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Transforming library systems in Africa: advancing literacy and cultural preservation through digital innovation

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Abstract

Transforming library systems in Africa is essential for advancing literacy and preserving cultural heritage in an increasingly digital world. The integration of digital innovation into African libraries has the potential to revolutionize access to information, promote lifelong learning, and safeguard indigenous knowledge. This review explores the role of modern technologies, such as digital archiving, e-libraries, and mobile platforms, in enhancing literacy rates and preserving Africa's rich cultural traditions. By transitioning from traditional, print-based models to digital systems, libraries can bridge the educational gap in underserved communities, offering wider access to educational resources and promoting literacy at all levels. Additionally, digitization facilitates the preservation of local languages, oral histories, and cultural artifacts, ensuring that future generations can engage with Africa's diverse heritage. The challenges of digital transformation in African library systems, including limited infrastructure, funding, and digital literacy, are also discussed. The review emphasizes the need for strategic investments in technology, capacity building, and policy frameworks to create a sustainable digital ecosystem. By harnessing digital innovation, African libraries can evolve into dynamic centers of learning and cultural preservation, contributing to both socio-economic development and the protection of African identities. This transformation is critical to fostering a more educated, culturally aware, and globally connected African society.

Keywords: Library systems; Africa; Cultural preservation; Digital innovation

1. Introduction

Libraries have historically been fundamental to education, knowledge dissemination, and cultural preservation across the globe (Ekpobimi *et al.*, 2024). In Africa, libraries play a vital role in providing access to information, fostering literacy, and preserving the continent's rich and diverse cultural heritage. However, the current state of library systems across the African continent faces significant challenges that have hindered their potential impact (Lynch *et al.*, 2021). With limited resources, outdated collections, and inadequate infrastructure, many libraries struggle to meet the educational and cultural needs of growing populations. Moreover, the digital divide between African countries and more developed regions has further constrained the ability of libraries to leverage modern tools that could enhance access and preservation efforts (Masenya and Ngulube, 2020; Ogedengbe *et al.*, 2023).

The library systems in many African nations are characterized by a lack of modernization and resource constraints. Public libraries, in particular, often operate with outdated books, limited technological access, and insufficient staff to serve the needs of their communities (Mojapelo, 2020). In rural and underserved regions, these challenges are more acute, with physical libraries being rare and difficult to access. Furthermore, the infrastructure necessary for building modern libraries such as stable internet connections, electricity, and digital equipment—remains inadequate in many

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regions. As a result, libraries are often underutilized and struggle to remain relevant in a rapidly evolving information landscape (McAllister *et al.*, 2022). In contrast, academic and university libraries in urban areas tend to be better equipped, but they also face challenges related to limited funding and outdated resources. The global shift toward digital learning and information access has further emphasized the need for African library systems to embrace digital innovation. Despite these challenges, libraries remain central to literacy efforts, especially in communities with low access to formal education. The transformation of these systems through digital innovation presents a significant opportunity to overcome existing limitations and extend the reach of libraries to a broader population (Okunlaya *et al.*, 2022).

Libraries in Africa serve as crucial hubs for education and literacy promotion, particularly in regions where formal education systems may be underdeveloped. By providing access to books, educational materials, and information resources, libraries support lifelong learning and help improve literacy rates, which are critical for socioeconomic development (Abumandour, 2020). In rural areas, mobile libraries, book banks, and community libraries play a pivotal role in supplementing formal education systems and offering alternative learning spaces. Moreover, libraries can bridge the gap for learners who do not have access to modern technology, ensuring that educational resources are available to all segments of the population.

Beyond their role in literacy, African libraries are custodians of cultural heritage. Many libraries house collections of indigenous knowledge, historical documents, oral histories, and cultural artifacts that are essential to the preservation of Africa's rich traditions (Falola, 2020). These institutions protect valuable cultural narratives, languages, and practices from disappearing in the face of globalization and modernization. However, many of these resources are at risk due to poor preservation techniques and lack of access. The advent of digital technologies offers an opportunity to safeguard these materials by enabling libraries to digitize and archive cultural resources for future generations (Pandey and Kumar, 2020).

Digital innovation is poised to revolutionize library systems in Africa by addressing some of the critical challenges faced by traditional libraries. The implementation of digital libraries, mobile applications, and cloud-based systems can significantly expand access to information, particularly in remote and underserved communities (Zhang *et al.*, 2022). Through e-libraries and online platforms, libraries can provide digital access to educational materials, books, and research resources that would otherwise be unavailable in print form. Mobile technologies also play a crucial role in widening access, as smartphones are increasingly becoming the primary medium through which many African populations access the internet. Furthermore, digital innovation facilitates the preservation of African culture through the digitization of local languages, oral traditions, and cultural artifacts. With the growing interest in preserving indigenous knowledge, digital libraries can serve as platforms for archiving and disseminating Africa's rich cultural heritage on a global scale. This transformation requires not only technological investments but also a focus on developing the skills and capabilities of librarians and communities to effectively use and maintain digital systems (Ashiq *et al.*, 2022; Ekpobimi *et al.*, 2024).

The purpose of this review is to explore the transformative potential of digital innovation in advancing literacy and preserving culture through African library systems. It examines the current state of libraries on the continent, the role of libraries in education and cultural preservation, and the ways in which digital technology can address existing challenges. The review will discuss key digital innovations that have been successfully implemented, analyze the socio-economic and educational impact of modernized library systems, and identify the challenges that must be overcome to achieve widespread digital transformation. By understanding these dynamics, this review seeks to contribute to the development of strategies for fostering sustainable digital ecosystems in African libraries, ultimately helping to build more literate, culturally aware, and globally connected societies across the continent.

2. The Role of Libraries in Advancing Literacy

Libraries have long been pillars of education and literacy promotion, serving as repositories of knowledge and learning. Historically, they have played a critical role in the spread of education, offering free or low-cost access to books, scholarly materials, and information (Betts *et al.*, 2021). In many parts of the world, libraries have been instrumental in increasing literacy rates by providing communities with the tools to read, learn, and engage with ideas. This role remains crucial in Africa, where libraries offer an opportunity to bridge educational gaps and promote literacy, especially in underserved and rural areas. However, traditional library systems in Africa face significant challenges, which digital innovation may help to address.

Historically, libraries have been key institutions in advancing education and literacy. In ancient civilizations like Egypt, Greece, and Rome, libraries were hubs of scholarly activity, housing texts that were accessible to scholars, students, and

citizens alike. The invention of the printing press in the 15th century dramatically increased the availability of books, further establishing libraries as centers for learning and education (Palmer, 2022). Public libraries, in particular, democratized access to information, enabling even those without formal education to improve their literacy and knowledge. In the African context, libraries have traditionally functioned as educational tools, particularly in the post-colonial period when many nations sought to improve literacy rates and expand access to education. Libraries have been vital in supporting formal education systems, providing students with textbooks, reference materials, and a space for independent study. However, the role of libraries extends beyond schools, as they serve broader community needs by offering information and resources to the general public, including adults seeking to improve their reading skills (Lo and Stark, 2021).

Despite their importance, traditional library systems in Africa face numerous challenges that hinder their effectiveness. Many libraries are underfunded, leading to a lack of updated materials and resources. Outdated collections often fail to meet the needs of modern learners, and the inability to acquire new books or technological resources limits the scope of what these libraries can offer (Khalid *et al.*, 2021). Additionally, many African libraries lack access to essential infrastructure, such as consistent electricity, internet connectivity, and technological equipment, making it difficult for them to evolve in a digital age. Physical access to libraries is another significant challenge, particularly in rural areas where there are few, if any, libraries. For many communities, especially those in remote regions, the nearest library may be hours away, making regular access impractical. The lack of trained library staff further compounds these challenges, as libraries struggle to offer high-quality services without skilled professionals to manage collections, guide users, and promote literacy programs.

In underserved and rural communities, libraries serve as vital educational lifelines. They are often the only source of books and educational materials available to people in these regions, where formal schooling systems may be weak or inaccessible. For children in these areas, libraries provide critical support in learning to read and write, as well as access to information that helps them stay connected to national and global developments. Libraries in rural areas often go beyond their traditional role by acting as community centers, hosting literacy workshops, reading programs, and adult education classes (Singh *et al.*, 2022). For adults, especially those who missed out on formal education, libraries offer an opportunity to engage in self-directed learning and improve literacy skills. In some cases, mobile libraries and outreach programs bring books and educational materials directly to remote areas, further emphasizing the crucial role libraries play in bridging educational gaps. Libraries in these communities also play a significant role in preserving local culture and language, ensuring that future generations remain connected to their heritage while also gaining access to modern knowledge.

Digital libraries present a powerful solution to many of the challenges faced by traditional library systems in Africa. By leveraging digital technology, libraries can dramatically expand their reach, making educational resources accessible to people who would otherwise be excluded due to geographic or financial barriers. E-libraries and mobile applications allow users to access books, research materials, and learning resources from anywhere with an internet connection, providing a more flexible and efficient way to learn (Odili *et al.*, 2022). In rural and underserved communities where physical libraries are scarce, digital libraries offer an opportunity to bridge the literacy gap. With the widespread use of smartphones across Africa, even in remote areas, digital platforms enable libraries to reach a broader audience. These platforms also offer the possibility of multilingual resources, ensuring that materials are available in local languages, which is particularly important for literacy development in diverse linguistic regions. Moreover, digital libraries help address the issue of outdated materials. By offering online access to the latest books, journals, and educational resources, they can provide users with up-to-date information that traditional libraries may struggle to acquire. Digital collections can also be easily expanded and maintained, offering a cost-effective solution for resource-poor libraries. In addition, by promoting the use of digital technology, libraries can help improve digital literacy, a key skill in the modern economy.

Libraries remain essential institutions for advancing literacy in Africa, particularly in underserved and rural communities. However, traditional library systems face numerous challenges that limit their effectiveness, including limited access, outdated materials, and inadequate infrastructure. Digital libraries offer a promising solution to these challenges, expanding access to educational resources and bridging literacy gaps across the continent. By embracing digital innovation, African libraries can not only promote literacy but also ensure that people have the tools and resources they need to participate in the global knowledge economy (Chatterjee *et al.*, 2021).

2.1. Digital Innovation in Library Systems

Digital innovation has the potential to transform library systems by enhancing access, improving efficiency, and enabling the preservation of cultural and educational resources. Traditional libraries face limitations such as physical

access, outdated materials, and a lack of modern infrastructure, especially in developing regions like Africa (Bouaamri *et al.*, 2022). However, with the advent of digital technologies such as e-libraries, mobile applications, and cloud-based systems, libraries are now able to overcome these challenges and expand their services. These innovations not only improve the availability of information but also enhance the overall experience of users, making libraries more accessible to diverse populations.

One of the most significant digital innovations in modern libraries is the development of e-libraries. E-libraries are virtual platforms that allow users to access digital books, journals, research reviews, and other resources through the internet. These platforms can be accessed from anywhere, reducing the need for physical visits to a library and enabling users to access materials around the clock. By eliminating geographical barriers, e-libraries increase the availability of educational materials to individuals in remote or underserved areas. Mobile applications are another critical innovation, especially in Africa, where smartphones are more widely available than personal computers (Paas *et al.*, 2021). These apps allow users to access library resources directly from their phones, providing a convenient and flexible way to engage with digital materials. Mobile apps often include features such as offline access, which is particularly useful in areas with unreliable internet connections. In addition, they support multilingual interfaces, making educational content available to diverse linguistic groups. Cloud-based systems have also emerged as essential tools in modernizing library infrastructures. Cloud computing enables libraries to store vast amounts of data and resources online, offering an efficient and cost-effective solution to resource management. Cloud platforms also facilitate collaboration between libraries by allowing them to share resources, thereby broadening the scope of accessible materials. Libraries can reduce their dependence on physical storage and hardware, increasing their scalability and sustainability in the long term (Nasir *et al.*, 2022).

Several successful digital library initiatives have already taken root in Africa, demonstrating the transformative potential of digital technology. One notable example is the African Digital Library (ADL), an online library that provides access to thousands of full-text books and research materials. Launched in the late 1990s, the ADL was one of the first large-scale digital libraries on the continent, aimed at democratizing access to knowledge and fostering literacy. Another prominent initiative is the eKitabu platform in Kenya. This digital library app offers users access to e-books in multiple languages, including Swahili, and features a catalog of books for primary, secondary, and higher education. By offering an affordable and accessible solution to learning materials, eKitabu has significantly impacted literacy rates and education quality, particularly in underprivileged communities (Adeniran *et al.*, 2023). In South Africa, the National Library of South Africa has adopted a digital library system that provides users with access to thousands of digital resources, including rare books, historical manuscripts, and cultural documents. This initiative is part of a broader effort to preserve the country's cultural heritage while making it accessible to a global audience.

Mobile technology has played a critical role in expanding access to library resources across Africa. With mobile phones being more ubiquitous than computers or tablets, many people in rural or underserved areas rely on mobile devices as their primary means of accessing the internet. This shift has encouraged libraries to develop mobile-friendly platforms and apps that allow users to engage with digital content easily. In regions where physical libraries are scarce, mobile technology serves as a bridge, connecting communities to educational resources that they would otherwise lack (Pearce, 2020). For example, mobile reading apps have become popular tools for advancing literacy by offering users access to digital books and learning materials in multiple languages. Additionally, mobile technology supports remote learning, which has become especially important during crises such as the COVID-19 pandemic. By ensuring that library resources can be accessed on mobile devices, libraries have been able to continue serving their communities even when physical spaces are closed.

The digital transformation of library systems in Africa has been driven, in part, by partnerships between libraries, technology companies, non-governmental organizations (NGOs), and governments. These collaborations are essential for providing the infrastructure, expertise, and financial resources necessary to implement and sustain digital innovations in libraries. Tech companies have contributed significantly to digital library initiatives by offering platforms, tools, and training to library staff and users (Deja *et al.*, 2021). For instance, Microsoft and Google have partnered with African libraries to provide cloud services, digital literacy training, and access to educational resources. These partnerships not only enhance the technological capabilities of libraries but also help close the digital divide by improving access to digital skills training. NGOs play an essential role in funding and advocating for digital library projects. Organizations such as the Bill & Melinda Gates Foundation have provided grants and support to libraries in Africa to foster the development of digital resources and expand access to information. Additionally, local NGOs often collaborate with libraries to implement literacy programs that leverage digital platforms to reach marginalized communities. Governments are also critical in facilitating digital library transformation by creating supportive policies and providing funding for infrastructure development. In countries like Kenya, government initiatives such as the Kenya National Digital Literacy Program have helped promote digital learning and library services across the country.

Digital innovation is transforming library systems in Africa by expanding access to educational resources, overcoming traditional limitations, and preserving cultural heritage. Key digital innovations such as e-libraries, mobile apps, and cloud-based systems have enabled libraries to reach underserved populations and enhance literacy efforts. Successful digital library initiatives, coupled with mobile technology's widespread use, have significantly improved the availability of knowledge across the continent. Partnerships with tech companies, NGOs, and governments are essential to driving this transformation and ensuring that Africa's library systems can fully embrace the digital age (Nyoka, 2022).

2.2. Cultural Preservation through Digital Archiving

The preservation of cultural heritage is a vital endeavor in safeguarding the identity, history, and diversity of communities across Africa. As globalization and modernization bring about rapid societal changes, there is a growing risk of losing valuable cultural knowledge, traditions, and languages (Yeganeh *et al.*, 2020). In response to these challenges, digital archiving has emerged as a crucial tool in ensuring that Africa's rich cultural heritage is preserved for future generations. By leveraging digital technology, African nations can capture, store, and disseminate their cultural knowledge in ways that are accessible to both local and global audiences.

Africa is home to a diverse array of cultures, languages, and traditions, many of which have been passed down through generations via oral histories, indigenous knowledge, and local customs. Preserving this cultural heritage is essential for maintaining the continent's identity and ensuring that future generations can understand and connect with their past. The digital age presents both challenges and opportunities for cultural preservation. On the one hand, rapid urbanization and the global spread of information have threatened the survival of traditional knowledge systems. On the other hand, digital technology provides unprecedented tools for documenting, archiving, and sharing cultural materials, making them accessible in ways that were previously unimaginable. Digital archiving allows African communities to preserve not only tangible cultural artifacts, such as art and historical documents, but also intangible heritage, such as oral traditions, indigenous knowledge systems, and local languages (Balogun and Kalusopa, 2022). This is particularly important as many African cultures rely heavily on oral transmission of knowledge, which can easily be lost if not carefully documented. Furthermore, the digitization of cultural heritage enhances its reach, allowing people across the world to access and appreciate Africa's rich cultural diversity.

One of the key aspects of cultural preservation in Africa is the digitization of local languages, oral histories, and indigenous knowledge. Africa is linguistically diverse, with over 2,000 languages spoken across the continent. However, many of these languages are under threat due to the dominance of colonial languages such as English, French, and Portuguese. Digitization efforts have sought to preserve endangered languages by creating digital records, audio files, and transcriptions of oral histories, traditional stories, and songs. These digital archives help ensure that future generations can learn, study, and appreciate their linguistic heritage. Oral histories are particularly important in African cultures, where knowledge has historically been passed down through spoken word rather than written text (Green and Troup, 2020). Digitizing these oral traditions involves recording and storing them in digital formats such as audio, video, and text files. For example, many communities have undertaken projects to record elders recounting traditional stories, rituals, and historical events, preserving this knowledge for future generations. Indigenous knowledge systems, which include practices related to agriculture, medicine, and environmental stewardship, are also being digitized, providing valuable resources for research and cultural education.

Several successful case studies demonstrate how digital platforms are being used to preserve and promote Africa's cultural heritage. One notable example is the World Digital Library, an initiative led by UNESCO and the U.S. Library of Congress, which features digital collections from around the world. African countries such as Egypt, South Africa, and Mali have contributed manuscripts, maps, and oral histories to this global digital repository, making African cultural heritage accessible to a worldwide audience (Mnjama, 2021). Another example is the Timbuktu Manuscripts project, which aimed to digitize the ancient Islamic manuscripts of Timbuktu in Mali. These manuscripts, some of which date back to the 13th century, contain valuable information about African history, law, science, and religion. The project was especially crucial following the threat of destruction during the political unrest in Mali. By digitizing these manuscripts, the project not only safeguarded them from physical damage but also ensured that their contents could be studied and appreciated by scholars and the public globally. Similarly, in Kenya, the National Museums of Kenya (NMK) has developed a digital platform that archives and shares the country's cultural artifacts, photographs, and oral traditions. The platform provides a space where Kenyans and people worldwide can access and explore Kenya's rich cultural history (Cairns *et al.*, 2022). This initiative highlights the role of digital archives in making cultural heritage accessible to those who may not have the opportunity to visit museums or libraries in person.

Libraries have always played a key role in preserving cultural memory, and this role is even more critical in the digital era. As custodians of knowledge and culture, libraries are responsible for collecting, archiving, and disseminating

cultural materials. In Africa, libraries have been at the forefront of digitization efforts, working to ensure that the continent's cultural heritage is preserved and made accessible in digital form. In the digital era, libraries are not only responsible for physical books and manuscripts but also for the growing wealth of digital content (Pokorná *et al.*, 2020). Many African libraries are developing digital collections that include audio recordings of oral histories, digitized manuscripts, and digital versions of indigenous knowledge systems. These libraries are also working to ensure that their collections are available to users both locally and globally, often in collaboration with international institutions and digital platforms. Moreover, libraries serve as educational hubs where communities can learn about their cultural heritage through digital resources. By providing access to digital archives, libraries help foster a sense of cultural identity and pride among younger generations, while also promoting intercultural understanding globally.

Digital archiving is an essential tool for preserving Africa's rich cultural heritage in the face of globalization and modernization. Through the digitization of local languages, oral histories, and indigenous knowledge, Africa's diverse cultural traditions can be safeguarded for future generations (Kugara and Mokgoatšana, 2022). Successful case studies, such as the World Digital Library and the Timbuktu Manuscripts project, highlight the transformative potential of digital platforms in cultural preservation. Libraries, as custodians of cultural memory, play a pivotal role in this process, ensuring that both physical and digital collections are maintained and accessible. Digital archiving not only preserves African culture but also connects it with the global digital landscape, fostering broader appreciation and understanding.

2.3. Challenges in Transforming African Library Systems

The transformation of library systems across Africa, especially through digital innovations, holds significant potential to enhance access to knowledge and preserve cultural heritage (Edewor, 2020). However, this transformation faces numerous challenges that must be addressed for the full benefits to be realized. These challenges range from infrastructure limitations and funding constraints to digital literacy gaps and resistance to change. Understanding and overcoming these obstacles is key to enabling African libraries to fully embrace digital innovation and provide equitable access to information.

One of the most significant challenges facing African libraries in their digital transformation is the continent's infrastructure limitations. Many African countries, particularly in rural areas, suffer from unreliable internet access and frequent power shortages, which hinder the implementation of digital library systems. High-speed internet, necessary for accessing digital resources, remains limited in many regions, creating a digital divide between urban and rural populations (Lee *et al.*, 2021). In some cases, even basic internet connectivity is unavailable, leaving libraries in these areas unable to provide access to online educational materials and e-libraries. Power shortages also pose a critical challenge. In countries with frequent blackouts and unstable electricity grids, maintaining the necessary infrastructure to support digital systems can be difficult and costly. Libraries rely on a consistent power supply to run computers, servers, and other digital devices. Interruptions in power can lead to data loss, equipment damage, and disruptions in service, making it hard for libraries to offer reliable digital services. As a result, digital libraries in Africa often struggle to provide continuous access to resources, limiting their effectiveness in promoting literacy and education.

Funding is another significant obstacle to the digital transformation of African libraries. Many libraries in Africa operate on limited budgets, and the costs associated with implementing and maintaining digital systems can be prohibitive. Digital transformation requires significant investments in infrastructure, software, equipment, and training, which many libraries are unable to afford. Without sufficient funding, it is difficult to procure the necessary technology or hire skilled personnel to manage and operate digital library systems. In addition to the initial capital required to set up digital systems, ensuring financial sustainability in the long term is a challenge. Maintaining digital library services requires ongoing expenses, such as subscription fees for digital content, server maintenance, and technical support (Shaw and De Sarkar, 2021). Many African libraries lack reliable funding streams and often depend on external grants and donations to stay operational. These financial constraints limit the ability of libraries to develop comprehensive digital services and restrict their capacity to expand access to educational resources.

Digital literacy, both among librarians and users, is another major challenge in the digital transformation of African libraries. For digital library systems to be effective, library staff must be proficient in using and managing digital technologies. However, many librarians in Africa lack the necessary training and skills to operate digital systems, manage online resources, and assist users in navigating digital platforms (Okeji *et al.*, 2020). This skills gap can result in ineffective use of digital tools, underutilization of available resources, and difficulties in managing digital collections. In addition to librarians, many users of African libraries also face digital literacy challenges. A large portion of the population, especially in rural areas, has limited exposure to computers, the internet, and digital technologies. This lack of familiarity makes it difficult for users to access and benefit from digital library resources. Training programs and

initiatives to enhance digital literacy among both librarians and users are essential, but they require time, funding, and a concerted effort from governments and institutions.

The transformation of library systems in Africa is also hampered by resistance to change and a lack of supportive policies. Many traditional library systems are deeply rooted in established practices, and transitioning to digital platforms can be met with resistance from both library staff and users. Some librarians may be reluctant to adopt new technologies, fearing that digitization will render their traditional skills obsolete or lead to job loss. Similarly, users who are accustomed to physical books and face-to-face interactions may be resistant to using digital platforms (Ogedengbe *et al.*, 2024). Moreover, policy gaps in supporting digital transformation create additional hurdles. In many African countries, national and institutional policies do not adequately promote or support the digital transformation of libraries. For example, there may be a lack of clear guidelines or funding allocations for implementing digital library systems. Without strong policy frameworks, libraries face difficulties in securing the resources and support needed to transition to digital services. Governments and library institutions need to establish policies that encourage digital transformation and provide a roadmap for integrating digital innovations into traditional library systems.

The transformation of African library systems through digital innovation holds immense potential to improve access to knowledge and promote literacy across the continent. However, several significant challenges stand in the way of this transformation. Infrastructure limitations, such as unreliable internet and frequent power shortages, hinder the implementation and sustainability of digital systems. Funding constraints make it difficult for libraries to invest in the necessary technology and training, while digital literacy gaps among both librarians and users limit the effective use of digital tools (Ekpobimi *et al.*, 2023). Resistance to change and policy gaps further complicate the transition to digital platforms. Overcoming these challenges will require coordinated efforts from governments, institutions, and international organizations to provide the necessary infrastructure, funding, and policy support. With the right strategies in place, African libraries can harness the power of digital innovation to bridge literacy gaps and preserve cultural heritage for future generations.

2.4. Strategies for Sustainable Digital Transformation

The sustainable digital transformation of library systems in Africa holds significant potential to improve literacy, educational access, and cultural preservation across the continent. To achieve this transformation, a multi-faceted approach is required that addresses the technological, educational, policy, and community aspects of digital library systems (Ekpobimi *et al.*, 2024). Sustainable strategies must ensure that digital transformation benefits both urban and rural populations, bridges gaps in access to information, and preserves Africa's diverse cultural heritage.

Investment in technology and infrastructure is foundational to the sustainable transformation of African libraries. Digital libraries require reliable internet access, stable electricity, modern hardware, and cloud-based systems to store and manage digital content. African libraries often face severe infrastructure limitations, particularly in rural areas, where internet connectivity and power supplies are unreliable. Significant investment is needed to address these issues, including building robust internet infrastructure, expanding broadband networks, and ensuring stable power supplies in underserved areas. In addition, libraries must be equipped with up-to-date computers, servers, and software systems to support the delivery of digital content. Without adequate investment in these areas, the digital transformation of libraries cannot be sustained. Governments, development agencies, and private sector entities need to prioritize investment in technology as a means of creating equitable access to educational and cultural resources across Africa (Odulaja *et al.*, 2023). This investment will serve as the backbone of any successful digital library initiative, ensuring that digital resources are available and accessible to all.

For the digital transformation of libraries to be effective, librarians and educators must be equipped with the skills and knowledge necessary to manage digital systems and teach users how to navigate them. Training and capacity building for librarians is essential to ensure that they are proficient in using digital technologies, managing e-libraries, and curating digital collections. Many African librarians currently lack the technical skills required for these tasks, creating a need for extensive training programs (Ekpobimi, 2024). Capacity building initiatives should also target educators, as they play a critical role in teaching students how to use digital resources. Training programs should focus on integrating digital libraries into school curriculums and teaching students the digital literacy skills they need to access and benefit from digital content. Such initiatives can bridge the gap between traditional education systems and modern digital platforms, enabling educators to effectively guide students in using digital tools for learning.

Policy frameworks play a critical role in enabling and sustaining the digital transformation of libraries. Governments must establish national and regional policies that support the development, funding, and implementation of digital library systems. These policies should address several key areas, including infrastructure development, funding

mechanisms, and the promotion of digital literacy. National governments should create policies that allocate resources for the development of digital libraries and outline guidelines for integrating digital tools into existing library systems (Owusu-Ansah *et al.*, 2021). Regional cooperation is also crucial, as it allows countries to share resources, expertise, and best practices. Policies that encourage collaboration between countries can help to standardize digital library platforms and expand access to information across borders. Policy frameworks must also emphasize the importance of open access, ensuring that digital libraries provide equitable access to information for all members of society.

Engaging local communities in the digital transformation of libraries is essential for ensuring that these systems meet the needs and priorities of the populations they serve. Libraries are often seen as community hubs, and their success depends on the active participation and support of local users. Communities should be involved in the planning and implementation of digital library initiatives to ensure that these services are culturally relevant, accessible, and tailored to local needs. Consultation with local leaders, educators, and library users can help identify the most pressing needs in terms of access to information and educational resources. Engaging communities also helps to promote digital literacy and build trust in digital platforms, making it easier to transition from traditional library systems to digital ones (Tim *et al.*, 2021). Local involvement ensures that the benefits of digital libraries are shared equitably and that they reflect the diverse cultural heritage of Africa.

Public-private partnerships and international collaborations are key to the success of digital library transformations. Governments, NGOs, and educational institutions must work together with private companies, particularly those in the technology sector, to provide the necessary funding, technical expertise, and resources. Tech companies, such as those specializing in cloud computing, e-learning platforms, and mobile technology, can offer valuable support in building and maintaining digital library systems (Ali and Alourani, 2021). International collaborations can also provide important funding, training, and technology transfer. Organizations such as UNESCO, the World Bank, and international universities have supported numerous digital library initiatives in Africa, helping to provide digital content, technical support, and capacity-building programs. These partnerships allow African libraries to benefit from global expertise, leverage advanced technologies, and access international knowledge resources.

Sustainable digital transformation of library systems in Africa requires comprehensive strategies that encompass investment in technology, capacity building, policy development, community engagement, and international collaboration. Investment in infrastructure is critical for providing reliable internet access and stable power supplies, while training librarians and educators ensures that digital systems are effectively managed and used. National and regional policy frameworks are needed to guide the development of digital libraries and promote equitable access to information. Engaging local communities fosters a sense of ownership and ensures that digital libraries reflect local needs and cultural heritage. Finally, public-private partnerships and international collaborations provide the necessary resources, expertise, and support to drive digital transformation forward (Casprini and Palumbo, 2022). By implementing these strategies, African libraries can become sustainable, inclusive hubs of education, literacy, and cultural preservation.

2.5. The Socio-Economic and Educational Impact of Digital Libraries

Digital libraries have emerged as powerful tools that contribute to education, employment, and community development, while also playing a critical role in reducing inequality and fostering inclusion. The integration of digital libraries into educational systems offers long-term benefits, empowering individuals and communities by providing greater access to information, promoting lifelong learning, and supporting socio-economic development (Abiddin *et al.*, 2021).

Digital libraries significantly enhance access to education by providing a wealth of online resources that were previously unavailable to many individuals, especially in remote or underserved areas. Traditional libraries are often limited by physical space and resources, making it difficult to meet the diverse educational needs of users. However, digital libraries remove geographical and physical barriers, offering users access to vast collections of digital books, academic journals, multimedia resources, and open educational content (Kato *et al.*, 2021). This ensures that students, educators, and researchers can access up-to-date information and resources regardless of their location, improving the quality of education across the board. Moreover, digital libraries support employment opportunities by offering users access to resources that enhance their skills and knowledge. For instance, online training modules, e-books, and courses available through digital libraries allow individuals to acquire new skills, pursue continuing education, and engage in professional development. This, in turn, increases their employability and competitiveness in the job market. By fostering a culture of lifelong learning, digital libraries contribute to workforce development and promote economic growth. On a broader scale, digital libraries contribute to community development by serving as hubs of knowledge exchange and collaboration. Communities can use digital libraries to share local knowledge, promote cultural heritage, and access

vital information on health, agriculture, and entrepreneurship. The availability of such information supports informed decision-making and enhances the socio-economic well-being of communities (Hussain *et al.*, 2022).

Digital libraries have the potential to reduce social and educational inequalities by expanding access to information for marginalized and underserved populations. In many African countries, educational opportunities are unequally distributed, with rural and low-income communities often having limited access to quality learning materials and resources. Digital libraries provide a solution by offering free or affordable access to vast digital collections that can be accessed through computers, tablets, or smartphones (Guernsey *et al.*, 2021). This enables individuals in even the most remote areas to access the same educational resources as those in urban centers. Furthermore, digital libraries foster inclusion by accommodating diverse user needs. They provide resources in multiple formats, including text, audio, and video, making them accessible to people with disabilities, such as those with visual or hearing impairments. This ensures that people of all abilities can benefit from the wealth of knowledge available through digital platforms. Additionally, digital libraries often feature content in local languages, which helps bridge language barriers and promotes greater cultural inclusion. By making information more accessible and inclusive, digital libraries play a vital role in leveling the playing field and promoting equitable access to education and information (Adedokun and Zulu, 2022).

The integration of digital libraries into educational systems offers significant long-term benefits that extend beyond the immediate access to resources. One key advantage is the promotion of digital literacy, a critical skill in today's information-driven world. By engaging with digital libraries, students and educators develop essential digital competencies, including the ability to navigate, evaluate, and synthesize information from online sources (Falloon, 2020). These skills are increasingly important for academic success and career readiness, as the digital economy continues to grow. Digital libraries also facilitate more dynamic and personalized learning experiences. Unlike traditional libraries, which may have limited resources, digital libraries can offer a wide range of materials tailored to different learning styles and levels (Morze *et al.*, 2021). This allows educators to use diverse instructional materials and methods to engage students more effectively. Furthermore, the integration of digital libraries into educational curricula can enhance the quality of teaching by providing educators with easy access to up-to-date resources and research. This improves the overall learning environment and helps students stay abreast of developments in their fields of study. In the long term, the integration of digital libraries into educational systems contributes to the development of a knowledge-based society. As students and researchers gain access to a global wealth of information, they become better equipped to innovate, solve problems, and contribute to scientific and technological advancements. This strengthens the capacity of African countries to compete in the global economy and address pressing socio-economic challenges, such as poverty, inequality, and unemployment (Obute, 2021).

The socio-economic and educational impact of digital libraries is profound, particularly in their ability to expand access to knowledge, promote community development, and reduce inequalities. By providing users with the tools and resources needed to enhance their education and skills, digital libraries contribute to employment and economic growth (Khan *et al.*, 2022). Moreover, they play a key role in fostering inclusion by making information accessible to marginalized groups and individuals with disabilities. The long-term benefits of integrating digital libraries into educational systems are vast, promoting digital literacy, enhancing teaching and learning experiences, and ultimately contributing to the development of a knowledge-based society. As Africa continues to embrace digital transformation, the role of digital libraries in advancing education, equality, and socio-economic progress will become increasingly important (Zezeza and Okanda, 2021).

3. Conclusion

The potential of digital innovation to transform library systems in Africa is immense, offering opportunities to enhance access to information, promote literacy, and preserve cultural heritage. As libraries evolve from traditional repositories of knowledge into dynamic digital platforms, they can serve as catalysts for educational advancement and community development. By integrating digital technologies, African libraries can break down geographical and economic barriers, providing underserved populations with access to a wealth of resources that were previously out of reach.

Libraries play a crucial role in advancing literacy by offering diverse educational materials and programs tailored to various learning needs. In addition, they serve as custodians of cultural heritage, ensuring the preservation and accessibility of local languages, oral histories, and indigenous knowledge in an increasingly digital world. This dual role is essential for fostering a sense of identity and continuity in African communities while promoting lifelong learning.

Looking ahead, the future of African libraries in a digitally connected world holds great promise. By embracing digital transformation, libraries can expand their reach, enhance their services, and better serve their communities. However, achieving this vision requires strategic investment in infrastructure, technology, and training, as well as collaboration

between governments, educational institutions, NGOs, and the private sector. Such partnerships are vital for developing sustainable digital library systems that can adapt to the evolving needs of society. A concerted effort to invest in and support the digital transformation of library systems in Africa is essential. By doing so, we can ensure that libraries continue to play a pivotal role in advancing literacy, preserving cultural heritage, and contributing to the socio-economic development of the continent in the digital age.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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