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Research Article

Examining Digital Library in Education: A Systematic Literature Review

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ABSTRACT

The current research is a systematic literature review examining the digital library research in education. Based on 17 selected publications based on the PRISMA protocol, the definition of digital library is not a static concept but has evolved from the technical functional perspective to the socio-pedagogical and innovative experiential perspective. In this conceptual evolution, there is a contradictory feature: the digital library is not only about technical features but also the capacity to provide equitable access to knowledge that can be afforded across different socio-economic landscapes. In terms of the evaluation in the digital library, researchers focus on the user experience perspective. The data show three evaluative domains, namely technical performance as a foundation for satisfaction, psychological and behavioural indicators and pedagogical and ethical value. This conceptual evaluation retains a contradictory pattern where the evaluation should not only result in a better system but also be able to maintain the performance to benefit users. Furthermore, the existing research in digital libraries focuses on three pillars, namely service performance and technical governance, user behavioural patterns, and data integrity and knowledge management. The contradictory pattern in this case is the existing research pushing toward immersive use of technology but retaining a question regarding the data integrity and authenticity.

Keywords: Digital Library, Digital Content, Digital Literacy, Education.

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INTRODUCTION

This study uses the systematic literature review method by collecting scientific literature sources related to the research theme. The questions raised in this study are the conceptual evolution, conceptual evaluation based on user perspective and the landscape of the existing research on digital libraries in education. This study uses three international databases, namely (1) ProQuest, (2) ScienceDirect, and (3) SageJournals. The three databases indexing provides access to international scientific articles in full text. Articles collected from all database indexing are then checked against the publisher's identity to determine their registered status in SCOPUS.

METHODOLOGY

The number of reference sources in electronic scientific articles is enormous. Therefore, the focus of data collection is emphasised on articles relevant to this study's objectives. Published scientific articles are the priority sources used, but there is a limitation on the year of publication, namely a minimum of 10 years (January 2014 - July 2024). The second criterion is that articles that are prioritised are published in English. The scope or focus of the article is limited to the field of digital libraries, while articles in other fields are only additional if needed. The inclusion and exclusion criteria in this study are explained in Table 1 below:

The Systematic Review was done through PRISMA protocol that include identification, screening, eligibility, and inclusion (Pradana and Elisa, 2023). PRISMA can present a visualisation of a study's inclusion and exclusion criteria. The presentation of PRISMA in this study is described in Figure 1.

The synthesis section in this study describes summaries of the findings that appear in the articles used as research reference sources. This research synthesis is carried out in two ways: telling the findings and displaying the evidence obtained in descriptive tables. An important note in synthesizing reference sources is

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that tabulation is carried out only on essential points relevant to the research objectives. The synthesis results are presented in the form of a report in the research discussion section. Recordings of article descriptions used to describe the answers to the research objectives are explained in Table 2.

RESULTS

The current research aims to systematically investigate the digital library in education. The analysis focuses on three aspects, namely the conceptual evolution of digital libraries in education, conceptualising evaluation based on User Experience (UX) philosophy, and mapping the research landscape: strategic pillars and objectives. The detail finding can be seen in Table 2.

The Conceptual Evolution of Digital Libraries in Education

The systematic analysis of the selected publication revealed the definition of a digital library is not static; rather, it has evolved from a technical repository into a complex socio-technical environment. In this case, the digital libraries are conceptualised into three perspectives, namely the technical-functional perspective, the socio-pedagogical perspective and the innovative-experiential perspective.

In terms of functional perspective, a digital library is defined as a digital service system providing search features for digital collections such as books, slides, printed photos, manuscripts, maps, and audio-visual materials (Murphy *et al.*, 2021). It is in accordance with González *et al.*, (2022) definition that a digital library is seen as a service that is used to expand students' learning materials by becoming a database for essential resources. Through this feature, the digital library has a central role in digital scientific publishing literacy (Ciro 2021) and as a medium for task completion (Hu, 2018) as students demand a wide literature search for their academic purpose.

In terms of the socio-pedagogical perspective, the definition of digital literacy is not merely about what the system is, but what the system does for the students and the teachers. The perspective on digital literacy has shifted to a more modern aspect where a digital library is not merely a collection of data but an environment that brings together people and services to transform information into knowledge. Xu and Bai (2022) defined digital literacy as not only related to a collection of data with its managerial system but also related to the user satisfaction and fluffiness in acquiring the intended reference. A digital library should be concerned with user satisfaction, as it's not a database only but also a medium to acquire the required information (Hu, 2018). Other than that, the digital library has been viewed as a component of information science education, covering the collaborative aspect of computer science and social management, making the digital library a central part in the curriculum integration (Audunson and Shuva, 2016). Moreover, the definition has expanded to include the library's role in scientific publishing literacy, particularly in helping users to identify predatory publishing practices and ensuring the authenticity of machine-generated versus human-generated text (Ciro, 2021).

Other than that, emerging research defines the digital library through the lens of advanced user experience and immersive technology. For instance, a digital library is defined as a part of information science that collaborates on several aspects, such as computer science, management, and social (Audunson and Shuva, 2016). AalYateem and Hameed (2015) emphasised this by defining a digital library as the collection of digital material which utilises digital technology to develop the digital services. Alotaibi *et al.*, (2022) also assert that the library should follow the technological development so it can keep assisting teachers and students throughout their learning. It is to make sure that the digital library is up to date and able to provide the needs of the pedagogical aspect. Furthermore, digital library services can be innovated in aspects such as providing 360-degree virtual tours, digital chats with librarians, digital collections, remote services, and so on (Murphy *et al.*, 2021).

Based on the conceptual evolution of the digital library definition, there is still a contradiction between social equity and technological advancement. As Murphy *et al.*, (2021) and Sediyaningsih *et al.*, (2023) articulate the digital library as the technological ceiling, other scholars like Mengstie and Sendek (2023) emphasised the social floor. They emphasised that the functional definition of a digital library is tied to the economic family status, as the benefits of these platforms are only accessible to those who can afford the necessary hardware and internet connectivity. It drives the concern within the policymakers and cross-disciplinary aspect that a digital library should not be defined simply by its technical features but also by its capacity to provide equitable access to knowledge that can be afforded across different socio-economic landscapes.

Conceptualizing Evaluation: A User Experience (UX) Philosophy

In terms of digital library evaluation, the selected data indicates that evaluation in digital libraries has moved from the basic concept of evaluating libraries into a multi-dimensional assessment of users' experiences. This "UX Philosophy" can be categorised into three evaluative domains, namely technical performance as a foundation for satisfaction, psychological and behavioural indicators and pedagogical and ethical value.

In terms of technical performance as a foundation for satisfaction, evaluation in the digital library is depicted to be rooted in technical reliability. For instance, the utilisation of the Quality-of-Service (QoS) framework to assess the performance has a direct impact on how the end-user perceives and is satisfied with the library (Ahmad and Abawajy, 2014). Other than that, the use of Service Level Agreements (SLAs) became the formal effort to

maintain high service quality, emphasising that the library attains its operational commitments to the users (Ahmad and Abawajy, 2014b). Xu and Bai (2022) clearly stated that the systemic evaluation, such as data mining systems, information quality and the moderation of user preferences, is particularly aimed at making sure the system effectiveness fits with the use intention.

The psychological and behavioural indicators indicate how the evaluation in the digital library covers the invisible factor of user mindset and behaviour. In this case, evaluation of the digital library emphasises the user perception, which is assessed through a complex set of parameters of interaction services, individual services and information organisation (Muqtadiroh *et al.*, 2019). The evaluation focuses on securing a long-term user commitment by measuring the user loyalty, the tangible benefit for the user, and the overall usage system pattern (Nitu and Dascalu, 2024). Furthermore, with the rise of artificial intelligence, the evaluation can now span into the perceived interaction and perceived user convenience, moving from evaluation that measures user comfortability within the virtual library spaces (Sediyaningsih *et al.*, 2023).

The last conceptualisation of evaluation in a digital library is related to the aspect of pedagogy. It related to how the UX philosophy evaluates the library's contribution to the wider educational mission and intellectual integrity. The success of the evaluation is defined by the library's ability to become an environment that brings together people and services of interest in order to create information flow for knowledge acquisition (Xu and Bai, 2022). Divayana *et al.*, (2019) emphasised that the success of a digital library is seen in how effective it is and its implication for the educational field. Ciro (2021) also stated that digital libraries, as sources of knowledge and information, are mandated to deliver true knowledge that has the ability to mitigate predatory publication and ensure the authenticity of the content consumed by the user.

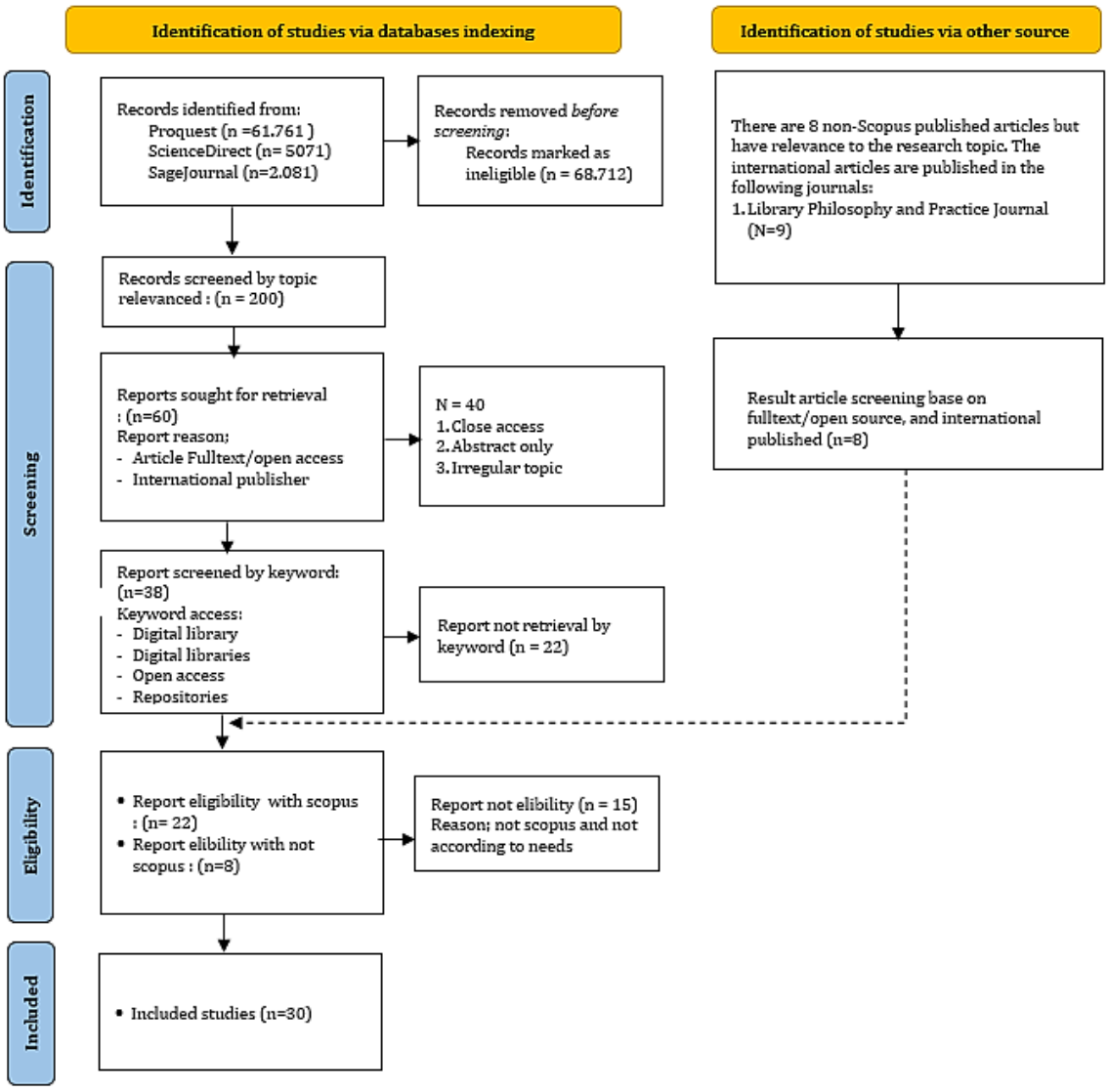

Figure 1: PRISMA Flow Diagram.

Table 1: Inclusion and Exclusion Criteria.

Criteria	Inclusion	Exclusion
Date	The Publication period starts from January 2014 - July 2024	Period Before January 2014 (if a needs)
Language	English	others
Types of manuscript	Published scientific journal articles and international conference articles	Book chapter, book, thesis, dissertation, and article journal publish in Indonesia
Context	Digital library (education)	Other disciplines
Topic	Digital library in education	Topic others which relevance with research goals
Access	Open access (fulltext)	Close access (abstract only)
Keyword focus	"Digital library in education"	Keyword others which context relevans
Published identifier	Digital Object Identifier (DOI)	URL link

However, the data indicate a contradictory pattern on the standardised excellent (QoS/SLA) with the perceived quality in the sphere of digital library evaluation. While Ahmad and Abawajy (2014) argue for the rigorous technical model, Hu (2018) stated a significant contradiction where the digital library provides user satisfaction in task completion, but they continue to cause concern about the high cost for the user to afford the service. It indicates that the technical aspect of the library may fail to satisfy user experience when they are not financially able to access the services. In the research aspect, it shifts the focus to not only just building better systems but also bridging the gap between systemic performance and equitable human benefit. It emerged in the discussion on which aspect should be the focus of the digital library evaluation, namely, emphasising the system utility or the concern for the availability of the sources for the wider user community.

Mapping the Research Landscape: Strategic Pillars and Objectives

The third aspect revealed in the current research is the landscape of research in digital libraries. The selected data indicate the transition in research focus from how to build to how to transform the digital library in an educational context. The identified research objective on the selected publication can be conceptualised into three main pillars, namely service performance and technical governance, user behavioural patterns and immersive integration, and data integrity and knowledge management.

The first pillar is service performance and technical governance. The existing research on digital libraries focuses on the formal commitment of the digital library provider in maintaining the evaluation framework, operational commitment, and maintenance and optimisation. For instance, Ahmad and Abawajy (2014) focus on developing a digital library service evaluation model through the Quality of Services model, Ahmad and Abawajy (2014b) focus on developing a Service Level Agreement (SLA) model and outlining commitments from digital library service providers, and Divayana *et al.*, (2019) proposed an overview of the effectiveness of the evaluation of the application used to evaluate and optimise the digital library services. Furthermore, Murphy *et al.*, (2021) explore the digital library development during the covid-19 pandemic. It is to adapt to the current condition as sectors are shifted and transformed as the result of the covid-19 pandemic. Other than that, research by AalYateem and Hameed (2015) compares several digital libraries from several universities, focusing on the advantages and disadvantages as well as the maintenance aspect of the libraries. Therefore, research on digital libraries inclines to the commitment to maintain the evaluation procedure in digital libraries in order to maintain the performance and services.

The second pillar related to the user's behavioural pattern and immersive integration. Not merely on the technical aspect, the research objective has shifted into understanding the psychological and behavioural pattern of users. In this case, research has focused on systematically evaluating digital libraries from a user perspective (Hu, 2018). For instance, Alotaibi *et al.*, (2022) explore information search behaviour and analyse and compare factors that influence indexing engines. Similar research was conducted by González *et al.*, (2022) aimed at exploring students' patterns of digital technology utilisation and learning approaches. Other than searching behaviour, the research also focuses on exploring the adoption factors, or the reasons for using the digital library. For example, Muqtadiroh *et al.*, (2019) research focuses on exploring factors that influence university students in using digital libraries. Riady *et al.*, (2023) even model the factors that influence the system usage, user satisfaction benefits, and user loyalty to digital library services.

The third pillar is about the data integrity and knowledge management. This pillar emphasises the mechanical and ethical aspects of the information stored within these systems. For example, Topçu *et al.*'s (2014) research explains the process and limitation of data standardisation in digital libraries. It is to make sure of the availability and quality of the stored data. Similar to that, Riady *et al.*'s (2023) research focuses on ensuring the

Table 2: Study Characteristic Included in Meta Analysis.

Authors	Aim research focus	Methods	Definition and concept
aalYateem and Hameed (2015)	Comparing digital repositories from several Arab universities Highlighting the advantages and disadvantages of digital repository maintenance aspects.	Qualitative (Comparative analytical study)	Repository is part of digital-based university library services. Digital repository is a digital service system that provides search features and has international language support Libraries collect and digitize collections such as books, slides, printed photos, manuscripts, maps, and audio-visual materials using digital technology to develop digital services.
Ahmad and Abawajy (2014)	Developing a digital library service evaluation model.	Research and development	Quality of service is used to evaluate digital libraries so that it has a direct impact on end-user perception and satisfaction. The QoS (Quality of Services) model is used as a material for evaluating digital library performance.
Ahmad and Abawajy (2014b)	Developing a Service Level Agreement (SLA) model and outlining commitments from digital library service providers.	Research and development	Service Level Agreement (SLA) is used in an effort to implement QoS in digital library services.
Alotaibi *et al.*, (2022)	Exploring information search behavior and analyzing and comparing factors that influence indexing engines and Google.	Quantitative (survey-based model)	Digital libraries must follow changing technology trends. Teachers must use digital libraries in learning to familiarize students with the DL system.
Audunson and Shuva (2016)	Exploring the status of digital library education from curriculum, future potential and competition among library science schools.	Survey (Quantitative Methods)	Digital libraries are part of the library information science curriculum LIS education comprises many collaborative aspects such as computer science, management, and social.
Ciro (2021)	Outlines the challenges librarians face in addressing digital publishing predators.	Survey (Quantitative Methods)	Libraries have a role in digital scientific publishing literacy practices Librarians have skills in open access but are weak in identifying predatory scientific publishing.
Divayana *et al.*, (2019)	Provides an overview of the effectiveness of evaluation applications used in evaluating the optimization of digital library services in higher education.	Research and Development (Borg and Gall Design)	The implementation of digital library services in higher education is considered effective and has implications for the field of education.
González *et al.*, (2022)	Exploring students' patterns of digital technology use and learning approaches	Qualitative methods	The use of digital devices such as digital libraries is used to expand student learning materials.
Hu (2018)	Systematically evaluating digital libraries from a user perspective	Mixed method (Exploratory methods)	Digital libraries support user task completion Digital libraries provide satisfaction to users but also still cause concerns and high costs.
Mengstie and Sendek (2023)	Investigating equity of access to government-owned digital learning platforms for Primary and Secondary School students in Ethiopia	Quantitative methods	Digital libraries and distance learning programs via mass media benefit students from economic families who can afford computers, laptops, televisions, and so on Digital learning technology benefits students who have the facilities to access digital media.

Authors	Aim research focus	Methods	Definition and concept
Muqtadiroh *et al.*, (2019)	Finding factors that influence students of Institut Sepuluh November Surabaya in using digital libraries.	Quantitative methods	Factors that influence students' perceptions of digital libraries can be viewed from six parameters, namely user perceptions, interaction services, individual services, information search services, information provision services, and information organization services.
Murphy *et al.*, (2021)	Exploring digital library development during the Covid-19 pandemic	Qualitative (Literature review)	The development of digital libraries must be followed by the utilization of skills, platforms, expertise, and capital provided for digital services to provide user experience. Digital library services can be innovated, such as providing 360-degree virtual tours, digital chats with librarians, digital collections, remote services, and so on.
Riady *et al.*, (2023)	Modeling factors that influence system usage, user satisfaction, benefits, and user loyalty to digital library services.	Quantitative (Survey methods)	Text in digital library content created by artificial machines tends to have high complexity, while human-generated text shows more diversity.
Nitu and Dascalu (2024)	This research focuses on ensuring the authenticity of text in content published in digital libraries.	Quantitative (Eksperimental tesktual)	Digital libraries can be assessed for quality based on criteria such as user satisfaction, system usage, benefits provided, and user loyalty.
Sediyaningsih *et al.*, (2023)	Investigating factors influencing intention to use metaverse technology in digital library services	Quantitative methods	User intention to use metaverse technology in digital libraries is influenced by perceived system usage, perceived interaction, perceived usefulness, and perceived user convenience.
Topçu *et al.*, (2014)	This study aims to explain the process and limitations of data standardization in digital libraries.	Qualitative Literature review	Collecting data from various content sources is an essential step in a digital library project. Therefore, standardization of the data used is necessary.
Xu and Bai (2022)	This study aims to explain large-scale data addition to improve digital libraries.	Qualitative Literature review	Digital libraries are not just collections of data with information management but an environment that brings together collections, services, and people to support the entire flow of data, transforming information into knowledge and from creation to dissemination Moderation of user preferences, quality of data mining systems, quality of information, quality of service, and feedback have an impact on user satisfaction with digital library information services.

authenticity of text in content published in the digital libraries. In terms of the data availability, Xu and Bai's (2022) research focuses on explaining how large-scale data can be inputted to the digital libraries system, and Mengstie and Sendek's (2023) research even focuses on investigating the access to government-owned digital learning platforms for primary and secondary school students. Therefore, the existing research on digital libraries emphasises the data quality and knowledge management of the digital library system.

CONCLUSION

Based on the research landscape in the existing literature, an aspect needs to be deeply investigated: while the existing research is pushing toward immersive use of technology such as AI and the metaverse, which can increase user engagement, there is a simultaneous and contradictory concern regarding the integrity and authenticity of the data within those spaces (Sediyaningsih *et al.*, 2023; Nitu and Dascalu, 2024). It emerges as a challenging research concern for future research as the possibility of digital libraries adopting more complex and immersive technology. The question that emerged is how can they maintain the rigorous data

standardisation and ethical authenticity required for academic credibility?. Further research needs to consider this aspect as it relates to the policymaking process to balance the integrity and equity as well as innovation in the digital library system.

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ABBREVIATIONS

DL: Digital Library; **SLR:** Systematic Literature Review; **PRISMA:** Preferred Reporting Items for Systematic Reviews and Meta-Analyses; **UX:** User Experience; **QoS:** Quality of Service; **SLA:** Service Level Agreement; **AI:** Artificial Intelligence; **LIS:** Library and Information Science; **DOI:** Digital Object Identifier; **LLM:** Large Language Model.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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