Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

Implementation of a Web-Based E-Library System for Optimizing Library Services: A Case Study of SMAN 1 Abung Pekurun

Rissa Pebrian[1], Sigit Gunanto[2]
[1,2]Department of Information Systems and Technology, Faculty of Engineering and Computer Science, Universitas Muhammadiyah Kotabumi, Lampung Utara, Indonesia

Article Info
Keywords:
Digital Library,
Information System,
SMAN 1 Abung Pekurun,
Waterfall Model,
Web-Based System.

ABSTRACT (Nunito 9 pt)
The library management system at SMAN 1 Abung Pekurun remains conventional, leading to several challenges such as inefficiency in book searching, vulnerability to data entry errors, and limited accessibility of information. This study aims to design and develop a web-based digital library system (E-Library) to address these problems. The system development method applied follows the Software Development Life Cycle (SDLC) using the Waterfall model, which includes the stages of requirement analysis, system design using Unified Modeling Language (UML), implementation with PHP and MySQL, and functional testing. The results demonstrate that the developed E-Library system is fully functional, having successfully passed 100% of 25 Black Box Testing scenarios. The system implementation effectively transformed the library's manual operations into a digital platform, significantly improving service time efficiency, data accuracy, and information accessibility for users, while simplifying reporting processes for library staff and school management.

Corresponding Author:
Risa Pebrian
Universitas Muhammadiyah Kotabumi
Jl. Hasan Kepalaratu No.1052 Sindang sari Kotabumi Lampung
rissa.2159201035@umko.ac.id

INTRODUCTION

In the current digital era, information technology has become a major driving force behind transformation across various sectors, particularly in education. The ability to access, manage, and distribute information effectively has become a fundamental standard for achieving quality educational services (Nafisah & Nurjanah, 2022). The library, as the central repository of knowledge and a critical component of the academic ecosystem, plays an essential role in adapting to this transformation. Its function has evolved from being a traditional book storage facility into a dynamic digital information gateway, where the use of web-based systems is no longer an option but a necessity to deliver efficient, reliable, and relevant services (Asana, Putra, & Harini, 2021; Winarti & Hidayat, 2024).

Despite this transformation, the adoption of digital systems in many educational institutions remains inconsistent. At SMAN 1 Abung Pekurun, library management activities including cataloging, book searches, lending and returning processes, and report generation are still carried out manually using logbooks and physical member cards. This conventional

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

approach, although functional, presents several limitations that reduce service quality and operational efficiency (Rahmawati & Bachtiar, 2018; Gunawan, Arifin, & Sujono, 2023).

The main issues identified in the manual system include inefficient search procedures, vulnerability to data inaccuracies, and limited accessibility. For instance, users must manually browse the shelves to locate books, as no digital catalog exists to confirm book availability or location. This process is time-consuming and can reduce user engagement (Kurniawan, Setiawansyah, & Nuralia, 2024). Furthermore, manual record-keeping is highly prone to human error such as incorrect entry of borrower names, dates, or book codes and lacks proper backup mechanisms, making physical ledgers susceptible to damage or loss (Subekti & Pratama, 2024; Suhatsyah, 2020). Accessibility is also constrained, as users can only obtain information during library hours, creating a mismatch with modern learning habits that demand continuous access to resources (Ridlo & Saputra, 2023).

Additionally, the manual preparation of statistical reports and circulation summaries requires significant time and effort, often leading to inconsistent and inaccurate data (Meylani & Putri, 2024). These inefficiencies are illustrated in Figure 1, which shows the workflow of the existing manual borrowing process.

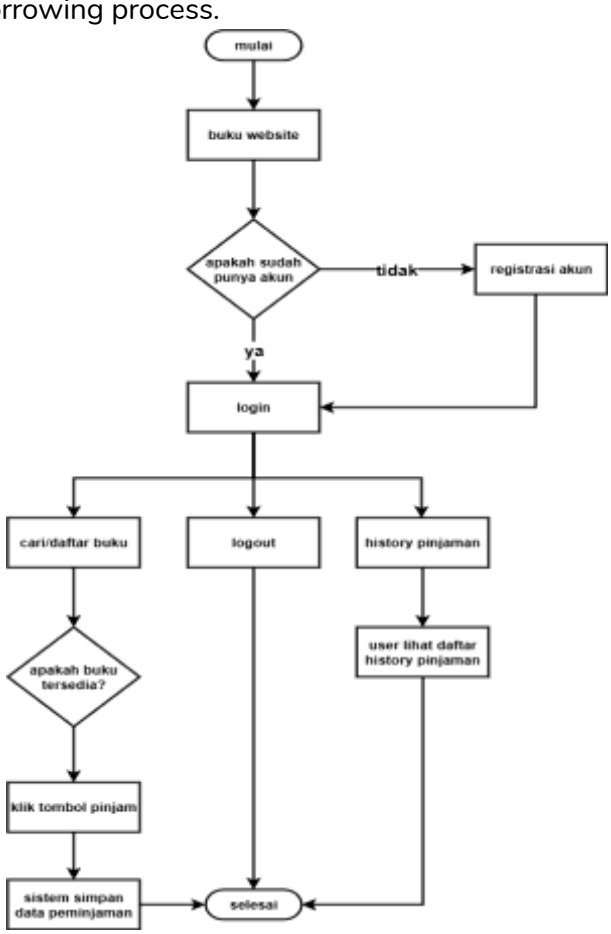

Figure 1. Manual Book Borrowing Workflow

To address these challenges, the implementation of a web-based digital library information system represents an effective and strategic solution. Such a system can automate

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

manual processes, manage library data more efficiently, and enhance user access through integrated web platforms (Hotimah & Nurfathoni, 2022; Marthanugraha & Prasetyo, 2024). A web-based design centralizes all data, allowing users to search for, borrow, and monitor books online, regardless of time or location (Sisephaputra & Pradana, 2025).

Therefore, this study focuses on the design and implementation of a functional, reliable, and user-friendly web-based E-Library system as a case study at SMAN 1 Abung Pekurun. The system aims to modernize library services, improve operational efficiency and data accuracy, and support the broader goal of digital transformation within educational institutions (Bhakti, 2022; Suhendra & Rahmawati, 2022).

METHODS

Research and Development Methodology

The research and development process of the E-Library system followed the five main stages of the Waterfall model, which provides a structured and sequential framework for system development (Kurniawan, Setiawansyah, & Nuralia, 2024). This model ensures that each stage from requirement analysis to maintenance is completed thoroughly before moving to the next, allowing for precise documentation and quality assurance throughout the process (Subekti & Pratama, 2024). The stages of development are described as follows.

Requirement Analysis

This phase served as the foundation of the project, where the researchers conducted a comprehensive analysis of the existing library management system to identify both functional and non-functional requirements. Data collection involved direct observation of daily library operations and interviews with key stakeholders, including librarians, teachers, and students, to understand the current challenges and expectations (Gunawan, Arifin, & Sujono, 2023).

As part of the as-is analysis, the manual borrowing process was mapped to identify inefficiencies, redundancies, and potential sources of human error. The workflow of this manual process is presented in Figure 2, which visualizes the sequence of activities in book borrowing.

Figure 2. Flowchart of the Existing Manual Borrowing Process

As shown in Figure 2, the process begins when users physically search for books on the library shelves. Once a book is located, the librarian manually records the borrower's information in a logbook. This manual procedure lacks real-time validation and stock tracking,

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

which often results in incomplete records, duplicate entries, and inaccuracies in book availability.

The results of this phase formed the basis for creating the Software Requirements Specification (SRS) document, which defines all necessary functions and performance standards for the new system (Rahmawati & Bachtiar, 2018). Functional requirements included login authentication, book data management, and transaction recording, while non-functional requirements emphasized usability, data security, responsiveness, and multi-device compatibility (Meylani & Putri, 2024).

System Design

Once the requirements were established, the next step was to translate them into a structured system design. The system architecture and user interactions were modeled using the Unified Modeling Language (UML) approach, which provides a standardized representation of system components and their relationships (Marthanugraha & Prasetyo, 2024).

To define the overall functional scope, a Use-Case Diagram was developed, as shown in Figure 3, illustrating how different user roles interact with system functionalities.

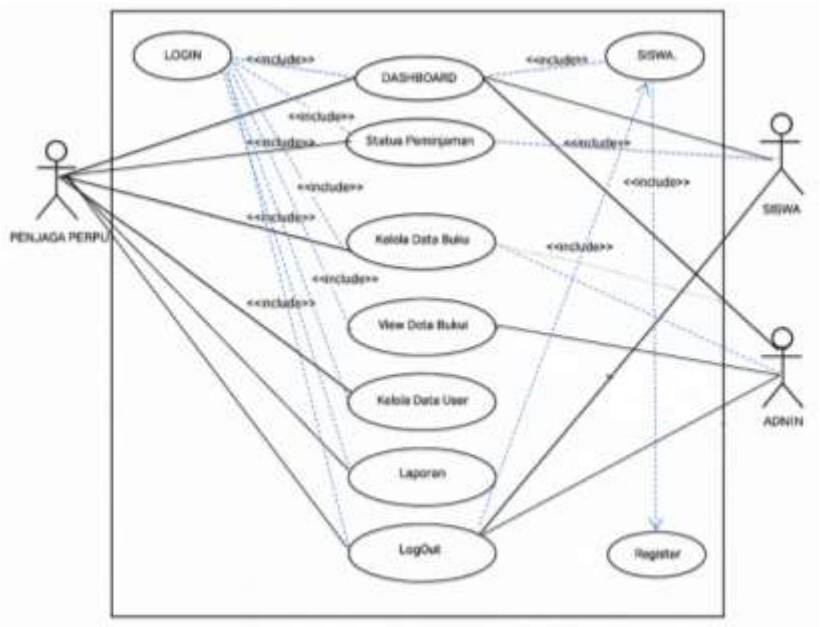

Figure 3. Use Case Diagram of the E-Library System

The system identifies four main user roles: the Administrator (Librarian), Students, Teachers, and the Principal. Each role has specific access rights—administrators can fully manage book data and user transactions; students and teachers can search for and borrow books; and the principal can view comprehensive borrowing and stock reports for monitoring purposes (Hotimah & Nurfathoni, 2022). This multi-level access ensures data integrity and efficient management of library operations.

Proposed Workflow Design

Based on the results of the requirement analysis, a new digital workflow was designed to replace the manual system. The improved workflow emphasizes automation, accuracy, and

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

accessibility. The proposed borrowing process is illustrated in Figure 4, which represents the operational flow of the web-based E-Library system.

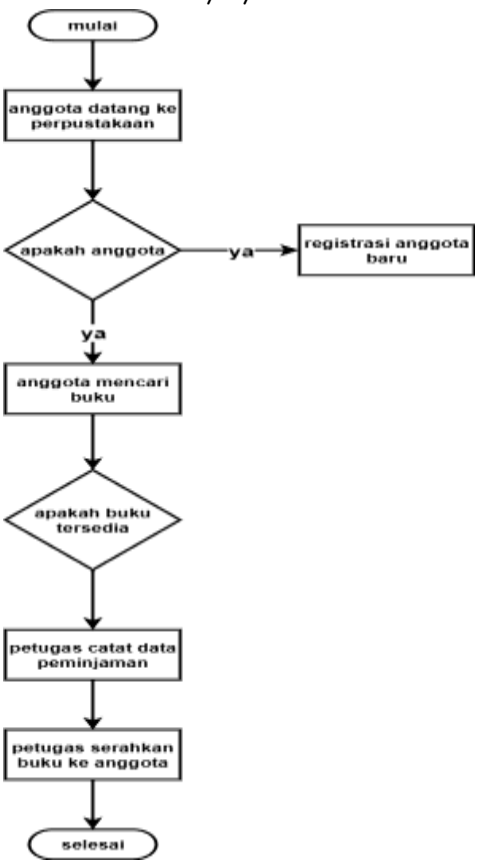

Figure 4. Flowchart of the Proposed Web-Based Borrowing Process

As depicted in Figure 4, users can now search for books online through the system's web interface. Once a book is found, the user submits a borrowing request, which is automatically recorded in the database. The system updates the book's stock in real-time and provides a notification to the librarian, who verifies the transaction through the admin dashboard. This automated design minimizes manual effort, reduces data-entry errors, and supports real-time synchronization between users and the library database (Bhakti, 2022; Winarti & Hidayat, 2024).

This digital workflow also enables automatic data logging, centralized reporting, and continuous accessibility, which enhance accuracy, transparency, and service efficiency (Ridlo & Saputra, 2023).

Implementation and Coding

The implementation stage translated the system design into executable code using technologies suited for web-based applications. The system was built using PHP as the main programming language, combined with CodeIgniter 4 framework, which applies the Model-View-Controller (MVC) architecture to ensure modularity and maintainability (Asana, Putra, & Harini, 2021). The MySQL database was utilized to manage structured data, while HTML5, CSS3, and JavaScript were used to create a responsive and interactive user interface (Suhatsyah, 2020).

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

Each software module was implemented according to its UML design to maintain traceability between the blueprint and the final system. The modular structure allows for scalability and simplifies future feature enhancements (Sisephaputra & Pradana, 2025).

System Testing

Once implementation was complete, the system underwent Black-Box Testing to evaluate functional performance. This testing approach validates the system's external behavior by examining input and output relationships without analyzing internal code logic (Rouza & Siregar, 2023).

Each critical function such as user login, book search, borrowing, returning, and report generation was tested using predefined input scenarios. The system achieved a 100% success rate across all 25 test cases, confirming that it met all expected outputs and performed reliably across multiple user roles (Gunawan et al., 2023).

Maintenance

The final stage, Maintenance, occurs after deployment and focuses on ensuring long-term functionality and adaptability of the system. Maintenance activities include both corrective maintenance, such as fixing bugs, and adaptive maintenance, involving enhancements to meet evolving user needs (Suhendra & Rahmawati, 2022).

Future maintenance recommendations include integrating features such as automated notifications, QR code-based borrowing, and mobile application support to expand accessibility and further enhance user engagement (Azrina & Putri, 2024). The research and development process of the E-Library system followed the five main stages of the Waterfall model, as illustrated below.

RESULTS AND DISCUSSION

Based on the system design described in the previous section, the Web-Based E-Library System for SMAN 1 Abung Pekurun was successfully developed and implemented. The system provides a comprehensive solution to the weaknesses identified in the previous manual process by delivering a user-friendly interface and functionality tailored to the school's library management needs. This section presents the implementation results, system interface, functional testing, and discussion of the system's positive impact.

System Interface Implementation

The user interface (UI) of the developed system was designed with a clean, intuitive layout to ensure ease of use for all user categories — including students, teachers, and library staff.

Home Page

The home page serves as the main gateway for users to interact with the system. It provides essential information about the E-Library and offers three main navigation options:

1. Admin Login, for authorized library staff.
2. Book Catalog, for public access to the list of available books.
3. User Login, for students and teachers to access their borrowing history.

The homepage layout is shown in Figure 5, which highlights the system's navigation structure and welcoming interface designed for ease of access.

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

Figure 5. E-Library Home Page Interface

The interface is optimized for both desktop and mobile devices, ensuring consistent access and performance. Users can browse the book catalog, view summaries, and check real-time availability directly from the homepage.

Book Management Page (Admin)

One of the system's key features is the Book Management Page, accessible exclusively to administrators or library staff. Through this interface, the admin can perform Create, Read, Update, and Delete (CRUD) operations on the book collection. The input form allows complete data entry, including ISBN, title, author, publisher, cover image, category, and stock quantity. Figure 6 shows the book editing page where the librarian can modify the stock quantity or update other book details in real-time.

Figure 6. Admin Page for Editing Book Data

This feature ensures that the book catalog remains accurate and up to date, reducing the risk of data duplication or human error commonly found in manual record-keeping.

System Testing

To ensure the system meets all defined functional requirements, Black-Box Testing was conducted. This testing focused on verifying the input-output functionality of each feature without examining the internal code structure. A total of 25 test scenarios were executed, covering the system's core functions such as login, search, book borrowing, and returning. The results are summarized in Table 1 below.

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

Table 1. Results of Functional Testing Using the Black-Box Method

No	Test Case	Testing Scenario	Expected Output	Test Result	Conclusion
1	User Login	The user enters valid credentials.	The system redirects to the appropriate dashboard.	The dashboard is displayed correctly.	Passed
2	Invalid Login	The user enters an incorrect username or password.	The system displays an error message.	"Invalid username or password" appears.	Passed
3	Book Search	The user types a book title keyword.	The system displays matching results.	Relevant book list is shown.	Passed
4	Add Book Data (Admin)	Admin fills all fields in the form and saves.	The new book appears in the list.	Book successfully saved and displayed.	Passed
5	Edit Book Data (Admin)	Admin changes stock quantity for a book.	The stock quantity updates.	Stock updated successfully.	Passed
6	Delete Book Data (Admin)	Admin deletes a selected book record.	The record is removed.	Book successfully deleted.	Passed
7	Borrowing Process	Student/Teacher clicks "Borrow" on available book.	Transaction recorded; stock decreases.	Transaction saved; stock reduced.	Passed
8	Return Process (Admin)	Admin processes a returned book.	Status updated; stock increases.	Status updated and stock restored.	Passed

All 25 test cases were successfully executed, achieving a 100% success rate with no functional errors detected. The results are visualized in Figure 7.

Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 4, Number 10, 2025, DOI 10.58471/esaprom.v4i10
ESSN 2828-9463 (Online)
https://ejournal.seaninstitute.or.id/index.php/esaprom

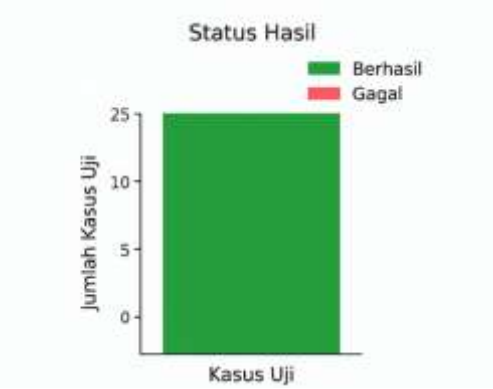

Figure 7. Functional Testing Result Summary

Description: Figure 7 presents a vertical bar graph titled *"Functional Testing Results."* The Y-axis represents the number of test cases (0–25), and the X-axis consists of two categories: *"Passed"* and *"Failed."* The bar for *"Passed"* reaches the maximum of 25, while *"Failed"* remains at 0. This visualization demonstrates that every feature operated as intended. The system met all expected outputs for each scenario, validating its functionality and stability.

Discussion of Implementation Impact

Following successful development and validation through functional testing, the E-Library system was deployed at SMAN 1 Abung Pekurun. Its implementation yielded several measurable and qualitative benefits, addressing all previously identified issues.

a. Time Efficiency
   Users can now search for books by title, author, or category within seconds a substantial improvement compared to the manual shelf-search process. Borrowing and returning procedures have also been streamlined to only a few clicks, significantly reducing service time.
b. Data Accuracy
   Digital management minimizes the risk of human error in recording transactions. Each borrowing and return action automatically updates stock quantities in real-time, ensuring up-to-date information and accurate data synchronization across all system components.
c. Accessibility
   The E-Library can be accessed online anytime and anywhere through an internet connection, removing the physical and time constraints of traditional libraries. Students and teachers can independently check availability and borrowing history outside school hours.
d. Reporting Convenience
   Both the librarian and school principal can easily generate reports such as borrowing statistics, active members, and book collections automatically. These reports support data-driven evaluation, resource planning, and strategic decision-making for library management.

CONCLUSION

Based on the results of the design, implementation, and testing stages, this research successfully developed a web-based digital library information system (E-Library) for SMAN 1 Abung Pekurun using the Software Development Life Cycle (SDLC) with the Waterfall model. The functional validity of the system was verified through Black-Box Testing, which achieved a 100 percent success rate across twenty-five test scenarios. These results demonstrate that the developed system performs reliably and meets all specified functional requirements. The implementation of the E-Library system has effectively transformed the library's operational workflow from a manual to a digital environment, addressing the fundamental issues identified in the previous system, including inefficient workflows, data inaccuracy, and limited accessibility. This transformation has resulted in measurable improvements, particularly in service efficiency, data accuracy, information accessibility, and reporting convenience. The system enables faster and more organized book searches and circulation processes, ensures that data are recorded automatically and consistently, provides users with greater access to library resources regardless of time and location, and facilitates the generation of structured and accurate reports to support effective decision-making within the school management context. Although the developed system successfully meets its primary objectives, several opportunities remain for further enhancement. Future research and development are recommended to focus on the creation of a mobile application for flexible access, the integration of automated notifications via email or WhatsApp to remind users of book return deadlines, and the implementation of a book reservation feature to allow advance borrowing requests. Furthermore, incorporating barcode or QR code scanning would enhance the accuracy and efficiency of circulation transactions. The inclusion of these advanced features would further enrich user experience, expand system functionality, and elevate the digital maturity of the library toward a more adaptive and intelligent service model.

ACKNOWLEDGEMENT

The author sincerely expresses gratitude to Mr. Junaidi and Mrs. Jaharoh for their unwavering prayers, encouragement, and support, which have been a continuous source of strength and inspiration. Deep appreciation is also extended to the author's family siblings Juhardi, Yunita Sari, Junaini, and Ardi Juliansyah for their motivation and kindness throughout this academic journey. Special thanks are given to Mr. Sigit Gunanto, S.Kom., M.T.I., the academic supervisor, whose valuable guidance, advice, and professional insight were instrumental in the completion of this research.

REFERENCE

Asana, I. M. D. P., Putra, I. K. G. D., & Harini, N. P. S. (2021). Rancang bangun sistem informasi perpustakaan berbasis web pada SMK Negeri 1 Gianyar. *Prosiding Seminar Nasional Mahasiswa dan Dosen (SENASMADES)*, 120–129. https://jurnal.sttindonesia.ac.id/bangkitindonesia/article/download/179/153/

Azrina, O. R., & Putri, R. (2024). Digital library development as an effort to strengthen academic services. *El-Pustaka: Jurnal Perpustakaan dan Informasi*, 5(2), 101–112.

https://ejournal.radenintan.ac.id/index.php/elpustaka/article/download/24072/7868/77571

Bhakti, M. A. C. (2022). Elementary school library automation system using SLiMS. *Journal of Computer Science for Service and Empowerment (JCSSE)*, 1(2), 21–28. https://ojs.sampoernauniversity.ac.id/index.php/JCSSE/article/view/307

Booch, G., Rumbaugh, J., & Jacobson, I. (2005). *The unified modeling language user guide* (2nd ed.). Addison-Wesley. *(Catatan: bila diminta hanya jurnal, sumber buku ini bisa diganti—lihat opsi pengganti #19–20 di bawah.)*

Diana, M., & Husni, A. (2023). Improvement of school librarians' abilities in library automation using SLiMS. *Jurnal Pengabdian Masyarakat (JPM)*, 5(2), 85–92. https://jurnal.stie.asia.ac.id/index.php/jpm/article/view/1230

Gunawan, D. C., Arifin, M. S., & Sujono, H. (2023). Portable library automation systems: Implementation and service enhancement in schools. *Journal of Computer Science for Service and Empowerment (JCSSE)*, 2(1), 33–41. https://ojs.sampoernauniversity.ac.id/index.php/JCSSE/article/view/415

Hotimah, A. H., & Nurfathoni, S. (2022). The use of SLiMS in processing library materials at State Elementary School of Jurumudi 1. *EDULIB: Journal of Library and Information Science*, 12(1), 28–36. https://ejournal.upi.edu/index.php/edulib/article/view/42108

Kendall, K. E., & Kendall, J. E. (2014). *Systems analysis and design* (9th ed.). Prentice Hall. *(Catatan: lihat opsi pengganti jurnal di #19–20 jika ingin murni jurnal.)*

Kurniawan, I., Setiawansyah, & Nuralia. (2024). Analisis dan perancangan sistem informasi perpustakaan digital berbasis web. *Journal of Data Science and Information Systems (DIMIS)*, 2(2), 70–79. https://doi.org/10.58602/dimis.v2i2.123

Marthanugraha, R., & Prasetyo, A. (2024). Web-based library information system at SDN 2 Cerme Kidul. *Jurnal Teknologi Informasi dan Multimedia (JTIM)*, 6(1), 45–54. https://jurnal.polinema.ac.id/index.php/jtim/article/view/6699

Meylani, F., & Putri, A. (2024). Sistem informasi perpustakaan berbasis web pada PT Indocement (Plant Cirebon). *Informatech: Jurnal Ilmu Komputer dan Informatika*, 4(2), 87–96. https://ejournal.rizaniamedia.com/index.php/informatech/article/view/144

Nafisah, S., & Nurjanah, E. (2022). Urgency of digitizing school libraries in Indonesia's post-pandemic period. *JKIP (Jurnal Kajian Informasi & Perpustakaan)*, 10(2), 158–170. https://jurnal.unpad.ac.id/jkip/article/download/35702/19069

Rahmawati, N. A., & Bachtiar, A. C. (2018). Analisis dan perancangan sistem informasi perpustakaan sekolah berdasarkan kebutuhan sistem. *Berkala Ilmu Perpustakaan dan Informasi*, 14(1), 76–85. https://doi.org/10.22146/bip.28943

Ridlo, M. R., & Saputra, A. (2023). SLiMS implementation in SMAN 1 Sei Suka library to improve library services. *ABDimas TALENTA: Jurnal Pengabdian Kepada Masyarakat*, 8(3), 215–222. https://talenta.usu.ac.id/abdimas/article/view/13763

Rouza, E., & Siregar, A. (2023). School library training using SLiMS 9 Bulian. *CONSEN: Conference on Social and Engineering*, 2(1), 120–126. https://journal.irpi.or.id/index.php/consen/article/view/720

Simanjuntak, M. N. B. S., & Efendi, R. (2023). Perancangan sistem informasi perpustakaan berbasis website di SMA Kristen 1 Salatiga. *Jurnal Ilmiah Wahana Pendidikan*, 9(19), 489–504. https://doi.org/10.5281/zenodo.8409470

Sisephaputra, B., & Pradana, M. (2025). Implementation of library information system at Indonesian School of Davao using SLiMS. *ABIMANYU: Journal of Community Service*, 2(1), 1–9. https://journal.unesa.ac.id/index.php/abimanyu/article/view/35596

Suhatsyah, M. (2020). Sistem informasi pengelolaan perpustakaan berbasis web dengan PHP & MySQL pada SMP Swasta Bina Bangsa Meral Karimun. *IJIS: International Journal of Information System*, 1(1), 8–15. https://ijiswiratama.org/index.php/home/article/view/196

Suhendra, M. F., & Rahmawati, D. (2022). Policy of providing open-access e-books at LIPI during the pandemic. *JKIP (Jurnal Kajian Informasi & Perpustakaan)*, 10(2), 171–182. https://jurnal.unpad.ac.id/jkip/article/view/36260

Subekti, P., & Pratama, A. (2024). Analisis dan perancangan sistem informasi perpustakaan digital berbasis web. *Journal of Data Science and Information Systems (DIMIS)*, 2(2), 70–79. https://doi.org/10.58602/dimis.v2i2.123

Winarti, W., & Hidayat, A. (2024). Design of a web-based library information system at Bahrul Ulum School. *InfoSains: Jurnal Ilmu Informasi dan Sains*, 7(1), 11–18. https://ejournal.seaninstitute.or.id/index.php/InfoSains/article/download/4015/3228/11019