

Technological Innovation in Indonesia : From Catalogs to Artificial Intelligence

Muhammad Fauzi Fathurrahman¹, Verry Mardiyanto²

Program Studi Ilmu Perpustakaan dan Informasi Islam, Fakultas Ushuluddin dan Adab, Universitas Islam Negeri Sultan Maulana Hasanuddin Banten

E-mail: fauziuinbanten@gmail.com

Abstract

This article employs a qualitative research approach using a literature review method to examine the transformation of technological innovation in libraries, particularly the shift from traditional catalog systems to the adoption of artificial intelligence (AI). Research data were obtained through a critical review and analysis of various relevant scholarly sources, including academic journal articles, books, and other publications discussing the application of AI technology in the library field. The analysis was conducted by identifying patterns, concepts, and emerging issues related to AI implementation, encompassing its benefits, challenges, and impacts on service efficiency and user experience. The findings indicate that the utilization of AI has the potential to enhance the quality of library services, although it still faces obstacles such as the readiness of human resources, implementation costs, and data security concerns. Therefore, AI-based technological innovation needs to be strategically integrated to ensure that libraries remain relevant in meeting information needs in the digital era. The conclusion of this article emphasizes that the adoption of innovative technologies, particularly AI, is a crucial step for libraries to remain relevant and effective in serving the information needs of society in the future.

Keyword: AI Based, Catalog, Technology Innovation

INTRODUCTION

Libraries have undergone significant transformation throughout their history, evolving from mere repositories of books into dynamic and interactive centers of information resources. In the contemporary digital era, technological innovation has fundamentally reshaped how libraries operate and deliver services to their users. One of the most prominent changes is the shift from traditional catalog systems to the utilization of artificial intelligence (AI) to enhance user experience and operational efficiency. Initially, libraries relied on manual catalogs that required substantial effort to organize and retrieve information. Users were required to search through physical indexes, a process that was often time-consuming and confusing. With the advancement of information technology, digital catalog systems were introduced, enabling users to search for and access materials more quickly and efficiently. Nevertheless, challenges remain in terms of database maintenance, collection management, and the provision of inclusive access.

At present, with advancements in technologies such as artificial intelligence and machine learning, libraries are able to offer more sophisticated services. AI can be employed to analyze user behavior patterns, recommend relevant materials, and support collection management in a more efficient manner. These technologies not only enhance user experience but also enable libraries to adapt more rapidly to continuously evolving information needs. A review of previous studies indicates that research on the application of artificial intelligence in libraries has largely focused on technical aspects, such as identifying types of AI technologies, examining AI's role in supporting librarians' tasks, and implementing AI in specific services, including chatbots, recommendation systems,

and service automation. However, these studies have not comprehensively examined the broader transformation of technological innovation in libraries from a systems development perspective, particularly the gradual transition from traditional catalog systems to AI-based systems.

Furthermore, most prior studies tend to highlight AI implementation in a partial and contextual manner, without systematically linking it to the dynamic changes in users' information needs and the strategic challenges faced by libraries in maintaining their relevance in the digital era. Therefore, this study seeks to address this gap by conducting a more integrative literature review on technological innovation in libraries, emphasizing the transformation process from conventional catalogs to AI implementation and its implications for service efficiency, user experience, and the long-term sustainability of library functions. The importance of technological innovation in libraries cannot be overlooked. In the context of learning and research, libraries that adopt modern technologies are better positioned to provide improved access, enhance user interaction, and expand the reach of their services. Thus, the shift from traditional catalogs to AI-based solutions is not merely a trend but a critical step toward a more responsive and relevant future for libraries.

This study makes a conceptual contribution to the development of library and information science by enriching scholarly discussions on technological innovation in libraries, particularly in understanding the transformation of service systems from traditional catalogs to the application of artificial intelligence. Through a comprehensive literature review approach, this study presents a theoretical synthesis that integrates technological developments, changes in information-seeking behavior, and their implications for library management and services. This contribution is expected to serve as an academic foundation for the development of new conceptual frameworks in library science, especially concerning institutional adaptation to the dynamics of the digital era. Moreover, the findings of this study may serve as a reference for researchers and library practitioners in formulating technology-based service development strategies oriented toward improving information access quality, operational efficiency, and the sustainability of libraries' roles as centers of knowledge.

Based on the author's review of several related scholarly works, a number of studies were identified that are relevant to the topic of technological innovation in libraries, particularly the transition from catalog systems to artificial intelligence (AI). These studies are summarized as follows.

First, a study entitled "*A Literature Review on Artificial Intelligence (AI)-Based Library Information Systems*" conducted by Mutia Atika in 2023 aimed to examine library information systems in the era of artificial intelligence. The study revealed that various AI domains can be applied to library management systems, including expert systems, natural language processing (NLP), expert structures, neural networks, intelligent agents, computer vision, and robotics. The application of AI has also been implemented in intelligent security services, where facial recognition and body temperature measurement technologies are used to protect librarians and users, particularly during the COVID-19 pandemic. Furthermore, AI plays a crucial role in library services, such as the issuance of official certificates using robots and expert systems, literature search services supported

by automated bookshelves and robots, and children's services assisted by humanoid robots capable of teaching basic coding skills (Atika & Sayekti, 2023).

Second, a study entitled *"The Implementation of Artificial Intelligence (AI) Technology in Supporting Academic Librarians' Tasks Toward Digital Library Transformation Through the Utilization of OpenAI ChatGPT"* by Pitoyo Widhi Atmoko aimed to illustrate the use of AI technology in supporting academic librarians' duties in the process of digital library transformation. The study employed a literature review and user experience approach to explore how the implementation of AI through OpenAI ChatGPT can assist in academic writing related to AI applications in libraries and support librarians' professional tasks. The findings indicate that ChatGPT can provide alternative ideas and preliminary content recommendations based on coherent, partially accurate, informative, and systematic articles. Additionally, OpenAI ChatGPT can enhance the efficiency and effectiveness of academic librarians in performing tasks such as responding to student inquiries and offering alternative answer recommendations for various questions. The implementation of AI technology was also found to contribute to improving academic librarians' competencies in adapting to emerging technologies.

Third, a study entitled *"The Role of AI Librarians as a Promotion Strategy for Academic Libraries in the Era of Revolution 4.0"* conducted by Evi Aprilia Sari in 2019 focused on the utilization of information and communication technology to manage information and deliver services effectively (Sari, 2019). This study emphasized the application of AI librarians as guides to assist users in accessing integrated information within libraries. The presence of AI librarians represents evidence of entry into the era of disruption, where technological advancements associated with the Industrial Revolution demand that librarians collaborate effectively and communicate automated content within information systems. Information technology and internet-based systems have the potential to replace certain human labor, particularly in routine and repetitive tasks. In the library context, activities such as digital management, acquisition, retrieval, and storage of library materials can be supported or replaced by information technology. This phenomenon highlights the need to reassess the sustainability of the librarian profession. Consequently, librarians' performance should be evaluated based on their competencies and skills in alignment with current technological developments (Nada, 2021). Librarians remain responsible for a wide range of services, including circulation, reference, management, acquisition, preservation, and technical services. In service-oriented tasks requiring concentration and accuracy, librarians may encounter challenges that affect performance, such as assisting users who lack information-seeking skills. However, with technological support, librarians can work more efficiently during peak service hours and experience reduced fatigue and disruption.

RESEARCH METHOD

This study employs a literature review method as the primary approach to examining technological innovation in libraries, particularly the transformation from traditional catalog systems to the implementation of artificial intelligence (Artificial Intelligence/ AI). This method is applied by systematically identifying, collecting, and selecting relevant literature sources, including scholarly journal articles, academic books, and previous

research publications that discuss information technology and AI within the library context (Riqi & Puspita, 2025). The data collection process is conducted systematically through the identification of appropriate keywords aligned with the research focus, followed by the screening of sources based on their relevance and academic credibility. The collected data are then analyzed qualitatively by examining the concepts, findings, and arguments presented by previous researchers. The final stage involves a synthesis process, which integrates various perspectives and research findings to develop a comprehensive understanding of development patterns, benefits, and challenges related to AI implementation in libraries. Thus, the literature review method enables the author to formulate conceptual conclusions and identify research gaps that form the basis for the development of this study.

The research was conducted through several systematically structured stages in accordance with the literature review approach to obtain a comprehensive understanding of technological innovation in libraries, particularly the transformation from catalog systems to the application of artificial intelligence (AI).

The first stage involved determining the research focus and scope. At this stage, the author identified the topic to be analyzed, focusing on innovation in library technology with particular attention to the advancement of catalog systems and the use of artificial intelligence in library services and management. This step was intended to ensure that the research remained relevant and well-directed.

The second stage consisted of literature searching and collection. Relevant sources were gathered by exploring academic journals, scholarly books, and previous studies discussing library catalogs, digital libraries, and the application of artificial intelligence in the field of library and information science. The literature search was conducted using appropriate keywords, such as library technology innovation, catalog systems, artificial intelligence, and digital library services.

The third stage involved the selection and evaluation of literature. At this phase, the collected literature was filtered based on criteria of topical relevance, source credibility, and publication recency. Literature that was not directly related to the research focus or lacked a strong scientific foundation was excluded, ensuring that only academically reliable and relevant sources were retained for analysis.

The fourth stage was the analysis of literature data. The selected literature was analyzed using a qualitative approach by exploring the key concepts, findings, and arguments presented by each author. This analysis aimed to identify patterns, similarities, and differences in perspectives regarding the development of library catalog systems, methods of AI implementation, and their effects on library services and the role of librarians.

The fifth stage involved the synthesis and integration of findings. In this phase, the results of the analysis from various literature sources were combined to create a comprehensive and integrated understanding of technological innovation in the library field. The synthesis linked findings from multiple studies to provide a conceptual

overview of the transformation of libraries from conventional catalog systems to AI-supported services, including the benefits and challenges associated with this transition.

The final stage involved drawing conclusions and formulating implications. Based on the synthesized literature findings, the author developed conclusions that reflect the key outcomes of the study and their implications for the development of library and information science as well as library management practices. These conclusions serve to emphasize the importance of technological innovation, particularly artificial intelligence, as a strategic approach to library development in the digital era.

RESULTS AND DISCUSSION

1. Concept of Technological Innovation

Technological innovation refers to the application of new ideas, methods, or products aimed at improving the efficiency, effectiveness, or quality of a system or process. This innovation encompasses advancements in hardware, software, and operational practices that enable organizations to adapt to changing needs and market demands. In the context of libraries, technological innovation includes the utilization of digital tools, information management systems, and artificial intelligence to enhance library services and improve access to information. The relevance of technological innovation in the library context lies in its capacity to support sustainable service development and institutional adaptability.

Innovative technology enables libraries to provide broader and faster access to users. The digitization of collections and online catalog systems allow users to search for and find information easily without physical limitations. By adopting automation systems and data management, libraries can reduce manual workloads, save time, and improve accuracy in collection management and services. Innovations such as mobile applications, chatbots, and AI-based recommendation systems provide a more interactive and personalized experience for users, which increases user engagement and encourages more active use of library services. Libraries that implement innovative technology are able to offer more diverse learning resources, including digital materials, online courses, and access to research databases. This supports more flexible and needs-based learning processes. Furthermore, technological innovation helps libraries adapt to rapid changes in the information environment, such as the development of social media, e-books, and other online information sources, enabling libraries to remain relevant and function as information centers in the digital era. Technology also allows libraries to collaborate with other institutions, share resources, and develop broader information networks, thereby contributing to the development of stronger learning communities.

Innovation can be categorized into several types based on the nature and objectives of its implementation. One of the most common type is product innovation, which involves the development or improvement of existing products to meet changing consumer needs. This may include the addition of new features, the use of better materials, or more attractive designs. An example of product innovation is a smartphone equipped with a more advanced camera.

Another important type is process innovation, which focuses on improving the way a product or service is produced or delivered (Suparmini, 2024). This may involve the adoption

of new technologies, the reduction of steps in the production process, or adjustments to working methods. An example of process innovation is the use of automation in factory production lines.

Business model innovation refers to changes in the way an organization creates, delivers, and captures value. This type of innovation may involve the development of new revenue models, such as subscription-based or freemium services. An example is a music streaming service that offers ad-free access for a monthly fee.

Technological innovation refers to the development or application of new technologies that can improve efficiency or provide new solutions. This may involve hardware, software, or new methods of data processing. An example is the application of artificial intelligence in data analysis.

In addition, organizational innovation involves changes in organizational structure or culture aimed at improving effectiveness and efficiency. This may include the introduction of cross-functional teams, flexible working arrangements, or changes in management practices. An example is the implementation of Agile working methods in product development.

Service innovation emphasizes improvement in the way services are delivered to customers. This may involve staff training, the application of new technologies in customer service, or the introduction of new services offerings. For example many organizations now use of chatbots to provide customer support on a 24/7 basis.

Social innovation is concerned with developing new solutions address social challenges and improve community well being. This can take the form of community-based projects, social business models, or programs aimed at improving social welfare. An example is educational initiatives that utilize technology to reach children in remote areas.

Finally, Environmental innovation focuses on the development of environmentally friendly and sustainable products or processes. This includes the use of renewable raw materials, waste reduction, and energy efficiency. An example is electric vehicles that reduce carbon emissions.

2. Digital Library

A digital library is a collection of information resources stored in digital formats and accessed electronically through computer networks. Unlike traditional libraries that store physical books and materials, digital libraries provide various types of content, such as e-books, articles, journals, images, audio, and video. Users can access, search for, and borrow these materials from anywhere and at any time, as long as they are connected to the internet.

The development of digital libraries began in the late 1980s and early 1990s alongside advances in information technology and the internet. Early projects, such as Project Gutenberg, focused on digitizing classic books to make them freely available (Setyawan et al , 2025).. With technological growth, particularly in data storage capacity and internet bandwidth, digital libraries began to expand rapidly. Many educational institutions and public libraries started to build their own digital collections, providing access to academic journals, e-books, and research resources.

The development of digital library management software and systems (DLMS) has enabled libraries to manage digital collections more effectively. These systems assist in organizing, storing, and lending digital materials, as well as providing user-friendly interfaces. Resource consolidation initiatives, such as the Digital Public Library of

America (DPLA) and Europeana, collect resources from various libraries and institutions to provide centralized access to diverse digital collections. This allows users to explore materials from different regions and cultures.

Although digital libraries now offer greater ease of access, they also face challenges such as copyright and licensing issues, as well as the digital divide, where access to technology and the internet is uneven across society (Wajdi & Hajiri, 2024).. Digital libraries continue to innovate through the adoption of emerging technologies, such as artificial intelligence for content recommendation, augmented reality for interactive experiences, and blockchain for data security. The future of digital libraries is expected to be increasingly integrated with advanced technologies and more responsive to the information needs of society.

3. Integrated Library Management System

An automated library management system (Automated Library Management System) is a software application designed to assist libraries in managing collections, services, and operational activities efficiently. This system replaces manual processes with automation, thereby increasing productivity and accuracy in information management.

The following are some examples of applications used to improve operational efficiency in various sectors, including libraries and other organizations. These applications are also commonly applied to support library operations, such as Integrated Library Systems (ILS).

- a. Project Management Applications
- b. Human Resource Management Systems (HRMS)
- c. Financial and Accounting System Applications
- d. Inventory Management Systems
- e. Team Communication Applications
- f. Time Management Applications
- g. Customer Relationship Management (CRM) Applications

4. Use of AI in Library

Artificial intelligence (AI) has revolutionized the way users search for information and interact with information systems. AI enables the development of more intelligent and responsive search engines. By using machine learning algorithms, systems are able to understand the context and intent of users' searches, thereby providing more relevant results. For example, Google Search uses AI to analyze user queries and deliver the most appropriate results based on search history, location, and user preferences.

AI also enables personalized recommendations by analyzing user behavior and search patterns to suggest relevant information. For instance, streaming platforms such as Netflix and Spotify use AI to recommend movies or music based on users' previous preferences, creating a more personal and engaging experience. In addition, natural language processing (NLP) allows computers to understand and process human language. Through this technology, users can search for information using natural language, such as everyday questions, and systems can provide relevant responses (Liu, 2023). Examples of NLP applications include virtual assistants such as Siri and Google Assistant, which can answer questions and provide information based on voice commands

Recommendations based on users' search history further enhance the relevance of search results. Ex Libris Primo is an AI-based discovery system designed for academic libraries. By utilizing machine learning algorithms, Primo is able to deliver relevant and personalized search results and offer features such as question-based searching, allowing users to find more specific information according to their needs. SirsiDynix Horizon provides intelligent search capabilities that utilize AI to enhance user experience. The system can group search results based on relevance and suggest additional materials that may be of interest to users based on previous search patterns. OCLC WorldCat is a global library catalog that uses AI to improve information retrieval by analyzing and organizing data from libraries around the world, making it easier for users to discover rich and relevant collections. SpringerLink also utilizes AI in its search system to provide recommendations for related articles and books based on users' interests and browsing behavior, thereby facilitating researchers in finding information relevant to their research topics .

Many libraries have also adopted AI-based chatbots to assist users in finding information. For example, services such as *Tanya Pustakawan* use AI to respond to user inquiries in real time and provide information about library collections, opening hours, and other services. The Digital Public Library of America (DPLA) integrates diverse digital library collections and employs AI to enhance search functionality and accessibility, enabling users to locate resources from multiple institutions more efficiently (Suparmini, 2024).

Based on the synthesis of various analyzed literature, it can be concluded that the development of technological innovation in libraries occurs gradually and continuously. This process began with the use of manual catalog systems, progressed to digital catalogs (OPAC), and eventually led to the adoption of artificial intelligence. Several studies indicate that catalog digitization represents an important initial step in improving information retrieval efficiency, although limitations remain in understanding user context and preferences. Consequently, AI implementation has emerged as a solution to address the need for more adaptive, personalized, and user-responsive information services (Yusufhin, 2017). Literature discussing the application of AI in libraries emphasizes that this technology functions not only as a tool for information retrieval but also as a strategic instrument for collection management, service quality enhancement, and optimization of librarians' roles (Amalia et al, 2024) . AI-based intelligent search systems, library service chatbots, and personalized information recommendations are concrete examples of innovations frequently identified in existing studies. These findings indicate a shift in the library service paradigm from a passive, collection-centered approach to a service model that prioritizes user needs and experiences.

On the other hand, the literature analysis also reveals consistent challenges in implementing AI-based technological innovations in libraries. These challenges include limited technological infrastructure, the readiness and capabilities of human resources, system development costs, as well as ethical and data security issues. Several studies highlight that the success of technological innovation depends not only on system sophistication but also on the organizational readiness of libraries to manage change and enhance technological literacy among librarians.

Thus, the synthesis of findings demonstrates that technological innovation in libraries, particularly the shift from catalogs to AI, is a multidimensional process involving technical, organizational, and social aspects. The integration of AI into library systems should be

understood as more than merely the adoption of new technology; it represents an ongoing transformation in information services. This synthesis also reinforces the position of this study as a conceptual examination that integrates diverse literature findings to provide a comprehensive understanding of the direction and impact of technological innovation in the development of modern libraries.

CONCLUSION

In this article, we examine how technological innovation, particularly the application of artificial intelligence (AI), has brought significant changes to library management and services. The transition from traditional catalog systems to AI-based solutions not only improves operational efficiency but also enriches user experience in searching for and accessing information. Through AI, libraries are able to provide better recommendations, facilitate more intuitive information retrieval, and increase user engagement through chatbots and automated services. Adopting new technologies presents its own challenges, including costs, staff training, and privacy concerns; however, the benefits far outweigh these challenges. Libraries that utilize innovative technologies are better equipped to meet the continuously evolving information needs of modern society. Therefore, the adoption and integration of advanced technologies are essential steps for libraries to remain relevant and to function as effective sources of information in the digital era.

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