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Research Data Management in University Libraries: Evidence from Nigeria

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This study provides a comprehensive assessment of Research Data Management Services (RDMS) in Nigerian University Libraries, exploring the current landscape, challenges, and prospects. Analyzing data from 55 librarians in the Niger Delta region, the study reveals a varied delivery of RDMS, with notable gaps attributed to limited librarian skills and inadequate technological infrastructure. While basic infrastructure exists, task-specific enhancements are needed for robust RDMS. Additionally, the absence of widespread RDM policy frameworks suggests a need for strategic planning. The competency level of librarians is generally high, but continuous upskilling is crucial. Perceived challenges, including funding constraints and administrative support, mirror broader issues in technology adoption. Acknowledging study limitations, future research should expand to a national context, offering a more nuanced understanding of RDMS challenges and practices.

INTRODUCTION

Research catalyses societal transformation, fostering development globally across various facets of human activity. Through the generation of new knowledge, research not only addresses existing knowledge gaps but also introduces innovative approaches to problem-solving, thereby contributing to the betterment of societies worldwide. Research is pivotal in offering enhanced solutions to pressing global challenges such as climate change, food shortages, biomedical complexities, and sustainable energy use (Ludwig et al., 2022). The resulting stockpile of knowledge provides nations, communities, organizations, and individuals with a competitive advantage, fueling an ongoing quest for further research endeavours.

The worldwide landscape of research production has witnessed a significant upsurge across diverse disciplines, with a notable emphasis on innovative approaches to addressing real-life problems, particularly in the Global South. According to the International Association of Scientific, Technical and Medical Publishers (STM), a 2014 comprehensive report identified approximately 28,100 active scholarly and peer-reviewed English-language journals. These journals collectively published around 2.5 million articles annually (Ware & Mabe, 2015). Subsequent STM reports in 2018 revealed a steady yearly growth of 4% in the number of articles and a 5% annual increase in the number of journals (Johnson et al., 2018).

Initiatives like Research4Life play a pivotal role in enhancing global access to scientific publications. As of 2015, Research4Life provides approximately 7,700 institutions across 109 developing countries with free or low-cost access to over 30,000 journals from 180 countries, along with other full-text resources (Ware & Mabe, 2015). This increased accessibility has not only democratised knowledge but has also led to a noteworthy surge in research output within developing regions. Researchers in these areas now benefit from a heightened ability to contribute meaningfully to the global pool of knowledge. A paper that examined science productivity in nine

developing countries, reveals that these nations are narrowing their science gap as their Research and Development (R&D) investments and scientific impact are expanding at a rate exceeding twice that of the developed world (Gonzalez-Brambila et al., 2016).

Universities globally are currently facing the challenges associated with the substantial production of research data, necessitating effective Research Data Management (RDM). Accordingly, there is a recognized imperative to oversee data generated at every stage of the research process (Elsayed & Saleh, 2018). Leveraging their inherent service capabilities, university libraries have strategically positioned themselves to undertake Research Data Management Services (RDMS). These encompass functions such as data depository services and metadata creation (Yoon and Schultz, 2017), research advisory services (Flores et al., 2015), preservation of research data (Boté-Vericad & Healy, 2022), data storage (Ashiq et al., 2020a), research data curation (Darch et al., 2020), and research data sharing (Sheikh et al., 2023). The comprehensive scope of these services substantiates the assertion that RDM squarely falls within the operational purview of university libraries. Consequently, university libraries worldwide are actively and purposefully engaging in RDM initiatives.

RDM, as defined by Whyte and Tedds (2011), encompasses the systematic organisation of data from initial entry into the research circle to the subsequent sharing and storage of valuable results. This multifaceted process, integral to the entire research lifecycle (Cox & Tam, 2018), involves various activities, including the design and creation of data, storage, security, preservation, retrieval, sharing, and reuse. As emphasized by Cox and Pinfield (2014), these activities necessitate consideration of technical capabilities, ethical considerations, legal issues, and governance frameworks. The overarching goal, according to Chawinga and Zinn (2021), is to ensure the preservation, accessibility, and utilisation of data for as long as it remains relevant and valuable.

The escalating growth of research activities globally, particularly in developing countries, has led to a proliferation of available data. However, this surge is accompanied by challenges such as data falsification, incomplete data, and difficulties in consolidating data into a unified storage system conducive to easy retrieval and recall. Ware and Mabe (2015) reported instances of incomplete or inaccurate data and fabricated or falsified data among a small percentage of scientists, highlighting deviations in publication ethics. The persistence of issues such as missing, inconsistent, or incomplete data has been a longstanding challenge addressed by professionals over the past four decades (Brown & Kros, 2003), impacting the outcome of data analysis and subsequent decision-making (Saleh et al., 2018). The imperative to manage research data, given its critical role in every stage of the research process, becomes particularly pronounced with the rapid expansion of research in the scholarly domain.

Despite the increased emphasis on RDM, especially in academic libraries, certain factors, whether institutional (such as technological infrastructure and policy frameworks) or personal (personnel competency), may influence the effectiveness of RDMS implementation. Ashiq et al. (2020b) assert that the starting point for adopting new interests and roles, such as RDM practices, lies in policy formation—an aspect often overlooked in university libraries. However, the existence and effectiveness of RDM policy frameworks remain uncertain, necessitating scholarly inquiry, especially in regions like the Global South.

In addition to policy frameworks, the availability of technical infrastructure emerges as a critical institutional factor influencing RDM practices. Ashiq et al. (2020b) note that, aside from formal policies, infrastructural challenges and the lack of professional development for personnel involved in RDM activities constitute significant concerns in the Global South. The competency level of personnel considered a personal factor, reflects on the effectiveness of RDM services. In the Global South, the uncertainty surrounding the RDM competency level of university librarians complicates the assessment of potential skill gaps that may impede effective RDMS provision.

While university libraries in developing countries are transitioning from traditional library services to RDMS delivery, there is a perception that they have not fully optimised RDMS. Empirical evidence supporting this assertion is evident in studies from developing countries, such as Chiware's (2020) report on the elementary phase of RDMS in African countries. Notably, limited empirical studies have specifically addressed the state of RDMS in Nigerian university libraries, underscoring the significance of this current study. Existing studies, such as David and Abbas (2020), have examined strategies for RDM in

Nigerian federal universities without explicitly detailing the level of RDMS deployment in these libraries.

Moreover, studies in Nigeria have not extensively addressed the existence of RDM policy, warranting empirical investigation into its availability in university libraries. The study recognizes that the availability of policy will strengthen RDM practices, emphasizing the crucial role of librarians' competence in delivering effective RDMS. Consequently, this research aims to assess RDM practices in Nigerian university libraries, intending to ascertain their readiness to deliver RDMS. To achieve this aim, the study sets forth specific objectives:

i.   Identify the RDMS currently delivered in university libraries in Nigeria.
ii. Examine the availability of technological infrastructure for RDM in the libraries.
iii. Investigate the availability of RDM policy frameworks in the libraries.
iv. Ascertain the competency level of librarians for RDM.
v.   Explore the perceived challenges facing RDM in libraries.

METHOD

The research employed a descriptive survey research design to assess RDMS in university libraries in the Niger Delta region of Nigeria. The selection of this design was driven by the study's objective to gather data comprehensively on RDMS. The population consisted of heads of Electronic Libraries (E-Libraries) and Research Units in various university libraries within the Niger Delta region, as these individuals play pivotal roles in research activities and are well-placed to evaluate RDMS. The population comprised 44 heads of E-Libraries Sections and 21 heads of Research Units, with some institutions having only an E-Library section. The total population for the study was thus 65 librarians across university libraries in the Niger Delta region, which encompasses nine states: Edo, Delta, Bayelsa, Rivers, Akwa Ibom, Cross-River, Ondo, Abia, and Imo.

Given the manageable size of the population, the study employed a total enumeration sampling technique. Data collection utilised a closed-ended, structured questionnaire comprising six sections (A to F). Section A covered respondents' demographics, including gender, age, and working experience. Sections B and C focused on the RDMS

currently delivered in university libraries and the available technological infrastructure for RDMS in Nigerian libraries, respectively. Sections D and E addressed the availability of RDM policy frameworks and the competency level of librarians for RDM, while Section F explored the perceived challenges facing RDM in Nigerian libraries.

To ensure the instrument's validity, the initial questionnaire draft, along with the study's objectives, research questions, and title, underwent review by two experts in the field of Library and Information Science. Their feedback was incorporated into the preparation of the final questionnaire used in the study. The reliability of the instrument was assessed using Cronbach's Alpha, yielding an overall coefficient of 0.89, considered adequate for the study.

The final questionnaire was transformed into an online survey format using Google Forms to facilitate a seamless data collection process. The survey link was shared with Heads of E-Libraries and Heads of Research Units in University Libraries across the Niger Delta Region. Data collection spanned two months, during which reminder notices were periodically sent to participants to maximize participation.

Within the data collection period, a total of 55 valid responses were received, reflecting a response rate of 85%, which was deemed adequate for the study. The collected data underwent thorough statistical analysis, and the results were systematically presented in tables and charts. The presentation of the study's findings adhered to the structure defined by the demographic data collected and aligned with the study's specific objectives. This meticulous approach ensured a comprehensive and organized representation of the results, facilitating a nuanced exploration of the RDMS landscape in Nigerian university libraries.

RESULTS

Demographic Characteristics of the Survey Respondents

Understanding the composition of the respondent pool is crucial for contextualising the subsequent analyses of RDMS practices in Nigerian university libraries. Table 1 provides a detailed overview of the demographic characteristics of the survey respondents, encompassing gender distribution, age groups, and years of working experience.

The survey reflected a balanced gender distribution, with 53% male respondents and 47% female respondents,

Table 1: Demographic Characteristics of Survey Respondents

| Characteristics	Number	Percentage (%)
Gender		
Male	29	53
Female	26	47
Age Distribution		
20 - 30 years	6	10.9
31- 40 years	21	38.2
41- 50 years	18	32.7
51 years and above	10	18.2
Years of Working Experience		
1-5 years	15	27.3
6-10 years	13	23.6
11-15 years	17	30.9
16-20 years	5	9.1
21 years and above	5	9.1

indicating a diverse representation within the study. The respondents' age distribution showcased a predominant presence in the age group of 31-40 years (38.2%), followed by the 41-50 years category (32.7%). This distribution provides insights into the generational perspectives shaping RDMS practices. The majority of respondents possessed between 1 and 15 years of working experience, with the 11-15 years category being the most prevalent (30.9%). This distribution suggested a substantial level of professional experience among the surveyed librarians, potentially influencing their engagement with RDMS.

Current Research Data Management Services in Nigerian University Libraries

The variety of services offered is crucial for understanding the extent to which libraries are actively involved in supporting researchers throughout the data management lifecycle. Figure 1 illustrates the distribution of RDMS currently delivered in university libraries in Nigeria.

According to a survey, almost a quarter of libraries were found to be actively guiding researchers in handling and managing unpublished research data. This indicates that libraries play a proactive role in assisting researchers with data management before publication. Additionally, 11% of libraries created Research Data Management Libguides, showing that they are committed to offering comprehensive guidance and resources on data management practices. Approximately 18% of libraries extended support for data citation and referencing, which showcases their commitment to facilitating proper acknowledgement and utilization of research data.

The most popular service, covering 40% of libraries, was providing a data repository selection service, which suggests a significant emphasis on assisting researchers in choosing appropriate repositories for storing and sharing their data. Furthermore, a substantial 36% of libraries offered data preservation services, demonstrating a strong commitment to safeguarding and ensuring the longevity of research data. A notable proportion of libraries (18%) were actively assisting researchers in various aspects of data management, indicating a hands-on approach in guiding
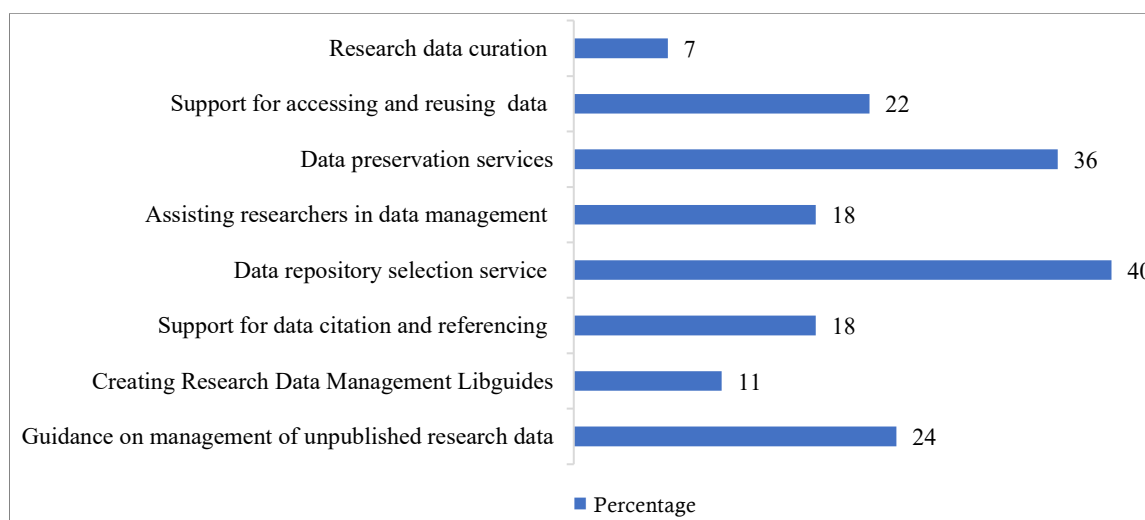
Figure 1: Current Status of Research Data Management Services in Nigerian University Libraries

scholars through the complexities of research data practices. In addition, a significant portion (22%) of libraries provided support for accessing and reusing data, highlighting their recognition of the importance of data accessibility and usability beyond the initial research project. While less common, 7% of libraries engaged in research data curation, reflecting an active involvement in the selection, organization, and maintenance of research data to enhance its long-term value and usability.

Technological Infrastructure for Research Data Management Services

Understanding the technological resources at the disposal of RDM is essential for evaluating the libraries' readiness to effectively implement and support RDM practices. Figure 2 provides insights into the availability of technological infrastructure for RDM in university libraries in Nigeria.

A significant majority of libraries, 64%, have computer hardware infrastructure, indicating a strong foundation for RDM activities. This high percentage suggests that there is a robust base for storing and processing data. Over half of the libraries (52%) have established computer networks, emphasizing the importance of network connectivity for smooth data sharing and collaboration among researchers. Only a small percentage (3%) of libraries reported having a Data Citation Manager, suggesting a slow adoption of tools designed to manage data citations effectively.

Approximately 27% of libraries were equipped with data processing software, indicating a recognition of the importance of tools for efficient data analysis and manipulation. A notable 12% of libraries reported having

Electronic Laboratory Notebooks, highlighting an emerging trend towards digitizing and organising research notes in electronic formats. Only a modest 3% of libraries had authentication systems in place, indicating a relatively lower prevalence of security measures for controlling access to research data. Almost half of the surveyed libraries (46%) have established data repositories, indicating a substantial investment in platforms for storing and sharing research data, aligning with contemporary RDM best practices.

Availability of Research Data Management Policy Frameworks

The availability of structured policies is pivotal in guiding libraries and researchers towards standardised practices, ensuring the effective management, preservation, and sharing of research data. Figure 3 portrays the responses from librarians regarding the availability of
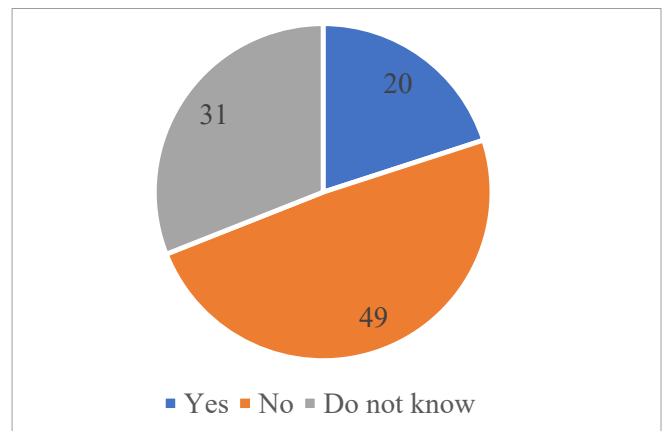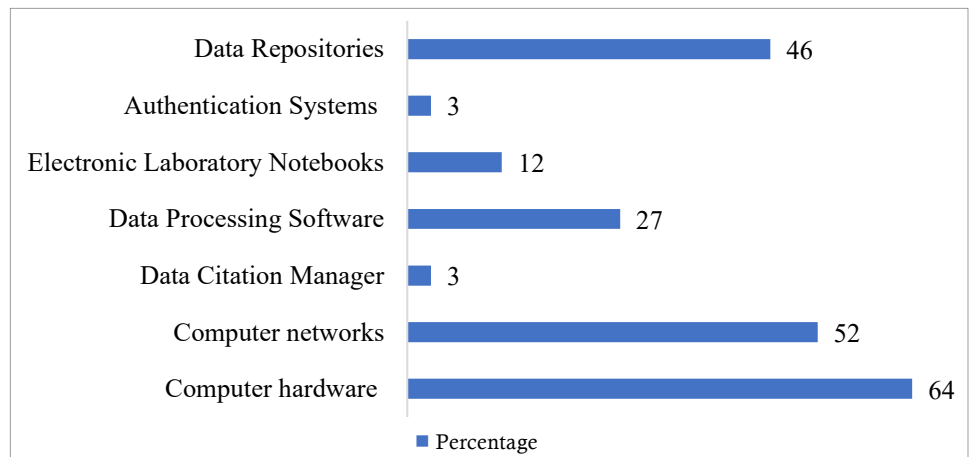

Figure 3: Availability of Research Data Management Policy Frameworks

Figure 2: Availability of Technological Infrastructure for Research Data Management

RDM policy frameworks in university libraries in Nigeria. This visual representation elucidates the librarians' awareness and certainty about the existence of structured policies guiding RDM practices within their respective institutions.

Only 20% of librarians affirmed the presence of RDM policy frameworks in their respective university libraries. This suggests that a relatively small proportion of libraries have established formalized policies explicitly addressing research data management. Nearly half of the librarians (49%) reported the absence of RDM policy frameworks in their libraries. This signifies a substantial gap in the formulation of structured guidelines for managing research data within these institutions.

A notable 31% of librarians indicated uncertainty regarding the availability of RDM policy frameworks. This suggests a considerable lack of clarity or awareness among librarians regarding the existence of formalized policies governing research data management practices within their libraries. The prevalence of uncertainty underscores a potential need for increased communication and awareness campaigns within the library community regarding RDM policy frameworks.

Competency Levels of Librarians for Research Data Management

Figure 4 provides an overview of the competency levels of librarians for RDM based on a 4-point scale. The assessment encompassed various aspects of RDM, shedding light on librarians' proficiency in utilising digital technologies, managing and integrating research data, and employing tools for data discovery and analysis.

Librarians have demonstrated a high level of competency (3) in curating data from diverse sources. This indicates their strong ability to systematically organize and manage research data. They have also reported an impressive competency level (3.32) in utilizing various digital technologies for the digital preservation of research data, which suggests a well-developed skill set in employing technological tools for data preservation. Furthermore, librarians have stated a moderate competency level (2.95) in linking and integrating research data from different sources, indicating their proficiency in establishing connections and collaborations among diverse datasets. They have also expressed a commendable competency level (3.02) in using Information and Communication Technology (ICT) tools for data management, which underscores their proficiency in leveraging digital tools for efficient data handling.

In managing data for reuse through various software applications, librarians have demonstrated a moderate competency level (2.71), suggesting their competence in facilitating the accessibility and usability of research data. They have also stated a moderate competency level (2.69) in using discovery and analytical tools for research data management, which reflects their ability to employ tools for uncovering insights and patterns within research data.

Regarding conducting data citations, librarians expressed a moderate competency level (2.64), indicating a reasonable proficiency in acknowledging and citing
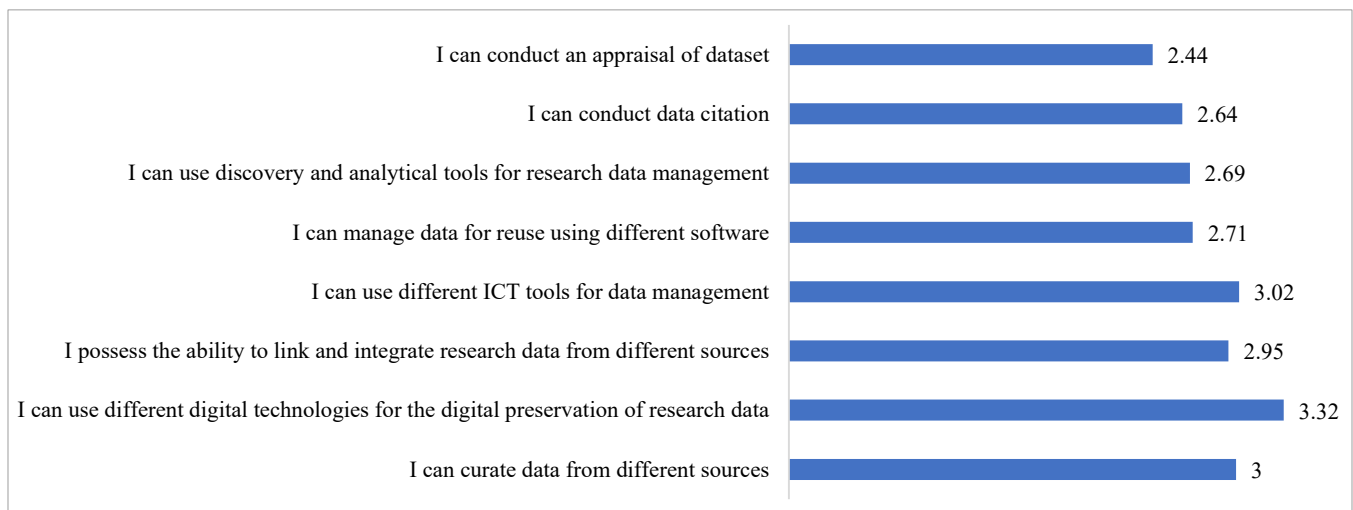

Figure 4: Competency Levels of Librarians for Research Data Management

research data appropriately. Finally, librarians stated a moderate competency level (2.44) in conducting an appraisal of datasets, which suggests their ability to assess and evaluate the quality and relevance of research datasets.

Perceived Challenges Facing Research Data Management in Libraries

Figure 5 encapsulates the perceived challenges facing RDM in libraries, providing a visual representation of the percentages associated with each identified challenge. This insight serves to highlight the key hurdles that libraries face in effectively implementing and sustaining robust RDM practices.

According to the survey, the most common challenge faced by Nigerian university libraries involved in RDM was inadequate financial resources, acknowledged by 82% of respondents. This highlights the critical need for increased funding to support various aspects of RDM, such as infrastructure, training, and technology. Another significant challenge, recognized by 78% of respondents, was the lack of skilled personnel, emphasizing the need for building and enhancing staff expertise in RDM activities. A significant 67% of respondents identified the absence of continuous training initiatives as a challenge. This highlights the importance of ongoing education to keep RDM staff updated on evolving practices and technologies.

A considerable 55% of respondents perceived negative user perception as a significant challenge. Overcoming this challenge is crucial as user support and collaboration are fundamental to the success of RDM initiatives. Nearly half of the respondents (47%) recognized the absence of university administrative support

as another significant challenge. Securing support from higher administration is crucial for allocating resources and institutional backing for RDM. A substantial 62% of respondents identified inadequate network bandwidth as a challenge. This emphasizes the importance of robust network infrastructure to facilitate seamless data transfer and access.

Only a minimal 1% of respondents perceived disparities in staff training opportunities as a challenge. Although this indicates a low level of concern, addressing and ensuring equitable training opportunities remains essential for building a proficient RDM team. Similarly, only 1% of respondents identified prolonged hardware maintenance delays as a challenge. While this issue is relatively less prominent, timely hardware upkeep is crucial for maintaining an efficient RDM infrastructure.

DISCUSSION

The study unveiled the existing landscape of RDMS in Nigerian university libraries, shedding light on key components such as service delivery, technological infrastructure, policy frameworks, librarian competency, and challenges faced by these institutions. Currently, a limited number of Nigerian university libraries provide RDMS, encompassing services like data repository selection, data preservation, and guidance on managing unpublished research data. This scarcity may contribute to the absence of comprehensive RDM policy frameworks and dedicated research units in many institutions. This aligns with Chiware (2020) and Mushi et al. (2020), indicating the early stages of RDMS development in African university libraries. The identified challenges in
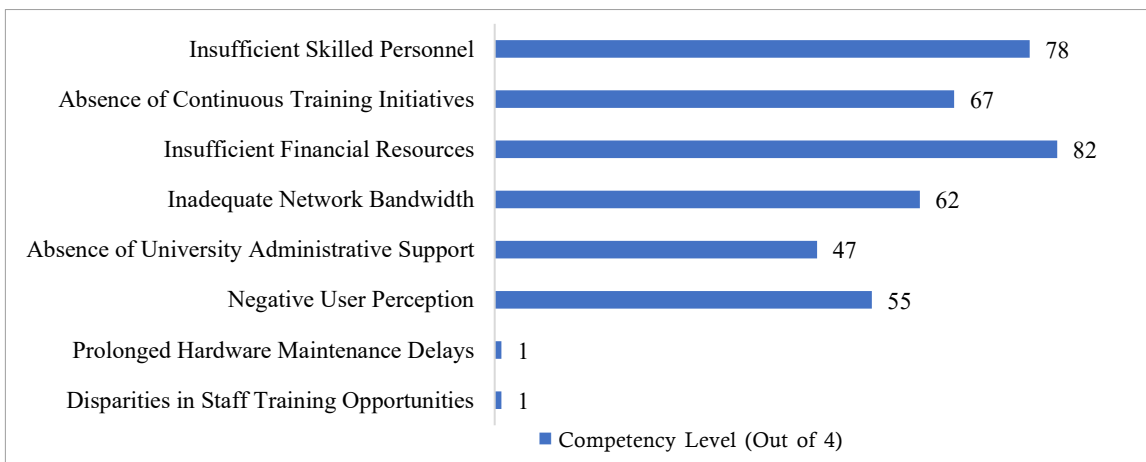

Figure 5: Perceived Challenges Facing Research Data Management in Libraries

RDMS delivery might be rooted in a lack of skilled librarians and a need for more robust technological interventions.

The study affirmed that Nigerian university libraries possess foundational technological infrastructure for RDMS, including computer hardware, data repositories, and networks. This finding supports previous studies by David and Abbas (2020); Anyim (2018); Anyaoku (2019). However, to enhance RDMS support, libraries need to acquire task-specific RDM infrastructure such as electronic laboratory notebooks, data citation managers, and authentication systems. Furthermore, the study revealed a widespread absence of comprehensive RDM policy frameworks in Nigerian university libraries. For those with existing frameworks, the focus primarily revolves around open access, data storage, sharing, documentation, and management. This gap is attributed to a limited understanding of RDMS operations among library administrators, coupled with insufficient deliberate efforts to prioritize RDMS. This aligns with Huang et al. (2020), emphasizing the need for concerted efforts to develop holistic RDM policy frameworks.

Moreover, the study indicates a high competency level among librarians in RDM, suggesting that their skills are developed over time through performing a range of data-related services (Ashiq & Warraich, 2023). Librarians, as information managers, possess foundational skills for data management planning, data repository access, and data sharing. However, there is a call for librarians to continually enhance their skills to keep pace with the evolving landscape of RDM.

The study identified several challenges that Nigerian University Libraries face in implementing RDMS. These challenges include inadequate financial support, a shortage of expert staff, insufficient provision for regular staff training, suboptimal network bandwidth, negative user perceptions about the library, and a lack of support from university administrators. These challenges are consistent with broader issues encountered in the adoption of technological innovations within libraries in Nigeria, as noted by prior research reported by Chigwada et al. (2017); Kennan and Markauskaite (2015). The challenges involve issues such as technological obsolescence, a dearth of skilled manpower, inadequate funding, and insufficient support from institutional management. Therefore, libraries aspiring to establish or enhance their RDMS must carefully assess and strategically plan for these challenges. A comprehensive approach that encompasses financial planning, skill development, and a supportive institutional framework is essential to address these issues. Properly navigating these hurdles is indispensable for libraries committed to delivering effective RDMS and for those seeking to leverage evolving technological innovations to serve their user communities optimally.

CONCLUSION

In conclusion, this study sheds light on the status of RDMS in Nigerian University Libraries. While certain libraries provide essential services, challenges persist. The findings underscore the imperative for improved technological infrastructure, comprehensive RDM policies, and ongoing librarian training. Challenges, such as insufficient funding and administrative support, underscore broader obstacles in technology adoption. Recognizing study limitations, such as potential biases in self-reported data and a regional focus, future research should aim to broaden the scope to a national context. Further investigations could delve deeper into specific aspects of RDM challenges and practices, providing a more nuanced understanding of the advancement of RDM in the evolving scholarly landscape.

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