

Librarians' Insights on Open Science and Research Data Management Practices for Sustainable
Library Services Delivery in Nigeria

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Abstract

In the evolving landscape of academic and research libraries, the adoption of Open Science (OS) principles and effective Research Data Management (RDM) practices are critical for sustainable library service delivery. This paper reports a study that explored the awareness and understanding of Librarians in Nigerian universities on the concept of OS and RDM. The study further investigated the current RDM practices and the challenges to the adoption and effective implementation of open science and RDM practices in some selected Nigerian university libraries. The study employed a qualitative approach using convenience sampling technique where participants were selected based on ease of access, availability, and willingness to participate. The participants comprised of experienced librarians with interest in open science and research data management drawn from six (6) universities in Nigeria. An interview protocol was developed and sent to participants seeking their consent, assuring confidentiality and anonymity. Asynchronous email interviews were conducted with each participant. The findings showed that the librarians have a basic awareness of Open Science principles, but their understanding is fragmented, with varying degrees of comprehension regarding the full scope of open science practices. The participants also believe that there are varying levels of understanding of RDM practices among library staff in Nigerian Universities. The findings further revealed that the University Libraries

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are at varying stages in adopting RDM practices. Whereas three (3) University Libraries have made significant progress in the adoption of RDM practices, two (2) are in their early phases, while one (1) is yet to adopt any RDM in their services. The key challenges to RDM practices identified included technological limitations, absence of policy frameworks, insufficient training, and cultural resistance to data sharing and open access practices. Finally, the study recommends the need for developing robust institutional OS and RDM policies, strategic investment in infrastructure including institutional repositories (IR) and continuous capacity-building initiatives for librarians to ensure that libraries can fully support open science and research data management activities in Nigerian universities.

Keywords: Open Science, RDM, Awareness, University Libraries, Nigeria.

Introduction

Open Science and Research Data Management have become increasingly important in recent years, as they can enhance research transparency, reproducibility, and collaboration. Open Science movement aims to make scientific research, data, code, and publications freely accessible to everyone without barriers thereby, promoting transparency, collaboration, and reproducibility in research to increase the accessibility and impact of scientific knowledge (Chiwere & Lockhart, 2023). This movement encompasses various principles, such as open access, open data, open methodology, and open peer review. Thus librarians, as information professionals, play a crucial role in promoting and supporting open science practices. Librarians who are aware of open science principles can support researchers and promoting open science practices within their institutions. They can also help researchers to understand the benefits of open science, provide guidance on how to make their research outputs more open, and facilitate access to open science resources.

On the other hand, research data management practices concerned with the organization, processing, documentation, storage, and preservation of research data emanating from research process be it in the form of raw data, numerical, observational, experimental, documentation, *Bayero Journal of Information Management, Maiden Edition. 2024* <https://bjim.com.ng>

images, audio, video, lab notebooks or processed data that is being published in journals or books. Kanza & Knight (2022) stated that behind every great research project is great data management. They emphasize that a research project without proper research data management (RDM) is akin to building a house without laying the foundations. Good RDM is critical to the success of a research project; however, it is an element that is often neglected even when required by funding bodies. Planning your RDM needs to take into account not just the current moment, but considering how you will look back on your information in several years or how you might be able to share the information with colleagues, possibly across multiple disciplines, in a form that they can easily understand.

If researchers are to strive for reproducible science that adheres to the principles of Findable Accessible Interoperable Reusable (FAIR), then they need to manage the data associated with their research projects effectively. It is imperative for any researcher to plan RDM strategies early on, and setup project organisation before embarking on the work. There are several different factors to consider: data management plans, data organisation and storage, publishing and sharing data, ensuring reproducibility and adhering to data standards. This pave ways to open science where researchers are expected to make their research findings or output public, by publishing it on open access platforms. The open science practices encompasses publishing open research, campaigning for open access movement, encouraging scientists to practice open-notebook science (such as openly sharing data and code), broader dissemination and engagement in science-and generally making it easier to publish, access and communicate scientific knowledge (Open Science, 2024). While awareness of open science principles is increasing among librarians in advanced world (Adamu, *et al.* 2024) observed that this area is still not fully explored in developing nations like Nigeria. Librarians may face challenges in implementing open science and research data management practices due to lack of awareness, understanding, institutional policies, technical limitations, or cultural barriers. This is what prompted the researchers to investigate librarians' *Bayero Journal of Information Management, Maiden Edition. 2024* <https://bjim.com.ng>

level of awareness and knowledge regarding open science and research data management practices in Nigerian University libraries.

Statement of the Problem

Open science and research data management practices promote research transparency, reproducibility, and accessibility globally. University libraries around the world are integrating these practices into their library service delivery. Nigerian university libraries do spend a huge amount of money in subscribing to different online databases amidst the scarcity of quality research materials. However, leveraging on effective research data management and open science practices will make research findings, articles, journals, books and other non-printed resources readily available for use, and reuse by community of researchers. To achieve this, librarians need to be aware of and understand open science concept and research data management practices. It appears that few librarians understand the issue of research data creation, storage, preservation, and access up to the end of the data lifecycle. Studies have shown that awareness and adoption of open science and research data management principles are still limited in many Nigerian universities. This is often due to factors such as lack of awareness, inadequate infrastructure, and resistance to change (Ofua, 2023). It is for this reason that the researchers investigated open science and research data management practices for library services delivery in Nigerian universities.

Research Objectives

The research objectives are:

1. To assess the level of awareness and understanding of librarians in Nigerian university libraries on the concepts of Open Science and RDM practices.
2. Assess the current RDM practices in Nigerian university libraries, and level of knowledge of library staff
3. To identify challenges hindering the adoption and implementation of open science and research data management practices in Nigerian university libraries.

4. Provide recommendations based on research findings to enhance the adoption of OS and RDM practices in university libraries.

Literature Review

Open Science represents a philosophy and set of practices aimed at making the entire research process more transparent, accessible, and accountable. It encompasses a range of initiatives, including open access publishing, data sharing, and open-source software development (Ng, et al., 2024). Open Science (OS) is the movement to make scientific research, data and their dissemination available to any member of an inquiring society, from professionals to citizens. It impinges on principles of scientific growth and public access including practices such as publishing open research and campaigning for open access, with the ultimate aim of making it easier to publish and communicate scientific knowledge. From development to dissemination of knowledge, several concepts belong under the umbrella term of 'Open Science' (*What Is Open Science?* 2020). Thus, the open science can be seen as a movement that makes scientific research data, findings, and publications freely available and accessible on the public Internet for everyone to access, use, and reuse. It can also be shared in a transparent and reproducible manner as well as to promote collaboration and enhance scientific progress.

In an effort to promote open science awareness, the Library Support for Embedded NREN Services and E-infrastructure organized a symposium in Nigeria to enhance the infrastructure and avenues for publishing and disseminating Nigerian research. This includes a specific emphasis on elevating its visibility and impact in alignment with the broader goals of participating organisations such as the Directory of Open Access Journals (DOAJ) and the Directory of Open Access Books (DOAB). These organisations are instrumental in promoting open access, ensuring publication quality and bolstering the infrastructure necessary for global accessibility of academic works. The event held on September 13th and 14th, 2024 in Nigeria covering critical open science matters,

including policy awareness, an open research commons and feature break-out sessions on capacity building, infrastructure, funding and governance.

This kind of awareness introduces participants on how to replace the current scientific publishing model with open science movement. A key step in making science open and transparent is open access to research data, also known as open data. As research is more and more data-driven, progress in scientific knowledge becomes intimately tighten to data availability. Open data policy enables researchers to make use of existing knowledge in innovative, complementary ways. ORION Open Science, (2024) stated that new organizations and not-for-profit research and educational institutions are experimenting and adopting the open access paradigm: the Public Library of Science (PLOS) supports a library of open access journals and scientific literature, arXiv provides electronic preprints across many fields, from computer sciences to quantitative biology, F1000Research is a platform offering immediate publication of life sciences articles and other research outputs with no editorial bias, and bioRxiv is a free online archive and distribution service for unpublished preprints in the life sciences.

One of the core principles in scientific research is the reproducibility of data, yet it continues to pose significant challenges. Issues such as poor data quality and unclear methodology make it difficult to validate research findings. Successful validation can only occur when independent researchers are able to replicate the results. An answer to this reproducibility issue is sharing research data and other science practices. The open research approach contributes to overcome low reproducibility by making science more reproducible. Several influential journal publishers as Nature, PNAS, PLOS, and Science already have data sharing policies and guidelines (What is Open Science?, 2020). The key principles of open science are making research publications freely available online, sharing research data in accessible and reusable formats, describing research methods and protocols in details, sharing software and code used in research, clearly reporting research procedures, materials, and limitations, enabling others to replicate and

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verify research findings, encouraging cooperation and knowledge-sharing among researchers, and involving the public in research process. This is where research data management (RDM) plays a significant role of ensuring that researchers adhere to the policy of data management plans.

Research data management (RDM) enables researcher to have data management plans (DMPs) from the onset. DMPs is about following each steps of data lifecycle where the researcher will state how to collect, care for, use, preserve and share the data that support research. Thus, the key elements of RDM include how to store data and back them up effectively so that they are protected against corruption and loss; how to organize data, using meaningful file names and logical folder structures, and applying version control to modified files; how to apply quality control to your data workflow, so that their integrity is maintained and the incidence and impact of error is minimised; how to document data, so that you (and others) can understand what the data are, how they were collected /generated, and how they have been processed and analysed; how to process personal and confidential data, to ensure you are meeting the requirements of the Data Protection Act and your ethical obligations; and how to preserve and share data so that they can be consulted and re-used by other researchers, usually by using suitable data repositories (*What Is Research Data Management?*, 2023).

Data organization and storage will shape researchers capability to find, manage, publish and re-use data easily when need arise. But, randomly naming files and putting in a haphazard folder structure will not benefit either researchers or anyone looking for such data to use in their research. Poor data management can lead to data breaches and subsequently, unsuccessful and potentially harmful research projects. Managing your data well and planning how to achieve this from the start is absolutely key to a successful research project and is often a requirement of Research Application Funding Bodies. In order to achieve this, a Data Management Plan (DMP) should be created which outlines how the data is going to be managed throughout the entire project lifecycle (Kanza & Knight, 2022). Data publication and sharing is another very important issue in *Bayero Journal of Information Management, Maiden Edition. 2024* <https://bjim.com.ng>

research data management and it is expected that librarians should have these skills to assist researchers make their research visible.

Historically, librarians are known for identifying, acquiring, cataloging, organizing, storing, preserving, and creating access to stored information resources in the library. But with the coming of technological advancement, this expertise has forcefully been reshaped to accommodate new skills. The specific role of librarians (and libraries) in research data management is in the areas of advocacy, support services, data literacy training, data citation, metadata, managing data repositories, and making a case to university management on the importance of RDM to researchers and institutions (Abduldayan, 2020).

The research data created need to be stored for long-term preservation. Data storage is all about securing activities along with supporting technical infrastructure. Dataworks (2022) stated that, once data has been created within the institution, it needs to be stored and protected, with the appropriate level of security applied. Pointing out that, a robust backup and recovery process should also be implemented to ensure the retention of data during the lifecycle. It is expected that universities should be able to provide much greater capacities of research data storage so that librarians will be able to help researchers with the hands-on or technical aspects of depositing data in a repository such as migrating data to best format, migrating data to suitable medium, back-up, and store data, creating or verifying metadata and documentation and archiving. Support services do not only stop with the assistance of researchers on how to develop Data Management Plans (DMPs) and metadata, but they also include data citation, archiving, and sharing or accessibility.

Data accessibility or sharing is all about making the research data available publicly by publishing it in an institutional repository or on open platforms for further use and reuse. When data is accessible, different researchers can use it to support their research findings. The more data a researcher has access to, the more statistical power they have to validate research conclusions

and forestall questions of data quality. Ensuring data availability and secure data accessibility is more relevant to universities today than it was in the past (Adamu, *et al.* 2024).

Keeping research data freely available is crucial for open science and ideally, librarians and other stakeholders should think through structured approaches to grant data access to different stakeholders, both internally and externally. These approaches are reinforced by permissions and security levels based on roles or responsibilities documented in data governance policies. Librarians can enhance data access by helping researchers to deposit their research output in an institutional repository, establish copyright issues, control access, and authorize capability for users to be able to retrieve data in an authenticated manner as approved by the institutions that own the data.

Research Method

Qualitative research methodology was employed using survey design that allows the researcher to explore the experiences and perspectives of each respondent in detail, gathering rich qualitative data. Non-probability sampling was applied using the purposive **sampling techniques** in selecting 6 participants in order to understand the central phenomenon through the use of asynchronous email interview. This method allows exchange of information repeatedly online between researcher and participant within a particular time-frame (Ratislavová & Ratislav, 2014). The justification of using this method was due to convenience or ease of access to participants. Thus, the participants were experienced librarians, comprising of Heads of library departments/units, e-librarians/ ICT librarians etc with interest in open science and research data management, drawn from six university libraries namely; Federal University Kashere (FUK), Usman Danfodio University, Sokoto (UDUS), Federal University, Wukari, Kaduna State University (KASU), Northwest University, Kano, and Maryam Abacha University, Kano. Interview protocol was developed and sent to the targeted participants seeking their consent for participation as well as assuring the participants confidentiality and anonymity. Semi structured

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interviews via emails were scheduled and held with each participant from 16th August, to 25th September, 2024. Content analysis was adopted using thematic analysis technique that identified recurring themes and patterns across the emails by coding different parts of the text for meaning and grouping them into relevant categories. This helped in identifying and understanding the overall attitudes, experiences, and opinions expressed by the participants.

Results and Discussions

Background Information of Respondents

Participants were asked the full name of their institutions, libraries, role, and their working experience to gather background information about the participants and the responses received are presented in table 1.

Table 1
Background Information of Participants and Codes

Institution	Library	Code	Role	Working Experience
Kaduna State University, Kaduna (KASU)	KASU Library	D1	Head of Research Support Division	13 Years
Federal University Kashere (FUK)	FUK Library	D2	Head Reference and Information Service Division	10 Years
Yusuf Maitama Sule University, Kano (YUMSUK)	Sule Hamma Library	D3	Head of E-Library Department	12 Years
Maryam Abacha University Kano–Nigeria (MAAUN)	Murtala Ramat Muh'd Library	D4	Ag. Librarian	3 Years
Federal University Wukari (FUW)	Prof. Ababakar Adamu Rasheed Library	D5	Head Readers' Services Division	9 Years
Usmanu Danfodiyo University, Sokoto	Abdullahi Fodiyo University Library	D6	Head ICT Librarian	15 Years

Table 1 gives some background information on the participants including the codes assigned to the participants of each institution. It is clear that the respondents are from different type of universities within the two Northern geopolitical zones of Nigeria (Northwest and Northeast). There are different types of university that comprised of private, state and federal universities. Most of the respondents hold significant leadership roles, such as Heads of various library divisions (e.g., Research Support, Reference and Information Service, E-Library Department). This suggests that they are likely to have substantial influence over library policies and practices, particularly regarding Open Science and Research Data Management (RDM).

The participants' working experience varies from 3 to 15 years, with an average experience of around 10 years. This indicates that the participants possess a considerable amount of professional experience, which likely contributes to their understanding and perspectives on Open Science and RDM practices. Indeed, the varying levels of experience and roles may lead to a rich discussion about the current state of library services in relation to Open Science and RDM, as well as the necessary steps for improvement.

Awareness and Understanding of Open Science and RDM

Understanding on concept of open Science and RDM

Participants were asked to briefly explain their understanding of the concept of Open Science and RDM. The responses received were as follows:

D1: "Open Science refers to the practice of making scientific research, data, and dissemination accessible to all levels of society.Research Data Management (RDM) involves the organization, storage, and sharing of data collected and used during research. I believe both concepts are crucial for enhancing collaboration and transparency in research".

D2: "...a way of making scientific research accessible and open to researchers and it is related to research data management".

D3: "Open science could be seen as a situation whereby researchers are expected to publish their research findings on open access repository for further use and re-use while research data management is the process of management research data right from its inception up to the end of its lifecycle."

D4: "...the Process of converting print 'resources into electronic format to make it available online. So that it can be easily accessible via the Internet".

D5: “open science is simply concerned with openness, availability, and access to research data”.

D6: “Open science is the process of encouraging researchers to publish their research findings on open access platforms while the research data management aimed at ensuring data management”.

The responses given above shows that while the participants do generally understand the basic concepts of Open Science (OS), their comprehension remains fragmented and often limited to specific aspects like data accessibility and Research Data Management (RDM).

For instance, D1 and D3 clearly identify that Open Science involves making research and data publicly accessible, with D3 specifically focusing on the reuse of research outputs in open repositories. These respondents acknowledge that OS supports transparency and collaboration.

However, D2 and D5 understood Open Science as a system for increasing accessibility and openness in research although they have not gone deeper into its broader components such as open peer review. In the same vein, D4 misunderstood Open Science with digitization whereby equating OS with converting print resources into digital format, which points to a misconception.

Similarly, D6 had mentioned encouraging researchers to use open access platforms but focuses more on the operational aspect rather than on broader principles like open licensing and open educational resources.

The implication of these findings generally suggests that while the participants have a general awareness of Open Science (OS), their understanding is fragmented and often limited to aspects like accessibility and research data management (RDM). Most participants correctly link OS with RDM, recognizing its role in enhancing research accessibility and collaboration, but there are misconceptions, such as confusing OS with digitization efforts. The results highlight a need for targeted training to broaden their understanding of OS principles beyond just data accessibility, enabling librarians to effectively support OS practices and become key enablers of research transparency and openness.

Benefits of RDM Practices to Researchers

In order to have more insights on librarian's knowledge on RDM, the Participants were further asked to explain the benefits of research data management practices to researchers. The responses received were as follows: -

D1: "It enhanced data sharing and collaboration opportunities. Improved data organization and retrieval. Compliance with funding agency requirements. Increased visibility and impact of research outputs and Long-term preservation of valuable research data".

D2: "Improving research quality, better research engagements, and increased research collaboration".

D3: "Research data management practices improve research efficiency; improve data protection and reduce data lost; as well as increased data availability and citation".

D4: "Research data management practices saves the time, energy, resources, making it easier to share, access and accountability".

D5: ".... access, increased research output, improve research activities, and promote research collaborations as the benefits of research data management practices in universities".

D6: "Improved research productivity, research visibility, and research discoverability as some of the benefits of research data management practices to researchers".

The participants identified several key benefits of research data management (RDM) practices for researchers. A number of the participants, including D1, D2, and D5 mentioned that RDM practices *improves data sharing and collaboration*. This includes increased opportunities for researchers to share data with colleagues and collaborate on joint projects. Other benefits mentioned were *improved research quality, efficiency, and productivity, better data protection, and reduced data loss* (D2, D3, D6). Besides, RDM was seen to *save time, energy, and resources*, while *facilitating access and accountability* by D4. RDM was also mentioned as *promoting research visibility, and discoverability* (D6).

Overall, respondents acknowledged that RDM plays a critical role in improving research quality and accessibility. However, the varying depth of responses suggests that some librarians may lack in-depth knowledge of best practices in RDM.

Role of Open Science and Research Data Management towards Sustainable Library Service Delivery

Participants were further asked on how they see open science and research data management practices towards contributing to sustainable of library service delivery.

The responses were as follows: -

D1:- *“Open Science and RDM can contribute to sustainable library services by fostering a culture of sharing and collaboration..... it enhances the library's relevance by positioning it as key players in supporting research excellence. The participants expressed that opportunities for Nigerian university libraries may include “forming partnerships with research institutions, participating in national and international Open Science initiatives, and seeking funding for RDM projects.” Thus, the participant further recommends increasing awareness and training opportunities for both library staff and researchers on Open Science and RDM.establishing dedicated teams for RDM initiatives could also help drive these practices forward”.*

D2:- *“Open Science and RDM can contribute to sustainable library services towards the betterment of research engagement.....open science and research data management will open unprecedented opportunities to further enhance information science delivery and make the library more relevant to researchers.”*

The participant further recommended providing training and support to the library and institutional staff, invest in RDM practices and encourage open science practices as well as the establishment of data management planning standards.

D3 *“Open Science and RDM can contribute to the sustainability of library services delivery in so many ways. Hence, Nigerian university libraries should embrace and promote the advancement of open science and RDM practices in order to remain the university repository centers.”*

The interviewee recommended that librarians need to be train on these new trend to better serve its community of users.

D4: *“Open Science and RDM can contribute to the development of library services delivery but they are yet to start these services in their library”.*

D5: *“Open Science and RDM can enhance global access, create opportunity for collaboration to enhance scholarship.”*

The interviewee equally recommended for awareness creation among both researchers and library staff”.

D6: *“Open Science and RDM can improve library sustainability more especially in this digital age where the library is opportune to create different kind of services that will win mind of their users.....Nigerian university libraries can form partnerships and collaboration with faculties, departments and faculty members towards their research activities.”*

The participant also recommends that management should provide training and re-training of both academic staff, students and library staff to ensure the sustainability of these initiatives.

Participants widely agree that OS and RDM have the potential to sustain and enhance

library services by fostering collaboration, relevance, and innovation. Most participants (D1, D2, Bayero Journal of Information Management, Maiden Edition. 2024

D5, and D6) recognize that OS and RDM foster a culture of sharing, collaboration, and engagement with the academic community. This collaborative environment positions libraries as critical players in research excellence, ensuring that they remain relevant to both researchers and institutions. Participants see opportunities for Nigerian university libraries to build partnerships with research institutions and engage in international OS initiatives, positioning libraries as essential research support hubs.

A common recommendation from participants (D1, D2, D3, D5, and D6) is the need for increasing awareness and providing training opportunities for library staff, researchers, and academic communities. This highlights the gap in knowledge and skills, emphasizing the importance of capacity building to implement OS and RDM effectively. Establishing dedicated RDM teams and standards for data management are seen as crucial steps toward institutionalizing these practices.

Current Practices on OS and RDM in Nigerian Libraries

Support for Open Science and Research Data Management Practices

In order to have some understanding on OS and RDM practices in their libraries, participants were asked to explain how their library currently supports researchers in terms of open science and research data management activities. The responses received were as follows: -

D1: *“Providing access to online resources, offering workshops on data management, and facilitating discussions about open science initiatives, assist researchers with the deposition of research outputs in institutional repositories.”* The interviewee expressed further that, they recently *“implemented a data management planning service to help researchers create data management plans for their projects.”* and their library’s future plans included *“Developing a comprehensive guide on open science practices.”*

The library also plays a supportive role in RDM by *“providing guidance on best practices, offering training sessions on data management tools, and assisting researchers in archiving their data.”*The library has a framework for data preservation, which includes backing up datasets on secure servers. *“However, we are in the process of formalizing our data sharing practices and establishing clearer guidelines.”* *“we equally*

have an institutional repository where researchers can deposit their research data and publications”.

D2:- *..... “have not yet started providing these kind of supportive services to researchers” but they are working towards that because they have infrastructure in place for hosting institutional repository”.*

D3:- *“.....library supports researchers towards published their research findings in an open access platform such as Research Gate and Google scholar”.*

The university has a policy where researchers must submitted their research publications on Research Gate and Google scholar platform for visibility. Also the library provides research data management related services to users where

“... we use to organize workshops for PG and Level400 students every year on academic project writing, with a view to creating awareness and imparting skills on good research data management practices”

Although we do not have a functional repository in place at the moment, the university has set up an institutional repository planning committee, with good representation from the library, which is working towards the implementation of a functional repository for the university”.

D4:- *“We have not yet started providing these services.... but hoping to start it in a nearer future”.*

D5:- *“Providing access to available information resources, pre-registration of articles, open educational resources, open peer review, open access publishing, access to a functional institutional repository in place....”.*

D6:- *“We provide researchers with research supportive services in the form of data analysis, data presentation, data virtualization, research data publishing and other technical aspect of data management..... we have a written policy document that guide research publications..... Organize training programmes for researchers..... we also have a functional institutional repository”.*

A look at the data from the participants given above has shown varying levels of activities of support for Open Science (OS) and Research Data Management (RDM) practices across the university libraries. While some libraries actively support researchers by providing access to online resources, offering workshops, data management planning services, and institutional repositories for research output (D1, D5, D6). Others have not yet fully adopted/implemented these services but are working towards establishing repositories and offering supportive infrastructure (D2, D3). Yet certain libraries are still in the planning stages with no formal OS or RDM services (D4). Likewise, libraries that offer services also provide data analysis, visualization, and open access publishing, with a focus on improving visibility and research impact (D5, D6). However, some institutions lack functional institutional repositories but have infrastructure in place and future

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plans to address these gaps (D3). Overall, there is a mix of established and emerging support for OS and RDM, with some libraries more advanced in their offerings than others.

4.3.2 Level of Knowledge among Library Staff on RDM Practices

Participants were asked whether they believe library staff are knowledgeable about research data management and if yes, to what extent. The responses were as follows: -

D1: “.... library staff have a basic understanding of Research Data Management, but the level of knowledge varies. Some staff members have attended workshops and training sessions, while others rely on self-study or peer learning”.

D2: “.... library staff are not knowledgeable enough on research data management practices”.

D3: “Library staff are not knowledgeable enough in research data management practices”.

D4: “....library staff lack knowledge of research data management practices”.

D5: “library staff are knowledgeable of providing research data management practices”.

D6: “This library staff have knowledge of providing research data management practices”.

The responses indicate varying levels of understanding and knowledge on research data management (RDM) among library staff. While one participant opined that some staff have a basic understanding, enhanced through workshops or self-study (D1), others expressed concerns about inadequate knowledge (D2, D3, D4). However, a few participants (D5, D6) believe that library staff are knowledgeable enough to provide RDM support. Overall, the findings suggest inconsistent knowledge levels, with some staff better informed due to training, while others lack sufficient expertise in RDM practices.

Challenges to the Adoption of Open Science and Research Data Management Practices in Nigerian University Libraries

Participants were asked to describe the challenges their library faces in adopting open science and research data management practices. The responses were as follows: -

D1: “This interviewee stated that, the use of their institutional repository is very low. Other challenges they faced include “limited funding for training and infrastructure, varying levels of understanding of RDM among staff and researchers, and resistance to change in established research practices”.

- D2:** “...infrastructure and technical limitations, lack of incentives and rewards, data poor quality, and inadequate funding for sustainability of open science and research data management practices.
- D3:** “...lack of awareness, staff negative attitudes, lack of technical skill on the side of librarians, lack of policy, lack of funds, and poor management support as some of the factors hindering adoption of open science and research data management practices in Nigerian university libraries.
- D4:** “.....lack of policy, and limited staff skills as some of the challenges hindering the adoption of open science and research data management practices in Nigerian university libraries.
- D5:** “....inadequate funding, erratic power supply, inadequate ICT facilities, policy issue, poor Internet connectivity, and lack of training as some of the challenges hindering the adoption of open science and research data management practices in Nigerian university libraries.
- D6:** “.....lack of funds, adhering to policy statement, poor Internet access, lack of awareness among librarians and researchers, technical issues, lack of collaboration, compatibility issues, and time constrained affect the adoption of open science and research data management practices in Nigerian university libraries”.

The participants identified several challenges hindering the adoption of Open Science (OS) and Research Data Management (RDM) practices in Nigerian university libraries. Common issues include inadequate funding for training, infrastructure, and sustainability (D1, D2, D3, D5, D6), as well as technical limitations such as poor Internet connectivity, erratic power supply, and insufficient ICT facilities (D5, D6). Other barriers include a lack of policy frameworks, low awareness, limited staff skills, and resistance to change among researchers and staff (D1, D3, D4, D6). In addition, some libraries face challenges with low usage of institutional repositories, poor management support, and negative attitudes toward new practices (D1, D3, D6). Overall, these factors collectively hinder the full adoption of OS and RDM practices, with financial, technical, and awareness-related issues being the most significant obstacles.

Summary of Findings.

1. The findings indicate that Librarians in Nigerian university have a basic awareness of Open Science (OS) and RDM but their understanding is fragmented, often limited to aspects like accessibility and research data management (RDM).

Most participants link OS with RDM, recognizing its importance in improving research accessibility and collaboration, though some misconceptions exist, such as confusing OS with digitization. Moreover, perceptions about staff and researchers' awareness of OS principles vary, with some participants noting moderate awareness and engagement, while others highlight low or inconsistent levels of understanding. Overall, awareness of OS principles is uneven across institutions.

2. The findings reveal varying levels of understanding of research data management (RDM) practices among library staff in Nigerian university libraries. While some staff have gained basic RDM knowledge through workshops and self-study, others demonstrate insufficient expertise. A few participants believe staff are knowledgeable enough to support RDM, but overall, the knowledge levels are inconsistent. The benefits of RDM for researchers are widely acknowledged, including improved data sharing, collaboration, and organization, compliance with funding requirements, long-term preservation, and increased research visibility. Furthermore, RDM enhances research quality, efficiency, and accountability, while reducing data loss and saving resources.
3. The study findings further revealed that Nigerian university libraries exhibit varying levels of support for Open Science (OS) and Research Data Management (RDM) practices. While some libraries actively provide resources, workshops, and institutional repositories to support researchers, others are still in the planning stages or working towards establishing these services. Some libraries also offer additional services like data analysis, visualization, and open access publishing to boost research visibility and impact. Despite the differences, participants generally agree that OS and RDM are vital for sustaining and enhancing library services, fostering collaboration, and increasing library relevance in research activities. There is a consensus on the need for increased training and awareness to fully integrate OS and RDM into library services.

4. The findings highlight several challenges hindering the adoption of Open Science (OS) and Research Data Management (RDM) practices in Nigerian university libraries. Key obstacles include inadequate funding for training and infrastructure, technical limitations such as poor Internet connectivity and power supply, and insufficient ICT facilities. Also, low awareness, limited staff skills, resistance to change, lack of policy frameworks, and poor management support further impede adoption. These financial, technical, and awareness-related issues collectively slow the implementation of OS and RDM practices.

Conclusion

The study highlights the varying degrees of adoption and support for Open Science (OS) and Research Data Management (RDM) practices across Nigerian university libraries. While some institutions have taken significant strides by offering robust support through workshops, institutional repositories, and data management services, others are still in the early stages of implementation. The findings underscore the critical role OS and RDM play in enhancing research visibility, fostering collaboration, and ensuring sustainable library services provision in the digital age. However, the challenges of inadequate funding, technical limitations, and lack of awareness present significant barriers to widespread adoption. To fully realize the potential of OS and RDM in supporting sustainable library service delivery, there is a clear need for increased and strategic investment in infrastructure, training, and policy development. Tackling these challenges, will help Nigerian university libraries position themselves as essential partners in advancing research excellence, collaboration, and global accessibility, thereby ensuring their continued relevance and impact in the academic community.

This study highlights the need for Nigerian university libraries to actively engage in OS and RDM practices to support sustainable research and academic services. Strategic investments in infrastructure, training, and policy development are crucial for integrating these practices into

library services. Future research should explore librarians' roles in shaping institutional policies on OS and RDM.

Recommendations

1. Library administrators in Nigerian universities should implement targeted and continuous training programs to enhance librarians' understanding of Open Science (OS) and Research Data Management (RDM) principles. These programs should go beyond accessibility to cover broader aspects of OS and equip librarians with the necessary skills to effectively support researchers and library users.
2. Universities should prioritize the development of comprehensive OS and RDM services by strategically investing in digital infrastructure, establishing institutional repositories, and formulating clear policies to support sustainable implementation.
3. There is the need for academic staff and other researchers in Nigerian Universities to actively engage with OS and RDM initiatives by collaborating with librarians, adhering to institutional policies on data sharing and management, and participating in training programs to improve data literacy and research integrity.

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