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Emerging Technologies in Library Services

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Abstract
Emerging technologies refer to those new, fast-growing technologies that are expected to have a major impact on organisations. Libraries are using several emerging technologies, such as AI tools, the Internet of Things, and Big Data visualisation. Understanding these new technologies is important to libraries because they continue to change how libraries provide services to their patrons and improve efficiencies while increasing access to library services. Libraries must also continue to evolve as community and information hubs that support the growing needs of their communities. The authors of this study performed a thorough systematic literature review using Google search databases to find articles published after 2015 that addressed the functions and impact of emerging technologies in library services. The authors analysed and synthesised the results of their search using the thematic analysis method. The findings of this study demonstrated that through the use of these emerging technologies, librarians would be able to provide improved service delivery, better user experiences, increased efficiencies and cost savings, greater inclusivity, redefined roles of librarians, enhanced innovation and creativity, and future-proofing libraries. Additionally, the authors identified other benefits of emerging technologies in library services, including streamlined workflows, greater access to diverse resources, greater user engagement, and improved research support, which will ensure that libraries remain innovative hubs of learning and information. The study concluded that the use of emerging technologies creates many transformative opportunities for libraries to enhance their operational efficiencies, provide greater personalised services, and redefine their role as modern-day knowledge centres. The authors recommended that libraries work collaboratively with technology vendors.

Keywords: Library, Library services, Emerging technologies, Artificial Intelligence (AI), Internet of Things (IoT), Big data visualisation

Introduction

Libraries have been an important source of preservation and distribution of knowledge through their extensive collections of books, journals, data sets and other information sources for their users. Today, libraries are considered dynamic resources for accessing both digital and physical

materials. Libraries can be structured: as a physical Library, a Virtual Library or a combined structure that allows for services like Circulating materials; Providing Reference Support; Providing Digital Learning Services etc. A library is characterized by: an organized collection; being a place to access information; having a Service-based relationship with its community; Providing a professional staff; and Flexibility to the changing information formats.

Library services include all forms of support, activities, and resources to help users find, retrieve, and use information in a timely manner. These services include the provision of relevant reading materials for both students who are undertaking education and for those who enjoy reading for pleasure (Ogar & Dushu, 2018). It also includes assisting users in understanding how to effectively utilize library resources. The core operations of a library typically include: circulating books, journals, multimedia, and digital media (circulation services); providing access to various resources, such as online databases and repository systems (information services); and offering assistance to users in locating and retrieving information that meets their needs (reference services). The primary goal of library services is to link users with the information that they need for learning, working, and fulfilling personal goals, but sometimes libraries' manual processes can delay users from obtaining what they are requesting, which can result in inefficiencies.

In recent years, the method of delivering library services has gone from being passive, whereby users would have to search for items independently, to being proactive, whereby librarians deliver relevant information to users through mechanisms such as Selective Dissemination of Information (SDI). Digital transformation has created an opportunity for library service delivery to extend beyond the physical buildings of libraries by providing users with 24/7 access and online support. The main objectives of Library Services today are to provide users with the ability to receive information in a timely manner, increase user productivity, assist with Education and Research, enhance Community Development, and close the digital divide by providing equal access to information (Howard, 2019).

The pace of society's transition to an information-based economy has resulted in the expectation of users to have access to accurate, comprehensive, and area-specific information in the least amount of time possible. The exponential growth of information production and consumption has presented librarians with many challenges in terms of organizing and disseminating that information to users in a quick and efficient manner. As the volume of information that is created has grown, so too has the slow and inefficient process of

managing that information through traditional methods (Edward, 2021). As a consequence, Library Services must implement and adopt modern technology in order to meet the growing demands of users for faster and more reliable service. According to the fourth Law of Library Science, Library Services must make the best use of their time to enhance the experience for users (Marqueiro, 2023).

Libraries have undergone a dramatic transformation with the Evolution of Technology. Technology previously considered to have been innovations have become an integral part of life (e.g., ATMs, cell phones, and personal computers). By incorporating advanced technologies into the work process, libraries have transitioned from being a repository of texts to becoming a hub for Knowledge Creation. The use of emerging technologies (e.g., AI, IoT, and Big Data Visualization) has altered the way that information is created, accessed, used, and shared. As libraries continue to incorporate new technologies into their operations, library systems will continue to improve the way in which they manage information for their patrons, enhance patron experiences, and provide greater security and accessibility to their patrons, ultimately through becoming a more vibrant and dynamic knowledge hubs in the digital age (Cox, 2018; Racheal, 2020; Suryawanshi *et al.,* 2025).

Methodology

A systematic literature review approach was utilised for this research, which included searching several academic databases for articles related to each of the three emerging technologies identified that impact library services from 2015 to present. All searches were conducted using a set of keyword combinations that pertain to each of the following themes – Emerging Technologies, Library Services, Library Functions, Applications, Advantages and Consequences of Emerging Technologies for Libraries: Artificial Intelligence, the Internet of Things and Big Data Visualization. Thirty scholarly articles were [retrieved, critically evaluated, and synthesised] according to the thematic analysis methodology given the objectives of the research.

Emerging Technology Trends in Libraries

New technology trends in the Library and Information Science profession (LIS) are based on using Artificial Intelligence (AI), immersive technologies (such as virtual reality [VR] or Augmented Reality [AR]), and data-driven technologies to develop Hybrid environments within libraries. By using cloud services, libraries will create Hybrid Spaces that

combine both physical spaces and digital online services using various types of mobile devices, robotic technologies (Chatbots), and automation tools (Robots). With this change in the way people access library resources, libraries will begin to provide Customized Learning, Enhanced Information Discovery, and Superior Management of all library operations; these are just a few of the areas in which libraries will continue to receive new technology to improve services to users and the community.

According to Reid (2025), new Library and Information Science (LIS) technology focuses on improving user engagement and efficiency through AI-based technology systems, mobile access to library information and services, using immersive technologies to facilitate learning, and creating smart infrastructure to support Libraries across all areas of their operations. Some technologically advanced platforms that have emerged in the library sector include AI and Machine Learning systems (e.g., chatbot and recommendation systems), immersive VR/AR platforms for Classroom Learning and Virtual Tours, mobile access to library services, cloud-based library platforms, and new tools powered by IoT (Internet of Things) technologies to improve operations (e.g., Smart Shelves and Robotics). In addition, libraries are using Big Data Analytics to better manage their resources, and they are providing digital literacy training to support community development. Through the development of new technology, library services are now providing users with easy-to-use, Personalized Learning Platforms; increasing the number of Automated Library Services; developing Innovative Learning Environments; providing Data-Informed Decision Making; and Bridging Digital Gaps using Mobile Access.

According to Agboke and Oladokun (2024), the opportunities and hurdles associated with the implementation of new technologies in Nigerian School libraries have been evaluated. They discovered that new technologies, including automated systems, AI, robotics, and electronic security, have made services more efficient; however, insufficient funding, inadequate infrastructure, limited knowledge of use, fear of the danger of losing jobs, and privacy concerns are viewed as significant obstacles. In the same manner, Owate and Iroeze (2023) report that although many new technologies are already available for use in libraries, many of these technologies are not widely adopted or used by the vast majority of public university libraries in Nigeria. They noted that lack of equal access to new technologies, lack of technical skills to use them, and cybersecurity issues are the main barriers to the use of these new technologies. While Genesamoorthy and Selvakamal (2024) pointed out that new technologies had increased services to library users and improved methods of delivery of library resources, Ubogu and

Ozoro (2024) pointed out that librarians who continue to develop their technological skills would be in the best position to perform their duties effectively in the 21st century. Ogwo et al. (2025) reported that while library staff were aware of the new technologies, many of them were not using these technologies effectively. Inamdar (2022) concluded that libraries are still critical to the educational process and to research and will continue to be relevant through the strategic implementation of new technologies.

Artificial Intelligence (AI)

Artificial Intelligence (AI) is a branch of computer science that is growing rapidly and aims at developing machines that can emulate some of the functions of human beings. Tasks that normally require human intelligence include processing language, interpreting images, making choices and solving problems. The way in which Gupta and Mangla (2020) perceive AI is that AI forms an intelligent computer that can imitate the behaviours of human beings. AI developed in the 1950's and has now become a transformative technology that is being applied to a wide range of sectors from academic libraries to libraries where the use of AI is transforming how libraries operate and their provision of library services (Zondi *et al.,* 2024).

Within libraries, some of the applications of AI include chatbots that answer user inquiries, notify users of library due dates, direct users to library locations, and provide scheduling functionality for users to set up appointment times. AI applications in libraries free up librarians from performing repetitive administrative tasks and, in turn, allow librarians to spend more time on complex library services such as providing research help and engaging with the community (Chakarova & Trabert, 2017). Yet in addition to the benefits of AI in libraries, AI is also faced with many of the same challenges that other fields deal with, such as algorithmic bias, concerns regarding privacy, and the ongoing need for staff training to remain current in technological advances (Montoya & Sison, 2024). Some of the major applications of AI that Asif and Singh (2019) identified in libraries include automated cataloguing and metadata generation; chatbot services; predictive analytics; robotic inventory control; and computer vision for digitising content. Amalia et al. (2024) also identified AI functions within libraries in terms of enhancing user engagement, increasing efficiency of library operations, facilitating discovery of information, and supporting preservation/accessibility of resources.

Internet of Things (IoT)

The Internet of Things is a system of everyday items connected to the Internet, allowing them to collect and share data automatically without human intervention. The Internet of Things (IoT) has increased the connectivity of Internet-enabled physical objects through the addition of sensors and software (Shashikumar *et al.,* 2019). By incorporating IoT technology into the library environment, libraries can manage their resources more effectively and enhance service delivery to patrons.

Liang (2018) describes how IoT works using a network of connected devices that send and receive data to one another without human involvement; he also mentions that some library management systems utilize IoT for automated data transfer. Library patrons use RFID-equipped books to track the location of books in real time and perform inventory checks automatically to reduce theft (Ram, 2023; Pajo & Rauch, 2022). The use of self-service checkouts and returns further increase the efficiency of the library's circulation system.

Additionally, IoT sensors monitor the conditions of items stored in libraries, such as the humidity, temperature, and air quality, as well as maintain optimal conditions that allow librarians to store rare materials safely and create comfortable environments for staff members and patrons (Ram *et al.,* 2023). Motion detectors monitor the use of space within the library, helping to create an efficient and well-utilized facility (Kumar & Ram, 2020). By using location-based technologies, libraries can provide patrons with personalized notifications and recommendations based on their location (Fernández-Caramés & Lamas, 2018). Libraries are incorporating IoT-enabled security systems for the purpose of providing safety through real-time alerting (Al-Jaafreh & Reyalat, 2021).

Data collected on patron behavior via IoT can create opportunities for libraries to offer personalized services to patrons, create assistive technology for patrons with disabilities, and provide patrons with the ability to explore self-guided virtual tours (Ram & Verma, 2023). The American Library Association has identified potential applications for IoT technology in libraries.

Big Data Visualization

Big Data is generally defined as being very large applications that encompass more information than a single user can manage and analyze with standard data-management techniques (Panda,

2021). The analysis of large datasets gives users insight into how to interpret the patterns within those datasets and use those insights in making decisions, through the creation of visual exhibits such as charts and graphs (Hussian & Shahid, 2022). The primary function of implementing large datasets of Big Data visualization in a library environment is to interpret an enormous amount of data; detect usage patterns, and assess library systems' performance over time. The process of visualizing large dataset through Big Data creates visual formats for more timely and well-informed decision-making(Shahzad *et al.,* 2025).

The use of Big Data Visualization can lead to greater access to digital libraries, as well as improved access to information from around the world(Anonymous, 2025). In order to accurately visualize Big Data, Yan and Liu (2025) suggest establishing the objectives; understanding what the end users need returned as an output from the visualization system; preparing quality datasets; selecting appropriate visualization tools; creating clear visual representation(s); and using feedback received from users to improve the visualization system. Utilising these bases instills evidence-based decision-making capabilities for collection development, user engagement, and service-quality improvements.

Benefits of Emerging Technologies in Libraries

The use of Artificial Intelligence (AI) is improving library services by automating repetitive tasks, increasing accuracy of searching, and speeding up how libraries create metadata for their materials (Banerjee, 2022). Automated chatbots provide line-by-line assistance for users 24/7 and give users recommendations tailored to their needs using AI technologies. Analytic tools also provide library managers with the ability to make informed decisions related to collection development and the use of resources (Ogar & Dushu, 2018). The Internet of Things (IoT) has made it possible to increase operational efficiencies of libraries by using radio frequency identification (RFID) technology in managing inventory, sorting material automatically and allowing for patrons to check out items independently via self-checkout machines. IoT technology allows libraries to control and monitor both the use of energy as well the environment in which materials are stored (Abo-Seada, 2019). IoT also aids libraries in keeping track of collections, preventing theft, as well as using space more effectively (Xu *et al.,* 2018).

According to Jakati and Kumar (2022), IoT permits libraries to monitor their environment in historical and real-time, manage inventory automatically, maintain good security and provide efficient circulation services. Additionally, IoT has improved: Improving fire detection and

prevention Digital Library services Liang (2018). The visualization of Large Data enables libraries to identify trends in borrowing patterns, allocate budgets optimally, provide personalized services, operate efficiently and effectively share insights with stakeholders by utilizing visual stories (Li *et al.,* 2019; Kamupunga & Chunting, 2019).

Conclusion

The three technologies that have a positive impact on the growth of library services today are Artificial Intelligence, the Internet of Things, and Big Data Visualization. AI is used to enhance information retrieval capabilities, personalize user services to fit an individual's needs, automate collection organization and cataloguing, and improve overall resource management. All these functions and improvements contribute to enhanced user satisfaction and improved user access. The Internet of Things allows automated systems for managing library inventory, increased security for library premises, higher levels of optimization for libraries' available spaces, and offers more customized service options to users. However, IoT also presents concerns regarding potential breaches of user data privacy. Big Data Visualization allows libraries to visualize user activity and use that information to better understand their users, plan strategically, and make improved, data-driven decisions. All of these technologies are creating user-centered, data-driven, and efficient library environments for users.

Recommendations

The results indicate that libraries should:

1. Emphasize user-centric applications of emerging technologies to improve satisfaction and engagement levels of users.
2. Continue to train and develop the digital competencies of staff.
3. Locate and build alternative funding sources to assist with technology implementation in addition to governmental assignments.
4. Establish clear policies and procedures for data governance as well as concerning all Data Governance, Privacy, Ethics, and Responsible Technology Usage-related topics.
5. Counteract algorithmic bias while also providing equitable access to all users.
6. Engage collaboratively with technology developers, librarians, and IT specialists to improve library operations through innovating technology.

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