

ENHANCING INFORMATION RETRIEVAL THROUGH EFFECTIVE CATALOGUING AND CLASSIFICATION IN A HYBRID LIBRARY SYSTEM

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Abstract

The methods used for cataloguing and classification have changed significantly, as the traditional setting of libraries has given way to a hybrid one. This paper examines how technological advancements, classification schemes, and metadata standards work together to facilitate efficient information retrieval in hybrid library systems. It considers classification schemes such as the Library of Congress Classification and the Dewey Decimal Classification, as well as key cataloguing tools including MARC21, Resource Description and Access, and Online Public Access Catalogues, and it assesses how well these instruments align with digital workflows. Particular attention is given to Nigeria, where real world examples from institutions such as Ahmadu Bello University and Covenant University illustrate challenges including insufficient information and communication technology infrastructure, a shortage of qualified staff, and uneven metadata quality. The impact of emerging technologies on cataloguing is also examined, including linked data, natural language processing, and artificial intelligence. The paper further discusses ethical dilemmas such as algorithmic bias and cultural representation, and it concludes by promoting localised metadata standards, continuous staff training, and inclusive system design to improve access and retrieval in hybrid library systems. The analysis of best practices for regulating bibliographic control and enhancing service delivery offered here can assist academic libraries that are leading the digital shift.

Keywords: information retrieval; cataloguing and classification; hybrid library; knowledge organisation; library technology

1. Introduction

Information is a basic human necessity and is central to all human goals, so that any library or society needs it to be available and accessible in order to function effectively. Whether in digital or printed form, information is a vital tool for communication, learning, growth, and decision making. According to Uwem (2008), information is a ready to use product that serves as both a communication medium and a source, and when it is properly directed to the appropriate group of individuals at the appropriate moment, it significantly improves the use of other resources, leading to increased productivity and efficiency. Information retrieval is the art of displaying, storing, organising, and gaining access to information in such a way that final users can reach it at any time to meet their requirements.

Information retrieval is essential for finding and pointing end users toward the data that answers their questions, and it is generally regarded as a branch of computer science that places emphasis on the representation, storage, and accessibility of information (Francois, Ranwez, and Montmain, 2015). According to Sagayam, Srinivasan, and Roshni (2012), information retrieval includes the systematic arrangement and extraction of data from numerous databases, while Anwar (2010) explains it as the process of representing, storing, and searching data collections in order to facilitate knowledge revelation in response to user research. The process consists of multiple stages, beginning with data representation and concluding with the distribution of valuable information to those who seek it. As the information landscape continues to change in the digital age, libraries are becoming more than physical repositories, and the library now operates as a hybrid system that combines print and digital collections (Hider, 2012).

This change has significantly increased access to resources while complicating the process of organising, managing, and retrieving information across a variety of platforms and formats. The specialised methods of cataloguing and classification enable a library's resources to be arranged logically and retrieved quickly. According to Aina (2012), cataloguing is a comprehensive method of bibliographic description used to develop access points, and Angbade and Udofot (2020) emphasise that the need for efficient organisation increases as knowledge production increases. Descriptive and subject cataloguing are the two primary categories, with descriptive cataloguing documenting bibliographic details such as author, title, and publication information. These efforts were later formalised in the Anglo American Cataloguing Rules and their second edition, and they have since been advanced by Resource Description and Access, which encompasses both print and digital resources.

Olajide and Yusuf (2010) explained that classification enhances access, while Madukom, Bamidele, and Edewor (2013) argue that ease of retrieval increases resource use. Two widely used classification schemes are the Dewey

Decimal Classification and the Library of Congress Classification. In the past, cataloguing and classification were more straightforward (Ejiroghene, 2020), but as information has grown and publishing has expanded, catalogers now carry more responsibilities, which makes efficiency and accuracy crucial. In spite of persistent challenges with exactness and workload, refining cataloguing and classification in hybrid libraries remains vital for making resources accessible, usable, and retrievable. This paper examines how effective cataloguing and classification can enhance information retrieval in hybrid library systems, with particular reference to the Nigerian academic library context.

The transition under discussion is best introduced visually. Figure 1 conveys the essential character of the hybrid library as an environment in which the physical and the digital are not rivals but complementary components of one continuous system of access.

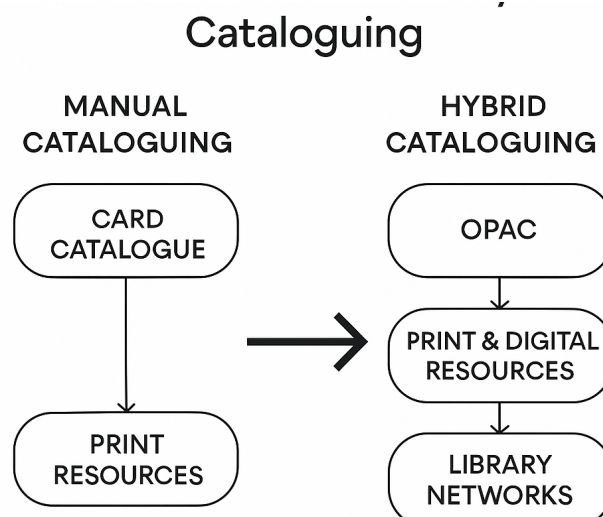


Figure 1: Conceptual depiction of the hybrid library, in which print and digital collections coexist within a single accessible knowledge environment. Source: Author supplied illustration.

1.1 Objectives of the Study

The broad aim of this paper is to examine how effective cataloguing and classification can enhance information retrieval in hybrid library systems. Specifically, the study seeks to examine the structure and function of hybrid library systems and the role of cataloguing and classification in facilitating information retrieval across print and digital collections; to assess the application of international cataloguing standards such as Resource Description and Access, MARC21, the Dewey Decimal Classification, and the Library of Congress Classification in hybrid library environments, with particular reference to Nigerian academic libraries; to evaluate the influence of emerging technologies, including artificial intelligence, natural language processing, and linked data, on cataloguing practices; to identify the ethical and professional challenges associated with technology driven cataloguing, including algorithmic bias, cultural representation, and accessibility for users with disabilities; and to propose best practice

recommendations for improving cataloguing and classification in hybrid libraries, with emphasis on locally adapted metadata standards, staff training, and inclusive system design.

2. Understanding the Hybrid Library System

In order to satisfy the changing needs of contemporary users, the hybrid library system purposefully integrates traditional print collections and digital resources. Hornby (2010) and the Cambridge Advanced Learner's Dictionary (2010) note that the hybrid model rests on the notion that distinctive characteristics can be blended to produce new and improved forms. By redefining libraries as information systems that can be accessed beyond physical boundaries, hybrid libraries, which emerged as a result of advancements in information and communication technologies, support digital scholarship and lifelong learning. Pearce, Cathro, and Boston (2000), Rayward (1998), and Sreenivasulu (2000) each reinforced the view that hybrid libraries represent a permanent and continuous integration of resources rather than a passing phase of library development.

A hybrid library is a controlled setting that provides uniform access to a variety of information resources, whether digital or physical, irrespective of format, location, or curatorial area. Sutton (1996), a pioneering figure in the field, raised an important question regarding how libraries intend to handle their expanding holdings of both traditional and modern materials. According to his account, libraries evolved from being merely physical establishments into logical and digital systems that, through institutional subscriptions and international networking, enabled unrestricted access to digital content. Carr (2006), who argued that libraries now function primarily as service providers rather than merely as physical repositories, strengthened this position, and hybrid libraries continue to develop in ways that facilitate user driven discovery across platforms.

The internal logic of the hybrid library can be represented as a layered architecture. Figure 2 shows how print collections and digital resources, though distinct in origin, are drawn together through a shared layer of metadata and bibliographic control and then surfaced to the user through a single discovery interface, so that the choice of format rests with the reader rather than the system.

Architecture of the Hybrid Library System

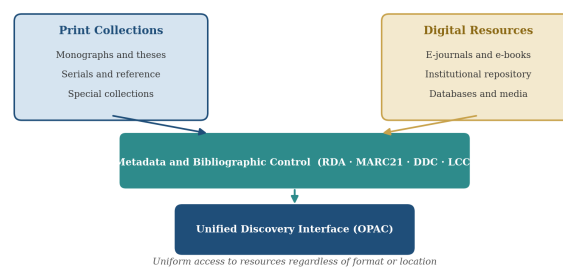


Figure 2: Architecture of the hybrid library system, showing print and digital streams unified through metadata control and a single discovery interface. Source: Authors' conceptual synthesis.

2.1 Hybrid Library Models

As a dynamic environment, hybrid library models make it possible to combine traditional information services with state of the art learning services, print and digital resources, and open source and proprietary technologies. A variety of models that demonstrate this increasing complexity have been developed. The Models Information Architecture of the United Kingdom hybrid library studies project envisioned the hybrid library as a dispersed setting containing a range of formats, from books to digital collections. Similarly, Dowler (2007) presented the gateway library model, which positioned the hybrid library as a bridge connecting more conventional print systems with newer electronic platforms. The Electronic Libraries Programme introduced the idea of a hybrid information environment focused on providing a single interface for access to both digital and traditional services, and as an extension of these concepts Dempsey (1998) developed the notion of information islands, emphasising the challenges posed by distributed access and the need for coordinated systems across various platforms.

3. Cataloguing and Classification

Cataloguing is one of the most crucial procedures in library and information science, since it guarantees that resources are characterised, arranged, and made available through metadata. As Joudrey, Taylor, and Miller (2015) explain, cataloguing involves describing resources, allocating access points such as names and titles, and keeping the catalogue up to date for user access. Cataloguing facilitates resource discovery across libraries, museums, and digital repositories by supporting efficient retrieval and standardised organisation. Catalogues serve as the central database for books, journals, multimedia, maps, and digital content, whether in traditional card formats or electronically through Online Public Access Catalogues.

Classification, on the other hand, groups resources according to their subject matter in order to produce both an intellectual and a physical map of knowledge. According to Joudrey, Taylor, and Miller (2015), classification assigns systematic categories through notations that are typically represented in a call number consisting of a class number for subject, a book number for authorship, and a collection number for library context. This hierarchical structure

ensures that related materials are grouped together to facilitate logical browsing and speedy retrieval, and unlike subject headings that can assign multiple terms, classification places each resource in a single most related category. The Dewey Decimal Classification, frequently used in public libraries and schools because of its simplicity, and the Library of Congress Classification, favoured in research and academic libraries because of its specificity and scalability, are the two most widely used schemes, while systems such as the Universal Decimal Classification, Cutter Expansive Classification, Bliss Bibliographic Classification, and Colon Classification also aid in the organisation of knowledge.

Both the Library of Congress Classification and the Dewey Decimal Classification are now available digitally through Classification Web and WebDewey, allowing for effective updates in contemporary hybrid systems. In addition to supporting digital search functionality through subject headings, thesauri, and authority files, effective classification enhances access by aligning related topics and guiding users from general to specific concepts. Classification systems are kept current by adhering to principles such as specificity, logical hierarchy, clarity, and adaptability. Together, cataloguing and classification in hybrid libraries ensure smooth information retrieval from both electronic and physical collections, preserving knowledge organisation within a growing information landscape.

The standards that govern hybrid cataloguing do not operate in isolation but form an interdependent ecosystem. Figure 3 places bibliographic control at the centre and arranges around it the content standard, the encoding format, the classification schemes, the conceptual models, and the linked data vocabularies, illustrating that coherent metadata depends on the interaction of all five rather than on any single instrument.

The Cataloguing Standards Ecosystem

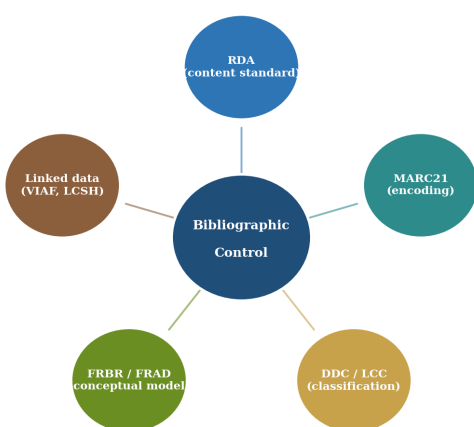


Figure 3: The cataloguing standards ecosystem, in which content, encoding, classification, conceptual, and linked data standards jointly sustain bibliographic control. Source: Authors' conceptual synthesis.

3.1 Evolution of Cataloguing and Classification Practices

Ejiroghene (2020) highlighted the long and demanding process of manual cataloguing, noting that before original cataloguing, classification, and record preparation for shelf lists and catalogue drawers were completed, bibliographic slips were first measured against existing entries. Because mistakes could disrupt retrieval systems, this procedure required a significant amount of time, precision, and expertise. The switch to digital systems brought new difficulties, and Esse (2013) asserts that the variety of information formats, changes in user behaviour, and the development of information and communication technologies have all contributed to the complexity of the modern cataloger's task. These modifications necessitate familiarity with metadata standards such as MARC21 as well as the use of resources such as classification web applications and cataloguing calculators. Despite these developments, Akidi and Omekwu (2019) observe that little empirical research has been conducted on Nigerian cataloguing practices, which underscores the importance of strategic planning, ongoing professional development, and technology investment.

International cataloguing standards are the principal means through which modern hybrid libraries achieve consistency, interoperability, and accessibility across various platforms, and they form the basis of bibliographic control. The most recent standard, Resource Description and Access, was created to replace the second edition of the Anglo American Cataloguing Rules, and unlike its predecessor it provides a flexible, content neutral framework for the digital era. Its alignment with the Functional Requirements for Bibliographic Records and the Functional Requirements for Authority Data allows catalogers to record the relationships between works, expressions, manifestations, and items, and its support for linked data principles positions it as a major force behind the Semantic Web, facilitating discovery across global digital networks. MARC21 remains extremely important for transforming authority and bibliographic data into computer decodable formats, guaranteeing the interoperability of Online Public Access Catalogues, digital repositories, and integrated library systems. Although the second edition of the Anglo American Cataloguing Rules was once the cataloguing standard, its inability to handle digital formats and evolving metadata requirements led to its replacement by Resource Description and Access, even as it continues to influence older records and legacy systems.

4. Utilisation and Impact of Hybrid Library Infrastructure

One of the most distinctive features of the hybrid library is the integration of the Online Public Access Catalogue, a computerised cataloguing system that offers searchable access to a library's holdings, including print materials, software, digital collections, and audiovisual content. For many institutions, implementing an online catalogue has been a crucial step in developing a local hybrid library

(Pearce, Cathro, and Boston, 2000). This intuitive interface improves discoverability and convenience by enabling users to access print and digital materials in a unified setting. Online Public Access Catalogues can be stand alone systems for individual libraries or integrated platforms that aggregate the catalogues of several libraries in a consortium, and they have largely replaced the traditional card catalogue in libraries built today.

Although both traditional and digital libraries have advantages, it is frequently inefficient to use different search engines for electronic and physical resources. Hybrid libraries resolve this by combining the two formats into a single information ecosystem in which electronic resources enhance rather than replace print collections, allowing users to select the format that best suits their academic or personal needs. User behaviour in hybrid libraries can vary significantly, since some users are hesitant to trust digital platforms while others may neglect print resources because digital materials are so easily accessible. Research from initiatives such as the HeadLine project showed that print journals are frequently underutilised, not because they are irrelevant but because they are hard to find, while the HyLife project showed that most students want simple access to sufficient resources for academic success regardless of format.

Nigerian university libraries have adopted hybrid models in order to take this reality into account. According to the University of Nigeria Nsukka Library Annual Report (2022), more than twelve thousand volumes, including rare theses and local publications, were digitised and incorporated into the Koha integrated library system and its Online Public Access Catalogue between 2019 and 2023. With the adoption of Resource Description and Access and MARC21, cataloguing quality improved significantly, leading to a forty seven per cent increase in electronic resource access, and staff were supported in transitioning from the Anglo American Cataloguing Rules to Resource Description and Access through training initiatives and global partnerships. The digitisation project at the University of Nigeria, Nsukka began with the objective of digitising and uploading roughly five hundred thousand files to the university website, with doctoral theses selected as the first group of documents for digitisation (Eke, 2011).

Mohammed (2013) noted that a survey at the Kashim Ibrahim Library of Ahmadu Bello University, Zaria, showed that digitising academic library information resources raises both the library and the institution to the top of institutional repositories, promoting scholarly work while safeguarding priceless holdings against the deterioration commonly associated with paper collections. Similarly, the Kenneth Dike Library of the University of Ibadan has digitised more than fifteen thousand scholarly materials, which are accessible through the University of Ibadan Institutional Repository. According to Yusuf (2010), the Covenant University Library in Ota is notable for its adept use of

digital infrastructure, employing the Koha integrated library system, cloud based cataloguing, and radio frequency identification tracking to conduct eighty five per cent of its cataloguing online, and its Smart Library initiative has made it a national leader in digital cataloguing.

The Nigerian evidence can be consolidated into a small set of reported outcomes. Figure 4 brings together the performance gains and digitisation volumes documented across four institutions, showing both the proportional improvements at the University of Nigeria Nsukka and Covenant University and the substantial digitisation output at Ibadan and Nsukka, while reminding the reader that these figures derive from institutional reports rather than from a single standardised audit.

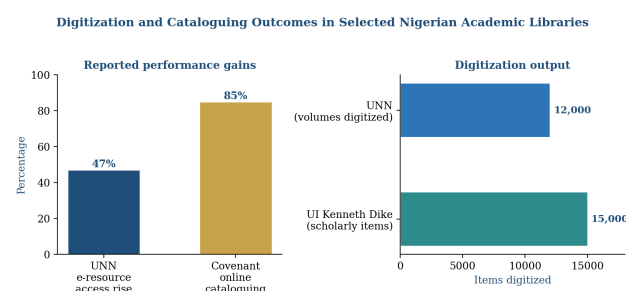


Figure 4: Digitisation and cataloguing outcomes reported by selected Nigerian academic libraries. Source: Compiled from Eke (2011), Mohammed (2013), Yusuf (2010), and the UNN Library Annual Report (2022).

These practical examples demonstrate how hybrid libraries use advanced cataloguing tools to enhance resource discoverability, advance equity, and promote access. The advantages of electronic libraries include multi user functionality, availability at all hours, and remote access, yet they cannot completely replicate the experience of browsing tangible materials, receiving help in person, or using communal study areas, all of which remain crucial in learning environments. Consequently, the hybrid library becomes a model for inclusive and sustainable librarianship in the twenty first century. The success of hybrid libraries depends on institutional commitment, cultural adaptation, and user education in addition to technology infrastructure, and library staff must oversee access to both digital and physical collections while promoting critical thinking and information literacy across all media.

5. Technological Innovations in Cataloguing

Technological developments are changing cataloguing practices in hybrid libraries, which integrate print and digital materials to improve accessibility, accuracy, and efficiency. Machine learning and artificial intelligence are increasingly used to automate descriptive records, subject classification, and metadata generation, reducing manual labour and increasing accuracy. Natural language processing enhances catalogues further by facilitating conversational searches, extracting bibliographic information from full text documents, and enabling automatic authority control, and these tools can also be applied to non textual materials such as pictures, videos, and

audio recordings. Large scale digitisation projects can be streamlined by subject tagging and recommendation engines, although algorithmic bias remains a concern because datasets that are centred on Western knowledge may exclude indigenous knowledge systems.

It is worth noting that while these technological tools offer considerable promise, they are best understood as aids to professional cataloguing work rather than replacements for it. Librarians remain the critical judges of quality, cultural appropriateness, and contextual accuracy in ways that automated systems cannot replicate, and the value of these tools lies in how thoughtfully library professionals choose to deploy and oversee them. There are also issues with the limited ability of natural language processing tools to adapt to Nigerian languages such as Hausa, Yoruba, and Igbo, a problem that can be addressed by testing open source solutions such as Annif on Nigerian theses, institutional repositories, and local publications, particularly at universities with sizable digital collections such as Ahmadu Bello, the University of Nigeria Nsukka, and Ibadan.

Beyond artificial intelligence and natural language processing, linked data technologies offer promising possibilities by connecting metadata to external knowledge bases such as the Virtual International Authority File, Wikidata, and the Library of Congress Subject Headings, making it possible to build richer and more relationship driven discovery experiences. Many libraries across Africa nevertheless face real barriers in the technical expertise and data quality standards required to implement linked data meaningfully. Cloud computing has become increasingly practical for managing digital collections at scale, offering flexibility and cost savings over traditional local server infrastructure, while radio frequency identification automation continues to improve everyday operations such as stock management, sorting, and shelving. Web 2.0 tools open further possibilities for user participation through collaborative cataloguing and tagging, and taken together these technologies hold considerable promise for hybrid libraries in Nigeria, provided that promise is matched by sustained investment in staff training and a deliberate focus on incorporating indigenous languages and knowledge systems.

The relationship between the promise of new technologies and the capacity to implement them locally is uneven. Figure 5 sets the perceived promise of six technologies against their estimated readiness in the Nigerian context, making visible an adoption gap that is widest for artificial intelligence, natural language processing, and linked data, and narrowest for the more mature infrastructures of cloud computing and radio frequency identification.

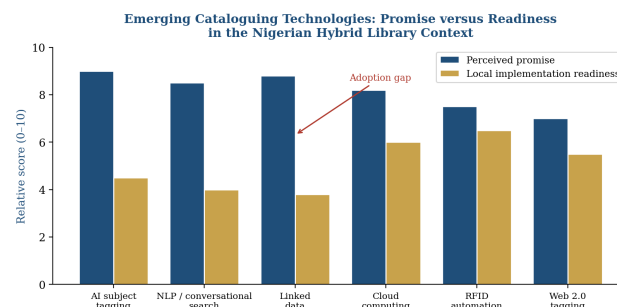


Figure 5: Emerging cataloguing technologies compared by perceived promise and local implementation readiness, revealing a persistent adoption gap. Source: Authors' analytical estimation based on the reviewed literature.

6. Ethical and Professional Concerns

The integration of artificial intelligence and natural language processing in cataloguing offers clear benefits, but it also raises ethical issues, chief among them algorithmic bias. Because many systems have been trained on datasets that reflect Western scholarship, challenges arise in representing African knowledge and local authorship, and Nigerian libraries can address this through collaboration with local entities to develop inclusive vocabularies and datasets while training cataloguers in ethical metadata practices. Practical challenges such as unreliable infrastructure necessitate a phased approach to introducing technology, in which budget friendly open source tools serve as entry points and funding is pursued through grants and partnerships.

Automation should not displace cataloguers; rather, their roles can evolve into those of digital curators and quality specialists. The localisation of metadata is vital in order to prevent cultural bias and to ensure the representation of African heritage within classification systems, and collaborative efforts across various sectors are necessary to develop culturally relevant metadata. Enhancing accessibility for users with disabilities is equally critical, so that libraries must meet recognised accessibility standards through practical adjustments such as improved navigation and compatibility with assistive technologies. These concerns are not peripheral to cataloguing but integral to it, because the manner in which knowledge is described and organised determines whose knowledge is found and whose remains hidden.

7. Recommendations for Best Practices

To enhance cataloguing and classification practices in hybrid library environments in Nigeria, several recommendations are proposed. First, libraries should adhere to internationally recognised standards such as Resource Description and Access, MARC21, the Library of Congress Subject Headings, the Library of Congress Classification, and the Dewey Decimal Classification for consistency and interoperability, adopting a phased approach in resource constrained settings. Second, the use of open source library management tools such as the Koha integrated library system can provide cost effective

solutions for managing collections, with consortium based hosting further reducing costs. Third, the design of catalogues must prioritise accessibility for users with disabilities in alignment with recognised accessibility guidelines.

Fourth, ongoing professional development for cataloguers is crucial in order to adapt to emerging technologies such as artificial intelligence and machine learning. Fifth, a unified discovery interface for digital and physical collections should be prioritised to enhance the user experience, incorporating Web 2.0 features for interaction and community engagement. Sixth, regular evaluation through audits and user surveys is essential for adapting to user needs and for demonstrating the value of the systems to decision makers. Cultivating a culture of reflective practice is vital for sustainable cataloguing in dynamic contexts, since the tools and expectations of the field will continue to evolve.

8. Conclusion

As libraries continue the shift from traditional to hybrid environments, the work of cataloguing and classification takes on renewed importance. Well organised, consistently described, and contextually appropriate metadata is what enables users to find what they need across both print and digital collections. This paper has examined that work through several lenses, namely the structure and function of hybrid library systems, the standards and tools that underpin bibliographic control, the experiences of Nigerian academic libraries navigating this transition, and the emerging technologies that are reshaping cataloguing practice. What the discussion consistently returns to is the central role of human expertise.

Technologies such as artificial intelligence, natural language processing, and linked data can assist and extend what cataloguers do, but they cannot substitute for the professional judgment, cultural knowledge, and ethical responsibility that skilled library staff bring to this work. For Nigerian academic libraries in particular, the path forward involves realistic and phased investment in infrastructure and training, a genuine commitment to culturally inclusive metadata, and sustained attention to the needs of all users. Libraries that approach the digital transition with these values at the centre will be well placed to fulfil their fundamental purpose, which is making knowledge accessible to everyone who needs it.

Declarations

Conflict of Interest Statement

The authors declare that no conflicting interests exist with respect to the research, authorship, or publication of this article.

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