Afr. J. Lib, Arch. and Inf. Sc. Vol. 34, No. 1 (April 2024) 168-182
https://dx.doi.org/10.4314/ajlais.v34i1.12

Digital Transformation of Academic Libraries in Africa: Challenges and Opportunities for Sustainable Information Service Delivery

Oladimeji Dube
Strathmore University, Kenya
oladimeji_dube@protonmail.com

and

Joseph Keïta
Strathmore University, Kenya

Abstract

Digitizing African academic libraries has become a crucial platform that can enhance access to information, better service delivery, and long-term growth of higher education. Due to the vast advancement in information and communication technologies (ICT), academics libraries are shifting towards electronic platforms of knowledge storage, retrieval, and distribution, and leaving old-fashioned print-based systems. The advantages of this change are multiple, such as the availability of more electronic resources, the ability to support more research, more involvement of users, and the ability to preserve the indigenous knowledge by storing it in a digital arrangement. Inclusion is also promoted through digital libraries where remote access to information is facilitated, and this makes it easier to conduct distance learning and coordinate research at national and international levels. In spite of these, there are various issues affecting the academic libraries in Africa as they go digital. The major difficulties are the lack of appropriate ICT infrastructure, unreliable power supply, limited budget, low rates of digital awareness among the library staff and clients, and the lack of institutional and governmental support. Moreover, the fear of copyright, information privacy and sustainability of online business becomes a hurdle to successful adoption. The e-gap between the urban and rural institutions exacerbates the information service disparities. The paper examines the issues and challenges associated with the digital transformation of African university libraries and evaluates how these issues would impact the future delivery of information services. The research uses available literature and practice to find out strategic measures that can enhance digital library operations, including capacity building, policy formulation, and partnerships. The results emphasize the need to invest over the long term, promote the structure of governance, and continuous technological adaptation to ensure the sustainability of academic libraries in Africa by making them resilient, inclusive, and sustainable in the digital era.

Keywords: Digital Transformation (DT), Academic Libraries (AL), Africa (AA), Challenges and Opportunities (C&O), Sustainable Information Service Delivery (SISD)

Introduction

In the era of modern fast digital and technological development and with the rapid global interconnectedness, academic libraries have been undergoing significant changes over recent years (Odunlade and Ojo, 2023). It also gets the attention of most of the researchers to study the digital transformation of academic libraries. In this research paper, we are talking about the digital transformation of academic libraries in Africa. The

academic libraries are rapidly developing into a digital environment that facilitates access to information and resources through electronic media, including various online platforms and well-organized networked resources (Ogwo et al., 2023). These changes are broadly known as digital transformation, which includes not only the implementations of the digital technologies but also transformations in organizational structures, users' experiences, service models and work processes. If we talk about the digital transformation of academic libraries in Africa specifically, we can say that Africa is a continent with diverse socio-economic contexts and various stages of technological infrastructure (Ikwuanusi et al., 2022). That is why digital transformation represents both a complex and an imperative challenge. In this research study, we explore the digital transformation of academic libraries, specifically in Africa, in detail, along with the direct focus on the challenges that they are facing nowadays, and the opportunities that have also been studied to develop sustainable information service delivery (Ikwuanusi et al., 2023). Apart from this, academic libraries work as an essential center of learning, knowledge dissemination, and research. Academic libraries provide access to important resources and information that support researchers, students, and faculty in their academic pursuits. The role of academic libraries has been gaining significance in Africa due to the developing higher education systems, increasing participation in worldwide knowledge networks and growing research output in African continent (Shahzad et al., 2023).

Whereas the traditional model of academic libraries' services, which only promotes physical access to the collection, no longer seems to be sufficient in order to meet the developing requirements and needs of the users in the digitally connected world. Digital transformation in academic libraries encompasses the combination of technologies and digital tools to improve the performance of library operations, enhance access to resources, and improve the operations of service delivery (Aruleba and Jere, 2022). These technologies involve cloud platforms, electronic databases, mobile applications, digital repositories, digital learning environments, and library management systems. The adoption of these technologies is helpful in reducing physical limitations, and it also facilitate to enhance the services beyond the boundaries of campus and also provides open access to a wide range of the community. However, along with the potential benefits of digital transformation, academic libraries have been facing various challenges in their digital transformation journeys, especially in Africa (Mashroofa, 2022). Barriers such as inadequate infrastructure, limiting funding systems, policies constrains, and insufficient technical expertise delay the sustainability and effective adoption of the digital services (Ikenwe and Udem, 2022). Apart from this, there are also various growing opportunities simultaneously, which can be driven by increased investments in ICT information and communication technology, open access movements, regional collaboration initiatives, as well as developing applications of the Internet and mobile technologies over the African continent (Onunka et al., 2023). So, the interplay between opportunities and challenges is necessary to understand in detail to create strategies that enable academic libraries to deliver impactful and sustainable digital services.

Furthermore, the academic libraries' transformation is not only depended on technology adoptions, but it also reflects an important change in how academic libraries work and engage with their users (Adigun et al., 2024). It improves the fundamental functions, including resource management, information retrieval, research facilitation and teaching support (Owolabi et al., 2022). Moreover, digital transformation in academic libraries provides open access to research materials, enhances visibility of local research materials, as well as facilitate interdisciplinary associations over geographical limits. In the era of the COVID-19 pandemic, the need for digital transformation has increased in education systems. It also highlights the essential role of digital libraries to provide continuous learning, no matter if access to physical resources is interrupted (Tshabalala and Dube, 2024). In the overall world, many academic libraries' services accelerated towards the digital transformation during the period of COVID-19; online tutorials, virtual reference services, and remote access through electron media have been implemented in most educational institutions during the COVID-19 pandemic (Dube and Jacobs, 2023). Even though digital transformation in academic libraries has presented significant prospects, but in Africa academic libraries have been facing various

significant challenges that hinder progress. All these challenges are divided into technological, structural, policy-related and human resources factors. In Africa, most of the education institutions operate with a controlled budget, which reduces their ability to participate in advance digital infrastructure. In digital services, reliable electricity, modern hardware, and high-speed internet connectivity are considered important factors (Palos-Sánchez et al., 2023). However, all these are unaffordable or inconsistent in various regions. In addition, insufficient funding also has a great impact on the achievement of the electronic licenses and resources.

An effective digital transformation always requires well qualified and skilled staff who have abilities to manage and curate digital content and digital systems effectively. Whereas the shortage of well-qualified and skilled library and information and communication technology staff pose various challenges in Africa. There is also a shortage of capacity-building programs and continuous professional development in Africa, which in turn causes many staff members of libraries to be unprepared and less supportive. In addition, despite all these challenges, there are many other developments that encourage momentum for the digital transformation of academic libraries in Africa. Some of them, including growth in information and communication technological infrastructure investment, many international organizations, private partners, and governments are investing progressively in information and communication technological infrastructure as well as enhancing Internet connectivity and developing digital willingness over educational institutions in Africa (Otolo, 2022). Academic libraries in Africa are taking part in collaborative networks and consortia that have the capacity to negotiate collective access to electronic resources, share resources, and encourage the exchange of knowledge. Apart from this, mobile technology penetration and the digital scholarship movement, as well as open access, are also considered opportunities for sustainable information service delivery (Figure 1).

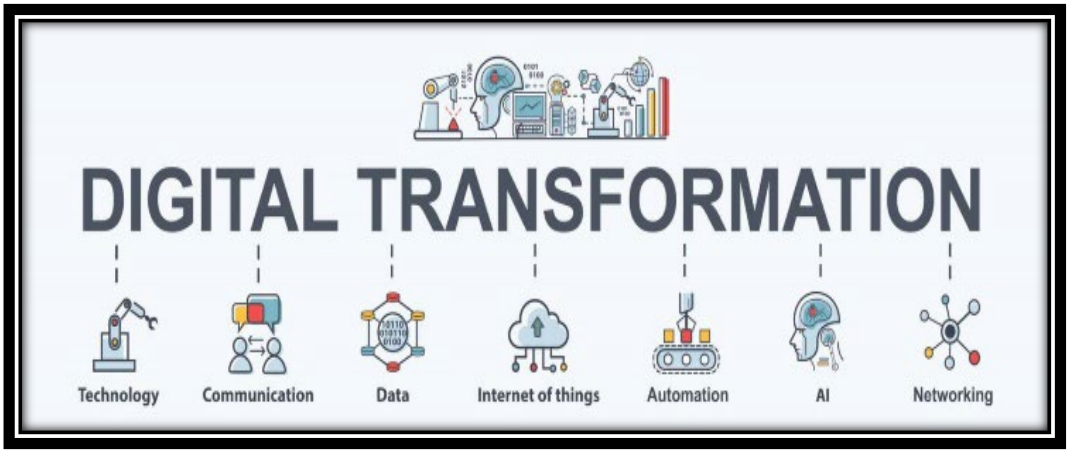

Figure 1: Key Components Involved in Digital Transformation.

Literature Review

The research on the digital transformation of academic libraries has increased all over the world in recent years. In this research article researcher presents digital transformation as a complete process of changing academic libraries in Africa. In which changing like information service in academic service have been described by utilizing digital technology in a revising organizational structure, and in a strategic way (Ikwuanusi et al., 2024). Studied investigated that this transformation has the ability of re-evaluation of the service delivery models, which can be modified to align with digital scholarship, changing expectations of users, and online learning. Nowadays, scholars have been examining this transformation as more than the digitization of collections (Okunlaya et al., 2022). In the context of African academic libraries, researchers continuously highlighted that institutional capacity, and a wide range of socio-economic conditions have a great impact on digital transformation, as well as the national development priorities have been slowing down the process in

institutions and regions in Africa (Chisita et al., 2022). Researchers have collected research from various regions in Africa; it was explored how the academic libraries in Africa are transforming from traditional service deliver models to digitally transformed environments. It was noted that although most of the institutions in Africa have adopted online catalogues, institutional repositories, and online electronic resources, full digital transformation still remains incomplete (Okoro et al., 2025). This incomplete transformation is known as fragmented implementation, in which some of the digital tools might be introduced, but when implementing them into online research, teaching, and academic workflows. Researchers claimed that it can become sustainable only if all the technological aspects of digital transformation are implemented with effective strategic planning, institutional commitment, and staff development (Otike, 2023).

Furthermore, in the advance developing environment, technological development has been widely considered as the fundamental factor of transformation. The increasing applications of mobile technologies, cloud services, AI, and digital repositories were explored in order to enhance service efficiency and information access. Researchers examining studies from various regions of Africa claimed that all these digital technological transformations have increased access to online research articles, improves resources visibility, and facilitated remote users. Whereas studied highlighted that digital reliance development mostly works to get long-term influence because of weak maintenance and integration challenges, which in turn emphasize the requirements for sustainable digital infrastructures (OKWOLI, 2025). Research claimed that during the era of the COVID-19 pandemic, most of the institutions in Africa have established an environment of digital transformation, and this pandemic has enhanced the needs of digital academic libraries throughout the world. The era of the COVID-19 pandemic is mostly considered as the catalyst which enhance the process of digital transformation across academic libraries of Africa continent. Studied explored how distant learning in the case of any emergency compelled academic libraries to offer online resource services, virtual user support, and electronic resource access (Elgohary, 2022). Researchers claimed that organizations with advance digital learning investment can adapt emergency remote learning more effectively, as compared to others, who mostly faced service disruptions. Apart from all these developments, most of the persistent challenges have been discussed in this study related to African research (Adekoya et al., 2024). Studied highlighted that inconsistent information and communication infrastructure remain a significant limitation, especially in regions with limited bandwidth, Internet connectivity, and continuous power interruptions. Furthermore, research conducted in East and West Africa explored the financial challenges that academic libraries have been facing in Africa (Mhlanga et al., 2022). It was claimed that financial constrains limit the abilities of academic libraries to access digital databases, upgrade systems, and maintain platforms. Researcher investigated that low funding systems affect continuity and frequently cause short-term projects instead of sustainable services. In addition, challenges related to human capacity have also been studied in the paper (Dei and Asante, 2022). Researcher describes how insufficiencies in the training of library staff affect the utilization of advance digital transformed technologies. Researchers claimed that most of the staff of academic libraries have ineffective training in the digital areas, including digital preservation, data management, and developing digital technologies (Adarkwah et al., 2024). Scholars said that inadequate access to consistent professional developments when integrated with limited institutional facilities might cause slow down the efforts of transformation.

Moreover, scholars in Africa continent examine the levels of digital literacy between faculty and students, and it was explained that high Internet costs, restricted technical skills, and inconsistent access to devices influence the applications of digital academic library services (Barsha and Munshi, 2024). Researchers claimed that there seems to be a need for academic libraries to combine users' educational data into digital transformation techniques to make sure strong, effective engagement with online platforms (Akinola and Telukdarie, 2023). Despite these factors, governance and institutional factors also have a great impact on the outcomes of digital transformation. It was investigated how the shortage of long-term planning models and the shortage of

clear digital policies generate ineffectiveness in implementation. Along with all these challenges, researchers also highlight the opportunities in the literature that seem effective for sustainable information service delivery (Ocran and Afful-Arthur, 2022). Studies have shown that digital transformation has the ability to improve access to academic resources, and it can enhance access to resources and facilitate remote learning. Digital transformation facilitates inclusion and equity in higher educational institutions. Researchers examined that digital transformation in academic libraries strengthens collaboration, enables students to take part in international and regional knowledge networks, as well as support to share resource over the sharing of African regions (Azam and Ahmad, 2024). Furthermore, development in the delivery of services and promotion of open visibility and access to African scholarships have also been considered as great opportunities to benefit from digital transformation. All these opportunities help to support a sustainable knowledge ecosystem as well as facilitate worldwide recognition of research outcomes in Africa.

Overall, it was highlighted in the literature that digital transformation of academic libraries is a complicated and gradual process, especially in Africa, which can be enhanced by the effective human resources management, technological capacities, and institutional support (Peláez et al., 2022).

Methodology

This paper adopts an exploratory, desk-based research methodology to explore the digital transformation of the African university libraries in terms of the challenges and the long-term prospects of providing information services. It is believed that a qualitative approach would be suitable as it will be possible to gain a deep insight into a multifaceted institutional, technological, and socio-economic context that governs the development of digital libraries in different African settings. The paper is largely founded on a critical examination and analysis of past publications. The secondary data collection is based on the numerous and credible academic sources such as peer-reviewed journal articles, conference proceedings, books, policy documents, institutional reports, and publications of international organizations, such as UNESCO, the International Federation of Library Associations and Institutions (IFLA), and the World Bank. These references will provide a detailed overview of digital library initiatives, the use of ICT, policy, and sustainability in the libraries of African universities.

Data Sources and Analysis

The relevant and reliability of the data is confirmed through a structured literature search method. The essential search terms will be digital transformation, academic libraries, Africa, information service delivery and sustainability. Relevant studies published within the past 15 years are identified through the use of electronic databases like Scopus, Web of Science, Google Scholar and archives of library and information science. Inclusion criteria are based on the research that covers digital technologies, library services, infrastructure, policy, and user engagement in African higher education institutions. Sources that are analyzed as of low academic quality or non-relevant to the context are dropped.

Data Collection Methods

Theme analysis is used to examine data. The chosen material is thoroughly analyzed, labeled and classified to discover redundant themes regarding the digital transition. The huge themes include technology infrastructure, human resource capability, financial models, policy and governance, user accessibility and sustainability initiatives. This would enable identifying of trends, similarities and differences across the various national and institutional contexts across Africa. Triangulation is performed to enhance the reliability of the findings by comparing evidence provided by many sources and points of view.

This will guarantee equitable perceptions of problems and opportunities that relate to digital transformation. The ethical issues are also considered through the correct reference to all sources and adherence to academic integrity standards. Though it is a study based on secondary data, the methodological design allows for analyzing the existing practices and the new trends comprehensively. The findings of this method provide a good outline of structuring the possible practical implications and policy suggestions that can be used to enhance sustainable digital information service provision in African university libraries (Figure 2).

Figure 2: Digital Transformation.

Numerical Analysis

Table 1: Results of Descriptive Statistics.

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Technology Infrastructure,	51	1.00	3.00	1.6275	.69169
Human Resource Capability,	51	1.00	4.00	1.9412	.75926
Financial Models	51	1.00	4.00	1.9412	.75926
Policy And Governance	51	1.00	3.00	1.8431	.67446
User Accessibility	51	1.00	3.00	1.6667	.68313
Sustainability Initiatives	51	1.00	3.00	1.8235	.71291
Digital Transformation	51	1.00	4.00	1.8824	.79113
Academic Libraries	51	1.00	4.00	1.9804	.88295
Valid N (Listwise)	51				

The above result of table 1 demonstrates that descriptive statistical analysis results represent the mean values, standard deviation rates, and explain the significant values of each variable. The financial models, the policy governance, user accessibility, the sustainability initiatives, and the digital transformation are considered as independent variables. According to the result its mean values are 1.9412, 18431, 1.6667, 1.8235, and 1.8824; all of them present a positive average value. The standard deviation rates are 67%, 68%, 71%, 79%, respectively shows that positive standard deviation values exist between them. The academic lib raries is dependent variables according to the result, their mean value is 1.98, the standard deviation rate is 88% deviate from the mean value. The overall result represents that the minimum value is 1.000, the maximum value is 4.00, respectively.

Table 2: Results of Coefficients.

Coefficients						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	1.158	.914		1.267	.212
	Technology Infrastructure,	.159	.212	.125	.752	.456
	Human Resource Capability,	-.117	.180	-.100	-.646	.522
	Financial Models	.123	.176	.106	.702	.487
	Policy and Governance	.224	.213	.171	1.053	.298
	User Accessibility	.028	.217	.022	.130	.897
	Sustainability Initiatives	-.013	.205	-.011	-.064	.949
	Digital Transformation	.061	.175	.055	.350	.728
a. Dependent Variable: Academic Libraries						

The above result of table 2 demonstrates that the linear regression model is between the dependent and independent variables. The academic libraries are the main dependent variable, and digital transformation is the main independent variable result shows that its t-statistic value is 0.350, and its significant value is 0.728, indicating a positive and 72% significant relation between digital transformation and academic libraries. The sustainability initiatives are an independent variable according to the result, which shows that its t-statistic value is -0.064, and the significant value is 0.949, showing a negative but 94% significant level between them. Similarly, the user accessibility shows that the t value is 0.130 the significant value is 89%, respectively.

Table 3: Results of Test Statistics.

Test Statistics								
	Technology Infrastructure,	**Human Resource Capability,**	**Financial Models**	**Policy And Governance**	**User Accessibility**	**Sustainability Initiatives**	**Digital Transformation**	**Academic Libraries**
Chi-Square	11.412a	23.588b	23.588b	10.706a	10.706a	6.706a	20.294b	13.392b
df	2	3	3	2	2	2	3	3
Asymp. Sig.	.003	.000	.000	.005	.005	.035	.000	.004
a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 17.0.								
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.8.								

The above result of table 3 shows that chi square values of each variables the technology infrastructure its chi square value is 11.412. Human resource capability shows 23.588 positive chi-square values. Overall result shows that 10.706, 6.706, 20.294, 13.392, respectively. The overall significant value is 0.000, which shows that there are overall significant levels between them.

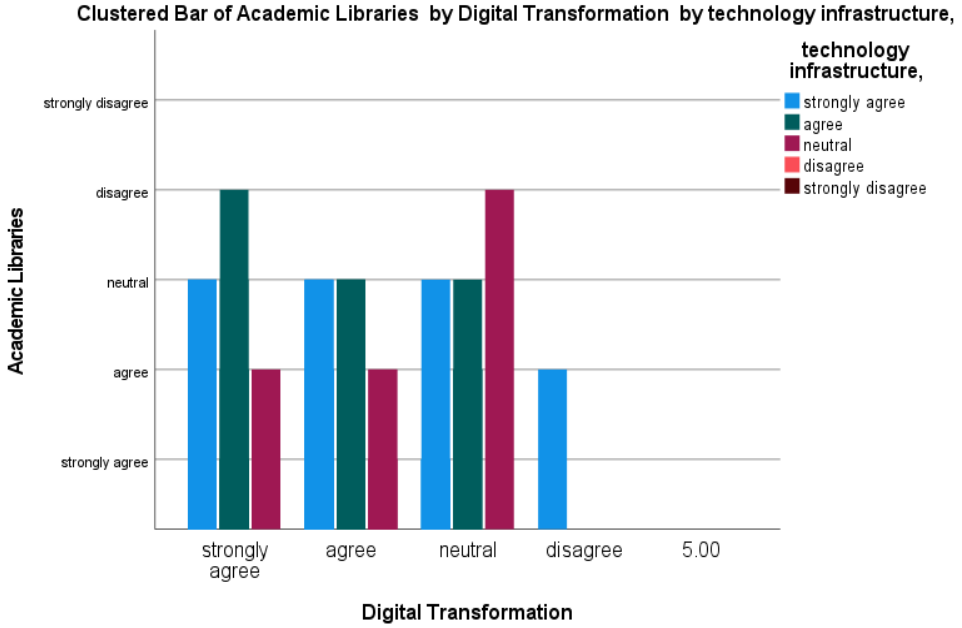

Figure 3: Clustered of Academic Libraries.

The above graph of figure 3 represents the relation in between academic libraries and digital transformation. The bar line represents the strongly agree factors between academic libraries and digital transformation. The green line represent that agree level the maroon bar line represent those neutral levels between the dependent and independent variables.

Figure 4: Challenges and Opportunities of Digital Transformation.

Challenges and Opportunities of Digital Transformation in Academic Libraries in Africa

- Digitization of African academic libraries is a complex space encompassing significant challenges and possible solutions to the information service provision in the long-term (Figure 4). The interpretation of this dichotomy is critical in the establishment of successful digital programs that enhance services in the library and advance higher education.
- Lack of technological infrastructure is one of the major challenges affecting the African academic libraries. The inadequate provision of high-speed Internet, lack of bandwidth and unreliable electrical supply hinders effective implementation and adoption of the digital library system. These infrastructural barriers impose a significant burden on the institutions in rural and poor locations, which worsens the digital divide between higher education institutions that are located within and outside of the border.
- Money is a major issue: Most academic libraries are facing limited funds, and this does not allow them to invest in digital tools, subscribe to electronic databases, support software applications, and upgrade hardware. The high cost of licensing electronic material and the associated cost of sustaining digital platforms also lower long-term sustainability.
- Poor funding also often results in the need to depend on donor-funded programs that can fail to continue their functioning once the external support is withdrawn. Lack of adequate digital skills and human capabilities is also another major challenge. A good number of the members of staff and patrons in the libraries are not appropriately trained in the digital technologies, information systems and data management.
- The unwillingness to change and the absence of the opportunity to develop professionally hinder the implementation of digital techniques. Digital transformation cannot fulfill its entire potential unless there is constant capacity building. Policy, legal and governance issues also influence digital transformation efforts. The absence of definite national and institutional policies that regulate digital libraries, copyright management, data protection and open access causes confusion and challenges in operations.
- Poor policy frameworks hinder coordinated planning and development of sustainable digital ecosystems in academic institutions. Anyhow such constraints, digital change holds great opportunities for academic libraries across Africa. Another prominent opportunity is the opportunity to expand access to the information resources. The digital platforms can be used by libraries to provide remote and 24/7 access to academic publications to facilitate distance education, collaborative research, and inclusive learning environments. This increased access enhances learning and sharing of

knowledge academically.

Opportunities

- Through online education, cross-border partnerships and working networks enable library workers to enhance their digital skills and adopt international best practices. These strategies enhance the quality of services and competitiveness of the institutions. Another distinguished potential is cooperation and sharing of resources.
- Collaborative innovation, common access to electronic resources and saving of money are some of the advantages of library consortiums and regional partnerships.
- Teamwork enhances sustainability through the sharing of limited resources and the sharing of information among institutions. Moreover, digital technologies can help to retain and manifest the African academia.
- Digital archives and institutional repositories promote open access, protect indigenous knowledge, and increase the global distribution of work created locally. This facilitates the continuation of culture and educational recognition. In conclusion, although African academic libraries are facing insurmountable physical, financial, and policy challenges as they embark on their digital transformation journey, there exist enormous opportunities to enhance access, sustainability, and creativity.
- To help seize on to these opportunities and guarantee the delivery of information services in the digital age, there is a need to have strategic investment, capacity building, enabling legislation, and collaborative strategies.

Figure 5: Applications of Digital Transformation.

Applications of Digital Transformation in Academic Libraries in Africa

A digital transformation has taken place in academic libraries in Africa, leading to the development and adoption of new technology and processes that enhance the delivery of information services, scholarly research, teaching and learning (Figure 5). Such applications are sustainable because they enhance accessibility, efficiency and the conservation of knowledge in the long run in institutions of higher learning.

Electronic resources and digital collections: Academic libraries are increasingly putting their investments in e-books, e-journals, online databases, and open-access repositories that enable them to access academic information anywhere and in real time. The application reduces the use of hardcopy materials, storage expenses, and accessibility to up-to-date education material, particularly in academies that have minimal print collections.

Digital collections are also useful in distance learning programs: immediate and poor students can have access to global academic expertise. Institutional repositories are online platforms used to store, organize, and publish research products in the form of theses, dissertations, journal articles, conference papers and technical reports undertaken by academic institutions. The institutional repositories increase the visibility of African scholarship both nationally and internationally, promote open access to knowledge, and promote the

impact and citation of research. They also contribute significantly towards the preservation of the indigenous knowledge and the research produced locally, which contributes to ensuring that there is cultural and intellectual sustainability. Another distinguished example of digital change is library automation systems.

Integrated Library Management Systems (ILMS) are automated systems that are used in cataloguing, circulation, acquisitions, serial management and services to the users. Automation leads to improved efficiency in operations, reduced manual errors and enables faster delivery of services. Online Public Access Catalogues (OPACs) help users search an online collection of libraries and enhance the user experience and retrieval of information. These solutions can be used to maintain the operations of the library since it enhances the management of resources and employee productivity.

Figure 6: Virtual and Distant Library Services.

Virtual and distant library services: Academic libraries are currently offering online reference services, virtual help desks, email-based consultations and chat services (Figure 6). These services extend user assistance on a continuous basis outside of the physical library settings. Virtual services are more applicable in cases where students are faced with mobility challenges or any disruption, such as pandemics or security limitations. Digital libraries enhance institutional resiliency and sustainability by guaranteeing continuity of the services.

The information literacy and the digital literacy programmes: Another significant outcome of the digital revolution is digital literacy as well as information literacy programs. Online learning systems, webinars, tutorials and multimedia technologies are being increasingly adopted by libraries to educate students and staff on information searching, evaluation, ethical information use and digital research. Through these programs, users can be able to navigate through digital spaces appropriately and encourage lifelong learning. Increasing the digital literacy level fosters long-term knowledge usage and academic achievement within African universities.

Figure 7: Academic Libraries of Resource Sharing Networks and Consortiums.

Academic libraries are becoming members of resource sharing networks and consortiums: Academic libraries are engaging in resource sharing networks and consortiums, which enable them to have access to electronic resources either in common, collaborate in digitizing materials, and share knowledge (Figure 7). These regional and global partnerships save on expenses, enhance the bargaining power with publishers and advance digital standards of practice. These alliances enhance sustainability since they share resources and promote mutual development between institutions. Digitalization is a technology that is being used in libraries to preserve rare manuscripts, historical records, and cultural heritage resources. Digital archiving enables access to important information over time whilst preserving delicate physical resources against decay. This application will help in the sustainability of a culture and safeguard the African intellectual legacy for future generations.

Data analytics and computer technology: Digital transformation has a new application in library management. The libraries use usage statistics, user behavior, and performance of the resources to assist them in making decisions and improving their services. The evidence-based management will help the libraries to effectively use the available resources, determine the needs of the users and develop long-term digital plans aligned to the institutional objectives. The digital transformation encourages comprehensive and available library services. Assistive technologies, mobile-friendly environments, and multilingual digital interfaces can help libraries to provide a wider range of services to people with disabilities and different language backgrounds. Smartphones are widespread in Africa; thus, mobile connection is much needed. Mobile technologies enable libraries to offer information services to more users and promote equity and inclusivity.

All in all, it can be noted that applications of digital transformation in African university libraries imply the latter becoming dynamic knowledge hubs as opposed to being recognized as traditional information storage facilities. Libraries play significant roles in the provision of long-term information service through digital resources, automation, virtual services, literacy programs, collaboration and preservation activities. Such applications not only facilitate academic achievements but also help to enlarge overall socio-economic development, due to the possibility to access knowledge, innovations, and international academic cooperation.

Discussion

The concept of digital transformation of the African academic libraries suggests that technological change is an organizational process that transforms the manner in which information services are provided, the capacity of an institution, and the engagement of users. These results indicate that despite the benefits of digital tools in terms of access to information and operational benefits, their effectiveness strongly relies on supplementary infrastructure, trained human resources, and sustainable policy frameworks. The employment of online resources, institutional repositories, and virtual services depicts the increased devotion of African academic libraries to the modernization of information access and adaptation to the global academic standards. These improvements support the prior studies, which highlighted the role of digital libraries in making research more visible and advancing distant learning. The increased access to electronic resources promotes academic productivity increases and cooperation across geographical boundaries.

However, the lack of balanced distribution of digital infrastructure still denies these advantages in full, which contributes to the widening of the disparities between institutes with resources and those with limited resources. The discussion reiterates that human capacity is one of the key elements in successful digital transformation. The libraries that invest in continuous professional growth and digital literacy initiatives show higher creativity and performance in service delivery. This is in line with the earlier studies, which have mentioned talented people as one of the strongest sources of continued digital library programs. Conversely, the opposition to change and lack of sufficient training opportunities hinder the use of technology and reduce the consequences of digital spending. The issue of financial sustainability has become a recurrent issue. Although the digital transformation reduces some of the operational costs in the long term, the initial cost and the maintenance costs remain significant challenges. Dependence on donor funds presents the question of the sustainability of digital projects. This highlights

the need for institutional commitment and various funding possibilities in order to be feasible over time. Digital transformation success is heavily dependent on policy and governance issues. The uncertainties in the operations lead to the unavailability of clear norms on copyright, data protection, and open access, which restrict innovation. The reinforcement of policy frameworks at institutional and national levels is therefore an important area of coordinated and sustainable digital development. On the whole, the argument presented states that digital transformation can transform African academic libraries, yet it needs comprehensive approaches, which will represent the combination of technological, human, financial, and policy factors. It needs a holistic approach to information service delivery through infrastructure building, capacity building, joint partnerships, and governance support to bring long-term information services delivery and maximize the potential of the digital libraries in African tertiary education.

Conclusion

Academic library digitalization in Africa is a landmark in the manner in which the information in the higher learning institutions is accessed, managed, and delivered. This paper will unveil the role of digital technologies as important instruments in the facilitation of teaching, learning, research, and preservation of knowledge in a more information-oriented academic scene. Use of electronic resources, institutional repositories, automated systems, and virtual services are methods that academic libraries are using to reinvent their role as dynamic knowledge centers instead of being seen as traditional repositories of print material. These results show that digital transformation enhances access to academic knowledge and increases research visibility and inclusive and flexible learning environments. The digital materials can be accessed remotely, and this means that academic libraries can provide a wide variety of users, such as distance learners and remote researchers. Moreover, the process of converting and storing indigenous knowledge and locally produced research contributes to the culture of sustainability and guarantees the accessibility of the intellectual history of Africa in the future. In spite of these positive results, the conclusion highlights the fact that there are still some unresolved issues that hinder the digitalisation of the African academic libraries. Limitations of infrastructure, lack of finance, low digital skills, and poor policy frameworks still hinder the rate and effectiveness of digital projects. The issues reveal that technology is not enough to provide sustainable information services. Rather, digital transformation needs institutional commitment, trained human capital, and regular systems of governance.

Another important point that the report highlights is the need to ensure sustainability in developing digital libraries. Very important for sustainable information services are continuous investment, responsive technologies and evidence-based management policies. The issue of balancing innovation and optimization of resources is a challenge that academic libraries will need to address to ensure that digital systems will be available, useful, and relevant as time goes by. The cooperation in library consortiums, collaboration with international organizations, and involvement with government agencies are all considered ways to achieve greater sustainability and cost-reduction. Moreover, the conclusion identifies the strategic significance of the policy formulation in shaping the future of digital academic libraries in Africa. Effective planning and innovation in the digital space must have clear institutional and national policies on digital access, copyright management, data protection, and open access. Supportive policies will help libraries combine their digital transformation efforts with other educational and development goals. Lastly, digitalization of African academic libraries is an important opportunity that can enhance the information service provision and help in sustaining the sustainability of higher education systems in the long term. Despite the challenges they have, they are not insurmountable. Digital transformation can be embraced by academic libraries, taking full advantage of integrated approaches that include technical investment, capacity building, policy support, and collaboration. Increasing these efforts would ensure that the academic libraries remain relevant in terms of knowledge creation, sharing, and sustainable growth in the digital environment of Africa.

Recommendations

1. Enhance ICT Infrastructure: Investing in a stable Internet connection, the right bandwidth and a stable electricity supply in academic libraries. Better infrastructure will be essential to the provision of

digital platforms, online resources, and reliable information services in isolated and underserved regions.

2. Encourage sustainable financing. Academic libraries ought to apply a complex funding concept that involves institutional budgets, government support, grants, and partnerships. Sustainable finance reduces reliance on initiatives supported by donors, but the long-term maintenance and upgrading of digital systems and electronic resources.

3. Enhance Capacity Building and Digital Skills: Introduce professional development initiatives that will train employees on digital skills, e.g., data management and preservation, as well as new technologies. The users are also advised to be offered regular training in order to become more digitally and information literate and utilize digital resources to their advantage.

4. Develop clear policies and structures of governance concerning digital library management, copyright, open access, data security, and intellectual property. Well-established governance frameworks promote accountability, cooperation and long-term digital transformation programs.

5. Promote community work and sharing of resources between academic libraries through participation in regional and global consortia to share electronic resources, knowledge and technological infrastructure. Partnership reduces expenses, enhances access to academic resources and fosters innovation within institutions.

6. Libraries ought to emphasize local research findings and native knowledge digitization and preservation. This guarantees sustainability, offers cultural sustainability and increases the global profile of African scholarship.

7. Introduce User-Focused and Inclusionary Digital Services: The digital platforms ought to be convenient, mobile, and responsive to the diverse needs of users, including individuals with impairments. There should be the use of user feedback tools that would continuously improve service delivery.

References

Adarkwah, M. A., Okagbue, E. F., Oladipo, O. A., Mekonen, Y. K., Anulika, A. G., Nchekwubemchukwu, I. S. *et al.* (2024). Exploring the Transformative Journey of Academic Libraries in Africa before and after COVID-19 and in the Generative AI Era. *The Journal of Academic Librarianship*, 50(4): 102900. https://doi.org/10.1016/j.acalib.2024.102900

Adekoya, C. O., Fasae, J. K. and Alade, A. V. (2024). Academic libraries, ICT use and sustainable higher education development. *Information Discovery and Delivery*, 52(1): 1-10. https://doi.org/10.1108/IDD-01-2022-0002

Adigun, G. O., Ajani, Y. A. and Enakrire, R. T. (2024). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) Industrial Revolution. *Libri*, 74(3): 211-223. https://doi.org/10.1515/libri-2023-0111

Akinola, S. and Telukdarie, A. (2023). Sustainable digital transformation in healthcare: Advancing a digital vascular health innovation solution. *Sustainability*, 15(13): 10417. https://doi.org/10.3390/su151310417

Aruleba, K. and Jere, N. (2022). Exploring digital transforming challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific African*, 16: e01190. https://doi.org/10.1016/j.sciaf.2022.e01190

Azam, M. and Ahmad, K. (2024). Adoption of big data analytics for sustainability of library services in academic libraries of Pakistan. *Library Hi Tech*, 42(5): 1457-1476. https://doi.org/10.1108/LHT-12-2022-0584

Barsha, S. and Munshi, S. A. (2024). Implementing artificial intelligence in library services: a review of current prospects and challenges of developing countries. *Library Hi Tech News*, 41(1): 7-10. https://doi.org/10.1108/LHTN-07-2023-0126

Chisita, C. T., Chiparausha, B., Tsabetse, V., Olugbara, C. T. and Letseka, M. (2022). Remaking academic library services in Zimbabwe in the wake of COVID-19 pandemic. *The Journal of Academic Librarianship*, 48(3): 102521. https://doi.org/10.1016/j.acalib.2022.102521

Dei, D.-G. J. and Asante, F. Y. (2022). Role of academic libraries in the achievement of quality education as a sustainable development goal. *Library management*, 43(6/7): 439-459. https://doi.org/10.1108/LM-02-2022-0013

Dube, T. V. and Jacobs, L. (2023). Academic library services extension during the COVID-19 pandemic: Considerations in higher education institutions in the Gauteng Province, South Africa. *Library management*, 44(1/2): 17-39. https://doi.org/10.1108/LM-04-2022-0039

Elgohary, E. (2022). The role of digital transformation in sustainable development in Egypt. *The International Journal of Informatics, Media and Communication Technology*, 4(1): 71-106. https://doi.org/10.21608/ijimct.2022.219953

Ikenwe, I. J. and Udem, O. K. (2022). Innovative digital transformation for dynamic information service sustainability in university libraries in Nigeria. https://doi.org/10.12775/FT.2022.004

Ikwuanusi, U. F., Adepoju, P. A. and Odionu, C. S. (2023). AI-driven solutions for personalized knowledge dissemination and inclusive library user experiences. *International Journal of Engineering Research Updates*, 4(2): 052-062. https://doi.org/10.53430/ijeru.2023.4.2.0023

Ikwuanusi, U. F., Azubuike, C., Odionu, C. and Sule, A. (2022). Leveraging AI to address resource allocation challenges in academic and research libraries. *IRE Journals*, 5(10): 311. https://tinyurl.com/4z296e6s

Ikwuanusi, U. F., Onunka, O., Owoade, S. J. and Uzoka, A. (2024). Digital transformation in public sector services: Enhancing productivity and accountability through scalable software solutions. *International Journal of Applied Research in Social Sciences. P-ISSN*: 2706-9176. https://doi.org/10.51594/ijarss.v6i11.1724

Mashroofa, M. M. (2022). Contribution of academic libraries towards sustainable development goals. https://doi.org/10.56042/alis.v69i1.56234

Mhlanga, D., Denhere, V. and Moloi, T. (2022). COVID-19 and the key digital transformation lessons for higher education institutions in South Africa. *Education Sciences*, 12(7): 464. https://doi.org/10.3390/educsci12070464

Ocran, T. K. and Afful-Arthur, P. (2022). The role of digital scholarship in academic libraries, the case of university of cape coast: opportunities and challenges. *Library Hi Tech*, 40(6): 1642-1657. https://doi.org/10.1108/LHT-09-2020-0238

Odunlade, R. and Ojo, J. (2023). Digital Transformation and Service Delivery in Academic Libraries: a Post Covid-19 Approach. *Lokoja Journal of Information Science Research*, 1(1): 41-60. https://ljisr.net.ng/lis/article/view/5

Ogwo, U., Ibegbulem, F. and Ezema, I. J. (2023). Prospects and challenges of cloud computing for effective information service delivery in academic libraries in Nigeria. https://tinyurl.com/y82bbuwj

Okoro, C. A., Wagwu, V. and Osuchukwu, N. P. (2025). Up-Skilling Library and Information Science Professionals for the 5th Industrial Revolution. *International Journal of Applied Technologies in Library and Information Management*, 11(2): 63-71. https://www.ajol.info/index.php/jatlimi/article/view/305022

Okunlaya, R. O., Syed Abdullah, N. and Alias, R. A. (2022). Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. *Library Hi Tech*, 40(6): 1869-1892. https://doi.org/10.1108/LHT-07-2021-0242

OKWOLI, M. E. (2025). IMPROVING INNOVATIVE TOOLS FOR DISSEMINATION OF INFORMATION IN ACADEMIC LIBRARIES IN NIGERIA. *Journal of Information Resource Management (JIRM)*, 10(1): 44-56. https://doi.org/10.61955/NUSQZR

Onunka, O., Onunka, T., Fawole, A., Adeleke, I. and Daraojimba, C. (2023). Library and information services in the digital age: Opportunities and challenges. *Acta Informatica Malaysia*, 7(1): 113-121. https://doi.org/10.26480/aim.02.2023.113.121

Otike, F. (2023). Digital transformation of academic libraries in developing countries in Africa. https://doi.org/10.21862/vkkv2022.419

Otolo, U. P. (2022). Information service delivery and utilisation in selected public libraries in rural Niger delta communities in Nigeria. *International information & library review*, 54(4): 341-353. https://doi.org/10.1080/10572317.2022.2046

435

Owolabi, K. A., Okorie, N. C., Yemi-Peters, O. E., Oyetola, S. O., Bello, T. O. and Oladokun, B. D. (2022). Readiness of academic librarians towards the use of robotic technologies in Nigerian university libraries. *Library management*, 43(3/4): 296-305. https://doi.org/10.1108/LM-11-2021-0104

Palos-Sánchez, P. R., Baena-Luna, P., García-Ordaz, M. and Martínez-López, F. J. (2023). Digital transformation and local government response to the COVID-19 pandemic: An assessment of its impact on the sustainable development goals. *Sage Open*, 13(2): 21582440231167343. https://doi.org/10.1177/21582440231167343

Peláez, A. L., Suh, S.-M. and Zelenev, S. (2022). *Digital transformation and social well-being: Promoting an inclusive society*. Taylor & Francis. https://lccn.loc.gov/2022014110

Shahzad, K., Khan, S. A., Javed, Y. and Iqbal, A. (2023). E-learning for continuing professional development of university librarians: a systematic review. *Sustainability*, 15(1): 849. https://doi.org/10.3390/su15010849

Tshabalala, N. and Dube, L. (2024). Emerging technologies and skills to improve service delivery in digital libraries. *South African Journal of Libraries and Information Science*, 90(2): 1-12. https://doi.org/10.7553/90-2-2393