DIGITAL TECHNOLOGY AND TRENDS IN ACADEMIC LIBRARIES IN INDIA

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Abstract
The rapid advancement of digital technologies has significantly transformed academic libraries in India. This paper examines how information and communication technologies (ICT), digital-resources, open source platforms, the Internet of Things (IoT), artificial intelligence (AI) and other emerging tools are reshaping library services in Indian higher-education institutions. Drawing on recent literature and empirical studies, the paper explores major trends, adoption levels, benefits and challenges. Key findings show that academic libraries are increasingly shifting from print-centric models to digital-first, user-centric, networked knowledge hubs. They are implementing digital repositories, e-resources, discovery tools, smart services, IoT enabled infrastructure and AI assisted workflows. However, they face constraints of funding, infrastructure, staff skills, interoperability and digital divide. The paper concludes with actionable recommendations for policy, infrastructure investment, capacity building and strategic planning to maximise the potential of digital transformation in Indian academic libraries.
Keywords: *Academic libraries, digital technology, ICT, e-resources, IoT, AI, India, library trends.*

1. Introduction

Academic libraries in India serve as vital knowledge infrastructure supporting teaching, learning and research activities in higher-education institutions. In the 21st century, the expansion of digital technologies has altered the ways in which library resources are acquired, managed, discovered and consumed. Libraries are no longer simply storehouses of print materials they are transforming into digital knowledge-hubs offering remote access, interactive services and intelligent systems. The advent of national-level policy initiatives such as the National Education Policy 2020 (NEP-2020) further emphasises the role of digital infrastructure in higher education and urges libraries to adopt modern technologies. Digital technology involves the use of electronic devices and systems to create, store, and manage data. It includes information technology (IT), which uses computers to process information. Some important features of information technology are social connectivity, fast communication, flexible working, learning opportunities, automation, and efficient data storage. This paper investigates the evolving digital technology landscape in Indian academic libraries.

Objectives:

- To identify the major digital technologies applicable in academic libraries in India.
- To examine the benefits achieved and challenges faced by libraries in the transformation.
- To suggest strategies for effective digital transformation.

2. Literature Review

A review of the literature reveals several streams of research focusing on the adoption of digital technologies and ICT in Indian libraries. Studies indicate that academic libraries have increasingly invested in e-resources and digital collections to enhance access and services. The use of Open Source Software (OSS) and other free software solutions for library management has also received considerable attention. Mani and Krishnamurthy (2014) examined the adoption of OSS in academic libraries, identifying key enablers such as adequate infrastructure, supportive policies, and trained manpower. In recent years, research has expanded to include emerging technologies such as the Internet of Things (IoT), artificial intelligence (AI), and robotics in library operations. Ghosh and Khayal (2024) emphasized the growing role of AI, robotics, and discovery tools in transforming library services. Similarly, Rajput and Pandey (2024) explored the digital transformation of Indian academic libraries, focusing on ICT integration, knowledge sharing, and resource optimisation.

3.1 Major Technologies trends in Use

The following major technology categories are evident in Indian academic libraries:

- **Digitization and Digital Preservation:** Digitization of archival materials, theses, special collections, and rare books remains a core activity. Libraries are increasingly pairing digitization with digital preservation strategies (metadata standards, file format selection.) to

ensure long-term access. Priorities include digitizing local special collections to support research visibility and institutional memory.

- **National Digital Initiatives**, The INFLIBNET Centre plays a pivotal role in India's digital library infrastructure. Projects such as Shodhganga (e-theses repository), Shodh Shuddhi (plagiarism detection), IRINS (researcher profiling), and Ind Cat (union catalogue) promote interoperability and resource sharing. The National Digital Library of India (NDLI) integrates millions of digital resources across subjects, providing unified access for students and researchers.
- **Library Management Systems, Discovery Tools & Open Source Software**: Many institutions use ILS/-LMS platforms (often OSS like DSpace, EPrints) to manage digital content.
- **Internet of Things (IoT) & Smart Library Infrastructure**: Emerging trend of IoT in libraries (e.g., sensors, RFID, mobile app integration) to enhance service delivery and tracking.
- **Cloud Computing and Hosted Services:** Cloud-based Integrated Library Systems (ILS) and discovery tools are transforming service delivery. They reduce maintenance overhead and enable remote access, aligning with hybrid and online learning models. Libraries are adopting Software-as-a-Service (SaaS) models for cataloguing, circulation, and analytics.
- **Research Data and Digital Scholarship Services:** Academic libraries increasingly support research data management (RDM) and digital scholarship. Platforms like IRINS enable research analytics and visibility. Libraries now conduct workshops on citation management, and open science broadening their role in the academic ecosystem.
- **Artificial Intelligence (AI) and Automation:** AI applications in libraries include chatbots, automated cataloguing, and personalized search. Indian institutions are experimenting with AI-powered plagiarism detection, text mining, and virtual reference services. However, implementation remains in early stages, requiring skill development and ethical oversight.
- **Institutional Repositories (IRs) and Open Access (OA):** Growth in institutional repositories to host theses, faculty publications, and datasets supports open scholarship and enhances institutional visibility. Libraries play central roles in repository administration, metadata curation, copyright mediation, and promoting OA policies.

4.2 Emerging Trends in Services and Practices:

- **Shift from Print to Digital-First**: Academic libraries are increasingly positioning digital access as primary, print as supplementary.
- **User-Centric, Remote and Mobile Access Services**: Users expect anytime/anywhere access; libraries are adopting mobile apps, discovery portals and remote authentication.
- **Collaborative Resource Sharing & Networked Services**: Libraries are participating in consortia, networked repositories, inter-library loan supported by digital systems.
- **Smart Library Spaces**: Use of IoT, mobile way-finding, RFID self-checkout to create "smart library" environments.
- **Data-Driven Decision Making, Analytics**: Libraries are leveraging usage data, analytics and metrics to inform collections, services, space-planning.
- **Open Access & Digital Repositories**: Many academic libraries are building institutional repositories to support open science, knowledge sharing.
- **Integration with Teaching-Learning and Research Ecosystems**: Libraries are being embedded into academic workflows digital scholarship services, research data management, AI tools for literature analysis.

4.3 Benefits

- Enhanced accessibility of information resources for users (remote, mobile).
- Improved service efficiency (automation, self-service).
- Broader resource sharing and cross-institutional collaboration.
- Better alignment with teaching-learning and research support roles of libraries.
- Potential for personalized, responsive services using analytics and AI.

4.4 Challenges

- **Infrastructure & Connectivity**: Many institutions (especially smaller or rural) lack reliable high-speed internet, adequate hardware, climate-controlled spaces.

- **Funding and Budget Constraints**: Upgrading infrastructure, acquiring e-resources, investing in new technologies demand budgets that many libraries struggle to secure.
- **Staff Skills & Training**: Librarians and staff require continuous professional development to handle new digital tools, analytics, AI and evolving services. The Web 2.0 adoption study showed low uptake due to lack of training.
- **Digital Divide & Equity**: Disparities exist urban vs rural, large university vs small college, may lead to unequal user access.
- **Interoperability, Standards & Preservation**: Ensuring metadata standards, system compatibility, long-term digital preservation are complex.
- **Change Management & Resistance**: Cultural change required; users and staff may resist new methods; strategic planning is required.
- **Policy & Strategy gaps**: Inconsistent open-access policies and metadata standards.

5. Recommendations

Based on the analysis, the following recommendations are offered:

1. **Develop Institutional Digital Library Strategies**: Libraries should align digital initiatives with institutional goals and create multi-year roadmaps that include staffing, infrastructure, and funding models.
2. **Ensure Infrastructure & Connectivity**: Invest in high-speed internet, cloud services, modern hardware, mobile-friendly platforms, and smart library spaces.
3. **Capacity Building & Staff Training**: Libraries must schedule continual training programmes for staff in digital tools, analytics, AI, metadata standards and user-services design.
4. **Adopt Open Source & Shared Solutions**: To manage costs and increase scalability, libraries should explore OSS platforms and collaborate with consortia for shared services (e.g., discovery tools, institutional repositories).
5. **Prioritize user-centred design:** Adopt mobile-first discovery interfaces, simplify authentication, and co-design services with students and faculty.
6. **Promote Collaboration & Resource Sharing**: Leverage consortia, networked repositories, inter-library loans and federated search to widen resource access and optimise costs.
7. **Embed into Research and Learning Ecosystem**: Libraries should align with institutional research support (data management, digital scholarship), teaching-learning (information literacy, digital literacy) and academic workflows.
8. **Monitor & Evaluate**: Establish metrics for digital service usage, user satisfaction, cost-benefit analysis; use data to refine services and justify investment.
9. **Policy & Governance Support**: Encourage institutional leadership and higher education governance bodies to prioritise library digital transformation, allocate budgets, and include libraries in broader digital-learning strategies.

6. Conclusion

The digital transformation of academic libraries in India presents a pivotal opportunity to enhance access, support research and learning, and reposition libraries as dynamic knowledge hubs in higher education institutions. From e-resources to IoT, AI and mobile access, the suite of technologies is expanding rapidly. While many Indian academic libraries are already on the path, the full potential will be realised only when foundational issues such as infrastructure, skills, strategy and equity are addressed. As higher education evolves under policy drives like NEP 2020 and global digital shifts, academic libraries must keep pace. By adopting a strategic, user-centred, collaborative and innovative approach, Indian academic libraries can lead the way in supporting digital-first, inclusive, research-intensive academic ecosystems.

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