Optimizing the Role of Islamic Higher Education Libraries in the Era of Technology 5.0

Optimalisasi Peran Perpustakaan Perguruan Tinggi Islam di Era Teknologi 5.0

Teguh Yudi Cahyono
Universitas Negeri Malang, teguh.yudi@um.ac.id
Umi Masruroh
Politeknik Negeri Malang, umimasruroh081136@gmail.com

Abstract

Background of the study: The rapid advancement of Technology 5.0 has had a significant impact on higher education, particularly in optimizing digital library services in Islamic universities. This research explores the role of digitization in improving information accessibility and social inclusion, focusing on the challenges and opportunities in implementing digital libraries.

Purpose: The main objective is to analyze key barriers such as infrastructure limitations, digital literacy gaps, and policy constraints and evaluate the integration of Artificial Intelligence (AI) to improve user experience

Method: Using a literature review approach, data was collected through a review of selected literature

Findings: Findings show that AI-powered tools, including chatbots and recommendation systems, improve service efficiency and accessibility for disadvantaged groups, including people with disabilities and those from low-income backgrounds. In addition, digital transformation in libraries promotes academic engagement and lifelong learning.

Conclusion: The study concludes that strengthening digital infrastructure, implementing inclusive policies, and improving librarians' competencies in AI-based services are essential to optimize library functions. Collaboration between the government, universities and society is essential to ensure sustainable and adaptive digital transformation in Islamic higher education.

Keywords: digital libraries; artificial intelligence; social inclusion; technology 5.0; islamic higher education

Abstract in Indonesia

Latar Belakang Penelitian: Kemajuan pesat teknologi 5.0 telah berdampak signifikan pada pendidikan tinggi, khususnya dalam mengoptimalkan layanan perpustakaan digital di universitas Islam. Penelitian ini mengeksplorasi peran digitalisasi dalam meningkatkan aksesibilitas informasi dan inklusi sosial, dengan fokus pada tantangan dan peluang dalam mengimplementasikan perpustakaan digital.

Tujuan: Tujuan utamanya adalah untuk menganalisis hambatan utama seperti keterbatasan infrastruktur, kesenjangan literasi digital, dan kendala kebijakan serta mengevaluasi integrasi Kecerdasan Buatan (*Artificial Intelligence/AI*) untuk meningkatkan pengalaman pengguna

Metode: Dengan menggunakan pendekatan studi literature review, data dikumpulkan melalui tinjauan literatur terpilih.

Temuan: Temuan menunjukkan bahwa alat bantu yang didukung AI, termasuk chatbots dan sistem rekomendasi, meningkatkan efisiensi layanan dan aksesibilitas bagi kelompok yang kurang beruntung, termasuk penyandang disabilitas dan mereka yang berasal dari kalangan berpenghasilan rendah. Selain itu, transformasi digital di perpustakaan mendorong keterlibatan akademis dan pembelajaran seumur hidup.

Simpulan: Studi ini menyimpulkan bahwa penguatan infrastruktur digital, penerapan kebijakan inklusif, dan

peningkatan kompetensi pustakawan dalam layanan berbasis AI sangat penting untuk mengoptimalkan fungsi perpustakaan. Kolaborasi antara pemerintah, universitas, dan masyarakat sangat penting untuk memastikan transformasi digital yang berkelanjutan dan adaptif dalam pendidikan tinggi Islam.

Kata Kunci: perpustakaan digital; kecerdasan buatan; inklusi sosial; teknologi 5.0; pendidikan tinggi islam

Introduction

Digital transformation has become a key element in the development of higher education, including in Islamic universities. The era of Technology 5.0 encourages academic institutions to adopt digital systems in order to improve the effectiveness of learning and information services. Libraries as knowledge centers play a strategic role in supporting inclusive digital education. Library digitization not only expands access to information, but also supports social inclusion, especially for vulnerable groups such as people with disabilities and students from economically disadvantaged families.(Hartono, 2017).

Islamic universities faces a number of challenges, such as limited infrastructure, uneven internet access, and digital systems. (Fadilah et al., 2023). The readiness of human resources, especially librarians and lecturers, is also a determining factor in the success of the transformation. (Sudaryanto & Hanny, 2023).

The advancement of artificial intelligence (AI) and human-centric technology opens up opportunities for libraries to improve service efficiency. Technologies such as chatbots, book recommendation systems, and user behavior analysis enable more personalized and faster services. (Sari et al., 2023). AI-based digital library is also adaptive to the needs of users, especially students.

Library digitization supports equality in education, as per Islamic principles, by providing more equitable access to academic resources. (Rifqi & Mardiyanto, 2020). At the same time continuous development in digital literacy for academic community is important to ensure access and utilization of digital contents (Wahidin, 2018). Transformation requires policy support and cross-sector collaboration-between universities, government, and the industry to ensure innovation sustainability.

This article aims to analyze strategies to optimize the role of Islamic university libraries in the era of Technology 5.0. The focus includes infrastructure challenges, human resource readiness, supporting policies, and the potential of AI in improving information services and social inclusion. This study is expected to contribute to the formulation of academic policies and best practices for inclusive and sustainable library digitization.

Method

This research uses a literature review approach to examine the optimization of the role of Islamic university libraries in the era of technology 5.0. This method was chosen because it allows in-depth exploration of relevant concepts, theories, and previous research results. Systematic literature review provides a strong foundation in developing a comprehensive understanding of the phenomenon under study, through synthesizing various credible academic sources (M. Ridwan et al., 2021).

The research began by formulating the main question related to how Islamic university libraries can optimize their role in supporting technology-based learning, research, and scientific development activities 5.0. The literature search process was conducted using leading academic databases, such as Scopus, Web of Science, Google Scholar, and national journal portals such as Garuda and Sinta. The inclusion criteria included articles that discussed the transformation of libraries in Islamic higher institutions, the development of technology 5.0 in higher education, and innovative strategies and policies in library management. Articles that were irrelevant or had

a limited scope of discussion were excluded from the analysis.

This research uses a systematic literature study method with a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol-based approach. The main objective was to trace and identify various academic literatures related to the role of Islamic university libraries in facing the Technology 5.0 era. Article searches were conducted in the following five scientific databases: Google Scholar, Scopus, ScienceDirect, Directory of Open Access Journals (DOAJ) and Garba Rujukan Digital (Garuda). The keywords used include: Islamic university library, library role, Library 5.0, technology adoption in libraries, digital transformation, Islamic higher education and library. The search was limited to articles published between 2015-2024 to ensure relevance to the Technology 5.0 era.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
English and Indonesian articles	Articles other than from scientific journals or conferences
Publish between 2015-2024	Articles that do not mention Islamic University libraries
Focus on university libraries	Duplication from other databases
Relevant with context of technology 5.0	Article not available in full-text

Source: literature review results, 2025

Table 2. Article Selection Process Table

Database	Article Found	Duplication	Retrieved	Reviewed
Google Scholar	62	10	34	20
Scopus	20	3	10	8
ScienceDirect	16	2	8	6
DOAJ	14	2	6	10
Garuda	27	4	14	10
Total	139	21	72	54

Source: literature review results, 2025

Data analysis was done thematically, where information from various literatures was grouped into main themes. The focus of the themes included digital library implementation, information access and social inclusion, integration of AI and technology 5.0, and strategies for optimizing services and management. The synthesis process was carried out by comparing findings from various studies to gain a broader and deeper understanding of the challenges and opportunities for optimizing the role of Islamic university libraries in the era of technology 5.0.

The validity of the research was through the use of reputable academic sources and the application of a systematic approach to literature selection and analysis. In addition, a source triangulation method was applied, comparing findings from different perspectives and contexts. This research also used a critical appraisal approach to assess the quality and relevance of the articles analyzed (Tod et al., 2022). The results of this literature synthesis are expected to make a significant contribution in understanding the strategy of strengthening the role of Islamic university libraries that are adaptive to the dynamics of the latest technology.

Result and Discussion

1) General Description

The study results show that library digitization in Islamic universities has a significant impact on information accessibility and social inclusion. The implementation of digital technology allows libraries to provide (AI)-based services, such as more accurate information retrieval systems, chatbots for reference services, and personalized book recommendation systems based on user preferences. This research also found that there are still constraints in technological infrastructure, especially in terms of limited internet access, library management systems that have not been integrated, and lack of adequate digital device support. (Noprianto, 2018).

The level of digital literacy of the academic community is a crucial factor in the effectiveness of digital library utilization. Students and lecturers are still facing difficulties in accessing and utilizing digital-based services due to limited understanding of the systems implemented (Adiyanto, 2021). Librarians are required to improve their competency in utilizing AI technology and technology-based library systems 5.0 in order to provide more optimal services. (Wijonarko, 2020).

This research recommends strengthening digital infrastructure with network upgrades and more sophisticated systems, developing inclusive services for vulnerable groups, and implementing policies that support digital transformation in Islamic universities. The involvement of various parties, including the government, universities and the academic community, is needed to ensure the sustainability of digital libraries that can be accessed by all equally. Through the right approach, digital libraries in Islamic universities can be a key pillar in supporting more inclusive and technology-based learning.

2) Implementation of Digital Library in Islamic Universities

In the era of Technology 5.0, digitization of library services is an absolute necessity, including in Islamic universities. This digital transformation aims to expand access to information, accelerate the search for reference sources, and reach a wider range of users. However, there are several challenges, especially related to infrastructure and human resource readiness.

Library digitization in Islamic universities is constrained by infrastructure limitations, including internet connections, outdated hardware, and non-integrated library management systems. As explained Sumiati (2023), low internet speed and unstable networks often hamper the process of searching for information and using online-based services.

According to R. Ridwan & Fajarini (2023), The lack of government and institutional support in providing adequate digital infrastructure is also a major obstacle. Many libraries still use systems that are not compatible with the latest technology, making it difficult to efficiently serve digital lending and AI-based reference. Lack of system integration with international academic platforms and databases creates an inconsistent and cumbersome user experience (Sabitha, 2024).

The solution to this problem is investment in high-speed internet, procurement of the latest technology tools, and development of cloud-based management systems. There needs to be synergy between the government, universities, and the private sector to create long-term and inclusive solutions.

The level of digital literacy of the academic community is an important factor in the successful implementation of digital libraries. Digital literacy includes not only the ability to use devices, but also the skills to critically evaluate and utilize digital information. Unfortunately, this level of literacy still varies between institutions and individuals (Andrianingsih & Mustika, 2022).

Students tend to adapt to digital technology faster than lecturers (Andina, 2019). This creates a gap in technology utilization, as lecturers still often rely on conventional methods and

are less familiar with digital systems. Institutions that have good digital literacy infrastructure and training tend to produce students and lecturers with higher digital skills (Jayanthi & Dinaseviani, 2022).

Improving digital literacy can be achieved through the integration of training in the curriculum, strengthening the capacity of lecturers, and developing AI-based digital learning and library systems. A systematic and sustainable digital literacy training program can improve the skills of students and lecturers in accessing and utilizing digital information more effectively (Arwien et al., 2024).

The transformation of digital libraries also requires an increase in librarian competence. It is not enough to manage physical collections, librarians must now master information technology, database management, digital management systems, and AI-based services (Tyas, 2023). Librarians also act as learning facilitators and information service innovators.

Some librarians do not have adequate technology skills. Librarians still face obstacles in adopting digital-based library systems (Sari et al., 2023). They need advanced training to understand user data analysis and AI utilization.

Satriani et al., (2021) also highlighted the importance of information literacy competencies for librarians, in order to guide users in evaluating the credibility of digital sources. While Harahap & Fitria (2020) revealed the importance of librarians' understanding of chatbot-based reference services and book recommendation systems supported by AI.

Solutions to improve librarian competence can be done through regular training, revision of the librarian education curriculum to be relevant to the digital era, and collaboration with technology institutions (Hapsari, 2019). Policy support is also needed so that librarians can become strategic actors in modern information services.

The role of institutions is crucial to the success of digital libraries. In addition to providing infrastructure and technology, institutions must also show commitment to policies that support open and inclusive access to information. As stated by Hartono (2017), the sustainability of digital library services is not only determined by the technology used, but also by the commitment of the institution.

Institutional support can include funding, training, human resource development, and integration of digital transformation policies in the university's strategic plan. Islamic universities need to position digital libraries as an important part of efforts to improve the quality of education, research and community service.

Table 3. Digital Library Implementation

Aspects	Key Issues	Solution or Strategy	Source
Digital Infrastructure	- Limited access to internet and digital devices - Unintegrated library management system - Platform fragmentation and lack of interoperability	- Investment in cloud-based technology and systems - Collaboration between government, universities, and private sector	Sumiati et al. (2023); R. Ridwan & Fajarini (2023); Susyanto (2022); Sabitha (2024)
Digital Literacy of the Academic Community	- Digital skills gap between lecturers and students - Not all universities have integrated digital literacy in the curriculum - Reliance on personal devices in 3T areas	- Integration of digital literacy training - Capacity building of lecturers - Strengthening access to digital resources	Andrianingsih & Mustika (2022); Andina (2019); Jayanthi & Dinaseviani (2022); Arwien et al. (2024); Rizkinaswara (2021)
Librarian	- Information technology	- Continuous training	Tyas (2023); Sari et al. (2023);

Aspects	Key Issues	Solution or Strategy	Source
Competencies	adoption gap - Low mastery of digital and AI systems - Lack of technology training	- Integration of digital literacy curriculum - Partnership with technology institutions	Satriani et al. (2021); Harahap & Fitria (2020); Hapsari (2019)
The Role of Institutions	- Lack of supporting policies and sustainable investment - Weak managerial role in library digital transformation	- Strengthening of digital regulations and policies - Empowerment of libraries as strategic partners of research and education	Hartono (2017)

Source: literature review results, 2025

3) Impact of Access to Information and Social Inclusion

Digital transformation has changed the role of libraries in Islamic higher institutions, from mere information providers to agents of social change that support social inclusion and equal access. By adopting digital library systems, access to information can now be done anytime and from anywhere through online platforms. This helps students from remote areas, people with disabilities, and those with economic limitations. Technologies such as AI, text-to-voice systems, and user-friendly interfaces have made library services more inclusive (Kurniasih & Saefullah, 2021).

In the era of Technology 5.0, libraries are not only information centers, but also digital collaborative spaces that transcend physical and geographical boundaries. This role expands the library's function as a space for cross-cultural learning and interaction (Triningsih, 2022). Digitalization not only increases academic productivity, but also shapes an academic ecosystem that is inclusive and socially just.

Digital accessibility is key so that all users, regardless of physical or economic condition, can utilize library services. Inclusive system design needs to consider assistive technologies such as screen readers for the visually impaired, alternative captions for images and videos, and voice-based interfaces (Panggabean & Hidayat, 2022).

Libraries can also provide collections in various formats such as e-books, audiobooks, and videos with subtitles, in order to reach users with diverse needs (Aisyahtul Husna, 2023). This development facilitates a more personalized and effective learning experience.

Regulations that require the implementation of international standards such as the Web Content Accessibility Guidelines (WCAG) are essential. The implementation of WCAG has been proven to increase user satisfaction, especially among people with disabilities (Windriyani, P., & Dirgantara, 2020). Challenges remain in rural areas and low-income communities, especially in terms of limited internet access and low digital literacy.

Collaboration between libraries, government and non-profit organizations is needed to build infrastructure and provide digital literacy training. Initiatives such as providing free Wi-Fi in public libraries have been shown to increase community engagement (Saputri & Khairani, 2021). Training librarians in accessibility services is strategic, and collaboration with social organizations such as Bookshare by Benetech is an ideal model as it provides more than one million books in accessible formats for the visually impaired and dyslexic (Turner, 2018).

Digital transformation brings new challenges for vulnerable groups such as people with disabilities, low-income communities, the elderly, and residents in remote areas (Wulansari Ayu, 2023). Access to technology devices and the internet is still a major obstacle. Low-income communities often do not have compatible devices or adequate internet access (Awailiyah et al., 2024)

Solutions include digital device subsidies, free hotspots, and device lending programs in libraries. Disability groups face major obstacles if digital platforms do not adopt WCAG

principles. Features such as automatic transcription, screen readers and voice-based interface design need to be widely implemented.

The elderly also need to be considered as they often experience difficulties in using technology. Special digital literacy training for the elderly, including the introduction of text magnification features and high contrast modes, can help them more confidently utilize digital library services (Darubekti et al., 2022).

Again, lack of librarians skilled in technology can be a barrier, especially in remote areas. Development of community-based libraries and partnerships with universities and NGOs can be an effective solution (Artina & Putri, 2023). The role of the government is vital through regulation, funding, and digital training, to avoid information exclusion (Widiyaningrum, 2020)

The main goal of digitization is equal access to information, but the fact is that there are still many groups that cannot optimally enjoy this service. The digital divide arises due to economic, geographic and social differences. Those who live in underdeveloped areas or have low economic backgrounds are particularly at risk of being left behind in the utilization of digital information.

As stated before, bridging the gap requires a holistic approach that includes strengthening digital infrastructure, developing human resource capacity, and continuous education. Only with an integrated and inclusive strategy can digital libraries truly become a fair and equitable public space for all.

Table 4. Impact of Access to Information and Social Inclusion

Aspect	Impact and Explanation	Source
Access to Information	Digitalization enables flexible access to academic resources from anywhere and at any time.	Kurniasih & Saefullah, 2021
Social Inclusion	Technology helps reach marginalized groups such as people with disabilities and remote communities.	Triningsih, 2022
Assistive Technology	The use of screen readers, alternative text, and disability-friendly design enhances the experience of users with special needs.	Panggabean & Ati, 2017
Inclusive Collection Formats	The provision of e-books, audiobooks and captioned videos supports diverse learning styles and user needs.	Aisyahtul Husna, 2023
Accessibility Standards	WCAG implementation promotes satisfaction and convenience for users with special needs.	Windriyani & Dirgantara, 2020
Government Policy	Free Wi-Fi and digital literacy training help bridge the digital divide in 3T (underdeveloped, frontier, outermost) areas.	Saputri & Khairani, 2021
Librarian Training	Librarian competence in accessibility services supports digital library inclusivity.	Listyaningrum, 2023
Organizational Cooperation	Collaboration with social inclusion organizations such as Bookshare extends the reach of services to vulnerable groups.	Turner, 2018
Vulnerable Groups - Disability	Access challenges as not all digital platforms comply with accessibility standards; need assistive features and trained librarians.	Wulansari Ayu, 2023
Vulnerable Groups - Elderly	Limited understanding of digital technology requires special literacy training programs for the elderly.	Darubekti et al., 2022
Vulnerable Groups - Poor & Remote Areas	Device and internet limitations exacerbate the digital divide; solutions include device lending and community-based libraries.	Awaliyah et al., 2024; Artina & Putri, 2023
Digital Divide	Economic and geographical differences are major barriers to equal access to digital libraries.	Widiyaningrum, 2020

Sources : literature review result, 2025

4) The role of AI and Technology 5.0

The development of digital technology has driven a significant transformation in library services, especially with the advent of AI and the concept of Society 5.0. Libraries are no longer just book repositories, but have evolved into more interactive and personalized information service centers. AI enables automation of services such as chatbot-based search, book recommendations based on preferences, and efficient smart catalogs (Wicaksono, Fikriansyah. & Rizka, 2019). Through the integration of humans and smart technology, Technology 5.0 creates flexible and inclusive library services.

The application of AI enriches the library experience through fast access to information, metadata management, archive digitization, and accessibility services such as text-to-speech and voice recognition (Taraya & Wibawa, 2022). One of the key innovations is the use of Natural Language Processing (NLP), which enables information retrieval with natural language without understanding Boolean logic (Atika & Sayekti, 2023). This can increase the accessibility of information sources for users.

An AI-based chatbot can be implemented as a real-time information consultant that assists with catalog navigation and answers administrative questions, making the service available 24 hours (Aliwijaya, 2023). The machine learning-based recommendation system can customize book suggestions with library patterns and interests, helping librarians make more accurate collection acquisition decisions.

AI also supports automatic classification, collection indexing, and service security with technologies such as facial recognition and AI sensors (Syahrul Gunawan Ramdhani & Enny Itje Sela, 2023). The technology also supports users with disabilities through accessibility features and automatic translation services (Syahruni, 2021).

Technology 5.0 emphasizes a human-centered approach while integrating innovations such as Internet of Things (IoT), Big Data, and cognitive computing. This creates a more personalized and responsive interaction between librarians and users (Wicaksono, Fikriansyah. & Rizka, 2019). The use of chatbots as virtual librarian assistants, as well as AI recommendation systems, helps to increase the relevance of library services (Atika & Sayekti, 2023).

IoT is also applied in reading room management and automatic access through facial recognition, while Big Data analysis helps librarians understand user behavior for data-driven service strategy development (Wang et al., 2023). Technologies like Virtual Reality (VR) and Augmented Reality (AR) even enable immersive digital learning experiences, such as 3D exploration of ancient manuscripts or virtual tours (Al-Alawi et al., 2023).

Improved efficiency and accuracy of information retrieval is a tangible result of the application of AI. NLP and machine learning enable more relevant and personalized search results. Semantic recognition technology accelerates contextual and in-depth searches (Amirullah, 2018), and automation features such as auto-complete and query suggestion simplify the search process (Rinartha, 2017). Challenges include digital literacy gaps and data privacy issues. Libraries need to provide training and maintain data security to optimize the benefits of technology for all users (Utkina, 2023).

Table 5. The role of AI and Technology 5.0

The role of AI	Explanation	Source
Information Chatbot & Virtual Assistant	AI enables chatbots as real-time information consultants that help navigate the catalog and answer questions 24 hours a day.	Aliwijaya (2023)
Personalized Book Recommendation	Machine learning is used to suggest collections based on user preferences and patterns, helping with collection acquisition.	Atika & Sayekti (2023)

The role of AI	Explanation	Source
Natural Language Processing (NLP)	NLP facilitates natural language searches without the need to understand Boolean logic.	Atika & Sayekti (2023)
Cataloging and Smart Search	AI improves search efficiency through features such as auto-complete, query suggestion, and semantic recognition.	Amirullah (2018); Rinartha (2017)
Digitization and Accessibility	AI supports archival digitization, text-to-speech, voice recognition, and automatic translation, helping users with disabilities.	Taraya & Wibawa (2022); Syahruni (2021)
Classification & Automatic Indexing	AI is used to automatically classify and index collections, speeding up information management.	Syahrul Gunawan Ramdhani & Enny Itje Sela (2023)
AI-Based Security	Facial recognition technology and AI sensors are used for reading room security and access management.	Syahrul Gunawan Ramdhani & Enny Itje Sela (2023)
Library Big Data Analytics	Big Data is analyzed to understand user behavior and design data-driven service strategies.	Wang et al. (2023)
Immersive Experience with AR/VR	AI is combined with AR/VR to create virtual tours and 3D digital collection exploration.	Al-Alawi et al. (2023)
Human-Centered Society 5.0 Services	The integration of technology and people in Society 5.0 creates personalized, flexible and inclusive library services.	Wicaksono, Fikriansyah, & Rizka (2019)
Challenges: Digital Literacy & Privacy	Digital literacy training and data protection are required to ensure that the benefits of AI are equitable.	Utkina (2023)

Source: literature review results, 2025

5) Optimization Strategy

An optimization strategy is a systematic approach to enhance efficiency and productivity of existing processes or systems. The transformation of libraries from physical repositories to digital information centers has led to the need for optimization strategies, especially in improving the efficiency of information search and access. One of the main challenges is to ensure that users can obtain information quickly, accurately and relevantly. AI technology provides a solution through the utilization of machine learning and natural language processing (NLP) that can understand the context, preferences, and relationships between search topics. This makes search results more precise and customized.

AI-based systems can recommend information based on a user's search history and interests, strengthening the efficiency of finding relevant literature. AI-powered chatbots and virtual assistants further enrich the user experience with automated reference services, without completely replacing the role of librarians. These services provide a more interactive and intuitive information retrieval experience in libraries.

As discussed before strengthening digital infrastructure is the main foundation for digital library development. The infrastructure includes a stable internet network, a cloud-based management system, and hardware and software compatible with the latest technology. According to Risparyanto (2022), a high-speed internet connection is essential for academic institutions with a large number of users and high data requirements. Investment in network strengthening, including fiber-optic procurement and increased bandwidth, is urgently needed.

Cloud-based library management systems are the main choice because they allow centralized management of digital collections and accessibility of information across locations. To strengthen the system Galih (2020) emphasized the importance of data security policies in cloud systems to protect library users' privacy from cyber threats.

The use of open-source software that is compatible across devices is also a solution to reduce operational costs. As Prianto (2022) said, open-source technology provides flexibility and

efficiency in system development according to the institution's needs.

AI also enhances digitization of physical collections through optical character recognition (OCR) technology, accelerating the conversion of printed archives into digital formats (Rismanto et al., 2020). In any system development today environmental sustainability must also be considered. This is where the use of green technology such as energy-efficient servers and environmentally friendly e-waste management is critical (Khromiak, 2022). The optimisation strategy also requires the development of relevant technical competencies among librarians.

The transformation of digital libraries requires supportive policies and regulations at various levels. Comprehensive regulations ensure infrastructure development, copyright protection, and inclusive access to information. Lusianai et al. (2021) mentioned the importance of open access regulations in expanding knowledge dissemination and enhancing academic collaboration.

In Indonesia, the policy on library digitization is regulated in Law No. 43 of 2007, which requires the development of ICT-based services. Some universities, such as the University of Indonesia, have internal policies such as the Digital Library Policy to ensure the sustainability of digital collection management.

Copyright issues are major concern among librarians, especially in the distribution of e-books and online journals. Sakila (2017) emphasized that open licenses such as Creative Commons can be a solution to provide broad access without violating Intellectual Property Rights (IPR). Collaboration between libraries, publishers and authors needs to be strengthened to support a fair digital lending model.

The protection of library data has become an urgency in the era of AI-based services. The General Data Protection Regulation (GDPR) policy in the European Union and Law No. 27 of 2022 in Indonesia are references for the protection of personal data in a digital environment.

Continuous funding is another vital aspect that determines the sustainability of digital transformation. Governments and educational institutions must allocate budgets for technology, librarian training, and procurement of digital collections. Marx & Owens (2015).mentioned that grant-based funding schemes such as the Institute of Museum and Library Services (IMLS) in the United States are examples of how the state supports digital library innovation.

One of the main objectives of digital library is information access or reach. Equality of access to those with disabilities, remote communities, and individuals with economic limitations. AI technology is able to support these special needs, such as the use of screen readers, text-to-speech, and digital sign language translation.

Universities in developed countries have provided collections in formats that support visually impaired and dyslexic users. In India, the Swayam Digital Library program has shown that digital collections in lightweight formats are helpful for users in internet-impaired areas (Seethal & Menaka, 2019).

It is important to ensure that collections reflect cultural and social diversity. Open access allows students from low economic backgrounds to still get quality references, minimizing the information gap due to cost barriers.

Table 6. Optimization Strategy

Optimization Strategy	Explanation	Source
Utilizing AI for Contextual Search and Recommendations	It uses machine learning and NLP technology to improve the relevance and accuracy of information search. The system is also able to recommend information based on search history and user preferences.	(Risparyanto, 2022)
Chatbot and Virtual Assistant Integration	AI-based chatbots provide interactive, automated reference services that help users get information without having to wait for a librarian, but do not replace the role of librarians completely.	(Galih, 2020)
Strengthening Digital Infrastructure	Building technological infrastructure such as stable internet network, cloud management system, and modern hardware/software as the main foundation of digital services. This	(Risparyanto, 2022)

Optimization Strategy	Explanation	Source
	infrastructure supports the transformation towards AI-based and fully digital services.	
Use of Open-Source Technology	Open-source software helps reduce operational costs and provides flexibility in developing systems that meet the needs of the institution.	(Prianto, 2022)
Collection Digitization through OCR and Green Technology	AI mendukung proses digitalisasi koleksi fisik menjadi arsip digital dengan OCR. Keberlanjutan juga diperhatikan melalui penggunaan server hemat energi dan pengelolaan limbah elektronik.	(Rismanto et al., 2020; Khromiak, 2022)
Implementation of Supporting Regulations	Regulations such as Law No. 43 of 2007 and Law No. 27 of 2022 support digitization and personal data protection. Open access regulations and copyright policies are also important for expanding access to digital information.	(Lusianai et al., 2021; Sakila, 2017)
Collaboration in Digital Lending Model	Collaboration between libraries, publishers, and authors is needed to support a fair and IPR-compliant digital lending system.	(Sakila, 2017)
Funding and Grant Schemes	Digital transformation requires adequate budget allocations, including from national and international institutional grants. Schemes such as IMLS in the US can be used as a model.	(Marx & Owens, 2015)
Development of AI-Based Inclusive Services	Services that support special needs such as text-to-speech, screen readers, and digital sign language. Reaching out to people with disabilities, remote communities, and access-restricted individuals.	(Seethal & Menaka, 2019)
Open Access and Diversity Representation	Collections should be socially and culturally inclusive and available in open formats to reduce the information literacy gap, especially for students with economic limitations.	(Seethal & Menaka, 2019)

Source: literature review results, 2025

6) Implications and Recommendations

Islamic university libraries face great challenges in dealing with digital transformation and the complexity of academic needs. Digitalization concerns not only infrastructure, but also service quality, ease of access, and suitability of collections to the needs of the academic community. This research identifies various challenges, such as limited infrastructure, low digital literacy of library users, and lack of librarian competence in information technology. The disparity between universities due to differences in funding availability also has an impact on access to digital resources.

Inclusive strategies based on library needs are needed, such as strengthening digital infrastructure, training librarians in the latest technology (AI, big data, technology 5.0), and implementing open access policies and partnerships with global platforms. The main goal is to ensure equal access to information for all academicians and students. Library digitization is also in line with 'maqashid sharia', supporting open access to classic and contemporary Islamic literature, without geographical or economic barriers. Strengthening the digital repository system is important to open wide access to Islamic literature through connectivity with global sources such as Al-Maktaba.

To ensure optimal utilization of digital resources students' digital literacy programmes needs to be integrated into the curriculum. To support the widespread and inclusive dissemination of research results, the protection of intellectual property rights must also be strengthened with the use of open licenses such as Creative Commons. The future direction of library development must transform into an interactive learning ecosystem that utilizes AI, IoT, AR, and VR. The smart library concept will create an immersive and adaptive learning experience. Libraries are also expected to become open access facilitators through institutional repositories and global partnerships.

Modern librarians need to be digital facilitators and data curators with competencies in research data management and information technology. Sustainability is also important through the development of energy-efficient green libraries. Stakeholder involvement is key to success. The government, universities, academic community, and technology industry need to work together in designing policies, supporting digital literacy, and strengthening infrastructure. Cross-sector collaboration will ensure that digital library transformation is inclusive and beneficial for the future of Islamic higher education.

Conclusion

Digital library transformation is a strategic step in facing technological developments and increasing information needs in the digital era. The application of artificial intelligence (AI), 5.0 technology, and data-driven systems has improved the efficiency of library services, from more accurate information searches to a more personalized user experience. The main challenges in library digitization still revolve around the digital divide, limited infrastructure, low digital literacy of the academic community, and the lack of librarian competence in adopting new technologies. Strengthening policies that support digital inclusion, increasing accessibility for vulnerable groups, and inter-stakeholder collaboration are key factors in ensuring the sustainability of digital libraries.

Libraries need to integrate more adaptive and human-centric technologies that not only facilitate access to information but also increase user engagement. Investments in librarian training and digital infrastructure upgrades should be prioritized to ensure that this transformation is optimized. Governments, universities, and academic communities have a crucial role to play in supporting the development of digital libraries through inclusive policies, funding, and strategic partnerships with technology industries. With a library-oriented approach and full support from various parties, digital libraries can develop into innovative, inclusive knowledge centers that are able to meet academic and social needs in a sustainable manner.

References

Adiyanto, W. (2021). Memahami Hambatan Dosen Dan Mahasiswa Dalam Perkuliahan Online : Fenomena Antisipasi Penyebaran Virus Covid-19. *Interaksi: Jurnal Ilmu Komunikasi*, *9*(2). https://doi.org/10.14710/interaksi.9.2.98-108

Aisyahtul Husna, N. (2023). Pengaruh Ketersediaan Koleksi Terhadap Kunjungan Pemustaka Di Perpustakaan Universitas Negeri Padang. *Educatioanl Journal*, *3*(2).

Al-Alawi, L., Al Shaqsi, J., Tarhini, A., & Al-Busaidi, A. S. (2023). Using machine learning to predict factors affecting academic performance: the case of college students on academic probation. *Education and Information Technologies*, *28*(10), 12407–12432. https://doi.org/10.1007/s10639-023-11700-0

Aliwijaya, A. & H. C. S. (2023). Peluang Implementasi Artificial Intelligence di Perpustakaan: Kajian Literatur. *Info Bibliotheca: Jurnal Perpustakaan Dan Ilmu Informasi*, *4*(2).

Amirullah, D. (2018). Sistem Pencarian Semantik Impresi dengan Mekanisme Pembobotan Kombinasi Fitur Warna dan Fitur Bentuk. *INOVTEK Polbeng - Seri Informatika*, *3*(1). https://doi.org/10.35314/isi.v3i1.332

Andina, E. (2019). Strategi Dosen dalam Pengondisian Perilaku Membaca Mahasiswa di Era Digital: Studi Kasus di Kalimantan Barat dan Sulawesi Selatan. *Aspirasi: Jurnal Masalah-Masalah Sosial*, *8*(2). https://doi.org/10.46807/aspirasi.v8i2.1265

Andrianingsih, R., & Mustika, D. (2022). Pemanfaatan Internet sebagai Sumber Belajar Siswa di Kelas Rendah Sekolah Dasar. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(6), 6164–6172. https://doi.org/10.31004/obsesi.v6i6.3388

Artina, M., & Putri, S. L. (2023). Pengaruh Kualitas Website dan Pengetahuan Pengguna Terhadap Kepuasan Pengguna Perpustakaan Digital Desa Jati Belarik. *Jurnal Ekonomi Dan Bisnis Dharma Andalas*, *25*(2). https://doi.org/10.47233/jebd.v25i2.884

Arwien, R. T., Wirawan, Z., Veryani, A. N., Sahabuddin, E., Muriati, S., & Sari, J. (2024). Pelatihan Literasi Digital dalam Mendukung Sustainable Development Berwawasan Lingkungan Hidup. *Malebbi: Jurnal Pengabdian Kepada Masyarakat*, *2*(1).

Atika, M., & Sayekti, R. (2023). Studi Literatur Review Sistem Informasi Perpustakaan Berbasis Artificial Intelligence (AI). *Palimpsest: Jurnal Ilmu Informasi Dan Perpustakaan*, *14*(1). https://doi.org/10.20473/pjil.v14i1.46405

Awailiyah, C., Oktaviana, D., & Herlambang, Y. T. (2024). Tantangan dan Peluang Teknologi dalam Dinamika Kehidupan di Era Teknologi. *UPGRADE : Jurnal Pendidikan Teknologi Informasi*, *1*(2). https://doi.org/10.30812/upgrade.v1i2.3729

Darubekti, N., Syaifullah, S., & ... (2022). Peningkatan Literasi Media dan Informasi pada Lansia melalui Pengembangan Perpustakaan Desa Berbasis Inklusi Sosial. *... Nasional Lppm Ummat*, *1*.

Fadilah, N., Ikhwan, A., & Alda, M. (2023). Pengembangan Sistem Informasi Perpustakaan Pada Dinas Perpustakaan dan Kearsipan Kota Medan Berbasis Android. *J-SISKO TECH (Jurnal Teknologi Sistem Informasi Dan Sistem Komputer TGD)*, *6*(2). https://doi.org/10.53513/jsk.v6i2.8228

Galih, A. P. (2020). Keamanan Informasi (Information Security) Pada Aplikasi Perpustakaan IPusnas. *AL Maktabah*, *5*(1). https://doi.org/10.29300/mkt.v5i1.3086

Hapsari, D. (2019). Tantangan Dan Kompetensi Pustakawan Di Era Digital. *Jurnal Pustaka Ilmiah*, *1*(1). https://doi.org/10.20961/jpi.v1i1.33108

Harahap, D. W., & Fitria, L. (2020). Aplikasi Chatbot Berbasis Web Menggunakan Metode Dialogflow. *J-ICOM - Jurnal Informatika Dan Teknologi Komputer*, *1*(1). https://doi.org/10.33059/j-icom.v1i1.2796

Hartono, H. (2017). Strategi Pengembangan Perpustakaan Digital Dalam Membangun Aksesibilitas Informasi: Sebuah Kajian Teoritis pada Perpustakaan Perguruan Tinggi Islam di Indonesia. *UNILIB : Jurnal Perpustakaan*, *8*(1). https://doi.org/10.20885/unilib.vol8.iss1.art7

Jayanthi, R., & Dinaseviani, A. (2022). Kesenjangan Digital dan Solusi yang Diterapkan di Indonesia Selama Pandemi COVID-19. *JURNAL IPTEKKOM Jurnal Ilmu Pengetahuan & Teknologi Informasi*, *24*(2). https://doi.org/10.17933/iptekkom.24.2.2022.187-200

Khromiak, Y. (2022). Implementation of green technologies in the library. *Integrated Communications*, *3*. https://doi.org/10.28925/2524-2644.2020.1.15

Kurniasih, R. I., & Saefullah, R. S. (2021). Inklusi Sosial Sebagai Transformasi Layanan di Perpustakaan Daerah Karanganyar. *Lentera Pustaka: Jurnal Kajian Ilmu Perpustakaan, Informasi Dan Kearsipan*, *7*(2). https://doi.org/10.14710/lenpust.v7i2.34599

Lusianai, W. O., Susilawaty, F. T., Jaya, A., Herman, L. O., & Ibrahim, C. (2021). Tingkat Literasi Informasi Dalam Akses Layanan E-Book Dan E-Journal Pada Mahasiswa FISIP UHO. *Jurnal Ilmu Komunikasi UHO : Jurnal Penelitian Kajian Ilmu Komunikasi Dan Informasi*, *6*(3). https://doi.org/10.52423/jikuho.v6i3.19593

Marx, M., & Owens, T. (2015). The National Digital Platform for Libraries and Museums. *American Libraries*, *46*.

Noprianto, E. (2018). Tantangan dalam Mewujudkan Perpustakaan Digital. *Pustakaloka*, *10*(1). https://doi.org/10.21154/pustakaloka.v10i1.1212

Panggabean, D., & Hidayat, D. (2022). Integrasi Teknologi Pembelajaran dalam Aktivitas Belajar dan Mengajar. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *5*(11), 5020–5024. https://doi.org/10.54371/jiip.v5i11.1061

Prianto, J. S. (2022). Membangun Perpustakaan Digital UII. *Buletin Perpustakaan*, *5*(2).

Ridwan, M., AM, S., Ulum, B., & Muhammad, F. (2021). Pentingnya Penerapan Literature Review pada Penelitian Ilmiah. *Jurnal Masohi*, *2*(1). https://doi.org/10.36339/jmas.v2i1.427

Ridwan, R., & Fajarini, R. A. (2023). Strategi Pengembangan Perpustakaan Perguruan Tinggi Di Era Digital (Studi Upt Perpustakaan UIN MATARAM). *Shaut Al-Maktabah : Jurnal Perpustakaan, Arsip Dan Dokumentasi*, *15*(2). https://doi.org/10.37108/shaut.v15i2.1172

Rifqi, A. N., & Mardiyanto, V. (2020). Implementasi Kebijakan dan Proses Pengembangan Koleksi Digital Perpustakaan Perguruan Tinggi Vokasi (Studi Kasus Perpustakaan Politeknik Negeri Malang). *Tik Ilmeu : Jurnal Ilmu Perpustakaan Dan Informasi*, *4*(2). https://doi.org/10.29240/tik.v4i2.1896

Rinartha, K. (2017). Simple Query Suggestion Untuk Pencarian Artikel Menggunakan Jaccard Similarity. *Jurnal Ilmiah Rekayasa Dan Manajemen Sistem Informasi*, *3*(1).

Rismanto, R., Prasetyo, A., & Irawati, D. A. (2020). Optimalisasi Image Thresholding pada Optical Character Recognition Pada Sistem Digitalisasi dan Pencarian Dokumen. *PETIR*, *13*(1). https://doi.org/10.33322/petir.v13i1.659

Risparyanto, A. (2022). Desain Infrastruktur Perpustakaan Digital. *Buletin Perpustakaan Universitas Islam Indonesia*, *5*(2).

Sabitha, A. Y. (2024). Transformasi Digital Dalam Manajemen Perpustakaan: Fokus Pada Pengembangan Sistem, Keamanan Data, Dan Peminjaman Buku Di Sd Muhammadiyah Gresik. *Multidisiplin Saintek*, *02*(https://ejournal.warunayama.org/index.php/kohesi/issue/view/164).

Sakila, F. (2017). Perlindungan Hak Atas Kekayaan Intelektual Pada Kemas Ulang Informasi Di Perpustakaan PDII-LIPI. *Journal of Documentation and Information Science*, *1*(1). https://doi.org/10.33505/jodis.v1i1.24

Saputri, E., & Khairani, S. (2021). Peran Pemerintah dalam Meningkatkan Minat Baca melaui Pojok Baca Digital (POCADI) di Kota Lhokseumawe, Aceh. *JIPKA: Jurnal Informasi, Perpusatakaan, Dan Kearsipan*, *Vol. 1*(1).

Sari, K. P., Masruri, A., & Rosalia, D. R. (2023). Optimalisasi Temu Kembali Informasi Dengan Teknologi Kecerdasan Buatan di Perpustakaan. *JIPI (Jurnal Ilmu Perpustakaan Dan Informasi)*, *8*(2). https://doi.org/10.30829/jipi.v8i2.17775

Satriani, S., Iskandar, I., Ahmad, L. O. I., & Haruddin, H. (2021). Peran Pstakawan UPT Perpustakaan dalam Mendukung Iklim Riset di Universitas Islam Negeri Alauddin Makassar. *Literatify : Trends in Library Developments*, *2*(2). https://doi.org/10.24252/literatify.v2i2.24971

Seethal, K., & Menaka, B. (2019). Digitalisation Of Education In 21 ST Century: A Boon Or Bane. *8th International Conference on Digital Outreach Adn Future of Management Practices*.

Sudaryanto, A. P., & Hanny, S. (2023). Manajemen Sumber Daya Manusia Sektor Publik Menghadapi Kemajuan Kecerdasan Buatan (Artificial Intelligence). *Musamus Journal of Public Administration*, *6*(1). https://doi.org/10.35724/mjpa.v6i1.5402

Sumiati, S., Suparman, S., & Supriyadi, S. (2023). Pengaruh Perpustakaan Digital Terhadap Peningkatan Kunjungan Dan Minat Baca Siswa Sma NEGERI 1 PLAMPANG. *Jurnal Ilmiah Mandala Education*, *9*(1). https://doi.org/10.58258/jime.v9i1.4375

Syahrul Gunawan Ramdhani, & Enny Itje Sela. (2023). Implementasi Face Recognition Untuk Sistem Presensi Universitas Menggunakan Convolutional Neural Network. *Indonesian Journal of Computer Science*, *12*(6). https://doi.org/10.33022/ijcs.v12i6.3498

Syahruni. (2021). Strategi Pelayanan Publik Bagi Penyandang Disabilitas Di Kantor Dinas Kependudukan Dan Pencatatan Sipil Kabupaten TAKALAR. *Frontiers in Neuroscience*, *14*(1).

Taraya, P. C., & Wibawa, A. P. (2022). Mewujudkan Society 5.0 Melalui Pemanfaatan Teknologi Kecerdasan Buatan. *Jurnal Inovasi Teknik Dan Edukasi Teknologi*, *2*(8).

Tod, D., Booth, A., & Smith, B. (2022). Critical appraisal. *International Review of Sport and Exercise Psychology*, *15*(1). https://doi.org/10.1080/1750984X.2021.1952471

Triningsih, C. E. (2022). Profesionalisme Pustakawan Dalam Membangun Layanan Informasi di

Era Society 5.0. *Indonesian Journal Of Library and Information Science*, *3*.

Turner, B. (2018). Benetech global literacy services: Working towards a 'born accessible' world. *Learned Publishing*, *31*(1). https://doi.org/10.1002/leap.1141

Tyas, Z. W. (2023). Transformasi Peran Pustakawan Dalam Mengelola Koleksi Digital Di Perpustakaan Kabupaten Bandung. *Jurnal Pustaka Budaya*, *10*(1), 10–20. https://doi.org/10.31849/pb.v10i1.11257

Utkina, M. (2023). Leveraging Blockchain Technology for Enhancing Financial Monitoring: Main Challenges and Opportunities. *European Journal of Interdisciplinary Studies*, *15*(2). https://doi.org/10.24818/ejis.2023.21

Wahidin, U. (2018). Implementasi Literasi Media Dalam Proses Pembelajaran Pendidikan Agama Islam Dan Budi Pekerti. *Edukasi Islami : Jurnal Pendidikan Islam*, *7*(02). https://doi.org/10.30868/ei.v7i2.284

Wang, T., Ma, Y., Wang, Z., Wu, X., & Li, L. (2023). User Behavior Analysis Based on Big Data and Artificial Intelligence. *Frontiers in Artificial Intelligence and Applications*, *373*. https://doi.org/10.3233/FAIA230881

Wicaksono, Fikriansyah., M., & Rizka, F. (2019). Penerapan konsep visitor experience dalam upaya mewujudkan perpustakaan digital di Era Society 5.0. *BIBLIOTIKA : Jurnal Kajian Perpustakaan Dan Informasi*, *3*(2).

Widiyaningrum, W. Y. (2020). Pengaruh Implementasi Kebijakan Peraturan Daerah Nomor 9 Tahun 2016 Tentang Penyelenggaraan Perpustakaan Oleh Dinas Arsip Dan Perpustakaan Terhadap Peningkatan Pelayanan Perpustakaan Di Kabupaten Bandung. *JISIPOL| Jurnal Ilmu Sosial Dan Ilmu …*, *4*(1).

Wijonarko, W. (2020). How To Improve Librarians Professionality In Era O F Society 5.0? *Indonesian Journal of Librarianship*. https://doi.org/10.33701/ijolib.v1i1.1050

Windriyani, P., & Dirgantara, H. B. (2020). Kajian Aksesibilitas Web Di Lingkungan Kalbis Institute Menggunakan Pedoman Wcag 2.0 Untuk Penilaian Webometrics. *Komputer Dan Informatika*, *15*.

Wulansari Ayu, W. B. R. M. (2023). Transformasi Perpustakaan: Peran Teknologi Digital Dalam Pengembangan Layanan Interlibrary Loan (Studi Kasus Smp Muhammadiyah Kabupaten Ponorogo). *SELAPARANG: Jurnal Pengabdian Masyarakat Berkemajuan*, *7*(4), 2595–2600.