

Adapting to new technologies: A systematic literature review of blockchain implementation in academic libraries

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Martin Elihaki Kanyika 

World History, Historiography and Source Studies, Al-Farabi Kazakh National University, Kazakhstan

Raikhana Sadykova

World History, Historiography and Source Studies, Al-Farabi Kazakh National University, Kazakhstan

Kalima Tuenbaeva

World History, Historiography and Source Studies, Al-Farabi Kazakh National University, Kazakhstan

Lucilla Chuwa

Computer Science, The Institute of Finance Management, Tanzania

Abstract

Blockchain technology (BT), despite being relatively new, is gaining significant attention in academic libraries owing to its unique features. This study aims to justify why academic libraries should adopt BT for certain sensitive functions over existing technologies or systems. The study utilized the SALSA framework and adhered to PRISMA criteria to systematically review literature on the implementation of BT in academic libraries. Six authoritative databases namely Scopus, Web of Science, ResearchGate, Refseek, Google Scholar, and Crossref were employed. Initially, 71 articles were retrieved from these databases. After removing duplicates and unrelated articles, 27 were included for synthesis. The findings indicate that most articles were authored by scholars in Asia and Africa, highlighting a significant interest in adopting new technologies in libraries among researchers in developing countries despite facing challenges such as limited skilled staff, financial constraints, and inadequate technological infrastructure compared to developed countries. The findings reveal a steady increase in the number of published articles on BT each year, with a significant contribution from authoritative publishers. The study also highlights the many benefits BT can bring to academic libraries, such as enhancing data security, increasing transparency, fostering collaboration both within and between libraries, and facilitating technological innovation and access control. The study concludes that BT holds great potential for academic libraries, offering benefits that surpass existing systems and significantly improving service delivery. As a result, the study strongly recommends adopting BT in academic libraries to enhance efficiency and effectiveness. For successful implementation, it is essential to provide comprehensive training to library staff on how to apply BT within the library context, as this is a relatively new concept in the education sector, particularly for libraries. Furthermore, library management should ensure a supportive infrastructure, including sufficient budget allocation, to cover the costs associated with the adoption and utilization of BT.

Keywords

Blockchain technology, academic libraries, systematic literature review, implementation, adoption of blockchain

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Introduction

In nearly all sectors, technology is rapidly advancing and revolutionizing service delivery. The adoption

Corresponding author:

Martin Elihaki Kanyika, Al-Farabi Kazakh National University, Al-Farabi Avenue 71, Almaty 050040, Kazakhstan.

Email: kanyikam87@gmail.com

of technology not only enhances service delivery but also increases efficiency and effectiveness (Mian et al., 2020). The education sector among others is notably proactive in implementing and utilizing emerging technologies. For example, academic libraries have undergone significant transformations due to technological advancements. Today, many academic libraries are evolving from digital to smart libraries, leveraging technology to improve service delivery and reduce human interactions (Ojo and Tope, 2024; Kanyika et al., 2024b). In developed countries for instance, many academic libraries are already using robots, with others in the process of adopting them. Many academic libraries, both in developed and developing countries, have adopted numerous new technologies and systems. However, despite the benefits these technologies bring in facilitating access to and dissemination of information, many of the systems currently in use have been reported as inefficient, lacking transparency, insecure, and not cost-effective (Ogbara and Okwu, 2023). For instance, library management systems (LMS) used for record-keeping in academic libraries, whether open-source or commercial, are often not highly secure, leaving them vulnerable to data loss due to catastrophes or sabotage (Coghill, 2018).

Moreover, current systems in academic libraries do not allow for selective purchase of specific chapters from e-resources like e-books. Instead, users are forced to pay for the entire e-book, leading to unnecessary budget expenditure (Chingath and Babu, 2020). It is clearly that academic libraries store valuable and sometimes confidential information in their systems, but these systems are prone to hacking, with hackers sometimes altering or deleting stored data. This highlights the security vulnerabilities in many of the systems currently used in academic libraries (Kelner et al., 2022; Kuo et al., 2017). Besides, despite adopting various systems to streamline access to information, some library operations, such as interlibrary loans, remain time-consuming due to the involvement of intermediaries, discouraging users from utilizing this important service. To address these weaknesses and improve the systems used in academic libraries, it is crucial for libraries to adopt and implement the latest technologies known as blockchain. Although relatively new to the academic sector, blockchain has the potential to resolve many of the challenges associated with the current systems (Jha, 2023).

Blockchain is defined as a decentralized technology that records transactions across multiple computers,

ensuring transparency, security and immutability (Aste et al., 2017; Bhaskar et al., 2021; Sicilia and Visvizi, 2018). It is a decentralized database that utilizes independent nodes to store and retrieve data, ensuring that no single entity controls the data or the network (LaFountain, 2021). According to Zayyad (2022), blockchain is a series of transaction records organized into blocks that represent sections of a ledger or register. This ledger is shared among peers who trust it as a secure and reliable authority for verifying the validity of records. The term “blockchain” comes from the way each block in the ledger is linked to the subsequent block, creating a chain of interconnected records. Similar to any technology, blockchain has evolved through several stages. Blockchain 1.0 focused on digital payment systems like crypto currencies. Blockchain 2.0 expanded to include economic markets such as stocks, bonds, shares, and smart contracts. Blockchain 3.0 encompasses a broader range of applications beyond the financial sector, including education, e-governance, digital health records, digital voting, science, literacy, culture, and digital art (Kushwaha and Singh, 2020; Swan, 2015). While blockchain 1.0 and 2.0 has proven successful in sectors such as economics and finance, Blockchain 3.0 is also seen as beneficial for the education sector, particularly academic libraries, as it addresses some challenges that previous technologies could not resolve (Hoy, 2017).

Despite being new to the academic sector, blockchain has gained the attention of librarians and information specialists in both developed and developing countries. Some academic libraries, particularly in developed countries, have already begun implementing it (Jha, 2023). Given its unique features, blockchain has the potential to address many of the weaknesses present in current library technologies and systems. For example, its decentralized and transparent nature can streamline the interlibrary loan process by allowing libraries to create a peer-to-peer network, enabling direct transactions between institutions without intermediaries. Smart contracts can further automate the loan process, allowing all parties to agree upon terms and conditions, thereby speeding up the process and reducing costs (Rosario Vasantha Kumar and Sunil Raja, 2023). In terms of privacy and security, blockchain provides solutions through cryptographic algorithms and consensus mechanisms. With blockchain, libraries can be confident that their sensitive data is secure, as any attempt to alter or delete data would require modifying

the entire blockchain, which is nearly impossible without detection (Mojjada, 2023; Verma, 2021). For academic libraries to fully benefit from blockchain technology, librarians must be knowledgeable and understand how it outperforms the current systems and technologies in use. This awareness will allow them to leverage blockchain's advantages effectively.

The implementation and utilization of blockchain technology in libraries is a new concept, resulting in limited studies in this area (Guustaaf et al., 2021; Khan et al., 2021; Rani et al., 2020). Existing studies primarily address the benefits of BT for libraries, potential implementation areas, and the challenges involved. To the best of our knowledge, there is no retrievable study that provides a justification or explaining what extra benefits that BT is providing over the existing technologies or systems used in the libraries. This study aims to fill this gap by demonstrating why BT is a superior fit for academic libraries and should be adopted over existing technologies or systems. In fulfilling this, the study adopts the Technology, Organization, and Environment Theory (TOE) to provide a justification of this argument. This is because the decision to adopt new technology depends on how users and organizations perceive its usefulness and ease of use compared to existing technologies.

Research question

To effectively address the problem under study, it was essential to design research question that would guide the findings toward a specific goal and provide a clearer focus for the study. As noted by Guyatt et al. (2008), well-crafted questions help to filter the research results and draw relevant conclusions from the literature selected for this systematic literature review (SLR). Therefore, the main research question was divided into one specific question (Q1) to guide different aspects of the study and maintain a focused investigation. Table 1 presents the research question formulated for this SLR, along with the purpose.

Theoretical framework

In providing justifications on the adoption of blockchain technology, this study utilizes the Technology, Organization, and Environment (TOE) framework.

Technology, organization, and environment theory (TOE). The model, as shown in Figure 1, consists of

Table 1. Research questions and their purposes.

General research question	Specific question	Purpose of the question
In what ways does blockchain technology performs better than the existing technologies or systems used in the academic libraries?	Q1: What are the benefits of using blockchain technology in academic libraries?	To understand how blockchain technology outperforms other systems, it is essential to examine its benefits in library service delivery

Source: Author's creation.

three components: technology, organization, and environment. It posits that the decision to adopt a new technology depends on several factors. Firstly, the characteristics of the technology itself, including its complexity, functionality, and compatibility with existing systems, are crucial. Secondly, the internal context of the organization, such as its size, available resources, culture, and structural setup, influences the adoption decision. Lastly, external factors, including social and cultural norms, prevailing market conditions, and regulatory requirements, are considered within the broader environmental context.

The study operationalizes that academic libraries might decide to adopt BT if users (librarians) perceive it as more useful and effective than existing technologies and that employing it will enhance performance. Additionally, if librarians find blockchain easy to use and capable of simplifying information delivery tasks, they are likely to develop positive attitudes and intentions toward its use. On the other hand, apart from librarians, the management might also decide to adopt BT if they determine it performs better than the existing technologies or systems, is user-friendly, and is compatible with existing systems. They might also consider the technology's appropriateness for the organization's size, the availability of resources (such as financial support), and its alignment with the organization's culture and structure. Furthermore, market demand may also influence management's decision to adopt BT.

Methodology

A systematic literature review approach

This study utilized the SALSA (Search, Appraisal, Synthesis, and Analysis) framework and adhered to the

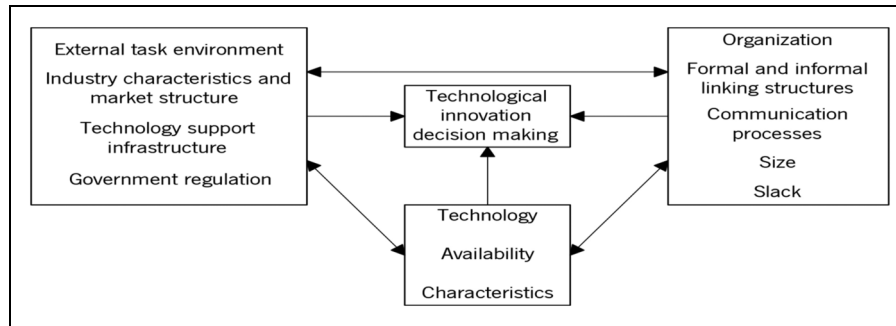


Figure 1. Technology, organization, and environment theory. Source: Tornatzky et al. (1990).

Table 2. SALSA framework for the systematic literature search and review.

Stage	Description
Search	Key actions: Keywords identification; search data sources Study scope: Limited to studies focused on the implementation and utilization of blockchain technology in libraries. This restriction provides critical insights, enabling a thorough appraisal and synthesis of the phenomena underpinning the study
Appraisal	Key actions: Studies selection through the PRISMA approach
Synthesis	Key actions: Data extraction and categorical organization
Analysis	Key actions: Data analysis, findings comparison and conclusion

Source: Amo et al. (2018).

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) criteria to systematically review the literature on the implementation of BT in academic libraries. According to Grant and Booth (2009) and Amo et al. (2018), the SALSA framework effectively identifies and evaluates literature, reducing subjectivity and enhancing accuracy. Table 2 illustrates how the SALSA framework was applied for the systematic literature search and review.

Meanwhile, the PRISMA statement ensures the study's accuracy and generalizability (Page et al., 2021). The PRISMA statement guided the compilation of information necessary for generating a comprehensive meta-analysis and systematic review report. In this study, the PRISMA framework provides a checklist that guides researchers through the process of identifying relevant materials, screening, determining eligibility, and selecting studies for inclusion in a literature review synthesis.

Search strategies

This SLR followed the PRISMA guidelines for selecting relevant articles, with the search conducted across six authoritative databases namely; Scopus, Web of Science, ResearchGate, Refseek, Google Scholar, and Crossref. The final search was completed on June 16, 2024. In addition, a backward citation tracking method was used to identify further relevant studies. According to Hirt et al. (2020), backward citation is the oldest and famous form of citation analysis, aimed at identifying all references cited in a single article. This approach was applied to examine the references within each article, aiding in the selection of articles for possible inclusion in the study. Therefore, it helps the researchers for easy identification of the related articles that were not easily retrieved using the normal search. The search employed a combination of key terms such as “implementation,” OR “utilization,” AND “blockchain technology,” AND “academic libraries,” and was conducted within each database, targeting articles containing these terms in their title or abstract. The publication period was set from January 2017 to June 2024, as the first article discussing the potential use of BT in libraries was published in 2017 (Hoy, 2017). Despite searching multiple databases, only a limited number of relevant articles were identified.

Inclusion and exclusion criteria

Articles relevant to the topic under study, published between January 1, 2017, and June 16, 2024 (with June 16, 2024, being the date of the final search), were reviewed. The inclusion criteria required that the terms “implementation,” OR “utilization,” AND “blockchain technology,” AND “academic libraries” appear in the title or abstract, and that the articles be published in scientific and peer-reviewed journals.

Table 3. Inclusion and exclusion criteria for article selection.

Criterion	Inclusion	Exclusion
Language	Articles written in English	Articles written in other languages apart from English
Article content	Articles that discuss the possible use of blockchain technology specifically in the libraries in any way	Articles that discuss the possible use of blockchain technology in education in general and other areas
Article type	Peer-reviewed academic articles	Non-academic articles such as newspapers, internet websites, magazines, etc.
Year of publication	From January, 01 2017 to June 16, 2024	Articles outside the time frame

Source: Author's creation.

To qualify for inclusion in this SLR, an article had to specifically discuss the potential use of BT in libraries. Articles addressing BT in other fields and in education in general were excluded from the study but were used as background references. The exclusion criteria eliminated preprints, non-English articles, and non-research-based publications. Table 3 summarizes the inclusion and exclusion criteria for the articles in this study.

Analysis process

In this study, the analysis was conducted based on the specific research question, using both content analysis and Microsoft Excel. All articles included for analysis were coded manually to streamline the review process, utilizing Creswell's coding technique. According to Creswell (2012), coding involves three stages: **Open coding:** In this initial stage, the researcher analyzes the data and generates codes to describe and categorize it. **Axial coding:** In the second stage, the researcher examines the relationships and connections between the codes generated during open coding. **Selective coding:** In the final stage, the researcher identifies the core category or central phenomenon that emerges from the data.

During open coding, codes were assigned to pieces of data without relying on predominant frameworks.

This means, words like “implementation”, “blockchain in the libraries” were given codes to simplify the process of analysis. After coding the first 10 articles, all assigned codes were reviewed and grouped by similarity to reduce redundancy, as part of the axial coding stage. The preliminary list of codes was then used to analyze the remaining articles, with any new codes added to the list as they emerged. Specific quotes were identified to further support the codes. Finally, in the selective coding stage, similar codes were organized into categories. Exemplary quotes that clearly illustrated each category were identified to enhance the consistency of classification. Multiple reviews of the data were performed to maintain consistency in coding.

Data extraction

A tabular approach was employed to summarize each eligible study. Data extraction, as shown in Table S4, includes information such as authors' names, article titles, publication years, authors' countries, journal names, and publisher names. This method was used to compile a summary from the 27 reviewed articles.

Results and interpretation

General description of the literature

Figure 2 illustrates the entire process of selecting articles for inclusion and exclusion in this study. A total of 71 articles were initially retrieved from the chosen databases. After removing duplicates, 52 records remained for screening. Many records were found to be outside the scope of this review. After thoroughly reviewing the titles, abstracts, and publication sources of the unique records, 30 full-text articles were assessed for eligibility. Of these, three articles were excluded: (1) two articles that were not related to blockchain technology in academic libraries, and (2) one article that was a conference proceeding. Some of the excluded articles were used as background citations. In the end, 27 articles were selected for synthesis. The list of included articles is provided in a separate sheet in the Supplementary materials.

Geographical distribution of authors of the articles

As previously mentioned, the implementation and utilization of BT in libraries is a new concept, therefore, researchers sought it is important to analyze the geographical distribution of the authors who wrote

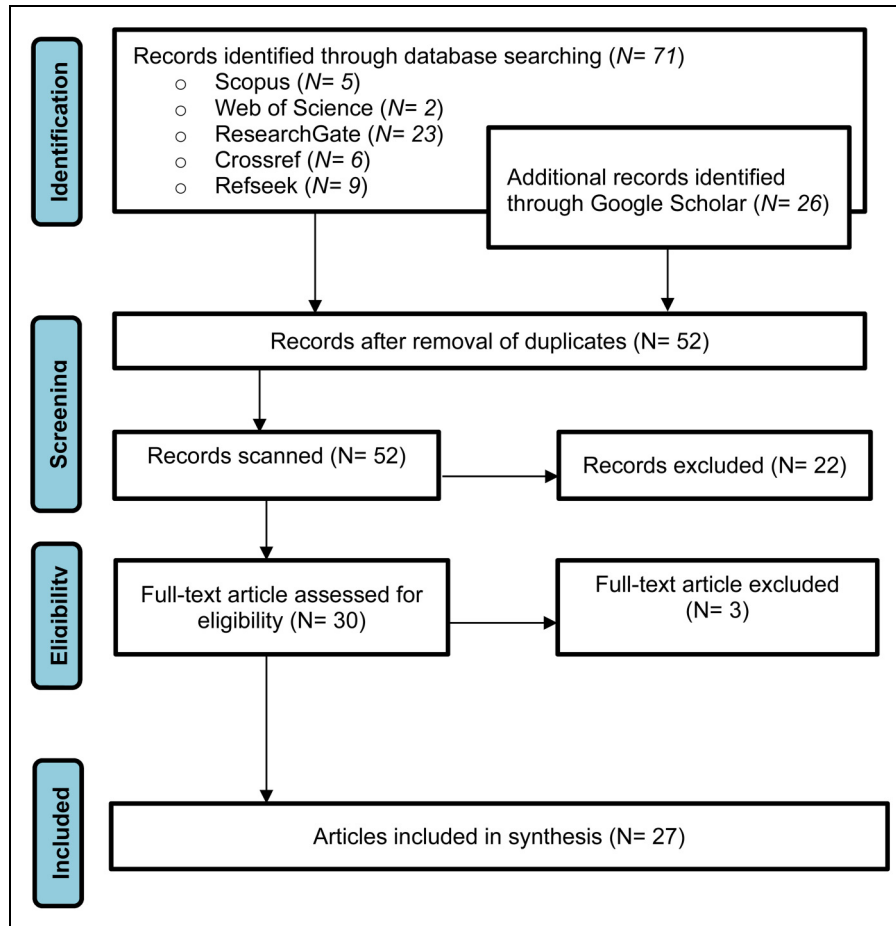


Figure 2. PRISMA flow diagram of article selection. Source: Page et al. (2021).

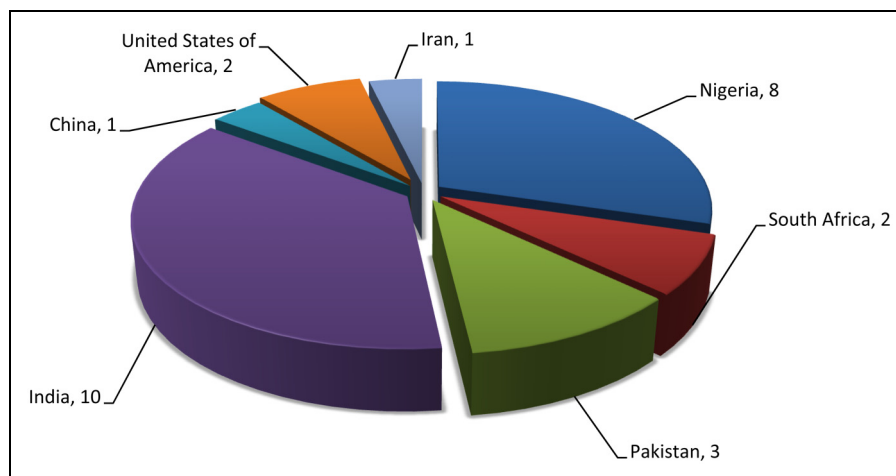


Figure 3. Geographical distribution of authors of the articles. Source: MS Excel output.

studies related to BT in libraries. The findings, as shown in Figure 3, reveal that the majority of authors are from India (10) and Nigeria (8), followed by

Pakistan (3), South Africa (2), and the United States of America (2). A smaller number of articles were authored by individuals from China (1) and Iran (1).

Table 4. Distribution of articles by publishers.

Publisher	Frequency	Percentage
Emerald	7	26%
Sage	1	4%
IGI Global	3	11%
Taylor & Francis	1	4%
Springer	1	4%
De Gruyter	1	4%
Universities (Nnamdi Azikiwe University, and University of Nebraska-Lincoln)	2	7%
Others (Information Today Inc., Elsevier Inc., NK Publishing, Information Practitioners Network, ACITS, SICSIT, and IAEME)	7	26%
Unrecognized	4	14%
Total	27	100%

Source: Author's creation.

As shown in Figure 3, the majority of articles reviewed were authored by researchers from Asia (India) and Africa (Nigeria). These findings indicate that, despite the newness of BT in the academic sector, researchers from developing countries are particularly interested in exploring its potential applications in libraries. Historically, developed countries have led the adoption of new technologies, and most studies on any new technologies typically originate from authors in these regions (Ojo and Tope, 2024). Therefore, it was anticipated that most authors of articles on BT would be from developed countries. This expectation was based on the fact that several academic libraries in Western countries have begun implementing and utilizing BT (Jha, 2023), supported by their greater financial resources and more skilled personnel compared to developing countries.

Distribution of articles by publishers

The study aimed to analyze the distribution of articles based on their publishers. Findings show that, a significant portion of the articles (7; 26%) were published by Emerald. Notably, 4 (14%) articles were found to be published by unrecognized publishers. Table 4 summarizes these findings.

The findings, as presented in Table 4, indicate that most of the articles included in the analysis were published in authoritative and reputable journals, with a significant presence of well-known and trusted publishers. Emerald accounted for 26% of the publications, followed by IGI Global (11%), and Sage, Taylor & Francis, Springer, and De Gruyter (each contributing 4%). Additionally, a considerable portion of articles were published in trusted publishers, like Elsevier Inc., and

universities like University of Nebraska-Lincoln (26%, and 7% respectively). This suggests that the findings of the articles included in this study are trustworthy. However, 14% of the articles were published in journals with unknown publishers. While the majority of the journals were from reputable publishers, the presence of unrecognized publishers raises some concerns, as predatory journals known for lacking academic rigor may compromise the credibility of their findings.

Distribution of articles by years of publication

The study aimed to analyze the year-wise publication of articles. The results indicate that 2023 had the highest number of publications (14; 52%) related to the implementation and utilization of BT in libraries. This was followed by 2021, with 5 articles (19%), and both 2022 and 2024, with 3 articles each (11%). Notably, there were no articles published in 2017, 2018, or 2019 that focused on the implementation and utilization of BT in libraries. Figure 4 illustrates the findings.

As illustrated in Figure 4, the study's findings indicate that the implementation and utilization of BT in libraries is still an emerging concept. However, it is gradually gaining the attention of researchers, as evidenced by the increasing number of publications over time. In the first three years analyzed, no articles were published on this direction. However, from 2020 to 2024, researchers began publishing articles on the implementation and use of blockchain in libraries, with 2023 seeing with the highest number (52%) of publications compared to other years. Since the final search was conducted in June, it is anticipated that by the end of 2024, more articles will be published,

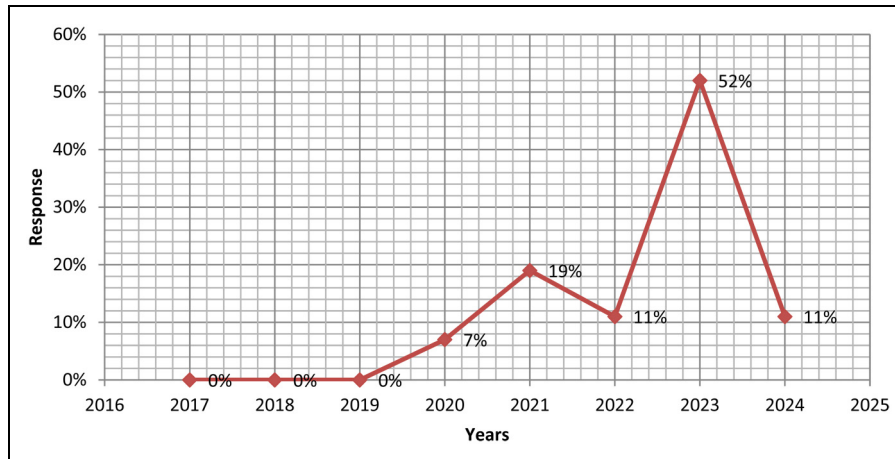


Figure 4. Distribution of articles by years of publication. Source: MS Excel output.

as this topic is attracting increasing interest from the research community. This trend is further supported by the fact that many academic libraries are transitioning to smart libraries, which encourages the adoption of innovative technologies like blockchain (Kanyika et al., 2024a; Kanyika and Sadykova, 2024).

Benefits of blockchain technology in libraries

Although blockchain is a relatively new concept in the academic sector, awareness of its potential among academics is growing rapidly (Jha, 2023). Academic libraries as the heart of academic institutions, are increasingly interested in adopting BT. These libraries perform numerous functions and employ various technologies or systems to enhance service delivery for their users. However, BT has the potential to significantly improve service delivery in several areas compared to many existing technologies or systems currently used in academic libraries. The benefits of BT as observed in Table 5 (becomes Table 6) are interpreted according to different categories based on a thematic analysis.

As shown in Table 5, the implementation of BT in libraries could bring numerous positive impacts, significantly enhancing the efficiency and effectiveness of information delivery. Security concerns are paramount in the digital environment, and blockchain provides users with robust protection for their personal information (Akintunde and Amuda, 2023; Jha, 2023). Shahzad et al. (2024) highlight that blockchain enhances user privacy by concealing identities within the chain, preventing users from identifying each other. This technology allows users to securely

access information from multiple libraries while maintaining privacy (Paganelli and Paganelli, 2021; Shahmirzadi and Khorasanchi, 2023).

Moreover, BT enhances data security due to its immutable and distributed nature, making it difficult for transactions or records to be altered, duplicated, or falsified (Suman and Patel, 2021). This immutability ensures that the integrity of preserved information in the library is protected (Rosario Vasantha Kumar and Sunil Raja, 2023). The decentralized nature of blockchain also makes it harder for any unauthorized changes to go unnoticed (Kaur et al., 2023; Manoj and Patil, 2024; Mojjada, 2023; Ojo and Tope, 2024; Safdar et al., 2023). Blockchain also enhances transparency (Lengoatha and Seymour, 2020) and facilitates effective records management by ensuring that library data is available 24/7 with complete transparency. This accessibility and transparency benefit both library users and staff (Kauri et al., 2023; LaFountain, 2021; Panda and Kaur, 2023; Tamilselvan, 2024; Verma, 2021).

More so, BT facilitates innovation and enhances access control in libraries. For instance, library staff can use digital currencies to pay vendors and publishers, mitigating the impact of currency fluctuations and helping libraries stay within budget (Dada and Mohammed, 2023; Manoj and Patil, 2024; Ojobor, 2023). Moreover, blockchain improves access control by preventing unauthorized access and asserting ownership over original digital works (Chingath and Babu, 2020; Oyelude, 2019), ensuring more secure and efficient management of digital resources.

Blockchain technology significantly enhances resource sharing between libraries (Mojjada, 2023).

Table 5. Benefits of blockchain technology in libraries.

Aspect	Description of the Benefits of BT	Representative Benefit	Other Representative Support
Increases security, transparency, and efficiency	Users Privacy	BT provides library users with robust security for their personal information (Akintunde and Amuda, 2023).	Jha (2023); Shahzad et al. (2024); Bashir and Warraich (2023); Paganelli and Paganelli (2021); Shahmirzadi and Khorasanchi (2023)
	Data Security	BT is immutable and distributed, making it difficult for transactions in the libraries to be changed, duplicated, or faked (Suman and Patel, 2021).	Ojo and Tope (2024); Safdar et al. (2023); Kaur et al. (2023); Rosario Vasantha Kumar and Sunil Raj (2023); Manoj and Patil(2024); Mojada (2023); Oyelude (2019); Panda and Kaur (2023); Verma (2021); Tamilselvan (2024)
	Transparency	BT record transactions and digital interactions in a transparent, secure, resilient, efficient and traceable way across untrusted parties (Lengoatha and Seymour, 2020).	LaFountain (2021); Ojo and Tope (2024); Safdar et al. (2023); Kaur et al. (2023); Mojada (2023); Panda and Kaur (2023); Verma (2021); Tamilselvan (2024)
Technological innovation and access control	Information management	BT can be used for transferring funds from libraries to vendors and maintaining contracts and records. Also, it can be applied for the audit purpose of the libraries (Dada and Mohammed, 2023).	Safdar et al. (2023); Manoj and Patil (2024); Ojobor (2023)
	Control access of content	It is used by some institutions for collection management, offering native protection against data tampering, for decentralized digital identity solutions, and in academic publishing, and also could be used in museums as a means of asserting ownership over an original digital work (Oyelude, 2019)	Tamilselvan (2024); Rosario Vasantha Kumar and Sunil Raj (2023); Chingath and Babu (2020)
Easy collaboration	Resources sharing between library and library	BT facilitates efficient resource sharing among libraries (Mojada, 2023)	Rosario Vasantha Kumar and Sunil Raj (2023); LaFountain (2021)
	Resources sharing within library	BT helps in preserving and sharing authoritative information, preventing copyright issues and digital peer- to- peer sharing (Chingath and Babu, 2020)	Ojobor et al. (2022); Jha (2023); Khan et al. (2021); Shahzad et al. (2024); Bashir and Warraich (2023); Shahmirzadi and Khorasanchi (2023)
Enhance circulation	Circulation control	It facilitates effective circulation control in the university libraries (Obim et al., 2023)	Ogbara and Okwu (2023); Tella et al. (2022)

Source: Author's creation.

Traditional interlibrary loans, though useful, can often be complex and time-consuming due to the involvement of intermediaries. Blockchain simplifies this process by eliminating intermediaries, allowing users to borrow resources directly from other users

without the need to return them to the library, thus streamlining and improving the service (LaFountain, 2021; Rosario Vasantha Kumar and Sunil Raja, 2023). Additionally, it facilitates resource sharing and service provision in digital libraries (Khan et al.,

2021) while fostering better collaboration between library users and staff (Shahzad et al., 2024). Blockchain technology also improves the sharing of authoritative information both within and across libraries (Chingath and Babu, 2020).

Another benefit of BT is its ability to enhance circulation control in university libraries (Obim et al., 2023). It assists libraries and archives by enabling the storage of information in distributed environments, facilitating the collection, preservation, and sharing of authoritative data. This technology supports librarians in creating unique, verifiable records that can be accessed by anyone in the libraries (Tella et al., 2022). Moreover, blockchain plays a significant role in improving various library services, including collection development, circulation services, research, and data management and storage (Ogbara and Okwu, 2023).

Discussion

In today's world, one of the common challenges academic libraries face is the threat of malware and hacker attacks on digital resources. Sensitive information can be altered or deleted by fraudsters, raising concerns about the authenticity and integrity of digital collections (Oyelude, 2019). However, blockchain's immutable nature can help address this issue. By adopting BT, academic libraries can create an immutable record for the entire lifecycle of digital collections, including acquisition, preservation, and access. This ensures secure and transparent record-keeping, preventing fraudsters from hacking the system or tampering with data (Lengoatha and Seymour, 2020; Mojada, 2023; Safdar et al., 2023; Shahmirzadi and Khorasanchi, 2023). The blockchain record typically includes information related to creators, copyright holders, timestamps, and any modifications made to the asset. This information can then be provided to users, ensuring transparency and building trust in the authenticity of the digital collections (Dada and Mohammed, 2023; Hussaini et al., 2022; Irving and Holden, 2016; Manoj, 2024; Ojo and Tope, 2024; Rosario Vasantha Kumar and Sunil Raja, 2023; Verma, 2021).

Most academic libraries face budgetary issues, though some receive annual budgets from their parent institutions for purchasing books and subscribing to databases. However, a common challenge is currency fluctuation. When the value of the US dollar rises significantly against the local currency,

these libraries struggle to spend their budget effectively. This can prevent them from meeting their targets as their budget's value decreases relative to their needs. Committed to providing new knowledge to users, academic libraries may overspend or reallocate funds from other areas to cover the shortfall to be able to purchase books and subscribing to databases. Consequently, they often experience budget instability. Blockchain technology has the potential to address challenges related to currency fluctuation and exchange. By using blockchain-based cryptocurrencies like Bitcoin, academic libraries can manage transactions with publishers and subscription payments more efficiently. Digital payments through Bitcoin remove intermediaries, thereby avoiding high commission and processing fees typically charged by banks. This approach not only mitigates issues of currency exchange and fluctuation but also saves time, as blockchain transactions are generally completed in less than three days, compared to the standard processing time offered by banks (Dada and Mohammed, 2023; Iskandar, 2017; LaFountain, 2021).

Moreover, academic libraries worldwide are increasingly relying on interlibrary loans due to budget constraints. These financial limitations make it challenging for libraries to purchase all the necessary titles for their users. Interlibrary loan is a cooperative effort between libraries to share their collections. However, the process involves multiple intermediaries and manual paperwork, making it bureaucratic and time-consuming (Rosario Vasantha Kumar and Sunil Raja, 2023). Library users often face delays of several days to receive the required materials due to the lengthy process involved in completing the transactions between the libraries in the network. Blockchain technology has the potential to streamline and simplify interlibrary loans by removing intermediaries. It provides a transparent and decentralized platform for resource sharing. Libraries participating in this peer-to-peer network can use smart contracts to adhere to agreed terms and conditions, allowing direct transactions between libraries without intermediaries (Shahzad et al., 2024). With Libchain, a Distributed Library Management System based on BT, a library user can lend an item directly to another user online without first returning it to the library (Oyelude, 2019; Suman and Patel, 2021). In this system, librarians from both libraries only receive notifications about the process, which is not feasible with current academic library systems.

While this process may seem complex and time-consuming, BT makes it easy, efficient, fast, and secure (Obim et al., 2023).

Researchers in academic institutions generate valuable information for their peers daily. However, some of this information such as lab reports, grey literature, and test reports does not meet the criteria for publication as articles or books (Suman and Patel, 2021). Although some academic libraries store this information in institutional repositories, it often lacks visibility and remains underutilized by the global scholarly community (Kanyika and Sadykova, 2023). Adopting BT can address this issue by providing a platform for publishing this useful information. Research institutions can utilize blockchain to publish grey literature, lab reports, and test reports that do not qualify for formal journal publication. Authors can independently publish their work on these networks, ensuring that other scholars can access and use the information for their research without concerns about data integrity or digital rights. Since blockchain records cannot be altered or deleted, the data remains secure and trustworthy (Bashir and Warraich, 2023; Oluchi Emmanuel et al., 2023; Sanjay and Hasan, 2020).

Libraries, publishers, and publishing houses continue to face significant challenges related to digital resources, primarily due to their reproducible nature. Dishonest scholars sometimes modify and claim others' works as their own. To combat duplication and academic dishonesty, publishers have employed a special key known as the draconian key to prevent copying. However, this method often conflicts with Digital Rights Management (DRM) tools used in libraries, posing further challenges (Dada and Mohammed, 2023). Blockchain technology offers a potential solution by creating unique and verifiable records. Integrating blockchain with digital resources can help prevent plagiarism, as it allows for unique identification, control, and transfer of digital assets (Griffey, 2016; Hoy, 2017; Kushwaha and Singh, 2020; Tamilselvan, 2024). This integration would assure libraries, publishers, and publishing houses that piracy and copyright issues are addressed and that no unauthorized copies or duplications occur (Akintunde and Amuda, 2023; Jha, 2023; Ojobor, 2023; Ojobor et al., 2022; Panda and Kaur, 2023).

Recently, many academic libraries have transitioned to digital formats. However, with the continuous emergence of new technologies, both developed and developing countries are now adopting smart

libraries that enable self-service for users. Despite this advancement, academic libraries face numerous challenges in intelligent sharing services, such as complex interactions, ensuring user privacy, high-speed data transmission, and managing large volumes of data. Blockchain technology can address these challenges with its features like decentralization, stable timing, reliable data relationships, and consensus mechanisms. It enhances security by preventing data tampering through its proof-of-work and consensus mechanisms. Being inherently tamper-proof, blockchain stores information on distributed nodes, aligning well with core library functions such as acquiring, storing, and sharing authoritative information (Liu, 2019). As academic libraries evolve into smart libraries, blockchain can play a crucial role in providing personalized services to users (Kaur et al., 2023). This technology can support the shift from traditional service delivery to a personalized, intelligent service model. It can create a credible data link for resource circulation, establish a platform for communication and learning between libraries and readers, and ultimately focus library services on meeting readers' needs (Ogbara and Okwu, 2023; Paganelli and Paganelli, 2021).

Various scholars write e-books to share their knowledge with the public. Since these scholars invest significant energy, time, and resources into preparing these e-books, they understandably seek financial benefits from their work. However, due to intermediaries, libraries and individuals often have to pay for complete packages even when they don't need the entire content, resulting in unnecessarily high fees. Moreover, the authors lose some control over their work (Suman and Patel, 2021). This challenge can be addressed through BT. Blockchain adoption eliminates intermediaries, allowing authors to create smart contracts with their own terms and conditions for the usage of their e-books. These smart contracts can be implemented on platforms like Ethereum (Kawaguchi et al., 2019). With such platforms, upon the author's approval, libraries or users can lend, borrow, and purchase e-books without limits or excessive fees through book tokens (Chingath and Babu, 2020; DECENT, 2016). Furthermore, blockchain supports platforms like Publica and Scenarex, which enable anyone to publish e-books (Tella et al., 2022). On platforms like Publica, a crowd funding application allows authors to pre-sell tokens, enabling them to start benefiting financially from their scholarly works early by raising funds to cover writing and

publication costs (Dada and Mohammed, 2023; Suman and Patel, 2021).

Figure 5 summarizes the challenges that face the existing systems in libraries and illustrates how BT can address these issues by offering effective solutions.

Practical and theoretical implications

This study offers both theoretical and practical implications. Theoretically, it contributes to the limited body of literature on BT in the library context. By raising awareness and providing a comprehensive understanding, the study informs librarians, library management, and policymakers in academic institutions about the potential applications of blockchain to enhance the efficiency and effectiveness of service delivery. Practically, the study provides strong justification for why academic libraries should adopt BT to address challenges that current systems cannot resolve. It highlights the limitations of existing technologies in academic libraries and demonstrates how the implementation of blockchain can overcome these challenges, ultimately improving the efficiency and effectiveness of service delivery.

Conclusion

Blockchain, like any emerging technology, is in the process of gaining traction within the academic sector, especially in academic libraries. Scholars are actively exploring how BT can be applied to enhance service delivery in these libraries. However, awareness of blockchain's potential among academic libraries remains limited, which may lead to hesitation in its adoption. According to the Technology, Organization, and Environment (TOE) Theory utilized in this study, librarians and managements are likely to adopt new technologies like blockchain based on their perceived usefulness and ease of use compared to existing systems.

Academic libraries are increasingly transitioning from traditional service delivery methods to modern approaches, relying heavily on various systems and technologies to meet user needs. While these systems offer significant benefits, such as streamlining service delivery, many also face challenges, including issues with transparency, security, efficiency, and cost-effectiveness. Although these technologies are

crucial for enhancing service delivery, it is essential to implement solutions that address these challenges. In this context, BT emerges as an ideal solution, either replacing or complementing existing systems to improve efficiency while overcoming their limitations.

This SLR provides a comprehensive understanding of BT by examining various studies that discuss the benefits of implementing and utilizing it in the libraries. In the context of libraries, BT offers numerous advantages, including enhanced security. It ensures robust protection for users' personal information and, due to its immutable and distributed nature, makes it difficult for transactions to be altered or deleted. More importantly, blockchain records transactions and digital interactions in a transparent, secure, resilient, efficient, and traceable manner, even across untrusted parties. Blockchain technology also enhance technological innovation and access control, as it can be applied in various library functions, such as transferring funds to vendors and managing contracts and records. Its native protection against data tampering supports decentralized digital identity solutions and plays a role in academic publishing. Additionally, it could be used in libraries to assert ownership over original digital works. Furthermore, blockchain enhances collaboration by promoting efficient resource sharing among libraries and sharing authoritative information, helping to prevent copyright issues and facilitating peer-to-peer digital sharing.

This study not only highlights the potential benefits of blockchain for academic libraries but also provides a detailed analysis of how it can improve information delivery compared to current technologies. The findings suggest that BT not only increases the efficiency and effectiveness of service delivery but also addresses challenges faced by existing systems, particularly in enhancing security. Due to blockchain's immutable nature, libraries can ensure that sensitive data remains highly secure, as altering or deleting information would require changes to the entire blockchain, an almost impossible task without detection. The study also reveals that blockchain can mitigate issues related to currency fluctuations. Blockchain-based crypto-currencies, like Bitcoin, offer academic libraries a more efficient way to manage transactions with publishers and handle subscription payments. Additionally, the decentralized and transparent nature of blockchain can streamline interlibrary loans by creating a peer-to-peer network

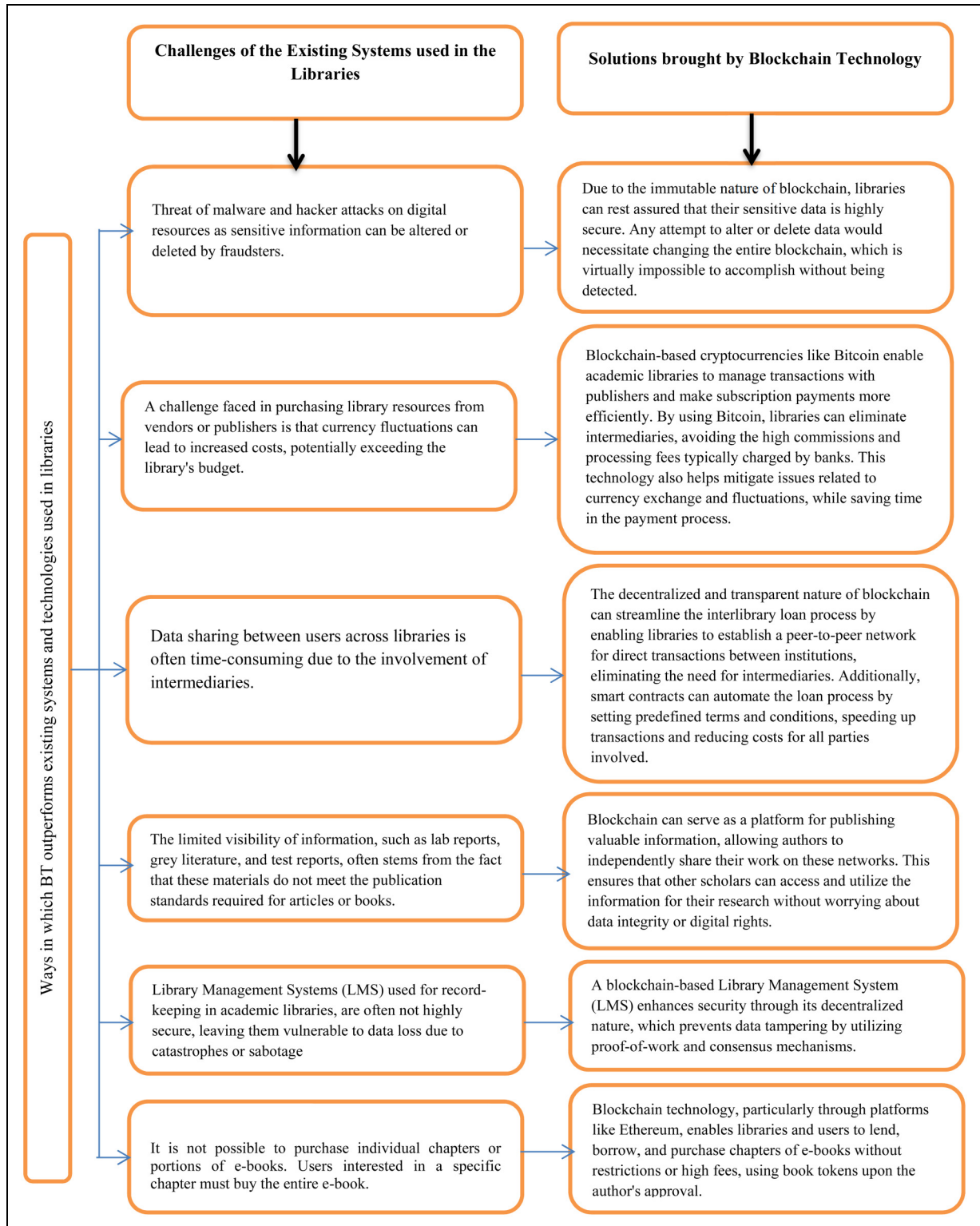


Figure 5. Ways in which blockchain technology outperforms existing systems. Source: Author's creation.

for direct transactions between institutions, eliminating the need for intermediaries. Furthermore, a blockchain-based Library Management System

(LMS) enhances security through its decentralized structure, preventing data tampering by using proof-of-work and consensus mechanisms.

Limitation of the study

This SLR is limited to academic peer-reviewed articles, which may have contributed to the relatively small number of retrieved studies. Future research should broaden the inclusion criteria to include non-peer-reviewed articles, such as preprints, to gain a more comprehensive understanding of BT in the library context. Also, this study only utilized six authoritative databases for article retrieval, which may have further limited the number of relevant studies. Future studies should aim to incorporate a wider range of databases to access a broader spectrum of articles discussing the potential applications of BT in academic libraries. As BT is still a relatively new concept for both librarians and researchers, even the awareness of this concept is still limited. Therefore, to gain a more extensive and in-depth understanding of this topic, future SLR studies should expand their inclusion criteria and database coverage to capture a greater variety of perspectives and research on the subject.

Recommendations

The study's findings highlight the strengths of BT in enhancing service delivery in academic libraries while addressing the challenges that face existing systems. Based on these findings, the study strongly recommends the adoption of BT in academic libraries to improve efficiency and effectiveness. This can be achieved by either replacing some of the current systems or integrating blockchain with them. For successful implementation, library staff must receive comprehensive training on how to utilize blockchain in a library setting, as this technology is still new to the education sector, particularly in libraries. Additionally, library management should ensure a supportive infrastructure, including adequate budget allocation, to cover the costs associated with the implementation and use of BT. This will provide the necessary foundation for libraries to adopt blockchain effectively.


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ORCID iD

Martin Kanyika  <https://orcid.org/0000-0002-1187-4040>

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About the authors

Martin Elihaki Kanyika is an Assistant Lecturer at the Eastern Africa Statistical Training Center in Dar es Salaam, Tanzania. He holds a BA (Hons) and MA in Information Studies from the University of Dar es Salaam. Currently, he is pursuing a PhD at Al-Farabi Kazakh National University in Kazakhstan, with a focus on Library Information Systems. His research interests include innovative technologies in libraries, open access, institutional repositories, digital literacy, and digitization.

Raikhana Sadykova is an Associate Professor at the Faculty of History of Al-Farabi Kazakh National University. She graduated from the Faculty of International Relations of Al-Farabi Kazakh National University. She defended her candidate degree dissertation and currently works with PhD degree (candidate). Her research areas: the history and development of library sciences, contemporary

problems and actual issues of world history. She has more than 100 publications in Kazakh, Russian, English and Turkish.

Kalima Tuenbaeva is a Professor at the Faculty of History of Al-Farabi Kazakh National University. She holds a MSc and PhD in Library Information Systems from the Al-Farabi Kazakh National University. Her research areas of interest include the history and development of library sciences, and application of digital technologies in libraries.

She has several publications related to information and library science in Kazakh, Russian, English and Turkish languages.

Lucilla Chuwa is an Assistant Lecturer at the Institute of Finance Management in Dar es Salaam, Tanzania. He holds a BS and MS in Computer Science from the Periyar University. Her research interests include information systems, data science, and artificial intelligence.

Digital literacy competencies among students in higher learning institutions in Kazakhstan

Global
Knowledge,
Memory and
Communication

Martin Elihaki Kanyika, Raikhan Sadykova and Zhansaya Kosmyrza
*Department of World History, Historiography and Source Studies,
Al-Farabi Kazakh National University, Almaty, Kazakhstan*

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Abstract

Purpose – This study aims to assess the digital literacy competencies among students in higher learning institutions in Kazakhstan.

Design/methodology/approach – A survey design was used. Simple random sampling was used to draw sample. Primary data were collected using Web/online questionnaires (Google Form). A total of 370 online questionnaires were disseminated to the respondents to their email addresses. Quantitative data collected were analyzed using MS Excel 2010. Thus, descriptive statistics were computed and the results were further presented in tables, charts and figures.

Findings – Results reveal that students are very competent in using digital technologies to communicate and share their educational digital contents, whereas they indicate moderate competence and incompetence in other essential digital literacy skills crucial for their academic pursuits. Furthermore, this study revealed that students frequently use digital technologies for educational purposes, with statistical analysis [$t(381) = 4.562$, $p < 0.00001$, two-tailed] indicating a significant difference between the extent and purpose of their digital usage. Moreover, findings identified health issues, technical issues and the constantly changing of hardware and software as primary challenges faced students when engaging with digital technologies.

Originality/value – This study is new in the context of Kazakhstan analyzing the digital literacy competencies among students, with a particular focus on elucidating the five fundamental facets of such competencies. This study therefore, recommends the implementation of comprehensive and consistent training programs aimed at imparting necessary digital literacy skills to students.

Keywords E-learning, Digital literacy, Digital technology, Kazakhstan, Technological tools

Paper type Research paper

1. Introduction

E-learning has emerged as a pivotal method of education, significantly broadening learning horizons for students worldwide. By definition, e-learning is an online educational platform that takes place in a formal setting and leverages various multimedia technologies. This system is supported by electronic hardware and software, functioning either offline or online (Al Rawashdeh *et al.*, 2021). Generally, it is learning facilitated by digital technologies. Its flexibility enables learners to access education anytime, anywhere and at their own pace. This transformative impact has made education more accessible and affordable, revolutionizing traditional learning paradigms (Ayu, 2020; Al Rawashdeh *et al.*, 2021). The surge in e-learning's popularity is evident, with its rapid acceptance and widespread adoption by education ministries globally. It is increasingly recognized as the logical next step in education delivery, both in developed and developing countries (Sparks *et al.*, 2016; UNESCO, 2020). Moreover, the advantages of e-learning extend far beyond mere convenience. It addresses challenges such as the scarcity of teachers, limited physical



infrastructure and the dispersion of students, thus effectively overcoming traditional barriers to education (Debes, 2021; Stecula and Wolniak, 2022; Akhter *et al.*, 2021).

However, Urakova *et al.* (2023) emphasized the crucial need for both lecturers and students to possess specific information and communication technologies (ICTs) skills and proficiency for the successful implementation of e-learning programs. In an e-learning setting, the utilization of ICTs becomes paramount, significantly influencing the learning process. Consequently, digital literacy is essential for both lecturers and students (Santos and Serpa, 2017; Maphosa and Bhebhe, 2019). Furthermore, the COVID-19 pandemic accelerated the adoption of e-learning globally, compelling educators and learners to engage online using various technological tools (Rahman *et al.*, 2020), thereby posing additional challenges to the education system.

Higher learning institutions in developing countries are increasingly embracing digital literacy, recognizing the growing prevalence of e-learning as a significant trend (Daya, 2020; Rahman *et al.*, 2020). As defined by the European Commission (2018), digital literacy encompasses the skills necessary for effective learning, living and working within a digital environment. Rodríguez-Torres *et al.* (2018a,b) further describing digital literacy as the ability to use digital technologies for information discovery, evaluation, creation and communication, requiring a blend of mental acuity and technical adeptness. Echoing this sentiment, Walsh *et al.* (2022) characterized digital literacy as the personal competency in using ICTs to navigate, comprehend, assess, generate and convey digital information. Consequently, digital literacy assumes paramount importance in facilitating e-learning initiatives, given its inherent reliance on technology (Krishnamurthy and Lartha, 2019). Moreover, digital literacy yields numerous benefits, fostering creativity, nurturing curiosity and empowering individuals to critically assess the information they encounter (Gutierrez-Angel, *et al.*, 2022).

Moreover, digital technologies have become indispensable in fostering education within e-learning environments for both lecturers and students (Urakova *et al.*, 2023). In this paper, digital technologies can be defined as the technological innovations such as artificial intelligence, virtual reality, smart devices, augmented reality, block chain, Internet of Things (IoT) and other software applications that help to facilitate learning (Gaol and Prasolova-Förland, 2021; OECD, 2021). The realm of digital technology encompasses a broad spectrum of ICTs (Van de Oudeweetering and Voogt, 2018; Fuentes *et al.*, 2019). Yet, to effectively harness the wealth of technological resources, proficiency in digital literacy is imperative (Chow and Wong, 2020; Vodá *et al.*, 2022). Furthermore, despite the widespread adoption of ICTs and their consequential impacts in tertiary education institutions worldwide, there persists a prevalence of inadequate ICT infrastructure in higher learning institutions in developing countries (Godrick, 2017). To effectively integrate e-learning into modern digital society, it is crucial for students to possess digital literacy skills. A digitally literate student is not only proficient in navigating e-learning platforms but also becomes a skilled contributor to the workforce (Maphosa and Bhebhe, 2019; Anthonysamy, 2020). These skills enable students to collaborate, communicate, generate content and exchange information online (Drew and Forbes, 2017).

A significant number of academic institutions in Kazakhstan have transformed their educational delivery by incorporating digital technologies. Among these institutions, Al-Farabi Kazakh National University (KazNU), a leading educational and research institution in Kazakhstan and Central Asia, has been a pioneer in evolving the academic landscape in the region (Kanyika and Sadykova, 2023). Since its establishment in 1934, KazNU has played a crucial role in the advancement of education and science in Kazakhstan. Committed to academic excellence, research and innovation, the university understands the importance

of integrating digital technologies to enhance the quality of education. The adoption of digital technologies is driven by the goal of enhancing accessibility, improving preservation and supporting research and scholarship within the university community (Negizbayeva *et al.*, 2017). KazNU as one of the smart universities it offers both conventional and e-learning mode of education, which needs both students and lectures to be digitally literate. However, Tang and Chaw (2016) claimed that most of the students in developing countries such as Kazakhstan lack skills or are not competent in critically evaluating digital information they access and utilize using digital technologies. On the contrary, it is unclear whether students in Kazakhstan possess all the basic competencies of digital literacy, as studies analyzing these competencies among students in Kazakhstan are irretrievable. Therefore, the current study aims at assessing digital literacy competencies among students in higher learning institutions in Kazakhstan.

1.1 Objective of the study

The study aims to assess the digital literacy competencies among students in higher learning institutions in Kazakhstan. Specifically, the study aims to:

- to identify digital literacy skills to effectively use digital technologies among students;
- to describe the purpose and extent of use of digital technologies among students; and
- to explore challenges faced students on the use of digital technologies.

2. Literature review

Following the advancement of technology, nowadays most of the students are aware of the digital technologies and know how to access and use online information as they help them in fulfilling their social, economic and personal purposes (Ting, 2015). Digital technologies are being used and are becoming a common method of delivering education through blended methods as it is among the easy, fast and more convenient ways of learning (López-Belmonte *et al.*, 2020a,b). In addition, digital technologies are useful for both teachers and students as they bring better learning flexibility, higher classroom flexibility and improve learning engagement.

2.1 Digital literacy skills to effectively use digital technologies among students

For a student to be digitally literate he/she must possess certain skills or competencies toward ICTs to be able to search information from the internet, produce digital information, disseminate digital information, understands the basics of digital technologies, etc. (Morduchowicz, 2021). Gutierrez-Angel *et al.* (2022) in their study found that university students had ICT skills and competences toward using digital technologies. These skills enable them to access information through the internet using devices such as laptops, desktops, smartphones, netbooks and tablets. More so, in South Korea, students observed to possess communication and collaboration as digital literacy competences as revealed by the study of Doh *et al.* (2016). These competences enable them to collaborate and communicate well during learning through the use of digital technologies. On the contrary, the study of Law *et al.* (2018) also found that most of the students had competences in using digital platforms such as search engines and online databases. Moreover, Abrosimova's (2020) in his study revealed that students possess ICT skills that enable them to effectively participate in their online classes. This indicates that students are digitally literate, as they can easily use digital technologies for online collaboration and communication.

2.2 Purpose and extent of use of digital technologies among students

In today's world, digital technologies have become among the vital parts in education as it brings changes in learning, but also engages more students into different learning and teaching modes (Pegalajar Palomino and Rodríguez Torres, 2023). The study conducted by Abrosimova (2020) found that the use of digital technologies in education has increased significantly in today's world. This rise is attributed to the fact that digital technologies not only make education more accessible but also simplify research processes, thereby enhancing learning. Recio *et al.* (2020), in their study found that university students frequently use digital technologies in their daily activities. These technologies have been observed to enhance students' performance in accessing and using information. Similarly, Indah *et al.* (2022) in their study revealed the dominance of digital technologies utilization among Indonesian students. The study found that these digital technologies support students to increase academic performance specifically in writing scholarly articles and assignments. On the contrary, the study of Chan *et al.* (2016) found that the majority of students use digital technologies due to high ICT skills and possession of positive perceptions toward digital technologies. Indeed, it was found that students use digital technologies for both academic and personal purposes.

2.3 Challenges faced students on the use of digital technologies

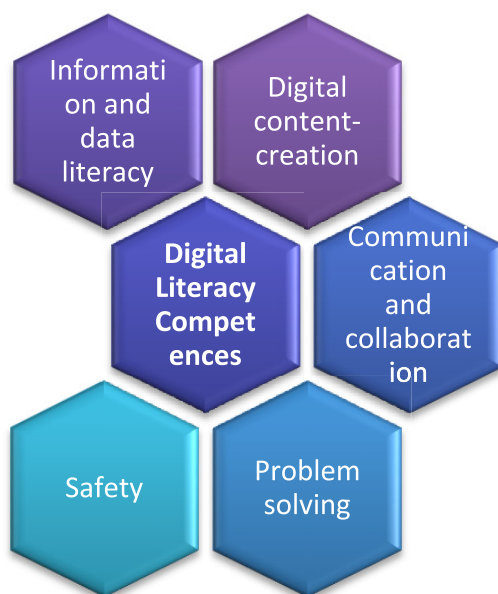
Despite the various opportunities e-learning offers in education, there are several challenges that students face toward using digital technologies. In South Africa, for example, digital divide was observed as the major challenges facing most of the students in proper utilization of the digital platforms and therefore, impede digital literacy as highlighted by Cloete (2015). Furthermore, research conducted by Chan *et al.* (2016) revealed that, although students possess ICT skills, they face significant obstacles in using computers, which are among the major challenges in the digital environment. Students may be digitally literate, but limited access to digital technologies such as computers can be a major factor in reducing their academic performance. Moreover, the study of Osuji (2010) found limited access to computers, limited access or slow broadband and high cost of internet access as the major challenges facing students from proper usage of the digital platforms. In addition, Liebenberg *et al.* (2012) on their study found difficulty in accessing ICTs and students' abilities in using ICTs as the major challenges facing students in South Africa toward digital literacy.

Based on the literature reviewed, only one study has delved into a singular aspect of digital literacy competences. Nevertheless, Ferrari (2013) has identified five fundamental digital literacy competencies essential for every student: information and data literacy, digital content creation, communication and collaboration, problem-solving and safety. These competencies are depicted in Figure 1 below.

Therefore, this study aims to fill this gap by assessing the five digital literacy competencies that students need to possess for effective e-learning.

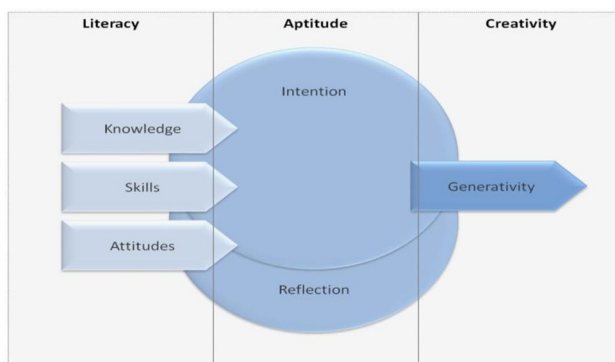
2.4 Conceptual framework

In this study, the ICT Literacy Model was used to explain the awareness, use and competence of digital technologies. The ICT Literacy Model, as outlined by Pérez and Murray in 2010 (see Figure 2), comprise three fundamental dimensions: literacy, aptitude and creativity. These dimensions represent a progression from foundational skills to innovative practices facilitated by digital technologies. Literacy encompasses three key components: attitudes, skills and knowledge. Attitudes reflect a student's perceptions regarding the use of digital technologies. Skills denote the proficiency acquired through training or experience with digital tools. Knowledge pertains to the ability to use digital technologies for information



Source: Ferrari (2013)

Figure 1. Adapted framework of digital literacy competences



Source: Pérez and Murray (2010)

Figure 2. ICT literacy model

analysis and evaluation. Aptitude involves intention and reflection, indicating a student's conscious utilization of digital technologies to generate new knowledge. Creativity is characterized by generativity, where the creation of new knowledge emerges as a culmination of awareness, proficiency and positive attitudes toward digital technology in the learning process.

This model is well-suited to the study because it delves deeply into the understanding of students' knowledge, skills and attitudes regarding the utilization of digital technologies, with a focus on fostering the creation of new knowledge, safety and problem-solving. It serves to elucidate the study's objectives, which aim to tackle the enhancement of skills, attitudes and the overcoming of challenges related to digital technology adoption. The study posits that for effective learning, especially in an e-learning context, both students and lecturers must possess comprehensive knowledge and awareness of various digital technologies. Moreover, fostering positive attitudes and perceptions toward these technologies is essential. In addition, proficiency in ICT skills such as adeptness in using computers, the internet, software and systems is crucial for both parties as will help them safely use the accessed information. Furthermore, a solid grasp of the subject matter enables students and lecturers to discern which digital tools are best suited to fulfill their requirements but more importantly will help them in critically evaluating the content and therefore help them in problem-solving. Overcoming any barriers that impede the optimal utilization of digital technologies is imperative for maintaining a conducive learning environment and facilitating the generation of new knowledge.

3. Methodology

This study used a survey design due to its capacity to define features of study's participants in a large population (Mertler and Charles, 2008). The study was conducted at KazNU. KazNU was deliberately chosen due to its status of being the leading smart university in Kazakhstan and therefore, it offers education in both conventional and e-learning mode. The study encompassed all enrolled students at KazNU as its target population. To determine the sample size for this large population, the approach proposed by [Saunders et al. \(2012\)](#) was followed, as outlined in [Table 1](#). Ultimately, 370 respondents (students) were selected using a simple random sampling technique. A list of all students was collected from each faculty, and then a simple random technique, specifically the lottery method, was used to select respondents (37 respondents each from ten faculties). Data were collected using Web/online questionnaires (Google Form). A total of 370 online questionnaires were disseminated to the respondents with the help of Survey Monkey to their email addresses. The validity of a study was tested through a content validity approach whereby 10 questionnaires were distributed to the respondents apart from those who were included in the actual study and requesting them to respond to the questions to see if structured and semi-structured questions are aligned with all the study objectives. For ethical purposes, all clearances were obtained from the relevant authorities before the actual fieldwork had to be done. The researcher further informed the respondents about the potentiality of the study and guaranteed confidentiality to their responses. Quantitative data collected through survey questionnaires in this study were analyzed using Microsoft Office Excel 2010. Thus, descriptive statistics such as frequencies and percentages were computed, and the results were further presented in tables, charts and figures.

4. Findings and discussion

4.1 Response rate

The researchers sent out 370 online questionnaires to participants. Of these, 196 were completed and returned by respondents who self-administered them, resulting in a response rate of 53%. [Bryman et al. \(2014\)](#) noted that online questionnaires often yield lower response rates. However, despite this trend, the researcher in this study is confident that the 53% response rate adequately captures a comprehensive range of digital literacy competencies among students.

Table 1. Sample size table (confidence level = 95%; margin error = 5%)

Population	Margin of error			
	5%	3%	2%	1%
50	44	48	49	59
100	79	91	96	99
150	108	132	141	148
200	132	168	185	196
250	151	203	226	244
300	168	234	267	291
400	196	291	434	384
500	217	340	414	475
750	254	440	571	696
1,000	278	516	706	906
2,000	322	696	1,091	1,655
5,000	357	879	1,622	3,288
10,000	370	964	1,936	4,899
100,000	383	1,056	2,345	8,762
1,000,000	384	1,066	2,395	9,513
10,000,000	384	1,067	2,400	9,595

Source: [Saunders et al. \(2012\)](#)

4.1.1 Sociodemographic characteristics of the respondents. Respondents were asked to indicate their gender and education level. [Table 2](#) below summarizes the findings;

The study's findings as observed in [Table 2](#) highlight a predominance of females over males. [Poza et al. \(2020\)](#) and [Roig et al. \(2015\)](#) asserted a significant correlation between gender and digital technology usage. However, the study of [Cobos-Velasco et al. \(2019\)](#) revealed that males are more digital literate than females. On the contrary, insights from [Hong Sinh and Thi Hong Nhung \(2012\)](#) and [Moore \(2016\)](#) emphasize the role of users' skills in digital technology adoption. Individuals with greater ICT proficiency are likely to use digital technologies more extensively.

Table 2. Sociodemographic characteristics of the respondents (*N* = 196)

Item	Frequency	%
<i>Gender</i>		
Male	88	45
Female	108	55
<i>Total</i>	196	100
<i>Education level</i>	98	50
Undergraduate degree		
Masters' degree	71	36
Doctoral degree	27	14
<i>Total</i>	196	100

Source: Field data (2023)

Statistically, regression analysis was conducted to examine whether there is any relationship between gender and the usage of digital technologies as opined by [Pozo et al. \(2020\)](#) and [Roig et al. \(2015\)](#); see [Table 3](#) below.

As shown in [Table 3](#), the R -squared (R^2) value is 2.7%, indicating a very weak relationship between gender and the use of digital technologies.

To know the significance of the impact, the ANOVA test was conducted as observed in the [Table 4](#) below.

The findings as presented in [Table 4](#) show that both the significance value (0.02) and the p -value (0.02) are below 0.05. This suggests that, although the relationship between gender and the use of digital technologies is very weak, it is still statistically significant enough to suggest that gender may influence digital technology usage to some extent. However, the higher representation of females in this study does not necessarily mean that they use digital technologies more than males. Instead, other factors – such as comprehensive knowledge and awareness of digital technologies, positive attitudes and perceptions toward these technologies and proficiency in ICT skills – are likely to have a greater impact on digital technology usage.

4.2 Digital literacy skills to effectively use digital technologies among students

The study sought to find out the digital literacy competencies students possess. Findings as illustrated in [Figure 3](#), indicating that a significant majority (120; 61%) of the students are very competent in using digital technologies for collaboration and communication regarding online information. However, a notable portion of students exhibit deficiencies in the ability to discern and critically evaluate online information, as well as protecting personal data and digital identity (141; 72% and 112; 57%, respectively). Moreover, findings reveal that a

Table 3. Model summary

Regression statistics	
Multiple R	0.16565941
R square	0.02744304
Adjusted R square	0.02242986
Standard error	0.493039639
Observations	196

Source: MS Excel outputs

Table 4. ANOVA

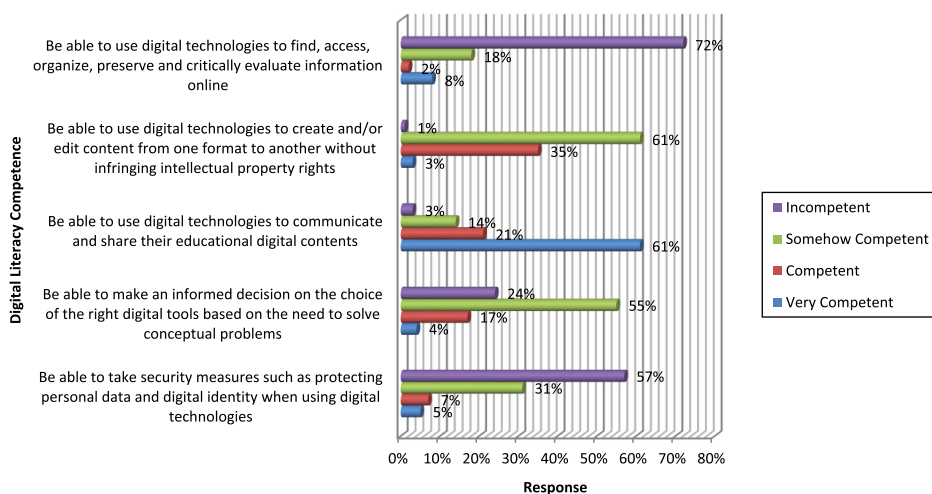
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>	
Regression	1	1.330707	1.330707	5.474178	0.020316363	
Residual	194	47.15909	0.243088			
Total	195	48.4898				
	<i>Coefficients</i>	<i>Standard error</i>	<i>t-Stat</i>	<i>p-Value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Gender	1.791662291	0.108714	16.48051	9.81E-39	1.577249216	2.006075
Use of digital technologies	-0.16549407	0.070733	-2.339696	0.020316	-0.304998756	-0.025989

Source: MS Excel outputs

considerable proportion of students possess moderate proficiency in generating digital content and leveraging digital technologies to address conceptual challenges (119; 61% and 108; 55%, respectively).

As depicted in Figure 3 above, students demonstrate high competency in sharing and communicating their educational digital contents using digital technologies because it is easy to use, social and collaborative, among the five fundamental aspects of digital literacy proficiency they should ideally possess. Nevertheless, there is a noticeable gap in their ability to critically evaluate accessed information, a crucial skill within the digital landscape. While students excel in finding, accessing and preserving information, this particular area of evaluating information critically appears to be lacking. In the digital realm, Maphosa and Bhebhe (2019) asserted that every student should possess information and data literacy. This competency equips them to effectively find, access, organize, preserve and critically evaluate information. Law *et al.* (2018) further emphasized that amidst the vast volume of online content, much of which lacks relevance and authenticity for educational purposes, students must be adept at discerning and evaluating the information they encounter online.

Furthermore, it was noted that few students exhibit high competence in digital content creation. This proficiency is crucial given the diverse formats of information in the digital sphere. It is imperative for students to possess skills facilitating seamless content creation and editing across formats without infringing intellectual property rights (Ferrari, 2013). The ability of students to generate digital content across different mediums not only fosters classroom engagement but also enhances their proficiency in utilizing digital technologies (Spires and Bartlett, 2012). Moreover, a few students demonstrated adeptness in leveraging digital technologies for informed decision-making. In the digital realm, many conceptual challenges are addressed through digital technologies, underscoring the importance of students having innovative and current skills in technological tool usage. In addition, the findings revealed that a limited number of students possess competence in protecting personal data and identity. Ferrari (2013) highlighted the close link between safety and the



Source: Field Data (2023)

Figure 3. Digital literacy skills to effectively use digital technologies by students ($N = 196$)

utilization of digital tools in the digital environment. Consequently, students should be equipped to implement security measures, including protecting personal data and digital identity, when utilizing digital technologies.

4.3 Purpose and extent of use of digital technologies among students

Students were asked to indicate the purpose and extent of using digital technologies. Findings of the study show that, the majority (105; 54%) of the respondents use digital technologies for education purposes only, whereas 91 (46%) students use digital technologies for education and other purposes. On the contrary, the majority (158; 81%) of the students use digital technologies more often, whereas few (38; 19%) students use digital technologies occasionally. Table 5 below summarizes the findings.

Findings of the study reveal that majority of the students frequently use digital technologies for education purposes only. This underscores the commitment of students to leverage available digital technologies for educational tasks such as research, collaboration and related activities. However, a noteworthy proportion of students are observed to use digital technologies for both educational and non-educational purposes. While the primary objective of digital technologies in universities is to facilitate learning, students also use them for recreational and other purposes.

Based on the findings, the study conducted a statistical test to analyze whether there is a statistical significance difference between the frequency of use of digital technologies and the intention behind of using digital technologies. Table 6 below summarizes the findings.

As observed in the findings, mean score for the frequency of using digital technologies was 1.454, whereas the mean score for the intention behind using digital technologies was 1.240. The *t*-test revealed a statistically significant difference between the use of digital technologies and the intention/purpose of using digital technologies [$t(381) = 4.562, p < 0.00001$, two-tailed]. This indicates that there is a significant difference in mean scores between the use of digital technologies and the intention/purpose of using digital technologies. The calculated *t* statistic (4.562) exceeded the critical value for both one-tailed (1.649) and two-tailed (1.966) tests. Therefore, we conclude that there is a significant difference in mean scores between the two groups. This suggests that the frequency of digital technology use is closely tied to its intended purpose. Students who primarily use digital technologies for educational pursuits, driven by academic requirements such as assignments, exam preparation and scholarly writing, are more likely to use them frequently compared to

Table 5. Purpose and extent of use of digital technologies among students (*N* = 196)

Item	Frequency	%
<i>Purpose of using digital technologies</i>		
Education purposes only	105	54
Education and other purposes	91	46
Total	196	100
<i>Extent of using digital technologies</i>		
Frequently	158	81
Occasionally	38	19
Total	196	100

Source: Field data (2023)

Table 6. t-Test: two-sample assuming unequal variances

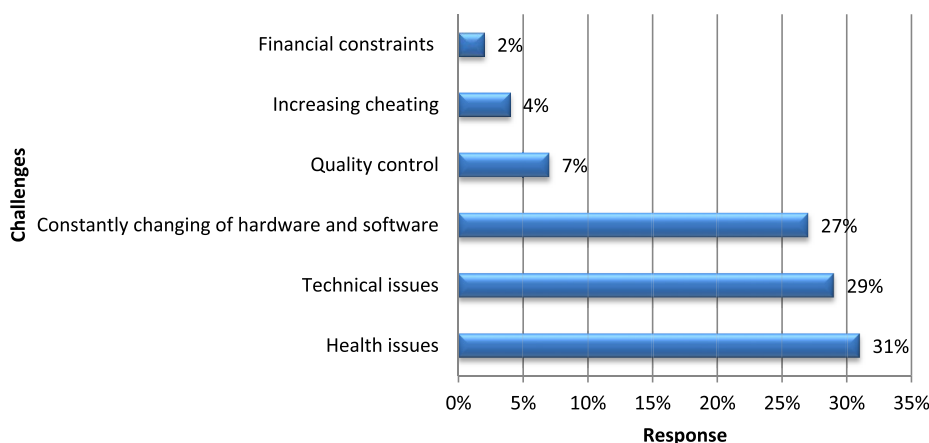
	<i>Use of digital technologies</i>	<i>Purpose of using digital technologies</i>
Mean	1.454081633	1.239795918
Variance	0.249162742	0.183228676
Observations	196	196
Hypothesized mean difference	0	
Df	381	
t-Stat	4.562288259	
P(T ≤ t) one-tail	3.41664E-06	
t Critical one-tail	1.648862822	
P(T ≤ t) two-tail	6.83328E-06	
t Critical two-tail	1.966209908	

Source: MS Excel outputs

those who use them for nonacademic reasons. The ICT model used in this study reveals that students possess knowledge and attitudes conducive to frequent digital technology use for educational purposes. However, merely developing attitudes is insufficient for students to attain competence in using these technologies. Comprehensive training is essential to equip students with the requisite skills to master all five fundamental digital literacy competencies, which are increasingly vital in today's digital landscape.

4.4 Challenges faced students on the use of digital technologies

The study sought to find out challenges faced students on the use of digital tools. Findings of the study as indicated in [Figure 4](#) show that, majority (61; 31%) of the students mention health issues as one of the major challenges, followed by 56 (29%) students and 54 (27%) who mentioned technical issues and constantly changing of hardware and software as among



Source: Field Data (2023)

Figure 4. Challenges faced students on the use of digital technologies ($N = 196$)

the major challenges. Few (4; 2%) students mentioned financial constraints as among the major challenges.

As depicted in [Figure 4](#) above, the majority of respondents (61; 31%) highlight health issues as a significant challenge encountered while utilizing digital technologies. Prolonged exposure to screens can adversely affect their health, with eye strain and sedentary behavior being notable issues. In addition, a considerable portion of respondents cite technical issues and the constantly changing of hardware and software as major challenges (56; 29% and 54; 27% respectively). Despite reliable internet connections, occasional slowdowns impede tasks such as downloading of files. Moreover, the perpetual changes in hardware and software sometimes render digital tools incompatible, hindering access, usage and sharing of online information. Furthermore, the study findings indicate that financial constraints do not rank among the primary challenges despite the presence of software and databases, which sometimes need a student to purchase the license to use digital technologies. Drawing from the ICT model used in this study, it elucidates that students must cultivate positive attitudes toward digital technologies. However, this can only be achieved through the acquisition of appropriate skills, encompassing the five fundamental digital literacy competencies. These skills empower students to use digital tools responsibly. Nonetheless, the model emphasizes the necessity of addressing all potential challenges or barriers to ensure smooth utilization of digital technologies.

5. Practical implications

This marks the new study into the digital literacy competencies among students in Kazakhstan, with a particular focus on elucidating the five fundamental facets of such competencies. The results of this study reveal that students are very competent in utilizing digital technologies to communicate and share their educational digital contents, whereas they indicate moderate competence and incompetence in other essential digital literacy skills crucial for their academic pursuits. Nonetheless, these findings are anticipated to serve as a clarion call to management and policymakers within higher education institutions in Kazakhstan, shedding light on prevalent challenges and prompting the implementation of effective remedies, including overcoming the issues associated with constantly changing hardware and software by purchasing hardware and software that are compatible with the latest digital technologies, but also overcoming all technical issues such as that of slow internet connectivity. On top of that, the establishment of routine training programs aimed at equipping students with the full spectrum of requisite skills crucial for their success should be done frequently in their classes and in the libraries as new digital technologies emerge on a daily basis.

5.1 Limitations of the study

This study is limited only in analyzing digital literacy competencies among higher learning students in Kazakhstan. During data collection, it was challenging to involve lecturers, as many were occupied with final lectures and preparing for end-of-year exams. It is important to recognize that in higher education, both students and lecturers must be digitally literate, proficient in all five core elements of digital literacy, to ensure efficient and effective learning. However, due to students' time constraints while preparing for final exams, this study only included five questions related to digital literacy competencies, based on the five essential digital literacy skills students should have. Future research should expand this to 25 questions based on the DIGCOMP framework to thoroughly assess students' digital literacy competence and also examine the digital literacy competences of lecturers. If both students

and lecturers become proficient in all basic elements of digital literacy, it will lead to smoother learning, especially in e-learning. In addition, as the use of digital technologies in education has become a common trend even in high schools, future studies should also examine digital literacy competencies among high school students.

6. Conclusion and recommendations

The emergence of new digital technologies has had both positive and negative impacts on students in both developed and developing countries. To effectively use digital technologies, students are supposed to possess all five basic elements of digital literacy competences. In this study, it was observed that students are very competent in using digital technologies to communicate and share their educational digital contents, whereas they indicate moderate competence and incompetence in other essential digital literacy skills such as critical information evaluation, problem-solving using digital tools and safe digital usage without infringing copyright and intellectual property rights that are crucial for their academic pursuits. Moreover, it was observed that the majority of the students frequently use digital technologies for educational purposes, only indicating their commitment to leverage available digital technologies for educational tasks. In addition, health issues, technical issues and constant changing of hardware and software were among the challenges facing students when using digital technologies.

Overall, given that Al-Farabi Kazakh National University holds the top position among universities in Kazakhstan according to the QS World ranking and considering its significant population size, expansive area and recognition as one of the finest smart universities, it follows that the conclusions drawn from this study can be broadly applied and generalize that students in Kazakhstan are not very competent in all five basic elements of digital literacy competences. To address this gap, the study recommends the implementation of comprehensive and consistent training programs aimed at equipping students with the necessary skills as new digital technologies emerge every day. In addition, higher learning institutions in Kazakhstan, whenever necessary, should proactively address challenges encountered by students in using digital technologies, ensuring robust and uninterrupted internet connectivity and regularly updating hardware and software to keep pace with technological advancements.

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About the authors

Martin Elihaki Kanyika is an Assistant Lecturer at the Eastern Africa Statistical Training Center in Dar es Salaam, Tanzania. He holds a BA (Hons) and MA in Information Studies from the University of Dar es Salaam. Currently, he is pursuing a PhD at Al-Farabi Kazakh National University in Kazakhstan, with a focus on Library Information Systems. His research interests include innovative technologies in libraries, open access, institutional repositories, digital literacy and digitization. Martin Elihaki Kanyika is the corresponding author and can be contacted at: kanyikam87@gmail.com

Raikhan Sadykova is an Associate Professor at the Faculty of History of Al-Farabi Kazakh National University. She graduated from the Faculty of International Relations of Al-Farabi Kazakh National University. She defended her candidate degree dissertation and currently works with PhD degree (candidate). Her research areas include the history and development of library sciences, contemporary problems and actual issues of world history. She has more than 100 publications in Kazakh, Russian, English and Turkish.

Zhansaya Kosmyrza holds a bachelor's degree in library science and a master's degree in library information systems from Al-Farabi Kazakh National University in Kazakhstan. She is currently pursuing a PhD at the same institution, specializing in Library Information Systems. Her research interests focus on artificial intelligence and the digitization of libraries.

User perspectives on library digitization and its impact on research capabilities

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**Martin Elihaki Kanyika** 

Al-Farabi Kazakh National University, Kazakhstan

Raikhan Sadykova

Al-Farabi Kazakh National University, Kazakhstan

Kalima Tuyenbayeva

Al-Farabi Kazakh National University, Kazakhstan

Evans Wema

University of Dar es Salaam, Tanzania

Abstract

This study assessed user perspectives on library digitization and its impact on research capabilities. A survey design with both quantitative and qualitative approaches was employed. Simple random sampling was used to select respondents whereas purposive sampling was used to select key informants. Data were collected using online questionnaires and interviews. MS Excel was used to analyze quantitative data while qualitative data was analyzed using thematic method. Findings show that the majority of the respondents utilize library resources frequently with statistical analysis ($MS = 0.387998$, $t = -1.45939$, $p < 0.146074$) indicating there is no significant difference between education level and the frequency of library resources usage. Also, the majority of respondents have positive perceptions towards the use of library resources with t -statistic (6.599663291, is above 1.649982976 for one-tail and 1.967956506 for two-tail) indicating a significant difference between age and perceptions towards the use of library resources. Moreover, findings show capacity of a single document to be used by many users at once and information to be accessed at a fingerprint are major impacts of library digitization. Furthermore, findings reveal issues related to licensing, subscription costs, and copyright and overwhelming volume of information available as the major challenges user face when utilizing digital library resources. This study marks the pioneering exploration into the impacts of library digitization on research capabilities. The study therefore, recommends a continuous training to students to be able to access and critically evaluate the overwhelming amount of online information. Also, users should be trained on how to navigate copyright issues when accessing digital library resources. Additionally, libraries should consider expanding their collections by incorporating more open access resources. Moreover, parent institutions should make sure that they increase the budget to their digital libraries so that libraries can increase the subscriptions of all useful resources.

Keywords

digitization, user perspectives, library digitization, library resources, research capabilities, digital library

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Introduction

In the twenty-first century, libraries particularly academic libraries have undergone a profound transformation in the way they fulfill their role in facilitating research but also access and dissemination of knowledge. This paradigm shift can be largely influenced by the rapid developments of information and communication technologies (ICTs) (Masrek & Gaskin, 2016; Soomro et al., 2018). To

date, the role of libraries has shifted from traditional repositories of tangible books and documents to

Corresponding author:

Martin Elihaki Kanyika, Department of World History, Historiography and Source Studies, Al-Farabi Avenue 71, Almaty 050040, Kazakhstan.

Email: kanyikam87@gmail.com

dynamic hubs of digital information, adapting to the changing needs of students, researchers, and the broader academic community (International Federation of Library Association and Institutions [IFLA], 2010). This shift is fundamentally revolutionized traditional approaches to teaching and research, with its core centered on the digitization of library resources (Sood, 2014; Tømte et al., 2023; Yadav et al., 2015). The widespread acceptance of digital libraries and the digitization of enormous repositories of academic content resulted in a new era of information accessibility to scholars. The impact of this digital revolution on research practices within academic institutions is a topic that has sparked significant scholarly debate (Ashraf et al., 2010; Castro, 2019; Laila et al., 2022).

Libraries are considered as the heart of any academic institution, acting as repositories of knowledge and key enablers of research and education (Simpson, 2016). Recognizing the transformative potential of digitization, libraries across the world have embarked on ambitious digitization projects to preserve and provide access to their valuable collections. The main reason for establishing digital libraries is to make information found in the libraries easily and timely accessible to its users whereas access is done over network (IFLA, 2010). Developed countries have been in the forefront of digital library advances due to their robust technological infrastructure and large financial resources. Libraries in the United States, the United Kingdom, and Germany have invested heavily in digitization projects, resulting in massive digital collections. For example, in the United States, the Library of Congress has digitized millions of artifacts from its large collection, making them available to anybody with an internet connection (Library of Congress, 2021). Similarly, the British Library's digitization activities have made thousands of historical documents and manuscripts accessible online (The British Library, 2021). These measures have not only protected important cultural treasures but have also enabled global scholarly research.

Furthermore, developed nations have assimilated cutting-edge technologies to improve the user experience and enable discovery of knowledge. AI and machine learning algorithms are used to offer appropriate research papers and books to consumers, guaranteeing that they have easy access to the most relevant content. Individuals can now access digital libraries on a variety of devices thanks to user-friendly interfaces and mobile applications, thus democratizing access to knowledge. These technological breakthroughs have

raised the bar for digital libraries around the world. Developing nations, on the other hand, have experienced distinct problems in establishing and expanding their academic digital libraries. Their progress has frequently been hampered by a lack of financial resources and an inadequate technological infrastructure. Despite these obstacles, several developing nations have made remarkable attempts to close the digital divide. For example, the African Union-supported African Digital Library (AfLi) initiative aims to give digital access to educational resources across the continent (African Union, 2021). AfLi works with local libraries and universities to digitize and exchange academic content, thereby enabling students and researchers in underprivileged communities. Furthermore, international organizations and collaborations have been critical in assisting developing-country digital library projects. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has actively promoted digital libraries as a means of improving access to education and preserving cultural heritage (UNESCO, 2021). UNESCO has fostered knowledge transfer and capacity building in developing countries through a variety of programs and initiatives.

The impact brought by the library digitization on research capabilities is unquestionable, ushering in an era of extraordinary accessibility, convenience, and efficiency for scholars (Amouzgar et al., 2022; Webb et al., 2021). As the digital environment continues to evolve, all stakeholders in academic arena, including researchers, librarians, and institutions, must be aware of all potential benefits and challenges associated with the digitization of library resources. Among the potential benefits brought by the digitization of library resources is the introduction of a wide range of types of digital library resources which helps researchers to have diversity in accessibility of academic materials (IFLA, 2010). The presence of different types of digital library resources helps researchers to have an abundance of resources at their fingertips to support their academic pursuits (Silkroad, 2013). These digital library resources cater to diverse research needs and preferences, offering users the flexibility to access information and from a multitude of sources. As the landscape of digital library resources continues to evolve, it is essential for academic libraries and information providers to adapt and ensure that these resources remain accessible, relevant, and user-friendly.

In an age characterized by the rapid dissemination of information and the global interconnectivity of societies, access to knowledge has emerged as a

critical driver of socio-economic development and progress (Zeb, 2022). For many countries, the mission to bridge the knowledge gap has been a core goal in their pursuit of sustainable growth and improved living standards. In this context, digital libraries have emerged as a transformative force, offering unparalleled opportunities for individuals, institutions, and nations to access, share, and contribute to the world's collective knowledge repository (Mustapha et al., 2021; Shaikh & Nikooherafmaher, 2022). Based on this, academic libraries in Kazakhstan have digitized all their collections to increase open access but more importantly to simplify access of information to users (Kanyika & Sadykova, 2023). However, despite the widespread implementation of digitization initiatives, it is imperative to understand the multifaceted impact of these changes from the perspective of the end-users, primarily the university's students, and lecturers. Despite several studies articulating the impacts of the digitization of library resources in facilitating teaching, consultation, and research, but no study could be traced which investigated the impacts of digitization of library resources in research capabilities in Kazakhstan. This study, therefore sought to investigate user perspective on library digitization and its impact on research capabilities using Al-Farabi Kazakh National University as a case study.

Research objectives

The specific objectives of this research paper are as follows:

1. To assess the user perspectives awareness on the digitization of library resources.
2. To analyze the impact of library digitization on the research capabilities and practices of users.
3. To identify challenges or barriers faced by users in utilizing digitized library resources for research purposes.

Literature review

User perspectives on the library digitization

The digitization of library has brought a significant transformation on the way individuals interact with technology and access information (Gul & Bano, 2019). One of the key aspects of user perspectives on library digitization is the shift from traditional to digital formats. Library users need to adapt to these changes, from relying on physical books and printed materials to digital e-books and online articles (Tømte

et al., 2023). However, it is understood that users have had mixed reactions to this shift. While some of them appreciate the convenience and accessibility of digital formats, others express nostalgia for physical books, highlighting the significance of personal attachment to tangible materials (Laila et al., 2022).

Recker (2006) conducted a study titled "Perspectives on Teachers as Digital Library Users: Consumers, Contributors, and Designers" and found that the majority of teachers as one of the key users of the digital libraries have positive perspectives towards library digitization. The study highlighted how digital libraries prove invaluable to teachers by facilitating ease of access to library resources, by furthering their content or teaching knowledge. Additionally, online resources were noted for their significant contribution to enriching classroom activities. Similarly, the study of Tammaro (2008) with the title "User perceptions of digital libraries: a case study in Italy" found that the participants expressed positive perceptions of digital libraries despite having limited awareness of the available services. Their favorable views stemmed from the ease of use of various digital library systems, showcasing the impact of user experience on their perceptions.

More so, the study of Sheeja (2010) titled "Undergraduate students' perceptions of digital library: a case study" revealed overwhelmingly positive feedback from surveyed students. These students found digital libraries to be highly satisfactory in meeting their needs, emphasizing the ease of use and the richness of available resources. On the other hand, the study of Matusiak (2012) titled "Perceptions of usability and usefulness of digital libraries" found negative perceptions towards digital libraries among the survey participants. The study revealed the difficulty of using digital library systems and limited resources found in the digital library when comparing using the Web was among the reasons. The digitization of information and services has brought about a myriad of changes in the way users engage with technology and access information. Yet, for a digital library to thrive, it must prioritize not only user-friendliness but, crucially, comprehensive content (Toyo, 2017).

The impact of library digitization on the research capabilities

The transformation of academic libraries from traditional repositories of physical resources into dynamic hubs of digital information has had far-reaching effects on multiple fronts, influencing the

accessibility and dissemination of information to users (Nneji, 2018). In the digital realm, individuals can now effortlessly and more extensively access research materials than in any previous era (Borgman, 2000). Moreover, the arrival of digital libraries has allowed library users to overcome geographical limitations whereby it also improves exchange of knowledge (Otubelu & Ume, 2015). This development not only enhances the exchange of knowledge, as noted by Otubelu and Ume, but also provides users with expansive opportunities to access resources for their projects from renowned scholars worldwide.

Initially, bygone era before the digital age, library users including researchers were obliged to physically visit libraries as a physical building to have access of specialized materials. However, in the modern era, the digitization of libraries stands out as a pivotal advancement, offering researcher's unparalleled accessibility (Turock & Friedrich, 2010). In this case, the digitization of library materials has revolutionized access, enabling scholars to retrieve materials remotely (Silkroad, 2013). This streamlined approach of accessibility not only nurtures inclusivity but also promotes interdisciplinary research by eradicating barriers to entry (Igwe & Uzuegbu, 2013). Besides, the digitization ensures round-the-clock availability of library resources, saving users from the limitations of traditional library hours and the delays of interlibrary loan. Additionally, digitization of library resources impacted researchers in the citation management, as it helps users to effortlessly store and organize enormous bibliographic collections easily (Adane et al., 2019).

Furthermore, the advent of digitized resources has not only revolutionized information access but has also facilitated seamless sharing among users across diverse locations, fostering collaborative efforts on online platforms (Igwe & Uzuegbu, 2013). Nevertheless, the digitization trend has prompted a heightened awareness regarding the preservation of born-digital materials and the long-term sustainability of digital archives. More so, users have been benefited with the ease of search and retrieval provided by digital libraries which speed up the research process, but also it empowers them to locate and access relevant materials more effectively and efficiently (Ezeani & Ezema, 2009). In the modern era, the search and retrieval of research materials has been revolutionized by digitization. The presence of advanced search algorithms, complemented by metadata tagging, contribute to heightened precision and speed in accessing and retrieving information. Consequently, the location

of suitable research materials is now characterized by precision and quickness, enhancing the overall research endeavor. The fusion of full-text indexing and keyword searching further empowers users to comprehensively explore materials, uncovering previously obscured connections and insights in the process (Dhule, 2018).

Challenges or barriers faced by users in utilizing digitized library resources

The digitization of library resources leads to a new era of accessibility; however, it has also introduced numerous challenges or barriers to users which impede them to effectively access digital library resources. One of the fundamental challenges faced users is the access to digitized library resources. Despite the expanded access caused by digitization, but not all materials are available digitally. Moreover, issues related to licensing, subscription costs, and authentication seem hinder seamless access to digital collections. Licensing and copyright restrictions cause significant challenges to users seeking to utilize digitized library resources. Digital library resources most of the times are subject to copyright regulations, restricting the extent to which users can use, share, or reproduce them for research purposes (Paithankar, 2018). This issue can inhibit the exchange of scholarly knowledge and limit the ability of researchers to build upon existing works. Researchers and librarians are increasingly advocating for open access initiatives and more flexible copyright arrangements to address these barriers (Warwick et al., 2008). Navigating these legal complexities can be particularly daunting for researchers.

One of the major challenges faced users in utilizing digitized library resources for their studies and research purposes is the overwhelming volume of information available. As digital libraries continue to increase their collections, users may struggle to locate relevant resources amid the vast sea of data (Castro, 2019). Also, accessibility issues, such as unreliable internet connectivity and insufficient technological infrastructure, hinder users, especially those in resource-constrained regions, from accessing these digitized resources effectively (Toyo, 2017). In his study, Toyo emphasizes the importance of addressing these accessibility issues to ensure equitable access to digitized library resources. The explosion of digital resources has led to information overload, making it challenging for researchers to sift through vast volumes of data effectively. Users must develop information literacy

skills to navigate these extensive collections efficiently (Tang & Chaw, 2016).

Users often express concerns about the privacy and security of their data when utilizing digitized library resources, especially when accessing databases and repositories that require personal information for registration or authentication (Tripathi and Jeevan, 2011). These concerns can deter users from fully engaging with digital libraries. Libraries must implement robust security measures and transparent privacy policies to build user trust and mitigate these barriers. Also, users encounter technical challenges related to the use of digitized library resources. These may include compatibility issues, platform navigation difficulties, and the need for technical support (Pal, 2015). Addressing these issues is crucial to ensuring a smooth research experience.

Another significant barrier faced by users is the need for adequate information literacy and digital skills (IFLA, 2010). Digitized library resources often require users to possess a certain level of digital literacy to navigate complex databases, search engines, and digital archives effectively (Rahman et al., 2020). As noted by Kanyika et al. (2024), students in developing countries, such as Kazakhstan, demonstrate certain digital literacy skills, such as communicating and sharing information online. However, they lack other essential digital literacy competencies, particularly the ability to critically evaluate the information they access online. Additionally, preservation challenges threaten the long-term availability of digitized materials. Users may face issues related to file format obsolescence, digital degradation, and the sustainability of digital repositories (Dappert & Farquhar, 2016). Users may encounter difficulties accessing historical materials as technologies evolve. Ensuring the preservation of digital collections is crucial for future generations of researchers. To address this issue, libraries must invest in robust preservation strategies and ensure the continuous migration of digital content to current formats.

The existing literature reviews shed light on how various studies tackle the focal issue. Yet, none of them comprehensively investigate the impact of critical factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions on behavioral intention and use behavior. These factors play a pivotal role in influencing users' decisions to digital library resources for their academic pursuits and research endeavors. Consequently, this study endeavors to bridge this gap. To achieve this

objective, the Unified Theory of Acceptance and Use of Technology (UTAUT) model serves as the theoretical framework.

Unified theory of acceptance and use of technology (UTAUT) model

This model was developed by Venkatesh et al. (2003). The aim of this model was to provide insights of how different factors could influence the use of technology. These factors are performance expectancy, effort expectancy, social influence, and facilitating conditions, as illustrated in Figure 1.

The study operationalize that, for electronic resources within a digital library to effectively support users in their academic pursuits and research endeavors, it is imperative that users develop positive attitudes toward utilizing these resources. However, several factors contribute to this phenomenon. Firstly, performance expectancy plays a crucial role; users must perceive that employing digital resources will facilitate easier access to information, consequently enhancing their academic performance. Secondly, effort expectancy is pivotal; users are more likely to view digital resources positively if they find them user-friendly and conducive to streamlined information retrieval. Thirdly, social influence holds significance; users tend to develop positive perceptions of digital resources when they receive encouragement from peers and educators, and when these resources are frequently utilized within their academic community. Lastly, facilitating conditions are essential; users are inclined to hold favorable perceptions of digital resources when the technological infrastructure supporting them is robust. Collectively, these factors contribute to the formation of users' behavioral intentions, ultimately leading to the active utilization of digital resources within the library. Such utilization, in turn, is indicative of users' positive perceptions toward the digital library resources.

Methodology

The study employed a survey design. According to Creswell (2014), Gideon (2012), and Guthrie (2010), survey design is appropriate for researcher if you want to generalize or measure quantitative facts, attitudes, opinions, beliefs, characteristics, and past or current behaviors. Triangulation methods such as quantitative and qualitative approaches were used for data collection and analysis. This study was conducted at Al-Farabi Kazakh National University

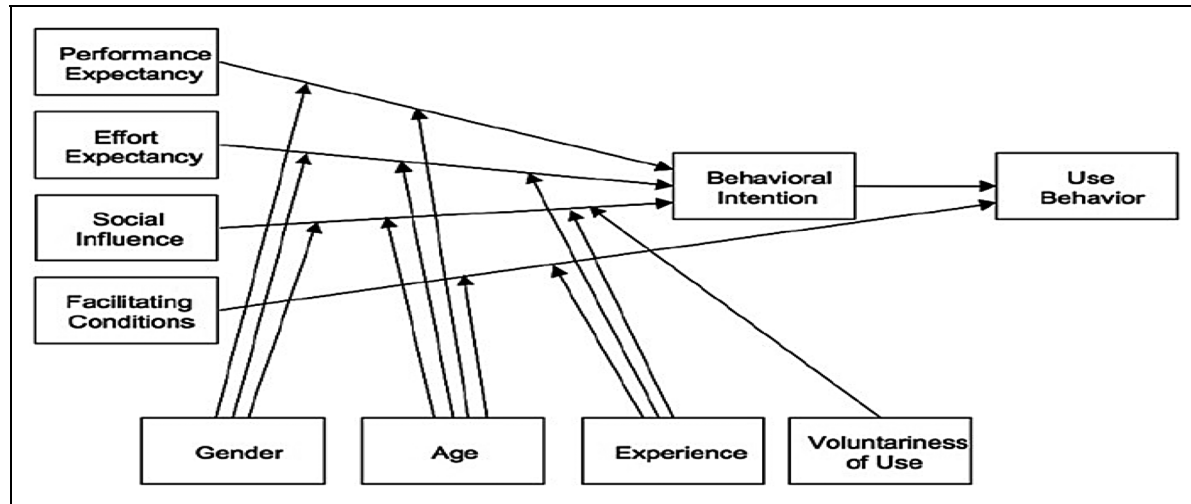


Figure 1. Components of UTAUT model. Source: Venkatesh et al. (2003, p. 447).

Table 1. Sample size table (confidence level = 95%; margin error = 5%).

Margin of error				
Population	5%	3%	2%	1%
50	44	48	49	59
100	79	91	96	99
150	108	132	141	148
200	132	168	185	196
250	151	203	226	244
300	168	234	267	291
400	196	291	434	384
500	217	340	414	475
750	254	440	571	696
1000	278	516	706	906
2000	322	696	1091	1655
5000	357	879	1622	3288
10,000	370	964	1936	4899
100,000	383	1056	2345	8762
1,000,000	384	1066	2395	9513
10,000,000	384	1067	2400	9595

Source: Saunders et al. (2012).

(KazNU) from October to December 2023. The choice of this university was due to the fact that it is one of the leading academic and research institutions in Kazakhstan and Central Asia in general (QS University ranking, 2023). The target population in this study included all master's and doctoral students of KazNU (5788). The study involved masters and doctoral students only because it is believed that they engaged more into research activities when compared to undergraduate students. The sample size was determined using Saunders et al.'s (2012) table and

the results give 357 respondents (Table 1). Simple random sampling was used to select respondents within seven faculties (50 respondents from each faculty). Purposive sampling was used to select seven lectures (one from each faculty) for interviews. Online questionnaires were used to collect data directly from the respondents. A total of 350 online questionnaires were designed reflecting the study's objectives using Google form and sent to the respondents through their email addresses. For ethical purposes, permission was obtained from the relevant authorities before the actual fieldwork had to be done. Also, the respondents were informed about the potentiality of the study and guaranteed confidentiality to their responses. The analysis of quantitative data was done using Microsoft Office Excel 2010, whereas qualitative data was analyzed using the thematic method of analysis. The results of the analysis were computed in the form of descriptive statistics which include frequencies and percentages, and presented using graphs and tables.

Results

Response rate

The researchers distributed a total of 350 online questionnaires to the respondents. Out of 350 online questionnaires distributed to the library users that were self-administered, only 196 questionnaires were filled in and returned; giving the 56% response rate. Bryman et al. (2014) suggest that online questionnaires tend to yield lower response rates. Nevertheless, the researchers in this study express confidence that the

56% response rate suffices to provide a comprehensive overview of user perspectives on library digitization and its impacts on research capabilities.

Demographic characteristics of the respondents

Respondents were asked to indicate their gender, education level and age. Table 2 summarizes the findings.

Findings of the study as depicted in Table 2, show that most (108; 55%) of the respondents were female compared to male (88; 45%). On the other hand, out of total 196 participated respondents, the majority (149; 76%) were studying master's degree while few (47; 24%) were studying doctorate degree. Additionally, most (102; 52%) of the respondents had age group ranged 20–25, followed by 64 (33%) respondents with age group ranged 26–30, then 26 (13%) respondents with age group ranged 31–35. Few (4; 2%) respondents had age group ranged 36 and above.

The findings presented in Table 2 show a higher participation of females compared to males. However, this predominance simply reflects that more females took part in the study, not necessarily a gender-based difference in the use of digital library resources. The usage of these resources is likely influenced by other factors, such as ICT skills. This aligns with the observations of Hong Sinh and Thi Hong Nhung (2012) and Moore (2016), who suggested that individuals with stronger ICT skills are more likely to utilize digital library resources than those with limited skills.

Table 2. Demographic characteristics of the respondents ($n = 196$).

Item	Frequency	Percentages
Gender		
Male	88	45
Female	108	55
Total	196	100
Education level		
Masters	149	76
Doctoral	47	24
Total	196	100
Age		
20–25 years	102	52
26–30 years	64	33
31–35 years	26	13
36 and above	4	2
Total	196	100

Source: Field Data (2023).

Frequency in using digital library of the university

The study sought to find out how often respondents use the digital library of the university to access information for their studies and research. Findings of the study show that most (107) of the respondents use university digital library frequently, while 89 respondents use university digital library occasionally.

The results (Figure 2) indicate that most (107; 55%) of the participated respondents were using university digital library more frequently when searching information be it for their studies or research purposes. On the other hand, 89 (45%) respondents reveal that they occasionally use university digital library when searching information for their studies or research purposes. However, the majority of the respondents who visited the digital library frequently were studying master's degree (77%) while few were studying doctoral degree (23%). These findings imply that master's students are more inclined to visit and engage with library resources compared to doctoral students perhaps to the recurring tests and examinations that master's students undergo each semester, necessitating regular access to library materials. In contrast, doctoral students typically have examinations and tests concentrated in one semester, with the remainder of their time dedicated to thesis writing. According to UTAUT model, one of the factors influencing users to develop positive behavior towards the use of digital library resources is the encouragement they get from their lecturers through assignments given.

This observation was validated by insights obtained from an interview with a lecturer;

We as lecturers usually encourage our students to make effectively use of our digital library resources. So, to make this happen we normally give them assignments and request them to make sure they use resources (as references) found in our university digital library. Also, we gave them continuous tests that prompted them to utilize our library resources for their preparation. (Lecturer 1)

The above comment implies that the use of the digital library was also influenced by teaching staff, apart from academic requirements that influence students to do so.

Based on the above findings, the study hypothesized that; education level has positively influence the use of digital library resources. To validate this hypothesis, regression analysis was conducted to investigate the potential impact of education level on the frequency

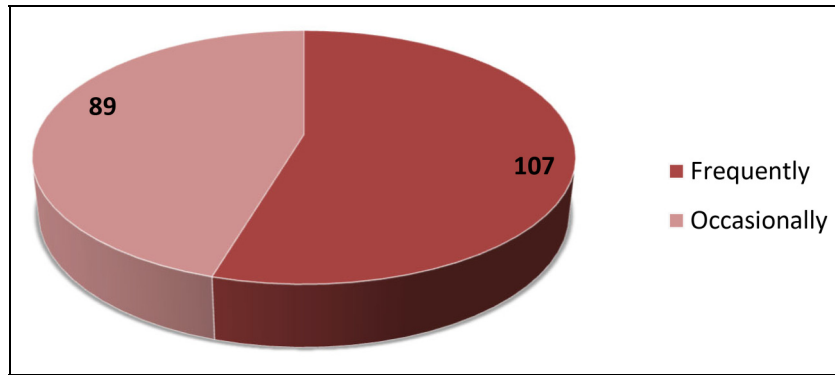


Figure 2. Frequency in using University Digital Library ($N = 196$). Source: Field Data (2023).

of digital library resource utilization. The results, as presented in Table 3, reveal a coefficient of $MS = 0.387998$, $t = -1.45939$, and $p < 0.146074$. Since p -value is greater than 0.05, results indicating that there is no a statistical significant difference between education level and the usage of digital library resources. Therefore, we reject the null hypothesis and conclude that education level does not have influence on the usage of digital library resources.

In this case, the statistical results confirm that differences in education level do not significantly impact how much or how often students utilize library resources. This means that education level does not directly influence library usage within the studied population as master's students have the same likelihood of using digital library resources as doctoral students. These findings contradict the earlier notion that master's students visit the digital library more frequently than doctoral students due to their regular assignments and tests they have.

User satisfactions in using university digital library

The study also sought to find out if users are being satisfied by university digital library when searching information for their studies or research purposes. The findings of the study show that the majority (97%) of the respondents were satisfied by university digital library, while few (3%) were not satisfied by university digital library as illustrated in Figure 3.

The results as indicated in Figure 3 clearly show that among the participated respondents in the study, a large number (191; 97%) of the respondents were being satisfied with the university digital library as they obtained almost all information they need. On the other hand, a marginal number (5; 3%) of the participated respondents were not satisfied with the

university digital library. The reason behind the un-satisfaction of few respondents could be due to digital divide as some of the students have low level of digital literacy which might cause them to not properly utilize digital technologies for searching and critically evaluating information. According to UTAUT model, users may develop behavior of using digital library resources only if they found it is easy to use and fulfills their needs.

These findings were statistically confirmed as indicated in Table 4 (mean = 1.0255, SD = 0.158, kurtosis = 35.147).

The findings in Table 4 show that the standard deviation (SD = 0.158) is close to the mean, indicating that most respondents expressed higher levels of satisfaction with the use of digital library resources. Additionally, the high positive kurtosis value (35.147) suggests the presence of extreme values or outliers in the satisfaction levels.

User perspectives on the library digitization

The respondents were further asked to state their perceptions towards digitization of library resources. As the results depict (Table 5) below, the majority (115) of the respondents who are studying master's degree have shown positive perceptions towards the usage of digital library resources, as compared to respondents (34) who are studying doctoral degree.

The results of the study, as presented in Table 5, reveal that the majority of respondents (149; 76%) have positive perceptions towards the digitization of library resources, while a smaller group (47; 24%) holds negative perceptions. This prevalence of positive perceptions among respondents could be attributed to the ease of using electronic resources. The study's model supports this, suggesting that users

Table 3. Statistical analysis (influence of education on the usage of dl).

Regression statistics									
Multiple R	0.104207891								
R ²	0.010859284								
Adjusted R ²	0.005760621								
Standard error	0.426817485								
Observations	196								
ANOVA									
	df	SS	MS	F	Significance F				
Regression	1	0.387997801	0.387997801	2.12983	0.146074				
Residual	194	35.34159404	0.182173165						
Total	195	35.72959184							
	Coefficients	standard error	t-Stat	P-value	Lower 95%	Upper 95%			
Intercept	1.369736428	0.094112174	14.55429591	6.37E-33	1.184122	1.555351			
Use of KazNU DL	-0.0893626	0.061232691	-1.459393576	0.146074	-0.21013	0.031405			

Source: MS Excel Output.

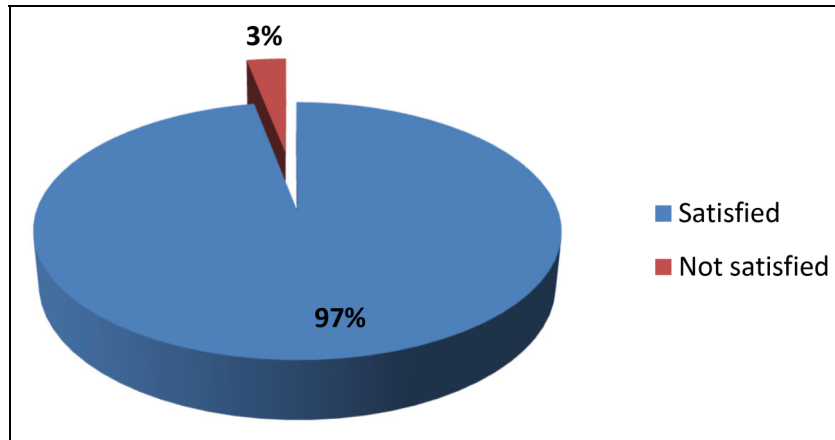


Figure 3. User satisfactions in using university digital library ($N = 196$). Source: Field Data (2023).

Table 4. Descriptive statistics on the satisfactions level.

Satisfactions level	
Mean	1.025510204
Standard error	0.011290893
Median	1
Mode	1
Standard deviation	0.158072508
Sample variance	0.024986918
Kurtosis	35.14685723
Skewness	6.065336076
Range	1
Sum	201
Count	196
Confidence level (95.0%)	0.022267946

Source: MS Excel Output.

are more likely to develop positive attitudes towards electronic resources if they find them easy to use. Additionally, the dominance of positive perceptions may be because these electronic resources meet the users' needs. This claim is supported by statements from two lecturers during the interview.

To be honest, I have positive perceptions towards the use of digital library resources. This is because whenever I wanted any information I can easily get it in our digital library and therefore it fulfills my needs. (Lecturer 2)

I have positive perceptions towards the use of digital library resources because it fulfills my needs, but more importantly our digital library enables me to have access of various academic materials found in other libraries within and outside the country. (Lecturer 3)

Table 5. User perspectives on the digitization of library resources ($n = 196$).

	Perception towards the usage of DL		
	Positive	Negative	Total
Level of Study			
Master's degree	115 (59%)	34 (17%)	149 (76%)
Doctoral degree	34 (17%)	13 (7%)	47 (24%)
			196 (100%)

Source: Field Data (2023).

The above comments imply that digital library resources were beneficial to users of library services.

Moreover, a comparison between master's degree and doctoral degree students indicates that most respondents with positive perceptions are master's degree students. A possible explanation for this could be that master's students tend to use library resources more frequently due to the numerous assignments and tests they have, which require regular reading. Lecturers often mandate the use of library resources for these assignments, encouraging students to utilize them regularly. Consequently, master's students develop positive attitudes toward library resources because they consistently find what they need. This notion is supported by the UTAUT model used in this study, which states that one factor contributing to positive attitudes toward the use of digital library resources is the encouragement from peers and lecturers, who promote regular utilization of these resources.

Furthermore, a statistical analysis (t -test) was conducted to determine whether age has a statistically

significant impact on perceptions towards the usage of digital library resources. As shown in Table 6, the mean for the age group (1.668367347) is significantly higher than the mean for perceptions (1.239795918). Additionally, the t-statistic (6.599663291) is well above the critical values (1.649982976 for one-tail and 1.967956506 for two-tail), indicating a statistically significant difference between age and perceptions towards the usage of digital library resources.

This finding suggests that younger users may have more favorable perceptions towards the usage of digital library resources compared to older users. This is supported by the UTAUT model used in this study, which posits that age significantly impacts the development of intentional behavior leading to the use of library resources. According to the model, younger users are more likely to develop intentional behavior towards using digital library resources than older users.

The impact of library digitization on the research capabilities

The study also sought to find out the existing impacts of library digitization on the research capabilities among users. Respondents were asked to agree or disagree on a number of statements on a Likert scale on impacts of library digitization on the research capabilities. Figure 4 summarizes the findings.

As depicted in Figure 4, a large proportion of respondents (102; 52% strongly agree and 66; 38% agree) agree that one of the impacts of library digitization on

the research capabilities is that it saves time in searching for information, whereas few (7; 4% disagree and 2; 1% strongly disagree) respondents disagree. Moreover, the majority of the respondents (147; 75% strongly agree and 35; 18% agree) also agree that another impact of library digitization on the research capabilities is that information can be accessed at fingerprint, while few (3; 2%) respondents disagree. Furthermore, a large number of respondents (160; 82% strongly agree and 27; 14% agree) again agree that the other impact of library digitization on the research capabilities is that a single document can be used by many users at once, though few respondents (1; 0.5%) disagree. Additionally, most of the respondents (104; 53% strongly agree and 72; 37% agree) agree that another impact of library digitization on the research capabilities is that it increases collaboration as scholars from different parts of the world can easily access information and collaborate online, whereas few respondents (2; 1%) disagree. Also, most of the respondents (93; 47% strongly agree and 54; 28% agree) agree that the other impact of library digitization on the research capabilities is that with full-text indexing and keyword searching, it empowers scholars to explore materials comprehensively, while 4 (2%) respondents disagree. Together with data from questionnaires, results from interviews indicate that respondents were more optimistic on the impact of library digitization, as the following comments indicate:

Digital library has a lot of impact to me as a researcher because with it I can easily access any information I want anywhere. There is no need for me to visit the physical library. (Lecturer 4)

I can say digital library impacted me and maybe all scholars because in a traditional library it happened we have to wait for a certain book which was borrowed by another user. But now, a single book or any electronic material can be used by many users at once. (Lecturer 5)

Table 6. The influence of age on the perception level.

t-Test: two-sample assuming unequal variances

	Age group	Perception of DL
Mean	1.668367347	1.239795918
Variance	0.643301936	0.183228676
Observations	196	196
Hypothesized mean difference	0	
df	298	
t-Stat	6.599663291	
P(T<=t) one-tail	9.41304E-11	
t Critical one-tail	1.649982976	
P(T<=t) two-tail	1.88261E-10	
t Critical two-tail	1.967956506	

Source: MS Excel Output.

The above comments imply that researchers valued digital library services as they facilitated information access towards accomplishing research undertaking more conveniently and efficiently. The findings are supported by the UTAUT model, as the majority of respondents have positive perceptions and believe that digital library resources significantly benefit their studies and research. Most of the library resources are easy to use, meet their needs, and simplify the process of accessing information. As a result, they develop a habitual use of digital library resources.

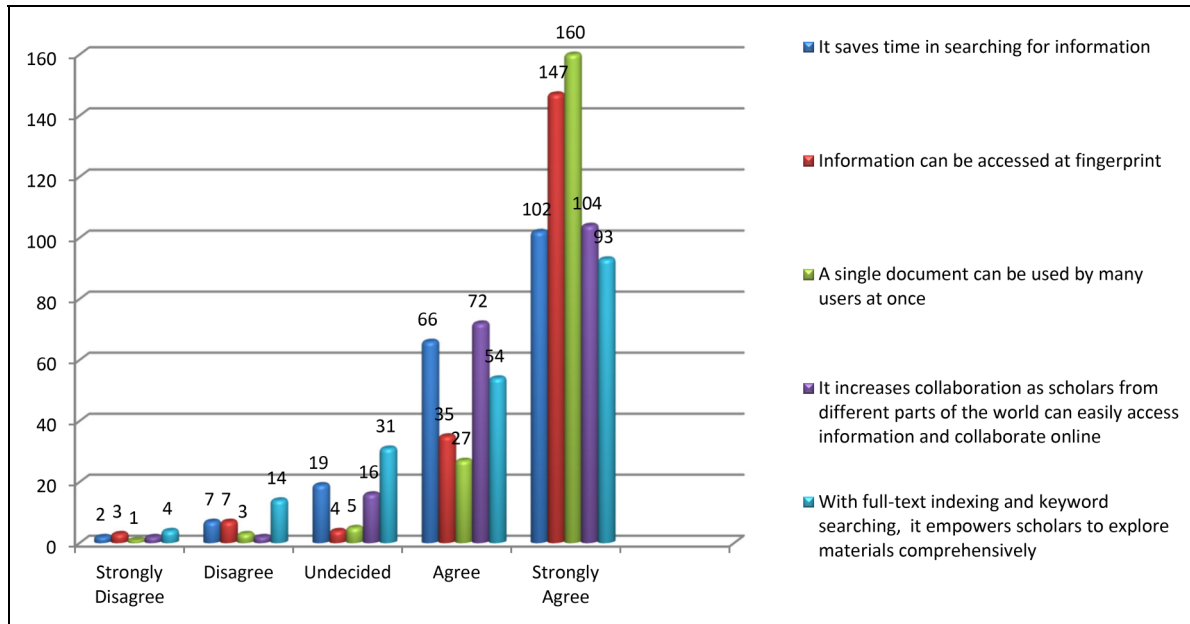


Figure 4. Impact of library digitization on the research capabilities ($N = 196$). Source: Field Data (2023).

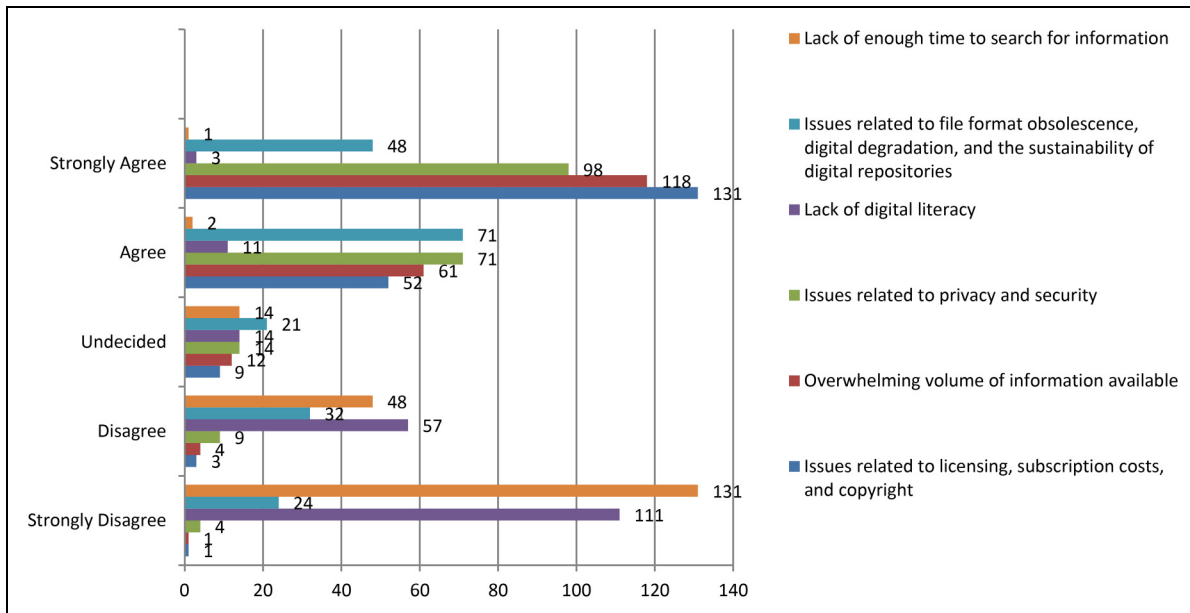


Figure 5. Challenges faced by users in utilizing digitized library resources ($N = 196$). Source: Field Data (2023).

Challenges or barriers faced by users in utilizing digitized library resources

Also, the study further sought to find out challenges or barriers faced users in utilizing digitized library resources. Respondents were also asked to agree or disagree on a number of statements on a Likert scale on the challenges users faced in utilizing library resources. Figure 5 summarizes the findings.

As illustrated in Figure 5, most of the respondents (131; 67% strongly agree, and 52; 26.5% agree) agree that issues related to licensing, subscription costs, and copyright is one of the major challenges users face in utilizing digitized library resources, while 1 (0.5%) respondent disagree. Also, a large number of respondents (118; 60% strongly agrees, and 61; 31% agree) also agree that overwhelming

volume of information available is another challenge user's face in utilizing digitized library resources, whereas 1 (0.5%) respondent disagree. Besides, a reasonable number of respondents (98; 50% strongly agree and 71; 36% agree) agree that issues related to privacy and security as the other challenge user's face in utilizing digitized library resources, whereas 4 (2%) respondents disagree. On the other hand, few (3; 1.5%) respondents agree that lack of digital literacy is one of the major challenge user's face in utilizing digitized library resources, whereas the majority (111; 56.6%) disagree. Moreover, the large number of the respondents (71; 36% agree and 48; 25% strongly agree) agree that issues related to file format obsolescence, digital degradation, and the sustainability of digital repositories is among the major challenges user's face in utilizing digitized library resources, while 21 (11%) respondents were undecided. Lastly, only 1 (0.5%) respondent agree that lack of enough time to search for information is among the major challenges user's face in utilizing digitized library resources, whereas the majority of the respondents (131; 67%) disagree. In addition to the above, interview results came up with additional challenges as stated by respondents below:

One of the challenge which I always face when utilizing digital library is that, sometimes I find a useful material but it's not for free so it needs me to purchase. So, sometimes I can afford to purchase but sometimes I can't. (Lecturer 6)

I think the major challenge to me when utilizing digital library resources is the issues related to subscriptions and copyright. To be honest this act as a barrier when conducting my researches because there are many useful materials found in various journal but they need us to purchase. So, not all the time I can manage to purchase. (Lecturer 7)

From the above comments, one can note that despite their benefits, digital library resources have access issues due to copyright and license restrictions, making them hard to utilize.

Discussion of the findings

The findings indicate that the majority of respondents frequently use digital library resources for their studies and research. Statistical analysis ($MS = 0.387998$, $t = -1.45939$, $p < 0.146074$) shows no significant difference between education level and the frequency of digital library resource usage. The high usage among

students can likely be attributed to strong and reliable internet connectivity, which enables them to effectively access the information they need. Additionally, social factors, such as assignments given by lecturers, may also contribute to this frequent use of digital resources. According to the UTAUT model, for individuals to develop a positive attitude toward using digital library resources, they must perceive these resources as easy to use. Social influence also plays a critical role—encouragement from peers and lecturers, such as requiring the use of digital resources for assignments, significantly influences students' adoption of digital library resources.

The majority of respondents expressed positive perceptions toward the use of digital library resources. Statistically, the t -statistic (6.599663291) is significantly above the critical values (1.649982976 for one-tail and 1.967956506 for two-tail), indicating a significant difference between age and perceptions of digital library resource use. Several factors may explain this. One key factor is the perceived ease of use; when users can easily access the information they need, they are more likely to have a positive perception of the digital library. Another factor is the availability of strong and reliable internet connectivity, which enhances the user experience. The positive perceptions reported by most respondents may also suggest that the digital library resources are user-friendly, encouraging users to develop favorable attitudes toward them. Furthermore, many students likely possess adequate ICT skills, which contribute to their positive perceptions and frequent use of digital resources. This is supported by the UTAUT model used in this study, which suggests that individuals are more likely to develop positive attitudes or perceptions toward digital resources if they find them easy to use and user-friendly. These factors—ease of use and the richness of available resources—play a critical role in influencing users' behavior, whether they use digital library resources frequently or occasionally.

Digital library resources have impacted users in various ways. Most respondents highlighted the ability for a single document to be accessed by multiple users simultaneously and the convenience of accessing information instantly as major benefits of library digitization for their studies and research. In today's digital era, libraries are no longer viewed solely as physical buildings. Many academic libraries globally are working to ensure that their users can easily access information anytime and anywhere.

The availability of information at the users' fingertips demonstrates the strong commitment of library management to provide resources on-demand, regardless of location. This aligns with the UTAUT model, which emphasizes the importance of a robust technological infrastructure in enabling easy access to digital library resources. Such infrastructure not only increases usage but also fosters positive attitudes and perceptions toward digital library resources.

Despite the numerous benefits of digitizing library resources, users still face several challenges when utilizing digital library resources. Many respondents pointed to issues such as licensing restrictions, subscription costs, copyright limitations, and the overwhelming volume of available information as key challenges. One contributing factor is the digital divide, as some students may lack the skills to critically evaluate the information they access online. In an age of information overload, it's essential not only to access information but also to assess its credibility, as misinformation can easily arise from unverified sources. Another significant challenge is the restrictions imposed by copyright laws, which limit how users can engage with digital resources. Copyright issues are a global concern and addressing them—particularly by promoting open access—could improve the proper and widespread use of digital library resources. Additionally, while libraries make every effort to subscribe to valuable digital resources, financial constraints sometimes prevent them from renewing subscriptions when they expire. This can place a burden on users, as they may lose access to critical resources still needed for their studies or research.

Conclusion and recommendations

Based on the findings of the study, digitization of library resources is of paramount importance to students, lecturers and researchers for the successfulness of their studies and research. The majority of respondents have positive perceptions towards digitization of library resources. Moreover, digitization of library resources has a lot of benefits to its users including the capacity of a single document to be used by many users at once and information to be accessed at a fingerprint. Despite the presence of numerous benefits of digitization of library resources to users, there are challenges that face users when utilizing digital library resources. Among the major challenges include issues related to licensing, subscription

costs, and copyright and overwhelming volume of information available. The study concludes that, students have positive perceptions on the usage of digital library resources with a significant difference between age and perception towards the use of digital library resources. So, to increase the usage and for a digitization of library resources to be fruitful, all challenges that impede effective accesses of information should be overcome. The study therefore recommends continuous training to students that will help them to critically assess and evaluate the overwhelming amount of online information. Users should also be trained on how to navigate copyright issues when accessing digital library resources. Additionally, libraries should consider expanding their collections by incorporating more open access resources. Moreover, parent institutions should make sure that they increase the budget to their digital libraries so that libraries can increase the subscriptions of all useful resources.


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ORCID iD

Martin Elihaki Kanyika  <https://orcid.org/0000-0002-1187-4040>

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About the authors

Martin Elihaki Kanyika is an Assistant Lecturer at the Eastern Africa Statistical Training Center in Dar es Salaam, Tanzania. He holds a BA (Hons) and MA in Information Studies from the University of Dar es Salaam. Currently, he is pursuing a PhD at Al-Farabi Kazakh National University in Kazakhstan, with a focus on Library Information Systems. His research interests include innovative technologies in libraries, open access, institutional repositories, digital literacy, and digitization.

Raikhan Sadykova is an Associate Professor at the Faculty of History of Al-Farabi Kazakh National University. She graduated from the Faculty of International Relations of Al-Farabi Kazakh National University. She defended her candidate degree dissertation and currently works with PhD degree (candidate). Her research areas: the history and development of library sciences, contemporary problems and actual issues of world history. She has more than 100 publications in Kazakh, Russian, English and Turkish.

Kalima Tuyenbayeva is a Professor at the Faculty of History of Al-Farabi Kazakh National University. She holds a MSc and PhD in Library Information Systems from the Al-Farabi Kazakh National University. Her research areas of interest include the history and development of library sciences, and application of digital technologies in libraries. She has several publications related to information and library science in Kazakh, Russian, English and Turkish languages.

Evans Wema is a Senior Lecturer working at the University of Dar es Salaam, Information Studies Program. He is a specialist in ICTs for libraries, records and archival institution. His areas of specialization include automation for records and archives, web design and authoring and database management systems. He has written a number of articles in the areas of records management, archives and information retrieval.