The Impact of Information and Communication Technology (ICT) on Academic Libraries: Opportunities, Trends, and Challenges

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Abstract:

The integration of Information and Communication Technology (ICT) in libraries has significantly transformed our libraries and revolutionized the way they provide services, manage resources, and engage with users. The background and context of ICT in libraries are rooted in the broader evolution of technology and its impact on information dissemination and access. This paper covered various topics related to Information and Communication Technology (ICT) usage in academic libraries, focusing on higher educational institutes.

Keywords: ICT, Information and Communication Technology, Academic Library, ICT Impact on libraries, Trends in ICT implication in libraries, Challenges in ICT implications.

1. **Introduction:**

The evolution of libraries in the digital age is a fascinating journey that reflects how these institutions have adapted to the rapid technological advancements and changing user expectations. This evolution encompasses a shift from traditional print-based collections to a dynamic blend of digital resources and innovative services. ICT enables the automation of various library processes, such as cataloguing, circulation, acquisitions, and resource management. Integrated library management systems (ILMS) streamline these processes, reducing manual tasks and improving accuracy. Libraries use social media, email newsletters, and online platforms to engage users, promote events, and share updates about resources and services. By implementing these ICT initiatives, academic libraries can adapt to the changing needs of users, enhance their services, and contribute to the overall success of teaching, learning, and research within the institution (Islam & Nazmul, 2007).

In summary, integrating ICT in libraries transforms these institutions into dynamic hubs of information, collaboration, and innovation. The benefits of ICT integration extend to users, library staff, and the broader community, contributing to more efficient operations, improved user experiences, and

enhanced access to knowledge and resources. Addressing these challenges requires a strategic approach that includes careful planning, stakeholder involvement, user training, ongoing assessment, and adaptation. By proactively addressing these barriers, libraries can maximize the benefits of ICT while minimizing potential disruptions. In this paper, we have done exploratory research on the use of ICT in modern academic libraries(Information and Communication Technology (ICT) Application in Libraries, n.d.). We have concentrated our scope on the academic libraries of higher educational institutes. In this work, we also tried to explore the current ICT usage trends and challenges in academic libraries.

2. Background and Context of ICT in Libraries:

The use of technology in libraries dates back to the mid-20th century with the automation of cataloguing and circulation processes. This marked the beginning of libraries' engagement with ICT. The growth of digital information in the late 20th century necessitated new approaches to information management. Libraries started to explore ways to digitize resources and provide online access. The development of online catalogues (OPACs) in the 1980s allowed users to search for library materials electronically(Shukla et al., n.d.). This shift marked a move towards digital information retrieval. The widespread adoption of the Internet and the World Wide Web in the 1990s further transformed how information was accessed and shared. Libraries began to create websites and provide online resources. The late 1990s and early 2000s saw a rapid increase in the availability of digital resources, including e-journals, databases, and e-books. Libraries embraced these resources to support research and learning(Lata & Sonkar, 2023). In the 2000s, libraries started promoting open-access initiatives, creating institutional repositories to provide free access to research outputs and scholarly works(Unesco, 2015). The proliferation of smartphones and tablets in the 2010s led to the development of mobile apps and responsive library websites, catering to users' need for on-the-go access. Libraries began leveraging social media platforms to engage with users, share updates, and create interactive communities around information resources(Pressreader Team, 2021). As digital content grew, libraries recognized the need for digital preservation strategies to ensure the longevity and accessibility of digital materials. Libraries expanded their roles to include support for research data management and guiding data sharing, storage, and preservation. Libraries integrated with institutions' VLEs to provide seamless access to library resources within online courses. Libraries began exploring emerging technologies like Augmented Reality (AR), Virtual Reality (VR), and Artificial Intelligence (AI) to enhance user experiences and engagement (Habiba & Ahmed, 2021).

In summary, the background and context of ICT in libraries are closely intertwined with the broader technological advancements of the past few decades. Libraries have evolved from manual systems to digital repositories, embracing ICT to enhance their services, resources, and user interactions. ICT's ongoing integration continues to shape libraries' future as dynamic hubs of information, knowledge dissemination, and community engagement in the digital age. A roadmap with significant milestones of ICT use in libraries has been shown in the figure-1 given below:
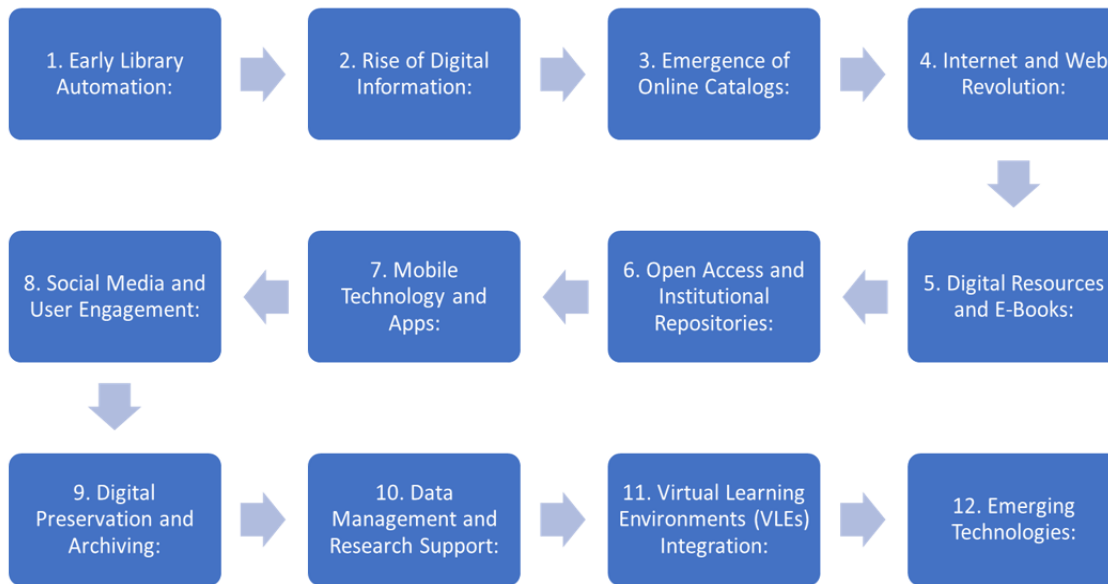

Figure 1: A roadmap with significant milestones of ICT use in libraries.

3. ICT Initiatives in Academic Libraries

Academic libraries play a crucial role in higher education institutions by serving as vital resources that support teaching, learning, research, and the overall educational experience. They are more than just repositories of books; they provide a diverse range of services, collections, and spaces that contribute significantly to the success of students, faculty, and researchers. Information and Communication Technology (ICT) initiatives in academic libraries encompass a wide range of strategies and projects that leverage technology to enhance library services, resources, and user experiences. These initiatives are designed to support teaching, learning, research, and collaboration within the academic community. Here are some common ICT initiatives in academic libraries:

3. 1 Online Catalogues:

Digital catalogues and discovery tools provide users with easy access to library resources. Online catalogues offer advanced search options, filters, and recommendations, enhancing users' ability

to discover relevant materials. Most Indian academic libraries have implemented OPACs, allowing users to search and browse their physical and digital collections through a web interface. Examples include (a) SOUL: Software for University Libraries (SOUL) is a state-of-the-art integrated library management software designed and developed by the INFLIBNET Centre based on requirements of college and university libraries. It is a user-friendly software developed to work under client-server environment. The software is compliant to international standards for bibliographic formats, networking and circulation protocols. (b) e-Granthalaya: This is an Open-source library management platform developed by National Information Centre, Government of India. The NIC platform offers a comprehensive ICT solution for libraries. This includes integrated Library Management Software, a Digital Library Module, cloud hosting, and a user-friendly library portal (OPAC).

3.2 Discovery Platforms:

A content discovery platform delivers personalized content to websites, mobile devices and set-top boxes. A large range of content discovery platforms currently exist for various forms of content ranging from news articles and academic journal articles to television Discovery Platforms could be categorized into two parts, The first one is Gateway Solutions, and the second one is Federated Search Engines. Gateway solutions aggregate resources from multiple sources, including OPACs, institutional repositories, and external databases, providing a unified search experience. Examples include, (a) Ebsco Discovery Service (EDS): A popular platform used by many universities for comprehensive resource discovery across various disciplines. (b) ProQuest Discovery: Another widely used discovery platform with a user-friendly interface and advanced search features.

Federated search engines allow users to search across multiple library catalogues and databases simultaneously. Examples include (a) MetaLib: A federated search engine developed by OCLC, providing access to library catalogues and databases worldwide. (b) Search.gov: A federated search engine for Indian government documents and publications.

3.3 Electronic Resource Management Systems (ERMS):

Libraries manage electronic resources using ICT tools that facilitate the acquisition, licensing, access control, and usage tracking of e-books, e-journals, databases, and multimedia content (Devi Antherjanam K Sheeja, 2008). ICT enables ERMs to automate repetitive tasks like license agreement renewals, invoicing, and usage statistics collection. This frees up librarians' time for more strategic work. ERMs can integrate with other library systems like the Integrated Library System (ILS) for a more unified workflow. This reduces data silos and improves efficiency. ICT protocols like

OpenURL allow users to seamlessly access subscribed resources from various platforms through the ERM. ERMs leverage ICT for detailed usage reports that help librarians analyse user behaviour and make informed decisions about resource acquisition and budgeting. ICT enables ERMs to track costs associated with e-resources, allowing for better financial planning and negotiation with vendors.

3.4 Virtual Learning Environments (VLEs) Integration:

Academic libraries integrate with learning management systems to provide seamless access to course materials, research resources, and library services within the institution's virtual learning environment (Hoque, 2023). VLEs with ICT tools enable librarians to create interactive learning activities, such as quizzes and polls, to assess information literacy skills. VLEs can be used to create personalized learning paths for students based on their needs and skill levels. Librarians can provide embedded research support by participating in online discussions and forums within the VLE, directly assisting students with their research needs.

3.5 Digital Collections and Exhibitions:

ICT enables the creation, management, and preservation of digital collections, including digitized manuscripts, photographs, audiovisual materials, and born-digital content. Create virtual exhibitions to engage users with special collections.

3.6 Mobile Apps and Social Media Engagement:

Mobile apps and social media, powered by ICT (Information and Communication Technologies), offer exciting opportunities for academic libraries to engage with users in new and innovative ways. Libraries can develop mobile apps that provide users with on-the-go access to the library catalogue, account information, e-resources, and mobile-friendly research guides. Mobile apps make library resources and services more accessible to users with disabilities by offering features like text-to-speech conversion and screen reader compatibility.

Social media platforms like Facebook, Twitter, and Instagram allow libraries to reach a wider audience and promote their services and resources to students, faculty, and the broader community (Bhoi, 2017). ICT facilitates two-way communication through social media. Libraries can use these platforms to engage in discussions, answer user queries, and foster a sense of community among students and researchers.

3.7 Remote Learning Support & Digital Literacy Programs:

ICT has significantly transformed how academic libraries support remote learning and digital literacy programs. ICT enables libraries to provide remote access to a vast collection of electronic

resources like e-books, scholarly journals, and streaming media. Libraries can leverage ICT to create and host online learning resources such as tutorials, webinars, and screencasts on research skills, information evaluation, and effective use of library databases. These resources can be accessed by students at their own pace and convenience. ICT facilitates communication tools like discussion forums and online communities. Students can collaborate and learn from each other remotely while engaging with librarians on research queries.

ICT enables the development of interactive online modules and tutorials that make learning digital literacy skills more engaging and effective for students. ICT allows for the creation of adaptive learning platforms that tailor the difficulty and content of digital literacy training modules to individual student needs and skill levels (Janakiraman et al., n.d.). ICT facilitates the delivery of digital literacy workshops and training sessions online through video conferencing and webinars. Students can participate in these sessions remotely, eliminating geographical barriers.

3.8 Data Management Services:

ICT allows libraries to adopt metadata management software that helps researchers effectively describe and organize their data with standardized formats. This facilitates data discovery and promotes data reuse. ICT enables libraries to offer training and support for data visualization tools. This empowers researchers to communicate their research findings through compelling visualizations effectively. For example, The University of Edinburgh Library developed a web-based Data Management Planning (DMP) tool. This interactive tool helps researchers create customized DMPs that address key data management questions for their specific projects (Use DMPonline to Write Your Data Management Plan | The University of Edinburgh, n.d.). ICT facilitates data-sharing platforms that connect researchers with collaborators across institutions. This promotes data sharing and fosters interdisciplinary research efforts. ICT facilitates creating and managing digital repositories where researchers can deposit, store, and share their research data securely. This promotes data accessibility for collaboration and future research endeavours.

3.9 Collaborative Spaces and Technology:

By leveraging ICT, academic libraries can create dynamic and technology-equipped collaborative spaces that foster student interaction, support team-based learning, and promote the development of essential collaboration skills for the digital age. ICT enables libraries to equip collaborative spaces with video conferencing equipment. Touchscreen whiteboards and interactive displays powered by ICT tools can be integrated into collaborative spaces. Libraries can provide access

to online project management software within their collaborative spaces. Student teams can track project progress, assign tasks, and share resources efficiently. For example, Chalmers University of Technology Library in Sweden transformed a traditional library floor into an innovative learning space called "The Hive". It provides all essential services discussed above.

3.10 Augmented Reality (AR) and Virtual Reality (VR):

AR and VR powered by ICT offer exciting possibilities for academic libraries to enhance the learning experience and engagement with library resources. Libraries with historical artifacts can leverage AR apps to display 3D models or animations, allowing users to explore these objects in detail and better understand their historical context. AR apps can be used to visualize complex anatomical models. Students in biology or medicine could use these apps to interactively explore different systems of the human body, enhancing their learning beyond static textbook diagrams. For example, the NCSU Libraries developed an AR app called "NC State Hunt" which uses AR technology to guide users on a scavenger hunt across campus landmarks. While exploring these locations, users can unlock historical information and stories through their smartphones, creating an engaging and interactive learning experience.

VR allows for the creation of 3D visualizations of complex scientific data sets. Researchers can use VR to explore and analyse data in a more immersive way, leading to new discoveries and insights. The USC Libraries created a VR experience called "A Scribe's Tale" that allows users to virtually travel back in time and experience the process of medieval manuscript creation. Users can interact with virtual tools and materials, gaining a deeper understanding of the history and craftsmanship behind these artifacts. Overall, AR and VR powered by ICT hold tremendous potential for academic libraries to create innovative and engaging learning experiences. While challenges exist, libraries that embrace these technologies can create a more dynamic and interactive environment for students, fostering deeper engagement with information and promoting a love of learning.

4. Current Trends of ICT Usages in Academic Libraries

The trends of ICT usage in academic libraries of higher educational institutes were evolving rapidly. Here are some of the critical trends in ICT usage in academic libraries:

4.1 Remote Access and Digital Services:

The COVID-19 pandemic accelerated the adoption of remote access technologies. Academic libraries expanded their digital services, offering online access to resources, virtual reference services, and digital delivery of materials. For example, The University of Toronto Libraries expanded their online services during the pandemic, providing electronic delivery of physical materials and virtual

reference assistance. Indian Institute of Technology (IIT) Bombay Library offers remote access to e-resources, e-books, and online databases to support remote learning and research during the pandemic.

4.2 Hybrid Learning Support:

With the growth of hybrid learning models combining in-person and online instruction, libraries integrated their services into learning management systems (LMS) and virtual learning environments (VLEs), providing seamless access to resources within courses. For example, The University of Washington Libraries integrated their LibGuides (resource guides) directly into the Canvas LMS, ensuring easy access for students within their courses. Jawaharlal Nehru University (JNU) Library in New Delhi integrated its digital resources with the Moodle LMS, enabling seamless access to e-resources within courses.

4.3 Open Educational Resources (OER):

Libraries increased their involvement in promoting and supporting open educational resources (OER). They assisted faculty in finding and adopting OER materials to reduce student textbook costs. Libraries are collaborating with faculty to adopt and create OER. For example, The Open Oregon Educational Resources project supports the creation and sharing of OER among Oregon's higher education institutions. In India, The National Digital Library of India (NDLI) provides free access to a vast collection of educational materials, including e-books, videos, and courses from various sources.

4.4 Data Management and Research Support:

Libraries played a significant role in assisting researchers with data management, including data curation, storage, and sharing, to comply with funding agency requirements and ensure research integrity. Libraries are providing workshops on research data management, too. For example, The University of California, Berkeley Library offers training on data management best practices and tools to assist researchers. Indian Institute of Science (IISc) Bangalore Library offers workshops on research data management, helping researchers effectively manage and share their data.

4.5 Artificial Intelligence (AI) and Machine Learning:

Libraries began exploring AI and machine learning applications for automating tasks like cataloguing, improving search algorithms, and providing personalized recommendations to users. For example, The University of Oxford's Bodleian Libraries implemented AI technology to improve search results and recommendations for users. Manipal Academy of Higher Education Library employs AI for chatbot services, assisting users with queries and providing instant responses.

4.6   Virtual Reality (VR) and Augmented Reality (AR):

Some libraries experimented with VR and AR technologies to create immersive learning experiences, virtual tours, and interactive exhibits. For example, Harvard University's Cabot Science Library offers VR experiences that allow students to explore scientific concepts. In India also, we can see Amrita Vishwa Vidyapeetham Library uses AR for interactive tours, allowing users to explore library spaces and resources through a smartphone app.

4.7   User Analytics and Insights:

Libraries utilized data analytics to understand user behaviour, preferences, and resource usage patterns, helping them tailor services and resources to user needs. Like, The University of Sheffield Library uses analytics to understand user behaviour, leading to adjustments in services and resources. Indian Institute of Management (IIM) Bangalore Library utilizes analytics to track user behaviour, helping in resource acquisition and enhancing services.

4.8   Preservation of Digital Content:

Libraries continued to focus on digital preservation strategies, ensuring the long-term accessibility of digital resources and preventing digital obsolescence. For example, The Stanford University Libraries' LOCKSS program ensures the long-term preservation of web-based content. In India, a significant example of this scenario is the National Institute of Fashion Technology (NIFT) Library, which they focus on preserving digital content, including design portfolios and academic projects.

4.9   Collaboration and Consortia:

Libraries are collaborating to share resources. Libraries collaborated within consortia to share resources, reduce costs, and enhance access to a broader range of digital materials. For example, The Colorado Alliance of Research Libraries operates the Prospector interlibrary loan system, providing users access to materials from multiple institutions. In India, DELNET (Developing Library Network) facilitates resource sharing among member institutions, enhancing access to resources across various libraries.

4.10   Accessibility and Inclusivity:

Libraries are focusing on accessibility; it emphasized accessibility, ensuring that digital resources, websites, and platforms are usable by all, including users with disabilities. A significant example is The University of Minnesota Libraries' Accessible U project, which ensures digital resources are accessible to all users. In India, the University of Delhi Library, among many others, provides its

website and digital resources are accessible to users with disabilities, adhering to international accessibility standards.

4.11 Privacy and Data Security:

Libraries emphasize privacy, focus on user privacy and data security, and implement robust measures to protect sensitive user data. In this goal in mind, The Library Freedom Project offers resources and training to libraries on protecting user privacy. A significant mention in this context is the Indian Statistical Institute (ISI) Library in Kolkata, which follows stringent privacy protocols for user data and ensures secure access to e-resources.

4.12 Online Instruction and Workshops:

Libraries offered online instruction sessions, workshops, and webinars on information literacy, research skills, and technology tools. For example, The University of Illinois Library offers virtual seminars on topics like data visualization and digital scholarship. Tata Institute of Social Sciences (TISS) Library conducts online workshops on topics like literature searching, referencing, and using online databases.

4.13 Social Media Engagement:

Libraries engage users through social media platforms, sharing information, resources, and updates while building a sense of community. Like, Libraries are engaging users on social media. The Library of Congress uses social media platforms to share digitized historical content and engage with the public. Indian Institute of Technology (IIT) Roorkee Library actively engages with users on social media platforms, sharing updates, resources, and tips.

4.14 Digital Humanities Support:

Libraries assist with digital humanities research it provides resources and expertise to support digital humanities research, including tools for text analysis, data visualization, and digital storytelling. For example, The University of California, Los Angeles Library offers resources and workshops for text mining and digital humanities projects. A noteworthy mention from India is the Aligarh Muslim University (AMU) Library, which provides resources and guidance for digital humanities research, supporting text analysis and digitization projects.

4.15 AI-powered Chatbots:

Some libraries adopted AI-powered chatbots to respond immediately to common user queries and assist with essential library services. For example, The University of Texas Libraries' AskUs

service uses a chatbot to respond instantly to user queries. Indian Institute of Technology (IIT) Kanpur Library employs a chatbot for quick responses to user inquiries and assistance.

5. Challenges and Barriers to ICT Implementation

While integrating Information and Communication Technology (ICT) brings numerous benefits to libraries, it also comes with several challenges and barriers that need to be addressed for successful implementation. These challenges can range from technical issues to human factors. Here are some common challenges and barriers to ICT implementation in academic libraries:

5.1 Infrastructure and Technology Constraints:

Inadequate IT infrastructure, including hardware and network resources, can hinder the effective deployment of ICT solutions. Libraries with limited budgets might struggle to invest in the latest technologies for seamless ICT integration.

5.2 Technological Obsolescence:

Rapid technological advancements can result in ICT systems quickly becoming outdated, necessitating regular updates and upgrades.

5.3 Resistance to Change:

Staff and users might resist changes associated with ICT implementation due to unfamiliarity with new technologies or fear of disruptions to established routines.

5.4 Lack of Digital Skills:

Some library staff and users might lack the necessary digital literacy skills to navigate and use ICT tools effectively.

5.5 Training and Capacity Building:

Training staff and users to effectively use and manage new ICT systems can be time-consuming and resource-intensive.

5.6 Data Privacy and Security Concerns:

The storage and handling of sensitive user data and digital resources require robust security measures to prevent unauthorized access or breaches.

5.7 Compatibility Issues:

Integrating new ICT solutions with existing library systems and technologies can pose compatibility challenges requiring technical expertise.

5.8 Financial Constraints:

ICT implementation often requires significant financial investment, including hardware, software, training, and ongoing maintenance costs.

5.9 Vendor Lock-In:

Depending heavily on specific vendors for ICT solutions can result in dependencies that limit flexibility and options for future changes.

5.10 User Engagement and Adoption:

Encouraging library users to adopt new ICT tools and services might require effective marketing, communication, and user education.

5.11 Content Management and Quality:

Managing and curating digital content can be complex, requiring clear policies for content creation, curation, and quality assurance.

5.12 Digital Divide:

Not all library users have equal access to digital technologies, leading to a digital divide that can affect the equitable use of ICT resources.

5.13 Sustainability:

Ensuring the long-term sustainability of ICT initiatives requires careful planning for system updates, technical support, and future scalability.

5.14 Legal and Copyright Issues:

The use of digital resources and technologies can raise legal and copyright concerns that need to be addressed to ensure compliance.

5.15 Fragmentation and Duplication:

Implementing multiple ICT solutions without a clear integration plan can lead to fragmentation and duplication of efforts.

5.16 Cultural and Organizational Change:

Introducing new technologies might require a cultural shift within the organization, necessitating change management strategies.

6. Conclusion

Online catalogues streamline resource discovery and access. Examples include OPACs, integrated library systems, and discovery platforms. Academic libraries manage electronic resources, like

e-books and journals, through Electronic Resource Management Systems (ERMS), ensuring efficient access and usage tracking. Academic libraries develop interactive websites and online portals, integrating resources, services, and engagement tools for a seamless user experience. Digital preservation ensures the accessibility of digital content over time, preventing obsolescence and loss, while digital archiving secures valuable materials for research and historical purposes. Current trends include remote access, hybrid learning support, OER promotion, AI and machine learning integration, digital preservation, and user analytics tailored to specific academic needs. In the Indian context, academic libraries are embracing trends such as remote access, LMS integration, OER support, data management, AI, and virtual experiences. This paper emphasizes how ICT has transformed academic libraries into dynamic, user-centric information centers, enhancing higher educational institutions' learning, research, and engagement. The continuous evolution of technology and its integration into library services reflect the commitment to adapting to the changing needs of users and ensuring access to knowledge in the digital.

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