preliminary observations by the researcher indicate that many academic libraries in North-Central, Nigeria, are struggling to develop comprehensive and effective digital preservation strategies for their collections. There is a noticeable absence of standardized practices, guidelines, and frameworks specifically designed to address the unique challenges of preserving digital library collections for sustained access.

The lack of robust digital preservation strategies poses considerable risks to the safeguarding of digital library collections. Unlike print media, digital materials are vulnerable to inadvertent destruction of their physical storage medium and the information they contain. Electronic texts are particularly susceptible to easy editing, manipulation, revision, and improvement, especially if not adequately secured or password-protected. Without proper preservation measures, digital library collections in academic libraries in North-Central, Nigeria, face risks such as format obsolescence, technological decay, and data loss. Consequently, these academic libraries may be unable to achieve their primary objective of meeting users' information needs through digital formats if digital preservation is not taken seriously. It is against this background that this study investigated the digital preservation strategies for long-term accessibility of collections in academic libraries in North-Central, Nigeria.

Objectives of the Study

The objectives of the study are to:

- i. determine the storage media that are used to preserve digital collections in academic libraries in North-central, Nigeria;
- ii. examine the strategies used to preserve digital collections in academic libraries in North-central, Nigeria;
- iii. identify the challenges faced in preserving digital collections in academic libraries in North-central, Nigeria.

Literature Review

Concept of Preservation and Digital Preservation

Preservation involves actions taken to ensure the enduring integrity and accessibility of various digital content, including documents, images, and videos. Abdullahi et al. (2024) define preservation as a branch of library and information science focused on maintaining or restoring access to artifacts, documents, and records through the study, diagnosis, treatment, and prevention of decay and damage. This concept should be differentiated from conservation, which pertains to the treatment and repair of individual items to slow deterioration or restore them to a usable

condition. Conservation is occasionally used interchangeably with preservation, particularly outside specialized professional literature (Tondo et al., 2022).

Digital preservation is a critical function of contemporary academic libraries, especially in the era of digital transformation. It involves the ongoing maintenance of digital content. Digital preservation is a comprehensive set of processes, activities, and digital information management practices implemented over time to guarantee the long-term accessibility of digital information. According to Abdullahi et al. (2024), digital preservation refers to a series of strategies, processes, and practices aimed at ensuring the longevity, accessibility, authenticity, and usability of digital content over extended periods. This includes protecting digital materials such as e-books, electronic journals, research data, multimedia content, digital archives, websites, and other forms of digital objects. Digital preservation is an continuous, proactive process that demands meticulous planning, adequate resource allocation, and specialized technical expertise (Barrueco and Termens, 2022). It necessitates collaboration among various stakeholders, including librarians, archivists, information technology professionals, and content creators, to effectively address the complexities of managing digital content. Through digital preservation, academic libraries and other institutions can safeguard their digital collections, thereby ensuring continued access to information and cultural heritage for future generations.

Strategies for the Preservation of Digital and non-digital Collections

It is important to recognize that academic libraries employ diverse strategies for preserving their collections to ensure long-term accessibility and utility for users. These strategies include:

Refreshing

Refreshing involves copying data from one storage medium to another of the same type. This method is crucial for preserving digital information resources, helping librarians securely store and maintain library information for future use. As technology evolves, libraries must copy information between media to ensure long-term preservation and continuous access (Abdullahi et al., 2024).

Migration

Migration is the process of transferring data to a new digital system, which includes converting resources from one file format to another. This is a widely used method that focuses on file formats,

striving to maintain digital objects in new formats to keep resources accessible (Formenton & Gracioco, 2020).

Cloud Storage

Cloud storage represents a significant method for preserving digital information resources. Tambe (2020) confirms that, for security reasons, cloud preservation of information resources is vital because it offers enhanced safety against accidents or hardware damage. This is because data is duplicated across virtual machines, and if one fails, the information is replicated on other machines in the cloud.

Encapsulation

Encapsulation is another strategy employed by libraries for preserving information resources. Deshpande (2016) explains that, in the context of non-print information resources, encapsulation refers to the act of grouping digital objects and data with all necessary components required to provide access.

Emulation

This process aims to preserve the original user experience of records by maintaining their appearance and style. According to Malekani and Wema (2024), the primary goal of emulation is not to focus on the digital object itself, but rather on recreating the hardware and software environment in which the object was originally integrated. Thus, it seeks to replicate the environment where the digital object was initially created.

Digitization

This process is undertaken to preserve rare and fragile collections by making them more widely accessible (Malekani and Wema, 2024). Therefore, digitization involves encoding information into a digital format to enable long-term access.

Problems and Challenges of Digital Preservation

As digital technology offers many advantages over the printed ones, Information technologies, as well as other related technologies such as the Internet and web, are always changing. It is difficult for academic libraries to keep up with the rapidly changing technology involved in digital preservation.

Fragility of the Media

The inherent fragility of digital media poses a substantial challenge to digital preservation efforts. Abdullahi et al. (2024) note that despite the unprecedented opportunities digital media offer for storing and accessing information, they are not immune to degradation and loss.

Hardware and Software Dependency

Digital content often relies on specific hardware and software for its accessibility. When these technologies become obsolete, accessing the stored digital content can become difficult, and sometimes impossible. Digital content is machine-dependent, requiring specialized hardware and software for data storage and retrieval (Abdullahi et al., 2024).

Natural and Man-Made Disasters

Digital media are susceptible to natural disasters such as fires, floods, earthquakes, and hurricanes, as well as man-made disasters like theft, vandalism, and cyber-attacks. These events can lead to irreversible data loss if not adequately protected. Additionally, factors such as inadequate funding, obsolescence of digital formats, insufficient technical expertise and knowledge, lack of standardized practices and guidelines for digital preservation, data corruption and loss, cyber-security threats, and potential data breaches all pose risks to the integrity of digital library collections. Frequent power failures and the absence of managerial support, along with sound rules and regulations governing digital preservation, were identified as challenges confronting the preservation of digital collections in academic libraries in North-Central, Nigeria.

High Costs of Preservation

Preserving digital content requires ongoing resources for storage, migration, and curation. Lack of funding and resources can hinder efforts to preserve digital materials effectively. As a result, many institutions may struggle to maintain and protect digital collections adequately (Rieger, et al, 2022).

Methodology

Research Design

The descriptive survey design was employed for this study. According to Iyypanda (2020), descriptive survey allows the researcher to collect and describe data on various variables and examine the relationships between them.

Population of the Study

The population of the study was 400 which consisted of librarians drawn from the university libraries in North-central, Nigeria. It consisted of federal, state and privately-owned university libraries.

Sample Size and Sampling Technique

The sample size of the study was 136 respondents. Multi-stage sampling procedure was adopted to stratify the university into Federal, State and Private universities.

Instrumentation

The research instrument that was used for this study was the questionnaire due to the nature of the subjects' study. The purpose of using questionnaire is to collect data on the digital preservation strategies for long-term accessibility of the collections in selected North-central, Nigeria academic libraries.

Validity and Reliability of the Instrument

The validity of the questionnaire was ensured through expert review by specialists in library and information science and measurement. Their feedback was used to refine the instrument, ensuring that it accurately measures the intended constructs. Reliability was established using a pilot study conducted using the librarians in Kashim Ibrahim Library, Ahmadu Bello University, Zaria. The Cronbach's Alpha coefficient was used to determine the internal consistency of the instrument.

Method of Data Collection

The researcher with the assistance of trained research assistants, administered the questionnaires directly to the respondents in the selected universities studied. Adequate time were provided for respondents to complete the questionnaires, and anonymity and confidentiality was assured to encourage honest responses.

Method of Data Analysis

The data collected for this study was analysed with the use of descriptive statistics. Descriptive statistical tools in form of percentages, frequency, mean and standard deviation was used to answer the research questions. The weighted mean was used as the benchmark or decision rule for agreeing or disagreeing.

Results and Discussion

Table 1: Storage Media Used to Preserve Digital Collections

S/N	Statements	SA 4	A 3	D 2	SD 1	$\bar{X}$	StD	Decision
13	The library use computers in the preservation of digital collections	41	60	15	5	3.13	0.63	Agreed
14	Cloud archival storage is used in the preservation digital collections	38	53	17	13	2.96	0.45	Agreed
15	The library use the Internet as media for preserving digital collections	35	64	17	5	3.07	0.56	Agreed
16	The library use external devices in the preservation of digital collections	22	18	53	28	2.28	0.22	Disagreed
17	Magnetic tapes are used in the preservation of digital collections in the library	16	10	54	41	1.98	0.51	Disagreed
18	Optical media are used by the library in the preservation of digital collections	33	51	20	17	2.82	0.33	Agreed
19	Spinning disk storage are used by the library in the preservation of digital collections	29	40	32	20	2.64	0.14	Agreed
Weighted mean						2.69		

Key: SA = Strongly Agreed, A = Agreed, D =Disagreed, SD = Strongly Disagreed

Table 1 presents the responses of librarians on the storage media used for the preservation of digital collections in academic libraries in North-central, Nigeria. Seven items were used to elicit information from the respondents, and the weighted mean score of 2.69 served as the benchmark for decision-making.

The results indicate that four out of the seven items recorded mean scores above the weighted mean, suggesting that several modern storage media are commonly used for digital preservation in the libraries studied. Notably, the statement “The library uses computers in the preservation of digital collections” recorded the highest mean score ($\bar{x} = 3.13$; $SD = 0.63$), indicating strong agreement among respondents that computers constitute the primary medium for digital preservation activities. This was followed by “The library uses the Internet as media for preserving digital collections” ($\bar{x} = 3.07$; $SD = 0.56$), reflecting the increasing reliance on network-based platforms for accessing and maintaining digital resources.

Table 2: Strategies Used to Preserve Digital Collections in academic libraries in North-central, Nigeria.

S/N	Statements	SA 4	A 3	D 2	SD 1	$\bar{X}$	StD	Decision
20	Implementation of metadata standards improves discoverability and usability of digital library collections	30	51	28	12	2.81	0.31	Agreed
21	Adoption of open and sustainable digital formats enhances long-term accessibility	38	49	20	14	2.92	0.41	Agreed
22	Continuous evaluation and adaptation of digital preservation strategies are necessary	38	47	21	15	2.89	0.39	Agreed
23	Collaborative partnerships with external organisations contribute to effective digital preservation	22	63	24	12	2.79	0.28	Agreed
24	Regular monitoring and auditing of digital preservation processes are essential	31	48	27	15	2.78	0.29	Agreed
25	Documentation and documentation maintenance practices support preservation of digital library collections	33	48	22	18	2.79	0.29	Agreed

26	Regular backups are performed to ensure data integrity and prevent data loss	32	52	21	16	2.83	0.32	Agreed
27	Refreshing digital library collection by periodical copying from one physical medium to another	28	54	22	17	2.76	0.26	Agreed
28	Technology preservation by replicating any old configuration of hardware and software	22	45	37	17	2.60	0.09	Agreed
29	Migration by transferring digital library collections from one generation of computer technology to a subsequent generation	34	49	25	13	2.86	0.35	Agreed
30	Emulation by preserving the original application program	28	47	25	21	2.68	0.18	Agreed
31	Encapsulation through creating the original application that was used to create or access the digital object on future computer platforms	30	44	28	19	2.70	0.20	Agreed

Weighted mean

2.78

Key: SA = Strongly Agreed, A = Agreed, D =Disagreed, SD = Strongly Disagreed

Table 2 reveals that twelve items were listed for librarians to respond on the strategies used in the preservation of digital collections. The result shows that eight items produced high scores above the weighted mean of 2.78. The items that have the highest mean are, “Adoption of open and sustainable digital formats enhances long-term accessibility” with a mean score of 2.92 and StD. 0.41. This is followed by “Continuous evaluation and adaptation of digital preservation strategies are necessary” with a mean score of 2.89 and StD. 0.39, “Migration by transferring digital library collections from one generation of computer technology to a subsequent generation” with a mean score of 2.86 and StD. 0.35, “Regular backups are performed to ensure data integrity and prevent data loss” with a mean score of 2.83 and StD. 0.32 and “Implementation of metadata standards

improves discoverability and usability of digital library collections” with a mean score of 2.81 and StD. 0.31 respectively.

Table 3: Challenges faced in the Preservation of Digital Collections

S/N	Statements	SA 4	A 3	D 2	SD 1	$\bar{X}$	StD	Decision
32	Obsolescence of digital formats poses a significant challenge to the long-term accessibility of digital library collections	37	54	20	10	2.96	0.47	Agreed
33	Insufficient technical expertise and knowledge hinder effective digital preservation practices	36	51	20	14	2.90	0.40	Agreed
34	Lack of standardized practices and guidelines for digital preservation is a challenge	38	56	20	7	3.03	0.53	Agreed
35	Data corruption and loss are major concerns in preserving digital library collections	32	51	23	15	2.82	0.32	Agreed
36	Cyber-security threats and potential data breaches pose risks to the integrity of digital library collections	50	35	20	16	2.98	0.47	Agreed
37	Lack of trained library personnel	13	18	53	37	2.06	0.44	Disagreed
38	Lack of preservation and conservation policy in academic libraries	9	14	56	42	1.92	0.58	Disagreed
39	Frequent power failure	41	48	20	12	2.98	0.47	Agreed
40	Inadequate funding of the academic library	50	45	13	11	3.07	0.57	Agreed
41	Poor library development initiatives	14	15	57	35	2.06	0.43	Disagreed
42	Absence of managerial assistance and sound rules	38	46	24	13	2.90	0.40	Agreed

and regulations guiding
digital preservation

Weighted mean

2.69

Key: SA = Strongly Agreed, A = Agreed, D =Disagreed, SD = Strongly Disagreed

Table 3 presents the responses of librarians on the challenges encountered in the preservation of digital collections in academic libraries in North-Central Nigeria. A total of eleven (11) items were used to elicit information on various technical, institutional, and infrastructural challenges. The decision rule was based on a weighted mean benchmark of 2.50, while the overall weighted mean of the table stood at 2.69.

The results reveal that eight (8) out of the eleven items recorded mean scores above the weighted mean of 2.69, indicating that respondents generally agreed that these factors constitute major challenges to digital preservation in academic libraries. Among the identified challenges, inadequate funding of the academic library ranked highest, with a mean score of **3.07** and a standard deviation of 0.57, suggesting strong agreement among respondents that financial constraints significantly hinder effective digital preservation efforts. This was closely followed by lack of standardised practices and guidelines for digital preservation (Mean = 3.03, SD = 0.53), indicating the absence of uniform procedures for managing and sustaining digital resources. Similarly, cyber-security threats and potential data breaches (Mean = 2.98, SD = 0.47) and frequent power failure (Mean = 2.98, SD = 0.47) were identified as critical challenges, highlighting technological and infrastructural vulnerabilities affecting digital collections.

Discussion

The study based on research question 1 revealed that the storage media used to preserve digital collections in academic libraries in North-central, Nigeria were mainly: through the use of computers, cloud archival storage and the use of Internet in the preservation of digital collections. This could be because libraries require these storage media in the digital preservation of library resources. This is in line with the findings of Mommoh and Saka (2019) who reported that the digital preservation of resources requires a reasonable number of ICT facilities such as computers, scanners, servers, printers, and other auxiliary storage media.

Findings based on research question 2 revealed strategies such as regular monitoring and auditing of digital preservation processes, regular backups are performed to ensure data integrity and prevent data loss, migration by transferring and documentation, and documentation maintenance practices support preservation of digital library collections were agreed among the respondents in the preservation of digital collections. On the other hand, refreshing digital library collection by periodical copying from one physical medium to another, technology preservation by replicating any old configuration of hardware and software, emulation by preserving the original application program and encapsulation through creating the original application that was used to create or access the digital object on future computer platforms were disagreed by the majority of the respondents as strategies used in the preservation of digital collections in academic libraries in North-central, Nigeria.

Research question 3 equally revealed that the respondents agreed with all the listed challenges encountered in the preservation of digital collections in academic libraries which include: inadequate funding, obsolescence of digital formats, insufficient technical expertise and knowledge, lack of standardized practices and guidelines for digital preservation, data corruption and loss, cyber-security threats and potential data breaches pose risks to the integrity of digital library collections, frequent power failure and absence of managerial assistance and sound rules and regulations guiding digital preservation with the exception of item 6, item 7 and item 10 respectively as presented in Table 4.6. These challenges affect the preservation of digital collection. This is in line with the findings of Osimetha (2019) who posited that inadequate funding remains a crippling problem in most institutions and the cost of making new purchases, and maintenance culture is another drawback for most institutions struggling to stay within budget allocations.

Conclusion

In conclusion, this study investigated the digital preservation strategies employed by university libraries in North-central, Nigeria, and offers valuable insights for ensuring long-term access to digital collections. The study revealed that certain strategies, such as implementation of metadata standards adoption of open and sustainable digital formats, continuous evaluation and adaptation of digital preservation strategies, regular monitoring and auditing of digital preservation processes, regular backups, migration and documentation maintenance were identified. The findings

emphasised the use of computers, cloud archival storage and the use of Internet to enhance digital preservation practices.

However, factors such as inadequate funding, obsolescence of digital formats, insufficient technical expertise and knowledge, lack of standardised practices and guidelines for digital preservation, data corruption and loss, cyber-security threats and potential data breaches pose risks to the integrity of digital library collections, frequent power failure and absence of managerial assistance and sound rules and regulations guiding digital preservation were identified as challenges confronting the preservation of digital collections in academic libraries in North-central, Nigeria.

Recommendations

1. The management of university libraries in North-central, Nigeria should develop robust mechanisms including magnetic tapes and spinning disk storage to ensure the authenticity and trustworthiness of digital collections. It is the responsibility of the library management to enhance and formalize guidelines for the long-term preservation of digital collections.
2. The management of university libraries in North-central, Nigeria should provide regular training by organising conference, workshops and symposia on digital preservation best practices, metadata management, and emerging technologies to enhance staff skills and confidence in managing digital collections.
3. The management of university libraries in North-central, Nigeria should allocate adequate funding for digital preservation initiatives. Additionally, they should provide alternative source(s) for power supply and develop good policies on preservation and conservation to checkmate cyber-security threats and potential data breaches, ensuring the integrity and security of digital collections.

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