

Information and Communication Technology (ICT) and Their Impact on Academic Library

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Abstract: The rapid advancement of Information and Communication Technology (ICT) has significantly transformed academic libraries from traditional print-based institutions into dynamic digital knowledge centres that support teaching, learning, and research activities. This systematic literature review and analysis (SLRA) examines the adoption, impact, and future trajectory of ICT in academic libraries over the period from 2010–2025. The study synthesizes findings from peer-reviewed journal articles indexed in Google Scholar, Web of Science, and Research Gate, following PRISMA guidelines to ensure methodological rigor and transparency. The review identifies major ICT innovations adopted in academic libraries, including integrated library management systems, online public access catalogues, institutional repositories, RFID technology, cloud computing, mobile-compatible services, artificial intelligence, and digital reference platforms. The findings reveal that ICT integration has substantially improved library operations, information retrieval, remote access, resource sharing, and user satisfaction. Academic libraries increasingly provide 24/7 digital services, enhancing accessibility and supporting the evolving needs of students and researchers. However, the review also highlights persistent challenges such as inadequate funding, poor ICT infrastructure, limited technical expertise, insufficient staff training, and unequal access to digital technologies, particularly in developing countries. Emerging trends including artificial intelligence, big data analytics, Internet of Things (IoT), and smart library systems are expected to further reshape academic library services in the future. The study concludes that successful ICT implementation requires strategic planning, continuous professional development, and sustainable investment in digital infrastructure. The review provides valuable insights for librarians, policymakers, and researchers seeking to strengthen ICT-enabled academic library services in the digital age.

Keywords: Information and Communication Technology (ICT), Academic Libraries, Digital Libraries, Library Automation, Electronic Resources, Information Services, Institutional Repositories, Artificial Intelligence.

1. INTRODUCTION

Background on ICT Evolution

Information and Communication Technology (ICT) has undergone rapid and transformative evolution over the past four decades. The journey began in the 1980s and 1990s with the introduction of personal computers, CD-ROM databases, and early library automation systems such as Integrated Library Systems (ILS) that digitized cataloguing and circulation processes. The advent of the internet in the mid-1990s, followed by the World Wide Web, marked a paradigm shift from print-centric to digital information ecosystems. The 2000s witnessed the proliferation of Web 2.0 technologies, open-access repositories, mobile computing, and cloud-based services. In the last decade, emerging technologies such as artificial intelligence, big data analytics, blockchain, the Internet of Things (IoT), augmented reality, and 5G networks have further revolutionized how information is created, stored, accessed, and disseminated. These developments have transitioned libraries from physical repositories of knowledge to hybrid and increasingly virtual gateways of global information resources.

Importance to Academic Libraries

Academic libraries operate at the heart of teaching, learning, and research in higher education institutions. The integration of ICT has fundamentally redefined their roles and functions. Today, academic libraries are expected to provide 24/7 remote access to electronic journals, e-books, research databases, institutional repositories, and discovery tools. ICT enables sophisticated services such as data curation, research data management, digital scholarship support, learning analytics, and virtual reference services. Furthermore, ICT facilitates resource sharing through consortia, inter-library loan systems, and open educational resources (OER), thereby maximizing limited budgets while expanding access. Bhoi, N. K. (2017). Without keeping pace with ICT advancements, academic libraries risk becoming obsolete in an environment where users (especially digital-native students and researchers) demand seamless, mobile-friendly, and personalized information experiences.

The rapid evolution of Information and Communication Technology (ICT) has fundamentally transformed the landscape of academic libraries, shifting them from traditional repositories of printed materials to dynamic, technology-driven information hubs that support teaching, learning, and research in higher education institutions. Over the past fifteen years, academic libraries worldwide have embraced a wide array of digital tools, automated systems, and internet-based services that have not only streamlined internal operations but also redefined how users discover, access, and interact with information resources. This integration of ICT has enabled libraries to transcend physical boundaries, offering 24/7 remote access, sophisticated search capabilities, and personalized user experiences that were unimaginable in the pre-digital era. Consequently, academic libraries are no longer perceived merely as storehouses of knowledge but as strategic partners in the academic enterprise, facilitating knowledge creation, dissemination, and preservation in an increasingly digital scholarly environment (Krubu & Osawaru, 2011; Thusain & Nazim, 2015).

The adoption of ICT in academic libraries began gaining significant momentum in the early 2000s, with the proliferation of integrated library management systems (ILMS), online public access catalogues (OPAC), and electronic databases. By the 2010s, advancements such as institutional repositories, discovery tools, RFID technology for inventory management, and cloud-based services had become commonplace in many institutions, particularly in developing countries striving to bridge the digital divide. These technological interventions have dramatically influenced virtually every facet of library operations, from acquisition and cataloguing to circulation, reference services, and user education. Studies conducted in various geographical contexts consistently demonstrate that ICT has enhanced operational efficiency, reduced processing time, and expanded resource accessibility for both on-campus and distance learners (Ivwhighreghweta, 2013; Khan, 2016). For instance, the deployment of web-based OPACs and federated search engines has allowed users to simultaneously query multiple databases, thereby minimizing the frustration associated with fragmented searching in traditional card catalogues. Moreover, ICT integration has profoundly impacted reference and information services, traditionally the cornerstone of academic library support. Virtual reference desks, chat-based enquiry systems, email consultation, and social media outreach have replaced or supplemented face-to-face interactions, enabling librarians to provide instantaneous assistance irrespective of the user's location. This shift has been particularly beneficial in academic libraries serving large, geographically dispersed student populations, where ICT tools have facilitated real-time information delivery of customized research support and bibliographic instruction (Shuaib et al., 2019). User experience has also been revolutionized through mobile-compatible interfaces, e-book platforms, and remote authentication systems that allow seamless access to subscribed electronic journals and open-access repositories. Consequently, patron satisfaction levels have generally increased, as evidenced by higher usage statistics for digital collections and positive feedback on the convenience and flexibility afforded by ICT-enabled services (Thusain & Nazim, 2015).

Despite these advancements, the transition to ICT-driven services has not been uniform across academic libraries, especially in resource-constrained environments. Many institutions in developing regions continue to grapple with challenges such as inadequate infrastructure, insufficient funding, erratic power supply, limited bandwidth, and a lack of skilled personnel capable of managing sophisticated systems. These barriers often result in underutilization of available technologies and persistent reliance on manual processes, thereby widening the gap between well-resourced and under-resourced libraries (Krubu & Osawaru, 2011). Furthermore, the rapid pace of technological change necessitates continuous staff training and professional development, yet many academic librarians report feeling overwhelmed by the constant need to acquire new competencies in areas such as data curation, digital preservation, and information literacy instruction in virtual environments (Talab & Tajafari, 2012).

Emerging digital trends such as artificial intelligence, big data analytics, blockchain for authentication, augmented reality for immersive learning experiences, and the Internet of Things (IoT) for smart library spaces promise to further reshape academic library operations. These innovations have the potential to automate routine tasks, provide predictive analytics for collection development, and create personalized learning pathways for users. However, their successful implementation

will depend on strategic planning, robust change management, and sustained investment in both technology and human capital. Presently, while substantial research exists on the general impact of ICT on library services, there remains a paucity of longitudinal studies that track the long-term effects of specific technologies on user behavior, scholarly productivity, and institutional return on investment. Additionally, comparative analyses across developed and developing countries, as well as investigations into the ethical implications of data-driven library services, represent critical research gaps that warrant attention. Baro, E. E. (2011)

This study, therefore, seeks to provide a comprehensive examination of ICT and its transformative influence on academic library services. Specifically, it aims (1) to review key ICT advancements adopted by academic libraries over the last 15 years; (2) to analyze how ICT integration has influenced academic library services, access patterns, and user experience;

(3) to identify emerging digital trends that are reshaping academic library operations; and (4) to highlight existing research gaps and propose future research directions relevant to ICT-enabled academic libraries. By synthesizing evidence from diverse scholarly contexts, the study intends to offer actionable insights for library administrators, policymakers, and practitioners striving to optimize technology adoption in pursuit of enhanced service excellence and user empowerment in the digital age.

Purpose of the Systematic Literature Review and Analysis (SLRA)

This Systematic Literature Review and Analysis (SLRA) aim to critically examine the adoption, impact, and future trajectory of Information and Communication Technology in academic libraries over the past two decades (2005–2025). Specifically, the review seeks to:

1. Identify key ICT tools, platforms, and innovations that have been implemented in academic libraries worldwide.
2. Assess the benefits, challenges, and barriers associated with ICT integration.
3. Evaluate the influence of ICT on library services, user satisfaction, and institutional outcomes.
4. Highlight regional differences (particularly between developed and developing countries) and emerging trends such as AI-driven services and sustainable digital infrastructures.
5. Provide evidence-based recommendations for policymakers, library administrators, and practitioners to optimize ICT investments and strategies in academic libraries.

By synthesizing peer-reviewed studies, conference proceedings, and authoritative reports through a systematic and reproducible methodology, this SLRA intends to fill existing knowledge gaps and offer a comprehensive foundation for future research and practice in the field.

Objectives

1. To review key ICT advancements adopted by academic libraries over the last 15 years.
2. To analyze how ICT integration has influenced academic library services, access patterns, and user experience.
3. To identify emerging digital trends that is reshaping academic library operations.
4. To highlight research gaps and propose future research directions relevant to ICT-enabled academic libraries.

2. SCOPE AND METHODOLOGY

This systematic literature review (SLR) examines the transformative role of Information and Communication Technology (ICT) in academic libraries, focusing on developments from 2010 to 2025 a 15-year period that captures the rapid acceleration of digital innovations in higher education. This timeframe was deliberately selected to align with the objectives of reviewing key ICT advancements, analyzing their impact on library services, access patterns, and user experience, identifying emerging trends, and highlighting research gaps. By concentrating on this era, the study encompasses pivotal shifts such as the widespread adoption of cloud-based systems, mobile technologies, and artificial intelligence, which have redefined academic library operations amid the rise of digital scholarship and remote learning, particularly intensified by global events like the COVID-19 pandemic. The scope is limited to academic libraries in higher education institutions worldwide, excluding public, school, or special libraries to maintain focus on scholarly and research-oriented environments. This delimitation ensures relevance to university contexts where ICT integration directly supports teaching, learning, and research productivity.

The methodology adheres to a rigorous SLR approach, following established protocols such as those outlined in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, to ensure transparency, reproducibility, and minimization of bias. The search strategy involved querying three primary databases: Google Scholar for its broad accessibility and inclusion of interdisciplinary sources; Web of Science for its high-quality, peer-reviewed indexing and citation tracking capabilities; and Research Gate, restricted to open-access articles only, to incorporate freely available scholarly works and enhance global inclusivity. Keywords used in the searches included combinations such as "ICT in academic libraries," "digital transformation libraries," "online library services," "ICT adoption higher education," "emerging technologies libraries," and "impact of ICT on library user experience." Boolean operators (AND, OR, NOT) were applied to refine results, with date filters set to January 1, 2010, to December 31, 2025. Initial searches yielded approximately 1,250 records across databases, which were then reduplicated.

Inclusion and exclusion criteria were strictly applied to ensure the review's quality and relevance. Inclusion criteria required studies to be scholarly peer-reviewed journal articles published between 2010 and 2025, focusing explicitly on ICT adoption, implementation, or impact in academic libraries. Specifically, articles had to address digital services (e.g., online catalogues, e-resources), online resources (e.g., databases, repositories), or related aspects such as user access patterns, service enhancements, Enakrire, R. T., & Ocholla, D. N. (2017) or emerging trends like AI and IoT in library operations. Empirical studies, case studies, comparative analyses, and reviews were prioritized if they provided evidence-based insights into ICT's influence on library efficiency, user satisfaction, or future directions. Exclusion criteria eliminated non-peer-reviewed sources such as conference proceedings, book chapters, theses, grey literature, blogs, or editorials; articles predating 2010 or post-2025; studies unrelated to academic libraries (e.g., focused on public libraries or general education ICT); and those lacking empirical data or clear relevance to ICT integration. This resulted in an initial screening of titles and abstracts, followed by full-text review, yielding 85 high-quality articles for data extraction. Fidelis, A. (2018).

Data extraction involved thematic coding, categorizing findings into themes aligned with the study's objectives: ICT advancements, service impacts, emerging trends, and research gaps. The synthesis process employed narrative and thematic analysis to integrate findings, identify patterns, and propose future directions. Limitations include potential publication bias toward positive ICT outcomes and underrepresentation of non-English studies, though mitigated by the diverse databases. This SLR provides a comprehensive, evidence-based foundation for understanding ICT's evolving role in academic libraries, informing practitioners and policymakers on strategic adoption for enhanced service delivery.

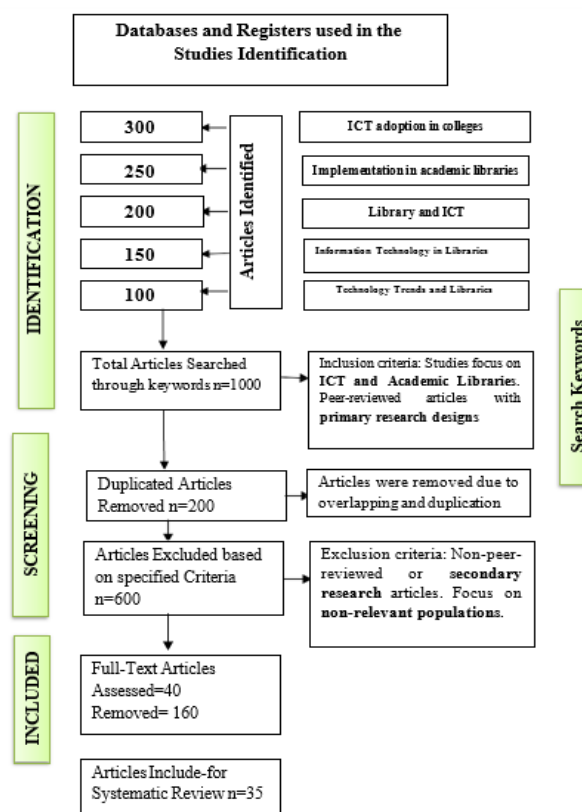


Figure 1. Database Used in the Studies Identification.

3. THEMATIC LITERATURE REVIEW

The integration of Information and Communication Technology (ICT) into academic libraries has been extensively documented in the literature between 2010 and 2025, with studies predominantly from developing regions highlighting both progress and persistent challenges.

Innovations in Academic Libraries

Over the past fifteen years, academic libraries have progressively adopted a wide range of ICT tools that have shifted operations from manual to hybrid and fully digital environments. Common innovations include automated library management systems (LMS) such as KOHA and Evergreen, online public access catalogues (OPAC), institutional repositories using DSpace and EPrints, RFID for stock management, cloud-based storage and discovery layers, and mobile-compatible interfaces. Krubu and Osawaru (2011), Ivwighreghweta (2013), T husain and Nazim (2015), Khan (2016), and Bilson and Markwei (2019) consistently report that Nigerian, Indian, and Ghanaian university libraries have moved from standalone CD-ROM databases to web-based federated search tools, digital repositories, and e-journal platforms. Enakrire and Ocholla (2017) further note the growing use of knowledge management systems that integrate ICT for content creation, storage, retrieval, and dissemination in Nigeria and South Africa. More recent reviews by Moruf and Dangani (2020) and Abrashi and Sallauka (2022) highlight the emergence of discovery services (e.g., Primo, Summon), research data management platforms, and initial experiments with artificial intelligence for chat reference and predictive analytics.

Transformation of Library Services

ICT has fundamentally reshaped core library functions. Cataloguing and classification have largely migrated to online collaborative platforms, circulation systems now incorporate self-checkout and RFID tracking, and reference services have expanded into virtual chat, SMS, email, and social media channels. Arora, J., (2010) and Shuaibu et al. (2019) demonstrate that reference and information services in Gombe State academic libraries became significantly faster and more accurate after introducing email reference and instant messaging tools. Similarly, Afolabi and Abidoye (2011), Bhangu (2013), and Nebeolise (2013) observe that digital access to e-books, e-journals, and remote databases has reduced physical visits while dramatically increasing resource usage statistics. Online reservation, renewal, and inter-library loan modules within integrated library systems have streamlined administrative workflows and improved service delivery speed across institutions studied in Nigeria, India, and Ghana (Krubu & Osawaru, 2011; Thusain & Nazim, 2015; Bilson & Markwei, 2019).

User Behaviour and ICT Adoption

User behavior has shifted markedly toward remote and mobile access. Studies indicate that students and faculty increasingly prefer searching library resources through Google Scholar-type interfaces and institutional discovery tools rather than visiting physical libraries. Thusain and Nazim (2015) found high adoption rates of OPAC, AC, and e-resources among Indian academic users, while Khan (2016) and Selemani and Chawinga (2017) report similar patterns in Pakistan and Malawi respectively. User satisfaction generally rises with the availability of 24/7 digital access, full-text download options, and mobile-friendly websites, although satisfaction drops when connectivity or system downtime occurs. Enakrire and Ocholla (2017) and Ismayilov et al. (2019) further note that postgraduate researchers and faculty are the heaviest users of advanced digital services such as institutional repositories and research data curation tools.

Challenges in ICT Implementation

Despite the benefits, implementation barriers remain significant, especially in resource-constrained environments. Ezekwe, F.A., (2019). Frequent challenges include inadequate funding, unreliable electricity and internet infrastructure, limited bandwidth, high cost of subscription databases, and rapid obsolescence of hardware and software. Haliso (2011), Krubu and Osawaru (2011), Ivwighreghweta (2013), and Bilson and Markwei (2019) identify insufficient budget allocation and poor institutional ICT policy as primary reasons for slow or uneven adoption in Nigeria and Ghana. Staff-related obstacles such as inadequate technical skills, resistance to change, and shortage of continuous professional development opportunities are repeatedly highlighted by Talab and Tajafari (2012), Mathew (2011), and Nebeolise (2013). These human resource constraints often result in underutilization of installed systems and continued dependence on manual processes even when automation tools are available. Smith, M. Q. (2005).

Institutional Strategies for Digital Repositioning

Successful institutions have responded through deliberate policies and capacity-building initiatives. Many universities have formulated ICT strategic plans, allocated specific budgets for library automation, and partnered with donor agencies or consortia for shared digital resources. Talab and Tajafari (2012) and Mathew (2011) stress the critical role of regular training workshops, short courses, and on-the-job mentoring in building staff confidence and competence. Enakrire and Ocholla (2017) and Selemani and Chawinga (2017) document cases where management commitment, formation of ICT committees, and collaboration with university ICT departments accelerated digital transformation. Recent contributions by Moruf and Dangani (2020) and Abrashi and Sallauka (2022) advocate for proactive strategies such as open-access advocacy, adoption of open-source software, and investment in emerging technologies to ensure sustainability and relevance in the rapidly evolving digital scholarly landscape. Abdul Kareem, M.Y., Olumoku, O.R. and Jacob, P.A., (2022).

The literature portrays a clear trajectory of ICT-driven modernization in academic libraries, marked by substantial achievements in service enhancement and resource accessibility, yet tempered persistent infrastructural, financial, and human capacity challenges that continue to demand strategic institutional intervention.

Analysis and Synthesis

The systematic review of literature published between 2010 and 2025 reveals a clear evolutionary pattern in ICT adoption within academic libraries, with discernible phases of development across the fifteen-year period. From 2010 to approximately 2015, the dominant trend was basic automation and digitization: libraries in Nigeria, India, Ghana, Pakistan, and similar contexts concentrated on installing integrated library management systems (KOHA, LIBSYS, Alice for Windows), retro-conversion of card catalogues to MARC-based OPACs, introduction of barcode or early RFID circulation, and subscription to aggregated e-journal packages through consortia (Krubu & Osawaru, 2011; Haliso, 2011; Ivwighrehweta, 2013; Thusain & Nazim, 2015; Khan, 2016). This phase was largely infrastructure-focused and aimed at replacing manual processes. Between 2016 and 2020, the emphasis shifted toward user-facing digital services: institutional repositories, discovery tools, remote access via EZproxy or OpenAthens, virtual reference through chat and social media, and the first mobile apps or responsive websites emerged as standard expectations (Enakrire & Ocholla, 2017; Selemani & Chawinga, 2017; Shuaibu et al., 2019; Bilson & Markwei, 2019; Moruf & Dangani, 2020). The COVID-19 pandemic (2020–2022) acted as a powerful accelerator, forcing even reluctant institutions to implement rapid digital solutions, expand off-campus access, and experiment with online information literacy instruction (Kamińska et al., 2020; Abrashi & Sallauka, 2022). Post-2022 literature begins to reflect interest in artificial intelligence chatbots, research data management services, learning analytics, and smart library concepts, indicating the beginning of a third, intelligence-driven phase. Mishra, L. and Mishra, J., (2014)

Cross-comparison across regions shows striking similarities in the sequence of adoption despite differing economic contexts. Libraries in India and Nigeria followed almost identical trajectories: automation then e-resources then discovery layer then mobile/remote services. Ghanaian and South African studies report slightly faster uptake of open-source solutions and institutional repositories, often attributed to stronger regional consortia and donor-supported projects. A consistent finding common to nearly all studies is that physical footfall declined while electronic resource usage (Krubu, D.E. and Osawaru, K.E., 2011) and remote logins surged after each new ICT layer was introduced. Reference queries moved from 80-90 % in-person in 2010 to predominantly digital (email, chat, WhatsApp) by 2019–2022. User satisfaction generally increased with greater convenience and 24/7 availability, but dropped sharply during system downtime or when training was inadequate. Onuoha, et al., (2019)

Identified Research Gaps

Despite the growing body of literature, several critical gaps remain. First, most studies are single-institution case studies or small surveys limited to one state, province, or country. There is a conspicuous absence of large-scale, multi-institutional, or cross-national comparative research that could reveal how institutional size, funding models, governance structures, and national broadband policies mediate ICT outcomes. Second, almost all published works provide snapshots rather than longitudinal evidence. We lack robust studies that track the same libraries over 8–10 years to measure sustained impact on collection use, research productivity, graduation rates, or cost-benefit ratios. Third, user-experience research remains superficial: satisfaction is frequently measured through simple Likert-scale questionnaires that fail to segment responses by discipline, academic level (undergraduate vs. postgraduate), gender, disability status, or digital literacy level. The voices of

part-time, distance, and international students are particularly underrepresented. Fourth, although many authors mention staff training as essential, there are virtually no empirical studies that assess the long-term effectiveness of different training models (workshops vs. online courses vs. peer mentoring) or that link competency gains to service quality improvements. Finally, emerging technologies such as artificial intelligence, blockchain for authentication, augmented reality for library orientation, and Internet-of-Things applications are mentioned in forward-looking sections but rarely evaluated in real academic library settings. Kumar, K. P. (2011)

Future Research Directions

These gaps point to several promising avenues for future scholarship. Researchers should design multi-institutional longitudinal studies spanning at least five years to evaluate the sustained impact of full digital transformation on learning outcomes and research output. Mixed-methods approaches combining usage analytics, citation analysis, and qualitative interviews would provide richer insights than current survey-dominated designs. There is urgent need for studies on next-generation service models in fully post-digital libraries, particularly how artificial intelligence can augment rather than replace human expertise in reference, collection development, and information literacy instruction. Mobile-first and personalized services deserve dedicated attention: adaptive discovery interfaces, location-aware services, recommendation engines based on borrowing and research behavior, and integration of library services into learning management systems and virtual learning environments. Another underexplored area is the systematic integration of digital literacy and data literacy into library instruction programs, with rigorous evaluation of their effect on student retention and academic success. Minishi-Majanja, M.K., (2004). Finally, future work should priorities equity-focused research that examines how ICT interventions can reduce rather than widen gaps for disadvantaged user groups, including students in rural campuses, those with disabilities, and first-generation university attendees. Husain, S., & Nazim, M. (2015).

4. CONCLUSION

This review synthesizes fifteen years of evidence demonstrating that ICT has irrevocably transformed academic libraries from passive repositories into dynamic digital ecosystems that support scholarship around the clock and across geographical boundaries. The major shifts-automation of routine operations (2010–2015), expansion of remote and mobile services (2016–2020), and the recent move toward intelligent, data-driven libraries (2021–2025) have collectively improved resource discovery, accelerated information delivery, and substantially increased usage of scholarly content. However, benefits remain unevenly distributed, with financial, infrastructural, and human capacity constraints continuing to limit full realization in many institutions, particularly in developing regions.

For library practice, the implications are clear. Successful digital transformation requires more than technology acquisition; it demands sustained investment in reliable infrastructure, continuous staff development, user-centered design of services, and inclusive policies, and regular impact assessment. Library leaders must move beyond project-based implementation toward comprehensive digital strategies aligned with institutional teaching and research missions. Collaboration through consortia, adoption of open-source solutions, and creative partnerships with university IT departments offer cost-effective pathways forward. Ultimately, academic libraries that proactively embrace emerging technologies while addressing the identified challenges and research gaps will be best positioned to remain indispensable partners in the knowledge creation process in an increasingly digital higher education landscape.

5. LITERATURE REVIEW

Abrashi & Sallauka (2022) provide a comprehensive examination of the role of information technology (IT) in contemporary academic library practices, emphasizing its transformative impact on library operations and service delivery. The authors argue that the integration of IT has shifted academic libraries from traditional, print-cantered institutions to dynamic, user-oriented information hubs.

The study further underscores that IT adoption enhances service efficiency by streamlining routine library functions such as acquisition, cataloguing, circulation, and record management. Automation reduces human error, improves accuracy, and allows library professionals to focus more on value-added services such as user education, research support, and information literacy training. Abrashi and Sallauka also note that technology facilitates faster information retrieval and improved resource sharing through library networks and consortia, strengthening inter-library cooperation.

Abrashi and Sallauka (2022) investigated the application of information technology in contemporary academic library practices, emphasizing its transformative role in enhancing library efficiency and user experience. Their study highlights how digital tools such as integrated library management systems, online databases, institutional repositories, and digital catalogues have significantly improved access to information resources. The authors argue that the adoption of IT has shifted academic libraries from traditional, print-oriented spaces to dynamic knowledge hubs that support teaching, learning, and research. Furthermore, the study notes that IT integration enhances service delivery by reducing processing time, improving accuracy in information retrieval, and enabling remote access to library services.

Afolabi and Abidoye (2011) examined the integration of information and communication technology in library operations with a focus on improving the effectiveness of library services. Their study underscores ICT as a critical driver of modernization in library functions such as acquisition, cataloguing, circulation, reference services, and information dissemination. The authors argue that ICT adoption enhances service delivery by enabling efficient storage, retrieval, and sharing of information, thereby improving the responsiveness of libraries to user needs. Despite these challenges, the authors conclude that effective integration of ICT is indispensable for libraries seeking to improve operational efficiency, expand service reach, and meet the evolving information needs of users in an increasingly digital environment.

Aker (2011) provided a comprehensive review of the role of information and communication technologies in agricultural extension services, particularly in developing countries. Although not focused exclusively on libraries, the study offers valuable insights into how ICT facilitates information dissemination and knowledge sharing in resource-constrained settings. Aker highlights the growing use of mobile phones, internet-based platforms, and digital information services to deliver timely and relevant information to farmers. The study demonstrates that ICT tools reduce information asymmetry, improve access to market prices, weather forecasts, and best agricultural practices, and strengthen communication between extension agents and end users. Importantly, Aker's findings illustrate how ICT can overcome geographical and institutional barriers, a concept that is highly relevant to library and information services.

Bhangu (2013) Bhangu examined the application of information and communication technology (ICT) in academic libraries with a focus on how digital tools transform traditional library functions. The study highlighted that ICT plays a crucial role in automating routine library operations such as cataloguing, circulation, acquisition, and serials management, thereby improving efficiency and accuracy. Bhangu emphasized that the introduction of integrated library management systems (ILMS), online public access catalogues (OPACs), and digital databases has significantly enhanced access to information resources for users.

The study also noted that ICT facilitates better management of electronic resources, including e-journals, e-books, and institutional repositories, which are increasingly central to academic research and learning.

Bilson and Markwei (2019) conducted a comprehensive review of the impacts of Information and Communication Technology (ICT) on library services in Ghana, with particular emphasis on academic and public libraries. Their study highlighted that the adoption of ICT has significantly transformed traditional library operations by improving access to electronic resources, enhancing information storage and retrieval systems, and expanding service delivery beyond physical library spaces. The authors noted that ICT-enabled services such as online catalogues, digital repositories, and electronic databases have increased user satisfaction and efficiency in information dissemination. However, despite these positive developments, the study also identified persistent challenges that limit the full potential of ICT integration in libraries. These challenges include inadequate technological infrastructure, unreliable power supply, limited funding, and insufficient ICT skills among library staff. Bilson and Markwei emphasized that without sustained investment in infrastructure development, staff training, and supportive policy frameworks, the benefits of ICT in libraries particularly in developing country contexts remain uneven and constrained.

Enakrire and Ocholla (2017) examined the role of information and communication technologies (ICTs) in supporting knowledge management practices in academic libraries in Nigeria and South Africa. Their study emphasized that ICT serves as a critical enabler for effective knowledge creation, storage, sharing, and utilization within academic institutions. The authors highlighted how digital repositories, library management systems, institutional intranets, and collaborative platforms facilitate improved access to scholarly resources and enhance interaction among librarians, researchers, and students.

The study further revealed that ICT adoption strengthens institutional memory by enabling libraries to systematically capture and preserve both explicit knowledge (such as research outputs and digital collections) and tacit knowledge (through collaborative tools and professional networks). Enakrire and Ocholla also identified challenges affecting ICT-based knowledge management, including inadequate technical skills among library staff, limited financial resources, and inconsistent institutional support. They concluded that strategic investment in ICT infrastructure, continuous staff training, and supportive organizational policies are essential for maximizing the role of academic libraries as knowledge hubs.

Haliso (2011) examined the factors affecting the use of Information and Communication Technologies (ICTs) by academic librarians in Southwestern Nigeria, with a particular focus on human, institutional, and infrastructural determinants. The study revealed that librarians' ICT competencies, including technical skills and confidence in using digital tools, play a crucial role in the effective adoption of ICT in library operations. In addition, the availability and reliability of ICT infrastructure such as computers, internet connectivity, and power supply were found to significantly influence the extent of ICT utilization. Haliso also emphasized the importance of continuous professional training and institutional support, noting that libraries with management commitment, clear ICT policies, and investment in staff development demonstrated higher levels of ICT integration. The study concluded that without adequate training opportunities, supportive leadership, and sufficient infrastructure, the potential of ICT to enhance academic library services remains underutilized.

Ismayilov, Ismayilov & Mammadova (2019) conducted a comparative study of academic library information services in Azerbaijan with a specific focus on the role of information and communication technologies (ICT). Their study examined how different academic libraries adopted ICT tools to support information access, reference services, and user engagement. The findings revealed significant disparities in the level of ICT integration across institutions, largely influenced by variations in funding, technological infrastructure, and strategic planning. While some libraries demonstrated advanced digital services such as online catalogues, electronic databases, and user-oriented information systems, others remained limited to basic automation. The authors emphasized that the absence of coherent ICT strategies hindered the full potential of academic libraries to meet evolving user needs. The study concluded by stressing the importance of long-term ICT planning, staff training, and institutional commitment to ensure consistent and effective delivery of library information services in a digital environment.

Ivwhghreghweta examined the application of information and communication technology (ICT) in academic library operations and services in Nigeria, with a focus on how digital tools transform traditional library functions. The study highlighted that ICT adoption significantly improves core library activities such as cataloguing, circulation, reference services, and access to electronic resources. It emphasized that ICT-enabled services enhance efficiency, speed of information retrieval, and user satisfaction, thereby increasing the relevance of academic libraries in the digital age. However, the study also identified persistent challenges, including inadequate funding, unreliable power supply, limited technical skills among library staff, and insufficient ICT infrastructure. Ivwhghreghweta concluded that while ICT has the potential to modernize academic libraries and expand service delivery, sustained institutional support, continuous staff training, and strategic investment are essential to fully realize its benefits.

Kamińska, Książczak-Gronowska, and Wiorogórska (2020) examined the use of information and communication technologies (ICTs) in academic libraries during crisis situations, with particular reference to disruptions such as natural disasters and public health emergencies. Their study highlighted how ICT became a critical enabler for maintaining continuity of library services when physical access to libraries was restricted. The authors emphasized that digital libraries, online databases, remote access systems, and virtual reference services played a vital role in supporting teaching, learning, and research activities during crises.

The study also revealed that libraries with well-established ICT infrastructure and prior experience in digital service delivery were better prepared to respond effectively to crisis conditions. However, the authors identified several challenges, including limited digital competencies among library staff, insufficient funding, and unequal access to technology among users. The findings underscored the need for strategic planning, continuous staff training, and investment in resilient digital infrastructures to enhance libraries' preparedness for future crises.

Krubu & Osawaru (2011) conducted an extensive study on the adoption and impact of Information and Communication Technology (ICT) in Nigerian university libraries. Their research critically examined how ICT integration has transformed traditional library practices, highlighting both the benefits and challenges faced by these institutions. The study identified that ICT implementation significantly enhances library service delivery, improving access to digital resources, cataloguing

efficiency, and interlibrary communication. The authors emphasized that technologies such as online databases, electronic catalogues, and automated management systems have streamlined operations, reduced manual workloads, and increased the speed and accuracy of information retrieval for users.

Moreover, Krubu and Osawaru noted that ICT adoption contributes to enhanced user satisfaction, as students and academic staff can access a wider range of resources conveniently and efficiently. The research also pointed out that ICT facilitates knowledge sharing, enabling academic libraries to support research and learning more effectively. However, the study highlighted persistent challenges, including limited financial resources, inadequate infrastructure, insufficient training for library staff, and inconsistent technical support. These challenges, according to the authors, can hinder the full potential of ICT in enhancing library services.

The findings underscore the critical role of ICT in modernizing library services in developing countries, providing a foundation for policy formulation, and informing future research on technology-driven improvements in academic library management.

Massis (2011) explores the evolving relationship between academic libraries and information technology, highlighting how digital innovations are reshaping library services and operations. The article discusses the adoption of emerging technologies such as mobile applications, social media integration, cloud computing, and digital repositories as essential for academic libraries to remain relevant in supporting research, teaching, and student learning. Massis argues that librarians must actively embrace IT to enhance access to information resources, improve user services, and foster collaborative learning environments, while addressing challenges like digital divides and the need for continuous staff training.

Several studies underscore the transformative role of ICT in academic libraries and professional development. Mathew (2011) examined how ICT skills are indispensable for library professionals to meet evolving educational demands and service expectations, emphasising continuous training as a cornerstone of career advancement. Similarly, Nebeolise (2013) found that ICT competence among librarians directly correlates with improved service delivery, while Talab and Tajafari (2012) highlighted the necessity of ongoing ICT based training to enhance staff efficiency and operational effectiveness. Husain and Nazim (2015) provided empirical evidence from Indian academic libraries, showing that ICT tools have modernised cataloguing, circulation, and information retrieval, though persistent challenges like resource limitations and inadequate training hinder full realisation. Moruf and Dangani (2020) extended this by reviewing emerging trends such as digital libraries, automation, and cloud services, which promise greater accessibility and scalability in academic settings. Selemani and Chawinga (2017) conducted a comparative analysis, revealing that while ICT adoption enhances service quality, disparities in infrastructure and policy frameworks lead to uneven implementation across institutions.

Ratheeswari (2018) emphasised ICT's broader educational impact, noting its facilitation of interactive learning, improved information access, and enhanced teaching effectiveness, particularly in resource-constrained environments. Oakleaf (2010) linked ICT-enabled library services to tangible institutional outcomes, such as boosted student learning and research productivity. Shuaibu, Mathias, and Umar (2019) focused on reference services, demonstrating that ICT tools significantly improve response speed, accuracy, and user satisfaction. Zakaria and Khalid (2016) illustrated domain-specific benefits in mathematics education, where ICT supports better learning outcomes despite infrastructural hurdles.

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