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# Digital library innovation and challenges in supporting sustainable development through digital transformation

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## Abstract

Digital transformation in libraries is essential in supporting the Sustainable Development Goals (SDGs) by expanding access to information and reducing the knowledge gap. This study examines digital service innovations at the Sebelas Maret University (UNS) Library and the challenges faced in the transformation process. Through a qualitative approach with interviews and document analysis, this study uncovers various initiatives, such as developing digital collections and library applications. However, challenges like limited infrastructure, user digital literacy, and budget constraints remain. The study results emphasize the need for an integrated strategy to maximize its impact, including increasing digital literacy, external collaboration, and technology investment. The UNS Library can become a national model for developing a digital library supporting SDGs.

## Keywords

Digital library, Digital transformation, Sustainable development, Digital literacy, Academic library

## Introduction

The introduction in the era of rapid technological advancement, digital transformation has become an essential agenda in various sectors, including libraries. Libraries are no longer places to store physical books but have evolved into dynamic platforms providing broader information access. This change is in line with global efforts to achieve the Sustainable Development Goals (SDGs), especially SDG 4 (Quality Education) and SDG 9 (Industry, Innovation, and Infrastructure). However, despite its promising potential, integrating digital libraries within the framework of sustainable development is not free from various challenges, especially in developing countries like Indonesia [1].

Previous studies have widely explored the role of digital libraries in improving the dissemination of knowledge and access to information [2]. For example, digitization of collections, open access initiatives, and innovative user interfaces have been key in expanding the reach of library services. In addition, libraries have implemented digital

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literacy programs to bridge the digital divide among users. However, there are still gaps in addressing problems such as inadequate infrastructure, low digital literacy, and budget constraints. These challenges hinder the ability of digital libraries to support sustainable development goals [3].

Most previous studies have focused on digital libraries' technical and functional aspects, with little emphasis on their role in reducing knowledge gaps and contributing to sustainable development [4]. In addition, the complexity of user experiences and the inclusiveness of digital library systems often escape comprehensive analysis. This study identifies these overlooked areas and proposes an integrative approach to enhance the effectiveness of digital libraries in achieving sustainability goals [5].

This study introduces a new perspective by analyzing innovations and challenges faced by digital libraries in Indonesia, particularly at the Sebelas Maret University (UNS) library. This study aims to bridge the gap by providing insights into potential strategies to overcome barriers, such as technological limitations and user accessibility.

In conclusion, this study seeks to contribute to the field by offering implementable recommendations to strengthen the role of digital libraries in supporting sustainable development. This study uses a qualitative approach by analyzing user experiences and institutional practices to propose future sustainability strategies. By addressing these gaps, this study aims to highlight the critical role of digital libraries in reducing knowledge gaps and fostering innovation in the context of global development goals.

## Method

This study used qualitative research to explore innovations and challenges in implementing digital library services at Sebelas Maret University Library. The qualitative approach allowed for an in-depth understanding of the experiences, processes, and perceptions of library professionals and users regarding digital transformation in library services. Data were collected through two main methods: interviews and document analysis. In-depth interviews were conducted with key stakeholders, including library staff, administrators, and regular users of digital library services. Participants were purposively selected based on their involvement in developing, managing, or using digital library services. The interviews aimed to collect qualitative data on innovations implemented in the library, challenges faced during the transformation process, and the perceived impact of these innovations on users and the university community. A total of 10 participants were selected, consisting of 4 library staff members, three academic staff members, and three students who actively use digital library services. The interviews followed a semi-structured format, allowing for flexibility while ensuring that key themes, such as digital infrastructure, digital literacy, financial constraints, and the impact of digital services on sustainable development, could be explored in depth. In addition, document analysis was conducted on related reports, internal policy documents, user surveys, and statistical data on library usage and adoption of digital services. This analysis provides further insights into the evolution of digital services,

resource allocation, and user engagement with digital resources at Sebelas Maret University Library, focusing on data from the last three years (2021–2023) to identify trends and evaluate the impact of recent innovations.

The collected data was analyzed using thematic analysis, which involves identifying, analyzing, and reporting patterns. Transcription of interview recordings and categorization of document data were the first steps in the study. The data were then coded to identify recurring themes, and the codes were grouped into broader themes that were refined to reflect key findings. The identified themes included Digital Service Innovation, Technology Challenges, Financial and Resource Constraints, and Impact on Sustainable Development Goals. These themes were then interpreted to assess the effectiveness of digital services at Sebelas Maret University Library and to highlight the challenges faced in contributing to sustainable development. This study used a descriptive case study design, focusing on Sebelas Maret University Library as a single case study within the broader context of digital transformation in academic libraries. The case study approach was chosen because it provided an in-depth exploration of library experiences and challenges, providing valuable insights that can be generalized to other institutions facing similar digital transformation issues. Ethical considerations were maintained throughout the study, ensuring that all participants provided informed consent and that their anonymity and confidentiality were maintained.

The novelty of this study lies in integrating interviews and document analysis as complementary methods, offering a comprehensive understanding of the process of implementing digital library services. The study's methodological rigor ensures that the findings obtained can be replicated or applied to other academic institutions undergoing similar transformations.

## Results and Discussion

### *Results*

The results of this study were obtained through thematic analysis of interviews and document reviews conducted at the Sebelas Maret University (UNS) Library Unit. The main findings are arranged based on the themes identified during the analysis: Digital Service Innovation, Technological Challenges, Financial and Resource Constraints, and Impact on Sustainable Development Goals (SDGs) (Table 1).

Regarding Digital Service Innovation, the UNS Library Unit has significantly progressed in developing digital library services. Interviews with library staff and users indicate that introducing digital services has increased access to resources and engagement with library materials [6]. One of the main innovations is developing a mobile application to access digital resources, which has seen a 30% increase in active users over the past year. This application makes it easier to search the catalog, access e-books, journals, and other resources, and engage with library services. In addition, the library regularly holds digital literacy training programs, which were attended by more than 500 students and

lecturers in 2023. These programs have received positive responses, with users praising the program's effectiveness in improving their ability to navigate and use digital library tools [7].

Table 1. Overview of Key Findings from the Research on Digital Library Innovation and Challenges

| Theme | Key Findings | Impact | Challenges Identified |
|---|---|---|---|
| Digital Service Innovation | Develop a mobile application to access digital resources. | 30% increase in active users within a year. | Need for more accessible platforms and features for all users. |
| Technology Challenges | Uneven internet quality across the campus, affecting access to digital resources. | Access to digital resources is inconsistent, particularly in remote campus areas. | An infrastructure upgrade is needed to ensure reliable connectivity. |
| Financial and Resource Constraints | Limited library budgets hinder the development of advanced digital technologies like AI and machine learning. | Digital resources and services may be limited in scope. | Financial constraints prevent significant upgrades and expansion of services. |
| Impact on Sustainable Development Goals (SDGs) | Improved access to education for students, especially those in remote areas or with disabilities. | Supports SDG 4 (Quality Education) by increasing educational access. | Infrastructure challenges hinder the full realization of SDG 4. |
| | Digital literacy programs have reduced the digital divide, particularly among marginalized students. | Supports SDG 10 (Reduced Inequalities) by fostering digital skills for disadvantaged groups. | Limited digital literacy training compared to demand. |
| Technology Acceptance Models | Mobile application adoption increased by 30%, reflecting ease of use and usefulness. | Increased acceptance of digital library services supports the adoption of technology. | 40% of users still struggle with the system, indicating the need for further training. |

Regarding Technology Challenges, despite the success of digital initiatives, several challenges have emerged that impact efficiency and user experience [8]. One of the significant issues identified by library staff and users is the uneven quality of internet access across campus [9]. While some areas of campus have reliable and fast internet connections, other regions, especially those further away from the central library, experience connectivity issues. This unevenness makes it difficult for users to access digital resources seamlessly [10]. Furthermore, while most users already have basic digital skills, interviews revealed that around 40% of users still struggle to navigate digital library platforms. This highlights the need for more focused, hands-on training to bridge the digital skills gap [11].

Financial and Resource Constraints were consistently identified as significant barriers to developing and sustaining digital library services. Limited library budgets were cited as a substantial barrier to upgrading digital infrastructure or integrating advanced technologies such as artificial intelligence (AI) or machine learning in resource management [12]. Furthermore, the cost of acquiring digital resources, such as e-books,

journals, and databases, was a financial challenge that limited the variety of digital resources available to users [13].

Despite the challenges, digital library initiatives have positively contributed to achieving several Sustainable Development Goals (SDGs) [14]. Regarding SDG 4 (Quality Education), digitizing academic resources has improved access for students and lecturers, especially those who cannot physically visit the library [10]. This has supported more inclusive education, with users from remote areas or those with disabilities still able to benefit from digital library services. About SDG 10 (Reduced Inequalities), the digital literacy programs implemented have helped to reduce the digital divide, especially among students from marginalized backgrounds, ensuring that all students have equal opportunities to develop the necessary skills. In line with SDG 9 (Industry, Innovation, and Infrastructure), integrating digital technologies into the library system has contributed to innovation in how resources are accessed and managed, although infrastructure challenges remain [15].

The results of this study highlight both the successes and limitations of the UNS Library Unit in implementing digital library innovations. These findings align with and test existing theories of digital transformation in libraries. For example, according to the Technology Acceptance Model (TAM), user acceptance of new technology is influenced by perceived ease of use and usefulness [16]. The success of the digital library application supports this model, as seen by a 30% increase in active users, indicating that easy-to-use and helpful technology can increase adoption rates. However, this study also challenges some aspects of the Unified Theory of Acceptance and Use of Technology, particularly the role of social influence. Although the use of the application has increased, approximately 40% of users still have difficulty navigating the system, indicating that digital literacy plays a significant role in technology acceptance, which is not fully accounted for [17].

## *Discussion*

Based on the research results presented previously, this discussion section will discuss the implications of the findings obtained and compare them with previous research. In this discussion, we will respond to the main findings related to digital service innovation, technological challenges, financial constraints, and their impact on sustainable development goals (SDGs).

This study shows that digital service innovation at the UNS Library has positively impacted access to library resources and reduced physical barriers to obtaining educational materials. These results align with the Technology Acceptance Model (TAM), which states that user acceptance of technology is influenced by their perceptions of its ease of use and usefulness [18]. The use of digital library applications increased by 30% in a year, showing that the adoption rate tends to increase when the technology is easy to use and considered valid.

However, the results of this study also provide a different perspective from the Unified Theory of Acceptance and Use of Technology, especially regarding social influence. Although digital library applications have been introduced and the number of users continues to grow, around 40% of users still find it difficult to operate this system. These findings suggest that digital literacy—often overlooked in technology adoption models—plays a critical role in successfully using digital library technology. Therefore, more attention needs to be paid to developing users' digital competencies so that the implemented technology can be utilized optimally [17].

In addition, the challenges faced by the UNS Library Unit related to uneven infrastructure on campus also strengthen the argument put forward by Lesk (2005), who stated that digital transformation in libraries can exacerbate inequality if the supporting technological infrastructure is inadequate. Although more than 22,500 documents were successfully digitized, the problem of unstable internet connectivity in several areas of the campus caused unequal access to digital resources. This emphasizes the importance of developing equitable infrastructure, so all users can feel the benefits of digital transformation [19].

In terms of SDGs, this study supports the achievement of SDG 4 (Quality Education) and SDG 10 (Reducing Inequality). The digitization of library resources has opened up more inclusive access to education, especially for students from remote areas or those with physical limitations [20]. The digital literacy training program that is held also plays a role in reducing the digital divide so that students from underprivileged backgrounds also get the same opportunity to develop their digital skills [21]. However, this finding also shows that to achieve this goal optimally, more efforts are needed to overcome challenges related to infrastructure, budget, and digital literacy gaps.

Finally, this study shows that although significant progress has been made in integrating digital technology into the UNS library, significant challenges related to budget constraints and lack of financial support hinder further development. This is due to previous studies' findings that inadequate funding is often a substantial obstacle to the digital transformation of libraries. In this context, fighting for sufficient funding to maintain the sustainability and development of digital library services is essential.

Overall, although the findings of this study support several theories of technology adoption and contribute to the understanding of the impact of digital transformation in libraries, this study also reveals shortcomings that need to be addressed. To support the SDGs more effectively, the UNS Library needs to continue to improve the quality of infrastructure, expand digital literacy programs, and seek more stable financial resources to support the development of digital library services in the future [22].

## Conclusion

The study on digital library transformation at Sebelas Maret University highlights innovations and challenges in leveraging digital technologies to contribute to

sustainable development. The study focuses on understanding the innovations implemented, identifying challenges, and analyzing their impact on achieving the Sustainable Development Goals (SDGs), specifically SDG 4 (Quality Education) and SDG 10 (Reduced Inequality). The findings highlight that Sebelas Maret University Library has made significant progress in digital transformation. Key innovations, such as the introduction of digital library applications, collection digitization, and digital literacy programs, have increased user engagement and improved access to knowledge. These efforts are in line with SDG 4 by enriching the educational experience and providing wider access to resources for students and lecturers. However, the study also reveals persistent challenges that hinder the library's full potential to contribute to sustainable development. Infrastructure limitations, including unstable internet connections and inadequate hardware, hinder effective access to digital resources. In addition, digital literacy remains a significant barrier, with 40% of users having difficulty navigating the system. Financial constraints exacerbate these issues, limiting libraries' ability to leverage technology and integrate advanced tools, such as Artificial Intelligence (AI). To fully realize the potential of digital libraries in supporting sustainable development, a holistic approach is needed. This includes addressing infrastructure gaps, investing in comprehensive digital literacy programs, and securing sustainable funding sources. By addressing these barriers, Sebelas Maret University Library can further contribute to SDG 10 by reducing inequalities and ensuring equitable access to education and knowledge for all. While this study provides valuable insights, it does not offer specific suggestions or recommendations to address these challenges. Future research and strategic planning may be needed to develop actionable solutions that can guide libraries in addressing these barriers and maximizing their contribution to sustainable development.

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