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The Implementation of Library Services in A Digital School: A Case Study at SMAN 1 Geger Madiun

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ABSTRACT

Background: The evolution toward "Digital Schools" has permanently repositioned school libraries as the potential nexus of the institutional information ecosystem. However, for libraries with established digital identities, the transition from analog-centric services to fully integrated digital ecosystems remains a complex institutional challenge.
Purpose: This case study assesses the service models, adaptation strategies, and systemic obstacles involved in incorporating digital library services at SMAN 1 Geger Madiun, specifically focusing on its transition into a digitally unified institution.
Methods: Utilizing a qualitative case study methodology, data were gathered through in-depth interviews, focus groups, and field observations involving librarians, educators, students, and IT personnel. Thematic analysis was applied within the framework of Calhoun's Digital Transformation, focusing on interoperability, service adaptation, and long-term sustainability.
Findings: The study indicates that the digital library model remains fragmented and "underdeveloped." A critical lack of interoperability exists between the school's RFID system and the library's manual user-access protocols, preventing a unified ecosystem. Despite these hurdles, the library has implemented adaptable "dual-access" models (stationary and portable) and diversified procurement through grants and perpetual licenses. However, progress is significantly stalled by a deficit in human resource digital literacy and inadequate data protection frameworks.
Originality/Value: The library's digital services still act as a separate entity from the school's digital ecosystem. This entails that the services offered by the library need to be integrated with the school's digital ecosystem. From an institutional perspective, this overwhelmingly points to the need for policies that prioritize an interdisciplinary approach to systems integration, the sustainability of personnel, and the protection of informational data.

Keywords: Library service; Digital library; Library management system

1. INTRODUCTION

Advances in information technology have generated both significant opportunities and complex challenges for educational institutions worldwide, including senior high schools. The

ongoing digital transformation of education is reshaping pedagogical practices, learning environments, and the provision of information services, fostering greater accessibility, interactivity, and efficiency. Nevertheless, cross-national experiences indicate that the implementation of digital learning policies is neither linear nor universally effective; rather, it requires careful calibration to local educational contexts, infrastructural readiness, and pedagogical needs. For instance, Sweden, a country that has actively promoted digital-based learning since 2009 has, through recent policy evaluations, re-emphasized the importance of printed textbooks, with reforms projected to take effect by 2025. This development underscores the necessity of maintaining a balanced and context-sensitive approach to educational digitalization (Akil, 2025). This phenomenon demonstrates that technology integration in education is not simply about accelerating digitalization but requires a balance between innovation and learning effectiveness.

In the Indonesian context, the trajectory of digital transformation in education is further shaped by the dynamics of information disruption and generational shifts in technology use. The rapid proliferation of digital platforms, algorithm-driven content, and real-time information flows has fundamentally altered how knowledge is produced, accessed, and validated. Within this environment, Generation Z, often characterized as digital natives demonstrates high levels of technological fluency, multimodal literacy, and a preference for interactive and on-demand learning experiences. In contrast, many educators continue to occupy the position of digital immigrants, having adopted technology later in life and often exhibiting differing levels of digital competence, pedagogical adaptation, and critical engagement with emerging technologies (Abad-Segura et al., 2020; Yuliandari et al., 2023). Therefore, the transformation of digital library services in senior school should be designed adaptively, taking into account user readiness and the desired pedagogical goals.

It has contributed to the emergence of 'digital schools' as a technology-assisted education delivery model (Ilyasa et al., 2024; Sulisworo et al., 2020) and provides more flexible and adaptive learning (Kurniawan et al., 2024; Ayu et al., 2023). In contrast, the transformation of educational content in Indonesia is still a work in progress. The Swedish policy phenomenon illustrates challenges in educational digitalization, such as the digital divide, which ignores the absence of digitally competent older teachers (Frolova et al., 2020) and pedagogical, administrative, and technical complexities (Håkansson Lindqvist & Pettersson, 2019).

The discourse on “digital schools” often represents optimism about technology-based educational transformation. However, practical implementation reveals a significant gap between the conceptual vision and operational reality. This gap is influenced by systemic barriers, such as unequal access to digital resources among students, limited teacher competency and training in utilizing learning technology, and education policies that are not yet fully adaptive to the dynamics of technology integration in the classroom (Ismail, 2015; Malizal & Rizqi, 2023).

Most studies tend to discuss the implementation of technology in learning or the digitization of library services separately, without analyzing how digital library services are systematically integrated into the design and governance of schools that promote their identity as digital schools. Thus, there is a research gap at the conceptual and practical levels regarding the formulation of a strategic integration model for digital library services within the digital school ecosystem at the secondary education level.

Previous research shows that digital library services have undergone significant transformations along with the development of technology-based learning ecosystems. Several studies emphasize the urgency of integrating libraries with digital learning (Abuzaid & Singh, 2021), utilizing big data for user-oriented services (Li et al., 2019), and through the use of various supporting technologies such as RFID (Wang & Ding, 2022), *blockchain* and robotics (Pratik, 2024), *the Internet of Things (IoT)*, and *cloud computing* (Ayuningtyas, 2023). Case studies in the context of Indonesian senior high schools have also mapped specific implementation models, such as at SMAN 2 Mataram (Pramesti & Haq, 2024) and SMA Negeri Bali Mandara (Budi, 2022), as well as managerial strategies to promote student literacy (Wasilah et al., 2025). However, these studies consistently identify similar challenges, namely budget constraints, HR skills gaps, dependence on internet infrastructure, and resistance to change (Budi, 2022; Santosa et al., 2022; Wasilah et al., 2025).

Digital technology in secondary education increases student engagement and achievement, though challenges like unequal access and limited teacher proficiency persist (Abildinova et al., 2024). Yet, the role of school libraries within this digital landscape is largely underexamined, particularly concerning their strategic integration into daily learning and the development of digital schools (Nafisah, 2022; Neves et al., 2020; Newsum, 2016).

This study is theoretically anchored in the digital library transformation framework advanced by Swiatek (2014), which delineates four foundational imperatives: system interoperability, community-oriented service provision, the governance of intellectual property rights, and long-term service sustainability. This framework is further reinforced by the conceptualization of library spaces as socio-institutional infrastructures of engagement, encompassing learning spaces, makerspaces, and participatory environments, alongside critical considerations surrounding digital collections, including capital investment, technological compatibility, and copyright regulation (Fahriyah, 2023).

Within this analytical lens, the institutional articulation of "Digital School" at SMAN 1 Geger Madiun signifies not merely a symbolic designation but a strategic reconfiguration of educational governance toward technology-mediated ecosystems. Institutional accounts indicate that this transformation is operationalized through the integration of instructional systems, academic administration, and information services, wherein digital library development functions as a pivotal infrastructural component. Consequently, the integration of digital library services assumes a strategic role in mediating access to knowledge resources and enhancing students' informational engagement within digitally enabled learning environments.

Methodologically, this study adopts a qualitative case study design to generate an in-depth, contextually grounded analysis of the processes, dynamics, and constraints associated with digital library integration in a digital school setting. Theoretically, it contributes to the advancement of library and information science by formulating a contextualized integration model that reconceptualizes the school library as an embedded strategic actor within institutional governance, pedagogical design, and identity formation. Practically, the study offers an operational framework to inform the development and implementation of sustainable digital library services for librarians, educational practitioners, and policymakers.

Accordingly, this study addresses the central problem of how digital library services can be systematically integrated into digital school ecosystems, as well as the factors that condition their effectiveness and sustainability. It aims to explicate implementation strategies, identify structural and operational constraints, and construct a context-sensitive integration

model to support the institutionalization of digital schools within the secondary education sector.

2. METHODS

This research uses a qualitative case study approach. This methodology fits best for the analysis of the scope and the assimilation of the processes of the digital library service at SMAN 1 Geger Madiun (Creswell & Creswell, 2023). The case study method allows for an exploration of the hybrid implementation framework and models, different integration strategies, and related issues within a certain boundary and specific context. Research was carried out at SMAN 1 Geger Madiun, Indonesia. The selection of this institution as a case study is predicated on its representative positioning within the broader landscape of Indonesian secondary education, which is currently undergoing a transitional shift toward digitally mediated learning ecosystems. Despite constraints related to infrastructural capacity and human capital, the institution demonstrates a pronounced commitment to technological innovation, thereby providing a critical empirical site for examining the implementation dynamics, integrative models, and structural challenges of digital library services.

Research participants and data sources were selected through purposive sampling to ensure the inclusion of information-rich cases aligned with the objectives of the study. The sampling strategy was guided by participants' direct involvement in the utilization, management, and development of digital library services within the school context. Accordingly, the participants comprised students as primary users of digital library services, teachers who integrate digital resources into pedagogical practices, library personnel responsible for the management and provision of digital collections, and information technology (IT) staff overseeing system integration and supporting infrastructure. The sample size was determined iteratively, following the principle of data saturation, defined as the point at which additional data collection no longer yields substantively new insights.

Data collection was conducted using methodological triangulation to ensure analytical depth and enhance the credibility of findings. First, in-depth, face-to-face interviews were carried out with key informants, including institutional decision-makers (e.g., principals and heads of libraries) and operational actors (e.g., IT personnel). To ensure ethical compliance and protect participants' confidentiality, all informants were anonymized using coded identifiers (e.g., INF-01, INF-02). Personal names and identifiable information were removed from the dataset and are not disclosed in this study.

These interviews were designed to elicit strategic, supply-side data concerning institutional vision, policy orientation, service models, and system interoperability. Second, Focus Group Discussions (FGDs) were conducted separately with user groups (students and teachers) and service providers (library staff) to capture demand-side perspectives, including collective perceptions, user needs, service utilization experiences, and operational challenges. Third, non-participant observation was employed to document actual practices related to digital library services, encompassing user–system interactions, service access mechanisms, and the operational workflows of library personnel.

Table 1. Research Source Data Tabel

No	Informant Code	Position
1	INF-01	Principal
2	INF-02	Librarian
3	INF-03	Teacher
4	INF-04	Information Technology Staff
5	INF-05	Student
6	INF-06	Student

(Source: Research documentation, 2025)

Data validity was tested using source and methodology triangulation, which involved cross-comparing findings from interviews, focus group discussions, and observational data to ensure consistency and validity. In addition to triangulation, research validity was also maintained through the application of trustworthiness principles, including credibility, dependability, and confirmability. Credibility is strengthened through intensive researcher involvement in the field and clarification of findings to key informants. Dependability is maintained through systematic documentation of research procedures, while confirmability is achieved by separating the researcher's interpretation from the raw data obtained in the field. All qualitative data collected were then analyzed using thematic analysis techniques (Braun & Clarke, 2022). The analysis process was carried out through several systematic stages, namely: (1) familiarization of the data through repeated reading of interview and FGD transcripts; (2) initial coding to identify relevant units of meaning; (3) grouping codes into initial themes; (4) reviewing and refining themes to ensure consistency with the data; and (5) defining and naming themes that represent the patterns of research findings. The entire analysis process was documented in detail as part of an audit trail to ensure transparency and traceability of the analysis. This analysis process involved systematically coding the data to extract, identify, and categorize key themes that directly address the three research problem formulations: integration model, implementation strategy, and challenges faced.

This research was conducted by paying attention to the ethical principles of social research. All participants were given an explanation of the purpose of the study and asked for informed consent before data collection. The identities of participants were kept confidential through the use of codes or pseudonyms, and the data obtained were used solely for academic purposes.

3. RESULTS AND DISCUSSION

SMAN 1 Geger is a public senior high school located at Jalan Raya Uteran No. 634, Sumberejo Village, Geger District, Madiun Regency, East Java. Before changing its name to SMAN 1 Geger, the initial establishment of SMA Negeri Uteran departed from the awareness of the people of southern Madiun, especially the Ex Kawedanan Uteran area, of the importance of high school level education, which at that time was not yet available in the area. This aspiration is in line with the government's program in equalizing education through the establishment of new schools throughout Indonesia. The community, together with the Madiun Regency Government, especially residents of Geger District, responded by preparing land and the requirements for establishing a school, even willingly handing over their land for construction. Based on the Decree of the Minister of Education and Culture

Number 0188/O/1979, Uteran State High School was officially established on April 1, 1979, in a strategic location on the edge of the Madiun-Ponorogo Highway, Suberejo Village, Geger District, Madiun Regency, on an area of 25,948 m^2.



Figure 1. SMAN 1 Geger School Building
(Source: Research documentation, 2025)

The Taman Ilmu Library of SMAN 1 Geger, Madiun Regency, is an information service unit located within the school environment and is fully managed by the school. The existence of this library is intended to support the achievement of school educational goals specifically, while also contributing to the achievement of educational goals more broadly. Legally and formally, the establishment of the Taman Ilmu Library of SMAN 1 Geger, Madiun Regency, is based on the Decree of the Head of the East Java Provincial Education Office Branch No. 420/1142/101.6.16/2023, which was issued on March 16, 2023.

SMAN 1 Geger was officially designated as a "Digital School" on August 23, 2024, marking a strategic institutional milestone in its digital transformation trajectory. This initiative was introduced under the leadership of the school principal (INF-01) as part of a broader effort to enhance students' preparedness for the demands of the digital era and the Fourth Industrial Revolution. Through this program, the institution aspires to position itself as a modern educational environment characterized by the comprehensive integration of information and communication technologies across teaching, learning, and administrative processes.

This implementation includes the digitalization of school administration, attendance systems, grade reporting, and communication between parents and schools via online platforms. Teachers receive special training to integrate technology into learning, including the use of tablets, online applications, and interactive media. Learning innovations also include computer-based exams (CBT), distance learning (PJJ), and the development of digital libraries (e-libraries).

Besides enhancing the technological infrastructure, SMAGER also aims to cultivate developing the 22nd century skills such as problem-solving, critical thinking, collaboration, and creativity. Strengthening such skills is appreciated by the stakeholders, particularly the students, teachers, and parents, as the experience more interaction in learning, information is more accessible, and the motivation to learn is higher. The support from the Madiun Regency Education Office further solidifies the digital education program and the school's commitment to aligning with the government's vision in the education sector. Through this program, SMAN 1 Geger affirms its role as a pioneering digital school in Madiun Regency, aiming to produce graduates who excel not only academically but also adapt to

technological developments. Through this digital school branding, students are required to have and bring laptops during the learning process.

As part of the digital school implementation, the library assumes a strategic role in supporting teaching and learning processes. This is reflected in the perspective of one teacher, who also serves as a library coordinator, who stated:

> *"Sometimes I go into the library during lessons. So I teach using my materials... using a projector... even though there's already a projector in the classroom, I bring it to the library to introduce the students to the library, so the learning environment isn't always in the classroom (INF-03).*" (July 31, 2025).

In other words, the library is used not only as a collection space, but also as an alternative learning space that provides a new atmosphere for students. This approach aligns with the concept of digital schools, which emphasizes flexible learning spaces and expanded access to learning resources.

The participant further emphasized that the availability of various learning tools and resources within the library significantly supports the instructional process, stating:

> "*For example, some of the materials have questions with answers in the book. So the children can find examples and answers in the book... and because this is a digital school, the learning uses Moodle-based e-learning platform. All my materials from the book are uploaded to the e-learning. All learning materials are uploaded to Moodle, including the assignments (INF-03).*" (July 31, 2025).

The collaboration between libraries and e-learning brings together elements of constructive learning ecosystems. Using Moodle, students can access digital resources, while the library's physical collection and spaces can assist in the comprehension of the materials. Overall, considering the above details and the result of the interview, the digital schooling implementation at SMAN 1 Geger is not only about the integration of technological devices but also about the change in learning culture. The library is an adaptive learning space and supports digital learning models by integrating physical and online resources. This strategy reinforces the position of SMAN 1 Geger as an innovative digital school in Madiun Regency and enables the students to engage in learning experiences that are indispensable in the modern world. This study identifies three main aspects of the implementation of digital library services at SMAN 1 Geger Madiun, which are presented below to answer the problem formulation.

Library Service Integration Model

The library service integration model at SMAN 1 Geger Madiun is hybrid (combining physical and digital), but is still found to be fragmented or not fully integrated. The library service integration model at SMAN 1 Geger Madiun in supporting a digital school environment can be categorized into four main aspects, namely library information system integration, provision of digital collections, provision of multimedia services, library innovation and creativity, and guidance on information and digital literacy. Each of these aspects supports the other to create a modern library ecosystem that is relevant to educational needs in the digital era.

Library Management System Integration

The library implements SLiMS 9 Bulian with public IP access. Available features include an OPAC, digital circulation services, a user dashboard, online library materials management,

and performance reporting. Regarding the use of digital attendance, a fundamental gap in digital attendance services can be identified. The school's main attendance system uses RFID, while the library's SLiMS system still requires manual input of the Student Identification Number (NISN). This issue was corroborated by a librarian (INF-02), who noted: "*Attendance still requires typing in the student ID number, while school attendance uses RFID. We have proposed to the vendor to have RFID for attendance included in their SLIMS.*" These findings suggest the two systems run in parallel but are not connected.

a. Provision of Digital Collections (Digital Library Integration). The library employs a dual strategy in providing its e-book collection through two different platforms: Kubuku and Digido. The procurement models differ: "*Digido is a grant from the East Java Library, while Kubuku is a freehold e-book; after cash payment, it becomes ours (INF-02).*" Furthermore, the access methods for the two platforms also differ. Digido is considered superior because it's web-based (no app installation required), while Kubuku requires app installation via the Play Store.

b. Provision of multimedia services. The SMAN 1 Geger Madiun Library is also equipped with various multimedia facilities that support interactive learning and access to digital information. These facilities are designed to meet the needs of students and teachers in utilizing technology for teaching and learning activities. These facilities include Chromebooks, personal computers, headsets, Wi-Fi, LCD projectors, printers/scanners, barcode readers, and indoor and outdoor digital reading rooms.

c. Spatial and Service Innovation: The library has developed various physical and virtual services, including the Digital Reading Corner (Pocadi), the outdoor Literacy Corner, the Literacy Gazebo, and the Student Work Gallery. An interesting finding was found in Pocadi, which functions as an extension service at the school entrance. Its use is actually dominated by secondary audiences, as expressed by the librarian: "So far, the number of users is limited to parents, the intensity of students is not that much..." In response, the library provides barcode access so that students can access the digital collection via mobile devices.

d. Literacy Guidance: The service model also includes proactive information and digital literacy guidance, including training in finding and evaluating information, techniques for avoiding plagiarism, and the use of references.

Service Implementation Strategy

The implementation strategy at SMAN 1 Geger Madiun was found to be very user-oriented, which began with a needs analysis.

a. User Needs Analysis: The library regularly conducts online surveys to map needs. Four main surveys are conducted: (1) Library Activity Needs, (2) Collection Needs, (3) Multimedia Service Needs, and (4) Infrastructure Needs. The results of these surveys have been used to design programmes. Examples of results include: students value meet and greet activities with successful entrepreneurs (31.8%); printed books (67.5%) are still the most urgently needed collection, along with books on life skills and science (both 21.5%); and the multimedia services most utilised are Wi-Fi (87.6%) and computers (61.5%).

b. Strengthening Human Resources (Literacy Activists): The human resources strengthening strategy was also carried out through the "Literacy Activist" collaborative ecosystem. This includes Library Friends (the Student Council literacy team), Reading

Ambassadors (students and teachers or educational staff), and the School Literacy Team. However, within the Library Friends, operational challenges such as erroneous book labelling, shelving confusion, and insufficient accuracy in circulation data entry are encountered.

c. School Literacy Movement (GLS): The GLS is anchored in the library, and it is organised in three stages: habituation (15 minutes of reading), development (reading awards), and learning (scientific papers).

d. Infrastructure Development and Collaboration: This strategy includes the implementation of SLiMS, collection digitisation, collaborative learning of teachers and librarian, and guided instruction of user's tasks.

Service Integration Challenges

This study identifies two main barriers that limit the effective delivery of digital services.

a. Human Resource (HR) Limitations: The most significant challenge is the unequal distribution of human resources. One librarian manages library services for more than 1,000 users. This situation is likely to result in a workload that encompasses all managerial and technical dimensions. Direct consequences include "*neglecting digital content development priorities,*" "*slow updating of digital collections,*" *and* "*information literacy activities … rarely being implemented on schedule.*"

b. The second major challenge is underdeveloped digital security. These systems lack basic digital security components such as robust firewalls, data encryption, and dual authentication. This vulnerability was confirmed by interviews with IT staff, who revealed that the school "*has experienced cyberattacks... including hacking and misuse of access for online gambling content (INF-04).*" As a reactive response, the IT team has replaced the server system from cPanel (deemed vulnerable) to aaPanel (deemed more secure).

DISCUSSION

Library Service Integration Model in A Digital School Environment

The research findings show that SMAN 1 Geger Madiun has implemented a Library Information System (*Library Management System*) through the SLIMS 9 Bulian Application with Public IP access. This implementation includes OPAC, digital circulation services, digital presence, a user access *dashboard, online* library material processing, and library performance reports that are recorded digitally and *in real-time*. This system integration is very much in line with the concept of a digital library that emphasizes efficiency, accessibility, and service automation.

SLIMS 9 Bulian application with Public IP access at SMAN 1 Geger Madiun fulfills this interoperability aspect by enabling *online access* for users and staff, as well as the integration of various library functions in a single *platform*. This is in line with the views of research results that emphasize the use of *big data* for library service reform oriented to user needs (Li et al., 2019), where data from SLIMS can be used to analyze usage patterns and user preferences. Implementation in various schools and universities has succeeded in improving service quality, accessibility, and the effectiveness of collection management (Desriyeni et al., 2022; Fitria et al., 2023; Siswadi, 2023). However, feature optimization is still hampered by

human resources and infrastructure in some institutions (Aliza et al., 2025; Rahayu et al., 2024).

The digital circulation service at SMAN 1 Geger, which uses *barcodes* /RFID and a digital system for circulation management, reflects technological innovation (Wang & Ding, 2022) for smart library services. RFID enables automatic identification, collection tracking, security, and supports self-services such as *self-checkout* and *book-drop*, thereby reducing service time and increasing user satisfaction (Baroqah, 2025; Ugochukwu et al., 2024).

Integrated and real-time digital presence services *also support* operational efficiency and user data analysis, in line with the need for accurate data for decision-making. The OPAC (*Online Public Access Catalog*), which allows users to retrieve library materials *online,* is a manifestation of ease of access (Xu & Bo, 2020) in the development of a reader service system for digital libraries. The user access *dashboard* that allows viewing of loan history and book recommendations is also a form of personalized user-oriented service, in line with the focus on user needs in *the big data era*. *Online* processing of library materials and digitally and *real-time library performance reports* also show that libraries have transformed from a conventional model to an automated library, even towards a fully digital library, as described in the evolution of libraries from traditional to digital.

Overall, the implementation of SLIMS 9 Bulian at SMAN 1 Geger Madiun demonstrates the library's comprehensive adoption of information technology to improve operational efficiency and service quality. This system integration is a crucial foundation for realizing a digital library that is responsive to user needs in a digital school environment.

Strategy to Effective and Efficient of Digital Library Service Integration

The integration of digital library services in schools such as SMAN 1 Geger Madiun is very important to improve literacy in the era of Industrial Revolution 4.0 and Society 5.0. The implementation of digital libraries in school settings has been successful with the user-centered framework, digitization of services, and proactive marketing. The most important first step is surveying users to understand their needs concerning collections, multimedia, and infrastructure. That way, other schools have developed services that are genuinely user-centered (Sulistyaningrum et al., 2021; Toresa et al., 2023). Research has indicated that services developed based on user needs are most likely to be successful and positively accepted (Suwarto et al., 2022; Timotheou et al., 2023).

The use of web-based library applications or digital *platforms* (e.g., Edoo) facilitates searching, borrowing, and managing collections. System development generally follows the stages of needs analysis, design, implementation, and maintenance, resulting in increased efficiency, data accuracy, and user satisfaction. (Agsiya, 2023).

Librarians and teachers are now required to have high digital competencies to manage electronic resources, digital catalogs, and online circulation services. This is reinforced by previous research that shows that ongoing training, technological skills development, and active collaboration significantly influence the effectiveness of new technology utilization in libraries and educational environments (Bolasco, 2023; Diseiye et al., 2023; Nur, 2023). Strong digital competencies enable librarians and teachers to utilize technologies such as *cloud computing* and *e-learning platforms*, and optimal digital library management systems (Liabor, 2023).

Challenges Faced in Integrating Digital Library Services

Incorporating digital library services in schools, such as SMAN 1 Geger Madiun, struggles to integrate digital library services because of scarce human resources (HR). A lack of skilled librarians impedes the advancement of digital services. This finding is supported by existing literature that identified five barriers to the development of an integrated semantic digital library system: ontology and interoperability, modeling, language multiplicity, insufficiently skilled personnel, and additional technological barriers (Shahzad, 2024). Furthermore, Ullah et al. (2023) explained that libraries, in addition to the digital resource inclusion, face the challenge of maintaining a proper balance between print and digital resources, as well as providing equal accessibility to everyone. Undoubtedly, Zareef and Jaben highlighted insufficient staffing as a challenge for libraries that provide digital curation services (Zareef & Jabeen, 2025). Zareef and Jabeen also observed that some librarians have insufficient information technology (IT) skills, and as a result, the digital systems and services are poorly utilized and poorly managed.

Rahmani (2022) also noted that this is a consequence of insufficient training and staff advancement. Research shows that the main issues are espoused in the management of digital services and data security, however, data security concerns are some of the more erroneous issues (Rahmani, 2022). Integrating virtual reality technologies in libraries is seen to have some ethical issues, especially concerning the protection and promotion of digital advocacy (Subaveerapandiyan et al., 2024). Poor protection measures can lead to the exposure of users' private information, the modification of digital materials in the collections, and the abuse of data. Digital service guarantees are at risk without some protective measures, considering the increase in cyber-attacks, more specifically malware, phishing, and ransomware. Protection systems (encryption, multi-layer authentication, and data backup) are needed to ensure uninterrupted digital services.

Digital services are limited by the physical and digital infrastructure. The digital infrastructure includes libraries' digital management systems and their integration systems, while the physical infrastructure consists of the servers, computers, and storage systems. Also, libraries' internet connectivity can be a limitation too. Poor infrastructure can result in delays in access, service interruptions, and inconsistency in service delivery. This can diminish the quality of the users' experience and the worth of the digital collections (Acheampong, 2021).

A shortage of qualified staff, lack of adequate staff training, and poor data protection systems can also be major impediments to the provision of digital library services in schools. These issues can be addressed through strategic interventions aimed at improving librarian training to support technology-based service management, as well as the installation of appropriate hardware, software, and internet network infrastructure, and the use of data security systems consisting of encryption, backups, and information protection policies. All of this will ensure that digital library integration in schools is optimized, secured, and maintained, and that quality services are provided to all users.

4. CONCLUSION

This study demonstrates that the integration of digital library services at SMAN 1 Geger Madiun has been systematically developed, sustainability-oriented, and responsive to user needs. The library functions as a strategic hub for digital learning resources, supported by integrated systems, diverse digital collections, and technology-enhanced literacy initiatives.

Its implementation is driven by user needs assessment, human resource development, infrastructure enhancement, and collection digitization, positioning the library within the broader educational transformation shaped by the Fourth Industrial Revolution and Society 5.0. Nonetheless, challenges persist, particularly limited professional human resources and inadequate data security, which constrain service optimization and interoperability.

Accordingly, strengthening librarian competencies, improving technological infrastructure, and establishing robust data governance are critical to ensuring sustainability. In addition, cross-sector collaboration and the advancement of users' digital literacy are essential to support innovation and effective service utilization. Overall, the digital library is reconceptualized as a hybrid learning ecosystem integrating technological, pedagogical, and organizational dimensions, contributing to digital school transformation and the development of 21st-century competencies.

AUTHORS' CONTRIBUTIONS

Kardi: Writing oiginal draft preparation. Ideas; formulation or evolution of overarching research goals and aims.
Eliana Sari: Overarching research goals and aims

CONFLICT OF INTERESTS

We state that there are no known conflicts of interest linked with this publication, and that there has been no significant financial assistance for this work that could have influenced its outcome.

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