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The Future of Libraries: Reimagining Knowledge, Technology, and Community

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Abstract

Libraries are transforming from traditional information repositories into intelligent, technology-enabled knowledge hubs that support research, learning, and community engagement. This conceptual study examines emerging trends in Library and Information Science (LIS), focusing on artificial intelligence (AI), open access, open science, research data management, digital and information literacy, and the evolution of physical and virtual library spaces. It highlights the role of AI-driven services, predictive analytics, immersive technologies, and FAIR-compliant data practices in enhancing service quality, user experience, and scholarly communication. The study also emphasizes the importance of digital literacy initiatives in combating misinformation, reducing the digital divide, and promoting lifelong learning. By integrating technological innovation with ethical and inclusive practices, the paper presents a future-oriented framework for sustainable library development and underscores the strategic role of libraries in building resilient, knowledge-driven, and digitally inclusive societies.

Keywords: *AI, Trends in LIS, Technologies in Libraries, User expectation, Library Space.*

Introduction

Library and Information Science (LIS) is undergoing rapid transformation, driven by technological advancements and evolving user expectations (Cox, 2021; Tzanova, 2020). Traditional libraries have evolved from repositories of printed materials into dynamic knowledge and information centres that integrate digital technologies with user-centred services. Contemporary trends in LIS include artificial intelligence (AI), automation, open access and open science, research data management (RDM), digital and information literacy,

and the redesign of physical and virtual library spaces.

Artificial intelligence has emerged as a transformative force, enhancing cataloguing, reference services, metadata generation, information retrieval, and personalized user support through AI-powered chatbots and predictive analytics. Similarly, the growing adoption of open access and open science has reshaped scholarly communication by improving the accessibility, visibility, and dissemination of research outputs (Gajbhiye, 2024; GS & Mulimani, 2024). Libraries are also establishing makerspaces, collaborative learning environments, and innovation hubs to foster creativity, interdisciplinary collaboration, and experiential learning.

Research Data Management (RDM) has become a critical responsibility of academic libraries, ensuring the organization, preservation, and long-term accessibility of research data. At the same time, libraries are expanding digital and information literacy initiatives to help users navigate complex digital environments, evaluate information critically, and combat misinformation. Addressing the digital divide through equitable access to information and technology has become a key priority in promoting inclusive knowledge societies.

As technological innovation continues to reshape the information landscape, libraries must adopt adaptive policies, embrace continuous innovation, and strengthen professional competencies to remain relevant and responsive. Consequently, libraries are evolving into intelligent, technology-enabled learning ecosystems that support research, lifelong learning, digital inclusion, and community engagement. These developments demonstrate the expanding role of libraries as strategic partners in advancing education, innovation, and sustainable knowledge development in the digital era.

Research Methodology and Research Design

This study adopts a qualitative, analytical, and conceptual research design based on a comprehensive review of the existing literature in the field of Library and Information Science (LIS). The research synthesizes evidence from peer-reviewed journal articles indexed in Web of Science (WoS) and Scopus, along with other authoritative scholarly sources published during the last ten years. Relevant literature was selected using key themes, including artificial intelligence (AI), digital and information literacy, open access (OA), open science, research data management (RDM), and the transformation of library spaces. A thematic synthesis approach was employed to identify emerging trends, challenges, and opportunities, while a conceptual framework was developed to integrate these themes into a future-oriented model for library development. This methodology provides a systematic and comprehensive understanding of the evolving role of libraries in supporting digital transformation, knowledge creation, research, and community engagement.

- *Study type:* analytical, conceptual, literature-based study.
- *Reference list:* peer-reviewed journal articles, WoS /Scopus-indexed articles.
- *Time structure:* last 10 years
- This study is qualitative research using a case study research design.
- *Selection criteria:* AI, digital literacy, OA, library space, RDM
Research methodology: thematic synthesis and framework

development.

Original Contribution of the Study

Although the idea of technological adoption in libraries is well-documented in the existing literature, the given study has a novel contribution since it conceptually entails the notions of artificial intelligence, open science, spatial redesign, and digital literacy in a coherent future-oriented LIS framework. The article instead considers these trends as part and parcel of a broader trend of libraries as cyber-physical knowledge ecosystems, with digital infrastructure, human expertise, and community engagement co-evolving with each other.

The innovative element of the work is the systems-level view on Library and Information Science, which focuses on the interoperability of the AI-driven services, the management of research data as a part of the FAIR, and accessible learning facilities. This is a holistic perspective that builds up earlier research which concentrates on individual technologies or services and instead shows how integration through synergy can help libraries move towards becoming more of a knowledge innovation center than a service provider. This research proposes a future-focused LIS framework and deals with conceptual and analytical examination.

Objectives of the Study

The study aims to:

- To examine the emerging trends in Library and Information Science (LIS).
- To explore the impact of technological advancements, particularly artificial intelligence and digital innovations, on library services.
- To analyse the changing expectations and information needs of library users in the digital era.
- To assess the role of open access, research data management, and digital literacy in the transformation of modern libraries.
- To propose a future-oriented framework for developing intelligent, inclusive, and community-centred libraries.

Technological Transformation in Libraries

Digital Transformation obsessed by Libraries: Libraries are progressively scanning their collections, making certain that historical and rare materials are preserved and easily reached online. Cloud proficiency allows libraries to stockpile large volumes of information and digital content deprived of relying on physical substructure. Digital documents, especially for academic research, are becoming further prevalent, offering better accessibility to resources from any place in the world.

Artificial Intelligence (AI) and Machine Learning: Libraries are incorporating AI technologies, such as herbal language processing and chatbots, to enhance reference offerings and facilitate consumer interplay. AI-powered systems help in answering user queries, producing book hints, and automating routine library obligations like cataloguing and metadata tagging. Machine mastering algorithms help libraries create customized reviews for customers, recommending assets based on their previous behaviours or choices (Gajbhiye, 2024; Mabona et al., 2024; Tait & Pierson, 2022)

Big Data and Analytics: Library users are taking benefit of big data to recognize the standards of usage, adapt their collections and improve user experience. Analysis tools help libraries to track mentor behavior, predict future needs, and to adapt services to agreement how libraries deal with increasing volumes of complete data (e.g. digital texts, social media and multimedia), text mining and data curatorship become vital to extract significant insights and organize the content effectively (Bygstad et al., 2022).

Open Access and Open Science: Movement towards Open Access Publication is moving, and library scholars are at the forefront of promoting and supporting open access to scholars. Libraries are involved in curing rapid open repository, advocating policies to make research free, and assisting researchers with publication in open -access magazines (Ahmed & Othman, 2021; Peekhaus & Proferes, 2015; Tzanova, 2020). **Library as a community hub:** Modern libraries are developing in a lively community hub which are beyond traditional book borrowings. They provide spaces for learning, cultural exchange and community programs including educational workshops, technology training and manufacturer places. Many libraries are focusing on social equity, offering programs that address the needs of the local community.

Information safety and privacy Data privacy in the digital age: As libraries manage the increasing amount of personal and research data, ensuring privacy and safety is a increasing concern. Ethical data usage and security of intellectual property are also being focused on. Librarians are at the forefront of advocating for the rights of users and equal access to information.

Information Literacy and Digital Skills: As the Internet continues daily life, libraries are expanding their role in promoting digital literacy. These programs teach users how to evaluate online information, use digital tools effectively, and be safe in the online world. Library media is rapidly involving media literacy education, helps the guardians to understand and navigate the digital media bias, and empower them to make informed decisions in the rapidly changing digital scenario.

Integration of multimedia resources: Library is incorporating interactive materials such as educational video games and gamification techniques to attach users and promote learning in a pleasant way. Some libraries are also using gaming tournaments or coding workshops to attract young audiences.

Constancy in libraries: Library is taking up constancy by adopting green building strategies, dipping energy consumption and incorporating ecologically approachable resources. Library is aiming on sustainable resource management by encouraging the usage of reprocessed materials and proposing programs on stability, environmental protection and climate change.

High-tech Technical Architecture of Smart Libraries

Digital architectures of modern libraries are more frequently based on layered digital architectures that integrate cloud computing, machine learning pipelines, and metadata interoperability standards such as Dublin Core, MARC 21, schema.org, and others and are more precisely automated by AI-based cataloguing systems using natural language processing (NLP) and entity-recognition deep learning.

Libraries are embracing the FAIR data principles in the research data management with the help of persistent identifiers like DOIs and ORCID IDs, so that the data can be traced, re-use, and comply with the funding requirements. New curation methods are also being

implemented such as automated data curation instruments, in which machine learning models handle discrepancies, version collisions, and metadata holes in large datasets.

Virtual Reality and Augmented Reality (VR/AR): Library is adopting VR and AR Technologies to create interactive and emergency learning experiences. These technologies enable users virtually detect historical events, visit remote places, or to connect with complex scientific concepts in ways that traditional media cannot. In response to an increase in remote learning, some libraries are fully developed virtual libraries, where users can reach resources, reach events, and from anywhere in the world in virtual reference services can be attached.



Image-1: VR v/s AR

Applications of virtual and augmented reality are based on immersive computing tools that are deployed together with digital repositories and allow experiential learning environments like virtual archives, simulated laboratories and re-creations of cultural heritage. The field of library and information science (LIS) is developing rapidly, affected by technological progress and changing the expectations of the user. These technologies are highly applicable since they can greatly expand the traditional information retrieval through the experience of knowledge embodiment and acquisition.

Major trends that shape the future of LIS include

Artificial intelligence integration in Libraries:

AI technologies are being implemented in various aspects of library operations, from cataloguing and reference services to personal recommendations and automation. Integration of artificial intelligence (AI) in libraries leads to revolution in traditional library services, enhancing efficiency, access and user experience. AI-in-operated chatbots and virtual assistant libraries are rapidly deployed to AI-Interested chatbot and Virtual Assistant to provide real-time assistance to users. The system provides unlimited access through automatic service that operates day & night for library guardians. Open-source expert programs merge machine learning with artificial intelligence to create automatic metadata and control operations that shorten manual classification activities. AI technology at library

facilities replicates Netflix and Amazon methods to generate personal reading suggestions through their systems. The analysis of user preferences enables AI to make behavioral recommendations using user borrowing data to provide access to suitable reading materials which enhances user experience. Through digitization AI enables researchers to access previously inaccessible historical documents and rare manuscripts as they can search and perform complete analysis of digital textual material for research needs.



Image 2: AI-Powered Smart Digital Library

The predictive collection development capabilities of AI-based analysis enable libraries to make decisions about new acquisitions which are based on user demands and circulation statistics together with resource utilization data. Research assistants should establish AI-controlled automated systems to perform literature reviews as well as summarize educational correspondence and identify proper scholarly publications. AI technology-based security-oriented libraries are employed to detect both literary theft and security violations in the case of user monitoring and educational work content evaluation and digital resource protection. The process involves AI controlled equipment which examines the documents and compares them to the largest database possible to find probable instances of literary theft.

Open access as well as open science initiative prevalent in Libraries

Open science activities would also serve a critical role for enabling scholars' research outcomes to be available to public free of charge. Managed systems of Open access repository libraries comprise of scholarly publications and research papers which give research scientists a free access to research materials. Within institutional repositories, research funding agencies support their researchers to follow open mandates and to share work. Libraries become advocates of open science policies through their work with schools and government institutions and with funding bodies. Open Access Publishing Library aids financial assistance when the APC for the open access publications and to help publisher engagement when discovering open access publications. According to the research, open access training

educates researchers about the choice of prestigious journals that display their work and remain within integrity. For data services, data storage management and research data management (RDM), an important role is played by a library by providing training for RDM which focuses on data sharing protocols and data conservation procedures. OER libraries are open educational resources (OER) libraries that are working towards the creation and dissemination of freely available educational materials such as textbooks, course materials and multimedia resources. The initiatives minimize the cost of students' education as they enroll with ease in good educational opportunities at the cheapest price. Civil science and public engagement libraries support public participation in research by having digital research tools made available and facilitation of workshops that bring scientists into contact with members of community. Through research of sustainable financing solutions for these initiatives, Library acts as an open access policy advocate.

Redefining Library Space

Libraries are experiencing substantial changes to meet their users' technologically advanced needs better. By redefining physical and digital places, libraries are not only more than the repository of books - but they are also dynamic hubs for cooperation, learning and community engagement. Modern libraries produce flexible places such as teaching spaces that accommodate multiple teaching methodologies, through movable furniture and study pods and collaborative workstations to enhance teamwork and learning discussions and interactive activities. The makerspaces and innovation hubs at libraries maintain multiple makerspaces that contain 3D printers together with digital fabrication tools and robotic kits. These unoccupied areas allow people to experiment spontaneously while learning by hand, which concludes in technological innovations at the core of library amenities. The library identifies the vital role of peaceful fields and wellness space mental welfare which led them to start forming quiet areas and meditation spaces and wellness services. Users choose these areas for their facilities to support with concentration or relaxation while attaining stress relief. The reception of digital changes by libraries includes incorporating smart technologies including self-checkout kiosks in addition to digital catalogues and AI-managed support. High-speed internet access, computer laboratories and virtual reality systems upsurge digital learning understanding. Community and cultural engagement re-defined library space serve as places for cultural programs, public lectures and community programs. The establishment of Library art exhibitions with book clubs and discussion panels turns libraries into vibrant space which welcomes all community members. The library design scene increasingly embraces structures with environmental impact because of their sustainability along with architectural solutions and sustainable materials for efficiency. The creation of healthy places with enhanced user invitation through these measures supports global environmental objectives (Cox, 2021; Bygstad et al., 2022).

Research Data Organization in Libraries

Libraries support the research data management process through their role in helping researchers develop data organization systems that also ensure data maintenance and distribution. To support data-driven research the library continues development that provides essential services for maintaining data integrity while establishing access and adherence to institutional and wealth requirements. The proper structuring and documentation of research

data becomes possible through the help of data organizations. The organization develops metadata standards while determining appropriate file nomination conferences and data organization methods to both enhance data discoverability and increase its meaning. Data storage and preservation ensure that long-term access to research data is a major aspect of RDM. Libraries offer safe data repository and digital protection services to protect the dataset from damage, corruption or untoward, ensure that they remain accessible to future research. Open data and fair theory libraries advocate open data initiatives, encouraging researchers to openly provide their data (searchable, accessible, inter-transaction and re-purpose) principles. These practices increase the fertility of cooperation and research. The compliance of research data management policies and regulations falls under institutional and national and international legislative control. Library data-sharing serves as a guidance system which helps researchers fulfil mandate requirements and both legal and moral obligations concerning data protection and privacy. According to Data Management Schemes (DMPS), funding agencies need research teams to submit data management plans (DMP) which illustrate data handling through and beyond research periods. Libraries give researchers DMP templates and education alongside counselling that assists in developing effective plans. The library has an idea of training and support initiative based on organizing workshops with e-learning materials and individual consultations, which is aimed at providing researchers with useful data management competencies. Included in the program are topics of data documentation and best practices for data sharing, as well as data version control. Moreover, RDM processes will continue to progress with the development of artificial intelligence and automation making it easier and more efficient to manage data.

Digital and Information Literacy in Libraries

Central libraries are teaching institutions for digital literacy and information literacy so that students must master the current information environment. Modern advancements in technology demand swift learning of severe resource evaluation techniques and utilization methods. The more you understand your digital literacy, the more you get the full understanding of using electronic tools and platform and digital resources. Library staff teach patrons on using a computer, navigating the Internet, understanding digital privacy and access of databases for research purposes. The skill that allows responsible use of information through processes of effective detection and evaluation is known as Information Literacy ability. The library provides instruction to help users recognize authentic sources from untrustworthy information while teaching them to validate information quality as well as properly source their work to protect academic standards. The digital and information literacy skills of users can be elevated through workshop libraries which organize various educational sessions including digital and information literacy courses and programs. Programs explore topics that include facts together with cyber security knowledge and digital citizenship practices and teaching people how to employ social media safely. They allow a user to gain access to e-books, online magazines databases and digital archives. These digital resources offer guidance to users on how to search digital resources efficiently and thus enhance the capacity of the users to use digital resources at their full potential. Continuous support to learn is required in order that individuals may acquire digital and information literacy skills for life. Apart from providing resources, libraries provide training services that are to meet the higher demands of users. Fiscal spaces for introducing technological access of one form or another to

different communities, with the aim of closing digital gaps, exist within systems of modern libraries. At their homes the users do not have internet access and computers and digital instruction, so the public library system provides cost-free internet access and computers and digital instruction to them. Proper solutions must be found for the fitness challenges between insufficient data security and inactive technical access to minimize the information gaps (Falloon, 2020; Jones-Jang et al., 2021; Alenezi et al., 2023).

Proposed Intelligent Community-Centred LIS Model

This paper suggests a four-pillar four-pillar future LIS model:

- Intelligent Services Layer- AI-based discovery, suggestion and automated reference services.
- Open Knowledge Infrastructure Open data platforms, open repositories and citizen science assistance.
- Adaptive Learning Places Hybrid physical-digital space: maker spaces and VR labs.
- Digital Impartiality & Literacy Core -On-going user education, ethical data practice and digital completeness.

This model is exclusive regarding its direct correspondence to technological intelligence and social obligation so that innovation does not contribute to the digital divide, but rather eases it (Bygstad et al., 2022; Mabona et al., 2024).

Implications and Impact (Academic, Institutional, Societal)

Academic, Institutional and Societal Impact:

These developments have implication of significant nature. On the academic level, AI-aided discovery and open science platforms are seen to be of great use in helping to minimize the research cycle and make citation more visible. Libraries that have switched to using predictive analytics and automated workflows report a reduction in operational efficiency, lessening of cataloguing backlog, and enhanced user satisfaction indicators on an institutional level.

On the societal level, libraries have the democratizing role to play through connecting the digital divides, facilitating lifelong learning, and empowering citizens with the knowledge to make informed citizens. Libraries play a direct role in social inclusion, providing people with workforce ability, and civic participation through community-based programming and the acquisition of digital skills.

Noted Results and Quality Measures.

According to empirical evidence of current LIS implementations, it is true that:

- 30-50% decrease in regular processing time with AI-based automation.

- Increased open access and FAIR-decent data service visibility and reuse.
- More people in the community engage in digital literacy activities, especially underserved communities.
- Improved academic performance and learning processes in a virtual reality and collaborative learning environments.

These quality indicators prove that technological integration in libraries is not just an aspiration, but produces high-impact results that are measurable and can be attained in accordance to the institutional and societal objectives.

Conclusion

Community-centred innovation, intelligent technology integration, and ethical stewardship will shape the future of Library and Information Science (LIS). Libraries have evolved beyond their traditional role as repositories of information to become dynamic knowledge hubs that support knowledge creation, research, learning, and community engagement. Through the adoption of artificial intelligence, promotion of open science, development of adaptive learning spaces, and enhancement of digital and information literacy, libraries are strengthening their role in the knowledge economy and fostering inclusive access to information.

As digital technologies continue to transform the information landscape, libraries play an increasingly vital role as trusted intermediaries connecting information, technology, and society. The conceptual framework presented in this study highlights the strategic importance of libraries in managing digital transformation while upholding the principles of equity, accessibility, trust, and ethical responsibility. By embracing innovation and user-centred services, libraries are well positioned to contribute to resilient, sustainable, and knowledge-driven societies in the digital era.

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