

The role of academic libraries in supporting open science: Infrastructure, policy, and practice in federal universities in South-East Nigeria

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Abstract

Purpose/Thesis: This study examines how academic libraries support open science through infrastructure, policy frameworks, and practices in federal universities in South-East Nigeria.

Approach/Methods: A survey of library staff across five federal universities (N = 208) employed a structured questionnaire; descriptive statistics summarised indicators of infrastructure, policy, and practice.

Results and Conclusions: Libraries demonstrate moderate infrastructural readiness and policy presence and engage in repository management, but lack stable power, effective outreach, and faculty collaboration; funding and ICT deficits are major barriers.

Originality/Value: Provides localised empirical evidence linking infrastructure, policy, and library practice to open science adoption in the region, thereby guiding institutional and national strategies.

Keywords

Academic library. Infrastructure. Institutional repository. Open access. Open science. Policy framework. Research support.

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1. Introduction

1.1. Background to the Study

Open science is reshaping scholarly communication by fostering transparency, collaboration, and unrestricted access to research outputs. Globally, institutions are embracing open access publishing, open data sharing, and digital repositories to enhance research visibility and drive innovation (UNESCO, 2021; Chiware and Skelly, 2022; Boulton *et al.*, 2020). In Africa, regional initiatives such as LIBSENSE and the African Open Science Platform are gaining momentum, yet implementation remains uneven due to infrastructural limitations and policy gaps (Mwelwa *et al.*, 2020; LIBSENSE, 2024).

Academic libraries are the intellectual backbone of higher education institutions, serving as gateways to knowledge, research, and innovation. Traditionally, they functioned as repositories of print materials, but the 21st century has seen a dramatic shift in their roles. Modern academic libraries now operate as digital knowledge centres that enhance research visibility and support open access initiatives. In Nigeria, academic libraries are increasingly expected to align with global standards, offering services that go beyond collection management to include digital literacy training, research data support, and repository development (Dangida and Magaji, 2021).

Infrastructure is a critical enabler of open science. Academic libraries require robust ICT systems, reliable internet bandwidth, digital storage, and a stable power supply to support open-access platforms and research data services (Ayodele *et al.*, 2022; Iyoha, 2023; Ogunbodede and Oribhabor, 2022; Schroeder, 2007). In Nigeria, infrastructural deficits remain a major barrier to digital transformation. Many university libraries operate with outdated systems, limited connectivity, and inadequate technical support, which hinder their ability to host repositories or facilitate open data practices (Basri *et al.*, 2018; Olaniyi *et al.*, 2022).

Policy frameworks are essential for guiding the adoption of open science. Institutional policies on open access, copyright, and data sharing provide the legal and strategic foundation for libraries to operate effectively. Nigeria's National Policy on Open Educational Resources (NUC, 2024; *Model Open Science Policy*, 2024) emphasised the need for institutional compliance, infrastructure development, and capacity building (UNESCO, 2021; Chiware and Skelly, 2022; LIBSENSE, 2024). However, many universities lack formal policies or implementation strategies, leading to fragmented practices and limited researcher engagement.

Library practices form the operational backbone of open science, encompassing institutional repository management, information literacy training, digitisation of collections, and research support services. Librarians play a pivotal role in facilitating access to digital resources, guiding researchers on publication strategies, and

promoting ethical data management. Their technical expertise, advocacy efforts, and collaboration with faculty are essential for sustaining open science initiatives. Ming and Ren (2020) emphasised the growing demand for data literacy and research data management skills among librarians in the digital era. In the Nigerian context, Olubiyo (2022) highlighted the need for digital competencies among librarians, including metadata creation, repository development, and handling of digital media, as critical enablers of open science.

Several implicit variables shape the effectiveness of open science adoption in Nigerian universities. Digital literacy plays a foundational role in determining how well librarians and researchers can navigate digital platforms and apply open science tools. Gutiérrez-Ángel *et al.* (2022) emphasised that digital literacy in university settings directly influences the ability to engage with scholarly technologies and resources. In the Nigerian context, Olubiyo (2022) highlighted that the gap in digital competencies among librarians hinders effective repository management, metadata creation, and research support. The availability and accessibility of digital resources such as journals, databases, and institutional repositories also affect the scope and quality of research output. However, utilisation patterns remain uneven due to infrastructural limitations, low awareness, and inconsistent ICT training. Oaiya (2023) underscored the need for national policy frameworks and institutional capacity-building to overcome these challenges and foster sustainable open science practices across Nigerian campuses.

The study covers all six federal universities located in South-East Nigeria: University of Nigeria Nsukka (UNN), Nnamdi Azikiwe University Awka (NAU), Michael Okpara University of Agriculture Umudike (MOUUAU), Federal University of Technology Owerri (FUTO), Alex Ekwueme Federal University Ndufu-Alike (AE-FUNAI), and Federal University of Health Sciences Otolu-Nnewi (FUHSO). The primary respondents will include academic librarians, library administrators, and research support staff. The scope of content includes infrastructure, policy frameworks, librarian practices, digital skills, and challenges in open science adoption. Private institutions and non-library-based initiatives are excluded from this study.

1.2. Problem statement

Despite growing awareness and emerging policy frameworks, the adoption of open science in federal university libraries across South-East Nigeria remains constrained. Infrastructure is fragmented, technical expertise is limited, and institutional commitment is inconsistent. Many libraries struggle with unstable power supply, inadequate ICT tools, and poor internet connectivity, which hinder their ability to sustain repositories or facilitate open data sharing. In addition, the absence of coherent policies, low researcher engagement, and insufficient funding

create systemic barriers. These persistent challenges highlight the urgent need for empirical evidence on how academic libraries in South-East Nigeria can support open science through infrastructure, policy frameworks, and professional practices.

1.3. Purpose of the study

The main purpose of this study is to examine how academic libraries support the adoption of open science through infrastructure, policy frameworks, and professional practices in federal universities in South-East Nigeria.

The study seeks to:

- (1) Identify the infrastructural resources provided by academic libraries that enable open science in federal universities in South-East Nigeria.
- (2) Examine the institutional policy frameworks that guide academic libraries in promoting open science.
- (3) Analyse the professional practices employed by academic libraries in support of open science.
- (4) Determine the key challenges that hinder academic libraries from effectively supporting open science.

To achieve the objectives of the study and to verify the adopted hypotheses, the following research questions were formulated:

- (1) What infrastructural resources do academic libraries provide to support open science in federal universities in South-East Nigeria?
- (2) What institutional policy frameworks guide academic libraries in promoting open science?
- (3) What professional practices are employed by academic libraries to facilitate open science?
- (4) What are the major challenges affecting academic libraries in their efforts to support open science in federal universities in South-East Nigeria?

2. Literature review

2.1. Conceptual framework

The conceptual framework for this study is anchored on the evolving role of academic libraries in supporting open science within Nigerian federal universities. It integrates six interrelated constructs: academic libraries, open science, infrastructure, policy frameworks, library practices, and implementation challenges. These constructs provide the theoretical basis for understanding how institutional structures, digital resources, and professional competencies converge to enable or constrain the adoption of open science. The framework is informed by current

literature and contextualised within the realities of Nigerian higher education, where infrastructural limitations, policy gaps, and digital literacy disparities continue to shape the trajectory of open science (Olubiyo, 2022; Oaiya, 2023). Open science has emerged as a transformative paradigm in scholarly communication, emphasising transparency, accessibility, and collaboration across disciplines and borders. In Europe, initiatives such as Plan S and the European Open Science Cloud (EOSC) have accelerated institutional adoption of open access publishing and data sharing (European Commission, 2020). In North America, universities have begun integrating open science principles into tenure policies and research evaluation frameworks, recognising their role in enhancing reproducibility and public engagement (McKiernan *et al.*, 2016; Tennant *et al.*, 2016). In Asia, countries such as South Korea have invested in national repositories and open data platforms to support innovation and enhance global visibility (Shmagun *et al.*, 2022).

In Nigeria, open science is increasingly regarded as a strategic tool for addressing development challenges and enhancing research visibility. Mwelwa *et al.* (2020) and Chiware and Skelly (2022) highlighted the role of regional frameworks such as LIBSENSE in promoting infrastructure development and policy alignment across African research institutions. Abduldayan (2024) emphasised the importance of capacity building and advocacy, noting that librarians are key agents in operationalising open science principles through repository management, metadata creation, and researcher support.

In Nigeria, studies have examined digital literacy gaps (Olubiyo, 2022), infrastructure readiness (Oaiya, 2023), and librarians' engagement in open science practices (Ango and Akporhonor, 2024; Sulyman *et al.*, 2023). However, most existing research is either national or regional in scope and lacks a specific focus on federal universities in South-East Nigeria. Moreover, few studies explicitly connect infrastructure, policy, and practice to measurable open science outcomes. This study addresses these gaps by offering a localised, empirical analysis of how academic libraries in South-East Nigeria support open science through strategic alignment of resources, policies, and professional practices.

Academic libraries have undergone a significant transformation over the past two decades. Once defined primarily by their print collections and cataloguing systems, they now serve as dynamic hubs for digital scholarship, research support, and knowledge dissemination. Their functions have expanded to include the management of institutional repositories, the facilitation of open-access publishing, and the provision of information-literacy training. Olubiyo (2022) highlighted the growing digital competencies required of Nigerian librarians to support these evolving roles. Agboke and Oladokun (2024) discussed the integration of emerging technologies, such as artificial intelligence and robotics, into Nigerian academic libraries despite infrastructure challenges. Globally, academic libraries are increasingly recognised as strategic partners in research development, contributing to the

visibility and impact of scholarly outputs. UNESCO (2021) emphasised the role of research libraries in advancing open science through infrastructure, policy advocacy, and support for researchers. Similarly, Salisu and Okpala (2024) found that academic libraries in Northern Nigeria actively promote open access publishing to enhance scholarly visibility.

In Nigeria, however, many academic libraries still operate under constrained conditions, with limited funding, outdated infrastructure, and inconsistent policy support. Sani and Tokawa (2025) reported that university libraries in North-West Nigeria face infrastructural deficits that hinder service delivery. Okuonghae and Ugwulebo (2021) also noted that digital literacy gaps and limited access to electronic resources hinder librarians' ability to support research effectively. These limitations continue to affect their full participation in the open science movement.

Infrastructure is a critical enabler of open science (see Diagram 1). Academic libraries require robust ICT systems, reliable internet connectivity, digital storage, and a stable power supply to support open-access platforms and research data services. Ogala and Okeh (2021) emphasised that ICT infrastructure in Nigerian university libraries significantly enhances teaching, research, and scholarly communication. The National Information Technology Development Agency (NITDA) has issued regulatory guidelines to strengthen ICT adoption across public institutions, including tertiary education, with frameworks supporting cloud computing, data protection, and public internet access. NITDA (2019) stated that, without adequate infrastructure, libraries cannot host repositories, facilitate data sharing, or effectively support digital scholarship.

Policy frameworks provide the legal and strategic foundation for implementing open science. Nigeria's draft *National Policy on Open Educational Resources* (NUC, 2024) outlined institutional responsibilities for infrastructure development and capacity building in higher education. The Model Open Science Policy developed by WACREN (2024) further articulates strategic priorities, including open science infrastructure, human resource development, and institutional compliance mechanisms. However, policy implementation in Nigerian universities remains fragmented. Chiware and Skelly (2022) argued that African science systems often operate in silos, lacking interoperable policies and coordinated frameworks. Augonus (2023) found that only a minority of Nigerian universities have formal institutional repository policies, limiting their ability to regulate and disseminate research outputs effectively.

Library practices are the operational expression of open science principles. These include managing institutional repositories, conducting information literacy training, digitising collections, and offering research support services. Ugwulebo and Okuonghae (2021) emphasised the importance of information literacy and digital resource utilisation among postgraduate students, highlighting librarians' role in guiding access to and use of digital resources. Digitisation efforts are also

central to modern library services, with Abduldayan (2024) noting that digitisation enhances preservation and access to educational resources in Nigerian academic libraries. Librarians play a central role in facilitating access to digital resources, guiding researchers on publication strategies, and promoting ethical data management. Their digital skills and ability to engage users are critical for sustaining open science initiatives. Adetunla and Chowdhury (2025) found that Nigerian university librarians face challenges in developing operational digital skills, which are essential for managing repositories, metadata, and research support services. Abduldayan (2024), through the LIBSENSE initiative, advocated for librarian-led capacity building and policy engagement to advance open science in Nigerian institutions.

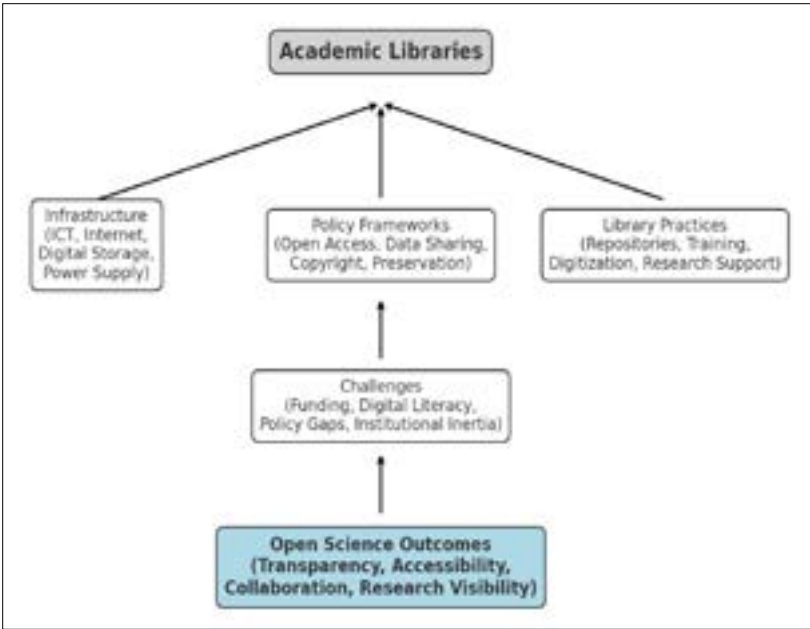


Diagram 1. Conceptual framework model

Source: Prepared by the Authors.

Despite growing awareness and emerging policy frameworks, the adoption of open science in federal university libraries across South-East Nigeria is hindered by infrastructural deficits, low digital literacy, policy gaps, and institutional inertia. Echedom and Anyira (2020) found that integrating open access into library workflows is challenged by poor ICT infrastructure, inadequate training, and a lack of formal policy support. (Worie, Unegbu, and Opara, 2022) emphasised that librarians in Nigerian academic libraries face declining morale and limited professional support, which affects their ability to engage with digital tools and open science

practices. Abduldayan (2024) highlighted that fragmented implementation and lack of institutional commitment continued to slow progress, despite national efforts to promote open science through policy and advocacy. Addressing these challenges requires coordinated efforts across policy, infrastructure, and capacity-building domains. It also demands a cultural shift within academic institutions, where openness, collaboration, and transparency are valued and rewarded.

2.2. Theoretical framework

This study is underpinned by Rogers' Diffusion of Innovations Theory, which provides a foundational lens for understanding how new ideas and technologies are adopted within institutional systems. Developed by Everett Rogers in 1962, the theory explains the process through which innovations are communicated over time among members of a social system. It emphasises five key elements: the innovation itself, communication channels, time, the social system, and adopter categories.

In this study, open science is understood as an innovation, encompassing practices such as open access publishing, open data sharing, and institutional repository development. Academic libraries serve as the primary agents of diffusion, responsible for introducing and facilitating these practices within the university system. The communication channels include training programs, digital platforms, and policy advocacy efforts led by librarians and institutional stakeholders. The social system refers to federal universities in South-East Nigeria, where the adoption of open science is influenced by institutional culture, leadership commitment, and resource availability. The time dimension reflects the varying pace at which different institutions engage with open science, shaped by infrastructural readiness and policy support. The adopter categories, ranging from innovators to laggards, are represented among librarians, faculty, and researchers, whose engagement levels vary with digital literacy, awareness, and institutional incentives. Furthermore, the adopter categories identified in Rogers' model, innovators, early adopters, early majority, late majority, and laggards, can be observed among stakeholders in this study. Some academic libraries and librarians function as innovators and early adopters, pioneering initiatives such as repository development and open access advocacy. Others, however, fall within the late majority or laggard categories due to infrastructural constraints, low digital literacy, or weak institutional commitment. These variations reflect the uneven diffusion of open science practices across federal universities in South-East Nigeria, demonstrating how institutional readiness and leadership support determine the pace of innovation adoption.

Rogers' theory is particularly relevant to this study because it captures both the structural and behavioural dynamics of innovation adoption. It helps explain why some libraries are early adopters of open science practices, while others lag due to infrastructural deficits, policy gaps, or resistance to change. By applying this

theoretical lens, the study examines how academic libraries navigate the diffusion process and how variables such as infrastructure, policy frameworks, library practices, digital literacy, and implementation challenges interact to shape the trajectory of open science adoption. This framework supports the study's analytical approach by linking theoretical constructs to empirical realities, offering a nuanced understanding of how innovation spreads within Nigerian higher education institutions. The theory thus provides a useful framework for interpreting how open science diffuses across university libraries, highlighting that adoption depends not only on the availability of technology but also on institutional culture and librarian initiative.

2.3. *Empirical studies*

Academic libraries are increasingly transforming into digital knowledge hubs. Abdu, Farouk and Maisango (2025) examined Nigerian open-access repositories and found that only 17 of 5,317 were registered in ROAR, revealing a significant shortfall in digital infrastructure. Similarly, Agboke and Oladokun (2025) reported that inadequate infrastructure and limited technical skills hinder digital library services, but their work did not focus on South-East federal universities. This study, therefore, investigates how the available infrastructure within those universities supports open-science initiatives, such as repositories and data sharing.

Adedoyin *et al.* (2024) evaluated institutional compliance with Nigeria's National Policy on Open Educational Resources, finding that fewer than 8 per cent of universities had formal OER policies due to weak administrative commitment. WACREN (2024) also introduced the Model Open Science Policy, emphasising infrastructure, human capacity, and governance, but implementation across institutions remains uneven. The current study builds on these efforts by exploring how library-specific policies function within federal universities in South-East Nigeria.

Ango (2024) investigated the adoption of open-source library management software in North-Central Nigeria, finding high usability but moderate levels of digital literacy among librarians. Onwubiko (2023) similarly observed that librarians in Ebonyi State were active in information dissemination but lacked adequate digital tools and training. This study extends those insights by linking librarians' professional practices directly to open-science outcomes, including open data, transparency, and collaboration.

Agboke and Oladokun (2025) further highlighted barriers such as poor infrastructure and resistance to new technologies, while Tella *et al.* (2023) found that inadequate facilities and low digital literacy limited access for distance learners. These studies confirm persistent challenges in Nigerian academic libraries but seldom address the open-science context of South-East federal universities. The present research, therefore, identifies the specific financial, technical, and institutional barriers affecting open-science adoption in the region.

3. Research methodology

This study adopted a survey research design, which was considered appropriate for collecting data from a large population at a specific point in time. Survey design enables researchers to describe existing conditions, analyse relationships, and make generalisations about a population based on sampled responses (Kabir, 2016). It is particularly effective in capturing the opinions, perceptions, and attitudes of library staff regarding infrastructural readiness, policy frameworks, and professional practices that support open science in federal universities.

The population comprised professional and para-professional library staff in the five federal universities located in South-East Nigeria. These universities include: University of Nigeria, Nsukka; Nnamdi Azikiwe University, Awka; Federal University of Technology, Owerri; Alex Ekwueme Federal University, Ndufu-Alike; and Michael Okpara University of Agriculture, Umudike. The total population of library staff across these institutions was 219.

Because the study population was relatively small and manageable, the entire staff population of 219 was used as the sample. This approach eliminated the need for sampling and ensured complete coverage of the study population.

The primary data collection instrument was a structured questionnaire titled the Academic Libraries and Open Science Adoption Questionnaire (ALOSAQ). The questionnaire was divided into four sections, covering infrastructural resources, policy frameworks, library practices, and challenges hindering open science adoption. Items were measured using a four-point Likert scale ranging from Strongly Agree to Strongly Disagree.

Copies of the questionnaire were administered to respondents via direct delivery by research assistants. This method was chosen to maximise response rate and ensure that the instrument reached the target respondents at each selected university.

The collected data were analysed using descriptive statistics, including the mean, standard deviation, median, and mode, to address the research questions. The decision rule was set such that mean scores of 2.50 and above were interpreted as agreement, while scores below 2.50 indicated disagreement. In addition to the mean and standard deviation, the median and mode were also computed to provide additional measures of central tendency, ensuring consistency and reliability in interpreting respondents' opinions.

The study upheld ethical standards by ensuring voluntary participation, informed consent, and confidentiality of responses. Permission was obtained from the university librarians at the participating institutions prior to data collection. Respondents were assured that their responses would be used solely for academic purposes.

4. Data presentation and results

Of 219 copies of the questionnaire distributed to library staff across the five federal universities under study, 208 were completed and returned, yielding a response rate of 95%. This high response rate enhanced the reliability of the data collected and minimised non-response bias.

4.1. Demographic information of respondents

The respondents' demographic data included variables such as gender, academic qualification, designation, and years of experience. The results are presented in Table 1.

Table 1. Demographic characteristics of respondents (N = 208)

Variable	Category	Frequency	Percentage (%)
Gender	Male	98	47.1
	Female	110	52.9
Academic Qualification	Diploma	36	17.3
	Bachelor's degree	82	39.4
	Master's degree	70	33.7
	PhD	20	9.6
Designation	Librarian II/III	58	27.9
	Senior Librarian	46	22.1
	Principal Librarian	42	20.2
	Deputy/Chief Librarian	62	29.8
Years of Experience	1–5 years	52	25.0
	6–10 years	60	28.8
	11–15 years	44	21.2
	16 years and above	52	25.0

Source: Prepared by the Authors.

The demographic results in Table 1 show that female respondents (52.9%) slightly outnumbered male respondents (47.1%), indicating balanced gender representation in the libraries surveyed. In terms of academic qualification, the majority of respondents held bachelor's (39.4%) or master's degrees (33.7%), suggesting that the workforce is well qualified to engage with professional and digital practices. A smaller proportion had diplomas (17.3%) or doctoral degrees (9.6%). Regarding designation, almost one-third of respondents (29.8%) held senior positions as Deputy or Chief Librarians, while the remainder were distributed across lower

cadres, reflecting a diverse mix of experience levels. Years of experience were distributed fairly: 25% had 1–5 years, 28.8% had 6–10 years, 21.2% had 11–15 years, and 25% had more than 16 years. This distribution demonstrates a healthy combination of early-career, mid-career, and senior professionals within the libraries.

4.2. *Infrastructural resources provided by academic libraries*

The first research question sought to identify the infrastructural resources provided by academic libraries to support open science in federal universities in South-East Nigeria. The results are presented in Table 2.

Table 2. Descriptive statistics on infrastructural resources provided by academic libraries for open science (N = 208)

S/N	Item	Mean	SD	Median	Mode	Decision
1	Availability of ICT facilities (computers, servers, etc.) for open science	2.83	0.91	3.0	3	Agreed
2	Availability of reliable internet connectivity	2.79	0.93	3.0	3	Agreed
3	Provision of institutional repositories for open access publishing	2.72	0.95	3.0	3	Agreed
4	Availability of adequate digital storage and data management systems	2.61	0.97	3.0	3	Agreed
5	Provision of stable electricity and backup power	2.48	0.98	2.0	2	Disagreed
6	Access to electronic databases and e-journals	2.76	0.92	3.0		Agreed
7	Availability of functional library websites for research support	2.64	0.96	3.0	3	Agreed
8	Accessibility of open-source research tools provided by the library	2.48	0.98	2.0	2	Disagreed
9	Availability of dedicated ICT support staff to manage the digital infrastructure	2.71	0.94	3.0	3	Agreed
10	Adequacy of physical facilities (e.g., computer labs, research commons) for open science	2.43	0.99	2.0	2	Disagreed
	Grand Mean/SD	2.65	0.94			

Note: Mean, median, and mode were used as complementary measures of central tendency. An agreement was defined as a score of 2.50 or higher. Source: Prepared by the Authors.

The results in Table 2 indicate that most libraries provide moderate infrastructural support for open science, particularly in ICT facilities (Mean = 2.83), internet connectivity (Mean = 2.79), and access to electronic databases (Mean = 2.76). Institutional repositories (Mean = 2.72) and ICT support staff (Mean = 2.71) are

also available, but not consistently across all universities. However, key challenges remain: stable electricity (Mean = 2.48), open-source research tools (Mean = 2.48), and physical facilities (Mean = 2.43) were rated below the acceptance threshold of 2.50. These findings suggest that, while digital infrastructure is gradually improving, systemic issues, such as power supply and dedicated research spaces, continue to hinder full support for open science.

4.3. Institutional policy frameworks guiding academic libraries

The second research question examined the institutional policy frameworks that guide academic libraries in promoting open science. The results are shown in Table 3.

Table 3. Descriptive statistics on institutional policy frameworks for open science (N = 208)

S/N	Item	Mean	SD	Median	Mode	Decision
1	Existence of formal institutional policy on open science	2.68	0.93	3.0	3	Agreed
2	Presence of an open access policy for scholarly communication	2.63	0.92	3.0	3	Agreed
3	Availability of copyright and intellectual property policies	2.59	0.97	3.0	3	Agreed
4	Existence of research data management and sharing policy	2.54	0.95	3.0	3	Agreed
5	Existence of library guidelines for repository management	2.72	0.94	3.0	3	Agreed
6	Institutional alignment with national or international open science frameworks	2.57	0.96	3.0	3	Agreed
7	Incentives for faculty participation in open access publishing	2.46	0.98	2.0	2	Disagreed
8	Inclusion of open science in university research strategy	2.62	0.95	3.0	3	Agreed
	Grand Mean/SD	2.60	0.95			

Note: Mean, median, and mode were used as complementary measures of central tendency. An agreement was defined as a score of 2.50 or higher. Source: Prepared by the Authors.

As shown in Table 3, most respondents agreed that institutional policy frameworks exist to guide open science in varying degrees. Policies on repository management (Mean = 2.72), open science (Mean = 2.68), and open access (Mean = 2.63) were particularly acknowledged. Copyright policies (Mean = 2.59) and alignment with national or international frameworks (Mean = 2.57) were also moderately affirmed. However, incentives for faculty participation in open access publishing

(Mean = 2.46) fell below the acceptance threshold, indicating that while policies are in place, mechanisms to encourage active researcher engagement remain weak. The overall grand mean (2.60) suggests that institutional policies provide a moderate foundation for open science, but practical enforcement and incentive structures are still underdeveloped

4.4. *Library practices supporting open science*

The third research question focused on the professional practices employed by academic libraries to facilitate open science in federal universities in South-East Nigeria. The findings are presented in Table 4.

Table 4. Descriptive statistics on library practices supporting open science (N = 208)

S/N	Item	Mean	SD	Median	Mode	Decision
1	Management of institutional repositories for open access publishing	2.77	0.94	3.0	3	Agreed
2	Digitisation of theses, dissertations, and other scholarly works	2.72	0.95	3.0	3	Agreed
3	Provision of information literacy and digital skills training	2.81	0.92	3.0	3	Agreed
4	Collaboration with faculty on research dissemination	2.69	0.97	3.0	3	Agreed
5	Promotion of open access publishing among researchers	2.65	0.93	3.0	3	Agreed
6	Offering research data management support services	2.56	0.96	3.0	3	Agreed
7	Conducting outreach and advocacy for open science awareness	2.48	0.98	3.0	3	Disagreed
8	Engagement in open educational resources (OER) initiatives	2.51	0.95	3.0	3	Agreed
9	Providing guidance on the ethical use of open data and research outputs	2.66	0.94	3.0	3	Agreed
10	Supporting collaborative research through digital platforms	2.59	0.96	3.0	3	Agreed
	Grand Mean/ SD	2.64	0.95			

Note: Mean, median, and mode were used as complementary measures of central tendency. An agreement was defined as a score of 2.50 or higher. Source: Prepared by the Authors.

The results in Table 4 reveal that academic libraries are actively engaged in practices that support open science. Strong practices include information literacy training (Mean = 2.81), repository management (Mean = 2.77), and the digitisation of scholarly works (Mean = 2.72). Libraries also moderately engage in faculty

collaboration (Mean = 2.69) and ethical guidance on the use of open data (Mean = 2.66). However, outreach and advocacy for open science (Mean = 2.48) fell below the acceptance threshold, indicating limited effort to promote awareness among researchers. Overall, the grand mean of 2.64 indicates that, although professional practices are moderately aligned with open science principles, there remains a need to strengthen advocacy, faculty partnerships, and data management services.

4.5. Challenges hindering academic libraries in supporting open science

The fourth research question sought to determine the challenges hindering academic libraries in federal universities in South-East Nigeria from effectively supporting open science. The results are presented in Table 5.

Table 5. Descriptive statistics on challenges hindering open science adoption in academic libraries (N = 208)

S/N	Item	Mean	SD	Median	Mode	Decision
1	Inadequate funding for infrastructure and services	2.86	0.90	3.0	3	Agreed
2	Unstable power supply and poor energy backup systems	2.81	0.92	3.0	3	Agreed
3	Insufficient ICT facilities and digital tools	2.74	0.94	3.0	3	Agreed
4	Poor internet connectivity and low bandwidth	2.77	0.93	3.0	3	Agreed
5	Lack of institutional open science policies	2.63	0.95	3.0	3	Agreed
6	Low digital literacy among library staff and researchers	2.71	0.94	3.0	3	Agreed
7	Limited training opportunities for librarians	2.68	0.96	3.0	3	Agreed
8	Low awareness and adoption of open science by faculty	2.59	0.97	3.0	3	Agreed
9	Inadequate collaboration between libraries and researchers	2.62	0.95	3.0	3	Agreed
10	Resistance to change from traditional publishing models	2.55	0.98	3.0	3	Agreed
	Grand Mean	2.70	0.94			

Note: Mean, median, and mode were used as complementary measures of central tendency. An agreement was defined as a score of 2.50 or higher. Source: Prepared by the Authors.

As shown in Table 5, respondents agreed that several challenges significantly hinder academic libraries' ability to support open science. The most critical barriers include inadequate funding (Mean = 2.86), unstable power supply (Mean

= 2.81), and poor internet connectivity (Mean = 2.77). Other notable challenges are insufficient ICT tools (Mean = 2.74) and low digital literacy among staff and researchers (Mean = 2.71). Institutional-level issues, such as the lack of policies (Mean = 2.63), low faculty awareness (Mean = 2.59), and resistance to traditional publishing practices (Mean = 2.55), also constrain adoption. The overall grand mean of 2.70 indicates that systemic, infrastructural, and cultural challenges collectively weaken libraries' capacity to embrace open science fully.

5. Discussion, conclusion and recommendations

5.1. Discussion of findings

The findings of this study reveal a multifaceted landscape of infrastructural readiness, policy engagement, and professional practices within federal university libraries in South-East Nigeria as they transition toward open science. Consistent with earlier studies by Abdu, Farouk, and Maisango (2025) and Agboke and Oladokun (2025), this research confirms that infrastructural deficits remain a significant barrier. Respondents cited unreliable internet connectivity, limited access to digital repositories, and inadequate ICT facilities as persistent challenges. However, unlike previous studies that focused on broader national or regional trends, this study provides localised evidence indicating that some federal institutions in the South-East have begun leveraging existing infrastructure to support open access publishing and data sharing, albeit inconsistently.

Policy engagement across institutions was uneven. While national frameworks such as the National Policy on Open Educational Resources (Adedoyin *et al.*, 2024) and the Model Open Science Policy (WACREN, 2024) offered strategic direction, only a minority of libraries reported having formalised internal policies aligned with these instruments. This finding echoes Adedoyin *et al.*'s (2024) observation of low institutional compliance and highlights a persistent gap between national aspirations and institutional realities. Furthermore, the study uncovered that policy awareness among library staff was generally low, suggesting a need for targeted advocacy and stronger administrative commitment.

Professional practices among librarians showed encouraging trends. A majority of respondents reported active involvement in managing institutional repositories, conducting information literacy training, and supporting research activities. These findings align with Ango (2024) and Onwubiko (2023), who documented increasing digital engagement among librarians in North-Central and South-Eastern Nigeria. However, the current study extends these insights by directly linking such practices to open science outcomes, including data transparency and collaborative research. Despite moderate digital skills, librarians demonstrated a willingness to adopt open

science tools, provided that adequate training and institutional support are available.

Finally, the study identified several implementation challenges, including limited funding, resistance to change, and lack of technical expertise. These findings corroborate those of Agboke and Oladokun (2025) and Tella *et al.* (2023), who emphasised the role of emerging technologies and digital literacy in shaping library service delivery. Within the South-East context, institutional inertia and fragmented policy execution were particularly pronounced, underscoring the need for coordinated efforts across infrastructure, policy, and capacity-building domains.

Overall, this study contributes new empirical insights by situating open science adoption within the specific realities of federal university libraries in South-East Nigeria. It highlights both the progress made and the systemic barriers that must be addressed to operationalise open science principles in the region fully.

5.2. Conclusions

This study explored the role of academic libraries in supporting open science through infrastructure, policy frameworks, and professional practices within federal universities in South-East Nigeria. The findings revealed that, although libraries provide moderate infrastructure support, such as ICT facilities, internet connectivity, and digital repositories, significant challenges persist. These include unstable power supply, limited access to open-source tools, and inadequate physical spaces, all of which constrain effective service delivery. At the policy level, institutional frameworks exist but are often weakly enforced, with minimal incentives to encourage faculty participation in open science initiatives. Although librarians actively engage in information literacy training and repository management, outreach and advocacy efforts remain underdeveloped, limiting broader institutional uptake. Systemic barriers, including funding shortages, infrastructure deficits, low digital literacy, and institutional inertia, continue to impede the full adoption of open science practices. Guided by Rogers' Diffusion of Innovations Theory, the study concludes that academic libraries in the region are gradually integrating open science principles. However, infrastructural, policy, and cultural constraints impede the widespread diffusion of this approach across universities. Strengthening these dimensions through targeted investment, policy reform, and capacity building is essential to advancing transparency, collaboration, and visibility in scholarly research across Nigerian federal universities.

5.3. Recommendations

Based on the findings, the following recommendations are made:

- (1) Federal universities should prioritise investment in ICT facilities, stable internet connectivity, reliable power supply, and adequate research spaces

- to support open science.
- (2) University administrations should formalise and enforce comprehensive open science policies, with clear guidelines for repository management, data sharing, and copyright compliance. Incentive structures should be established to encourage faculty participation in open access publishing.
 - (3) Academic libraries should intensify efforts in outreach and advocacy, actively engaging faculty and students in open science awareness programs. Libraries should also expand training on research data management and the ethical use of digital resources.
 - (4) Continuous professional development programs should be provided to enhance librarians' digital skills, enabling them to act as effective facilitators of open science.
 - (5) Adequate funding should be allocated to libraries for open science initiatives. Collaboration with national and regional bodies such as LIBSENSE, NITDA, and WACREN should be strengthened to align with global open science frameworks.

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Rola bibliotek akademickich we wspieraniu otwartej nauki: infrastruktura, polityki i praktyki na federalnych uniwersytetach w południowo-wschodniej Nigerii

Abstrakt

Cel/Teza: Celem badania jest analiza sposobów, w jakie biblioteki akademickie wspierają otwartą naukę poprzez infrastrukturę, ramy polityk oraz praktyki funkcjonujące na federalnych uniwersytetach w południowo-wschodniej Nigerii.

Podejście/Metody: Badanie ankietowe przeprowadzono wśród pracowników bibliotek pięciu federalnych uniwersytetów (N = 208), z wykorzystaniem ustrukturyzowanego kwestionariusza. Statystyki opisowe posłużyły do opracowania wskaźników dotyczących infrastruktury, ram politycznych oraz praktyk działania.

Wyniki i wnioski: Biblioteki wykazują umiarkowany poziom przygotowania infrastrukturalnego oraz obecność ram politycznych i angażują się w zarządzanie repozytoriami. Jednocześnie borykają się z brakiem stabilnych dostaw energii, nieskutecznymi działaniami informacyjnymi oraz ograniczoną współpracą z kadrą akademicką. Istotnymi barierami w realizacji działań z zakresu otwartej nauki pozostają niedostateczne finansowanie oraz deficyty w zakresie technologii informacyjno-komunikacyjnych.

Oryginalność/Wartość: Artykuł dostarcza zlokalizowanych empirycznych dowodów łączących infrastrukturę, polityki i praktyki biblioteczne z adopcją otwartej nauki w regionie, wspierając tym samym kształtowanie strategii instytucjonalnych i krajowych.

Słowa kluczowe

Biblioteka akademicka. Infrastruktura. Otwarty dostęp. Otwarta nauka. Polityki. Repozytorium instytucjonalne. Wsparcie badań.

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