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ENHANCING MANUSCRIPT UTILIZATION THROUGH MANUSCRIPT DIGITIZATION AND AUTOMATION: A CASE STUDY OF THE JANGKA JAYABAYA MANUSCRIPT AND KITAB ANASIR AT THE INTEGRATED LABORATORY OF ISLAMIC THOUGHT, UIN SALATIGA

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Abstract
This research aims to develop and improve the utilization of the Jangka Jayabaya Manuscript and the Anasir Book in the Islamic Thought Laboratory of UIN Salatiga through the digitization process and implementation of the Senayan Library Management System (SLiMS) Bulian automation system. The method uses Research and Development (R&D) ADDIE models with data collection through direct observation of the physical condition of the manuscript and the management process, in-depth interviews with laboratory managers, documentation studies, and comparative surveys of pre-post implementation, including quantitative analysis derived from the SLiMS Report Access feature. The results of the study show a substantial increase in utilization effectiveness: simultaneous access capacity has increased drastically (recorded to reach 17 to 32 users) in the same time session in conducting studies through scripts. In addition, accessibility has expanded to 24 hours non-stop due to the bold nature of the system, while significantly reducing the risk of physical damage to the manuscript due to direct contact. However, major obstacles include the inability of digital surrogacy to fully support in-depth codicological analysis that requires direct physical interaction with the artifact. Other challenges include limitations in technical infrastructure, especially in terms of database capacity and the resilience of the hosting domain which is still temporary.
Keywords: digitization, manuscript preservation, library automation, SLiMS, dan Islamic manuscript

INTRODUCTION

Research and preservation of ancient manuscripts are fundamental to maintaining the continuity of Islamic intellectual and cultural heritage, particularly in the Indonesian archipelago. These historic manuscripts not only serve as primary sources for tracing the historical development of Islamic thought, but also act as historical windows, enabling a deeper understanding of the social, cultural, and spiritual dynamics of societies in the past (Azra, 2002). Such collections often contain a wealth of knowledge that has yet to be fully uncovered and serve as an important foundation for philological, historical, and contemporary Islamic studies.

The Islamic Thought Laboratory of the Faculty of Ushuluddin, Adab, and Humanities (FUADAH) at UIN Salatiga plays a central role as a center for Islamic and humanities studies. It houses two highly valuable ancient manuscripts: Jangka Jayabaya and Kitab Anasir. These two

manuscripts possess unique philological and cultural value, presented in the form of macapat songs. Tembang macapat is a traditional Javanese poem with a specific metrical structure, historically often used by Javanese scholars and poets as a medium for conveying Islamic moral, philosophical, and spiritual teachings (Ramadhanti & Ayundasari, 2021). The use of macapat in this manuscript clearly demonstrates how Islam successfully interacted and harmonized peacefully with local culture, producing a contextual intellectual heritage (Mulyono, 2007).

Despite their invaluable historical and academic value, most manuscripts in Indonesia, including the collection at UIN Salatiga, face serious preservation challenges. These manuscripts have not been adequately documented, and most are still stored using conventional methods. These storage conditions make the collections vulnerable to physical degradation caused by age, climate fluctuations (temperature and humidity), pest infestation, and the lack of strict conservative care protocols (Gilliland-Swetland, 2000).

These limitations of conventional storage directly limit academic access. Access to physical manuscripts must be done on a rotating basis and only during specific operating hours. Each time a manuscript is opened and examined, particularly during the translation process, which requires repeated physical contact, the risk of permanent damage to the paper, ink, and binding increases exponentially. This limited access ultimately hinders the effectiveness of research for academics and external collaborators.

To address conservation and accessibility challenges, digitization and automation have emerged as strategic solutions offered by Library and Information Science (LIS). Digitization is defined as the method of converting physical documents into a secure and easily accessible digital form. Digitization involves translating a piece of information, such as an image, audio recording, book, or video, into bits. Bits are the basic unit of information in a computer system (Rasiman, 2011).

This digitization method converts any physical or other document into a digital form (Deegan & Tanner, 2002). This process serves as a preventative conservation tool, producing digital copies that researchers can use without having to touch the original manuscript (Rubin, 2016). The digitization methods applied will vary depending on the type of library material. For example, for sculptures and paintings, digital cameras are typically used to produce digital photos and videos. (Mustofa, 2018).

The next stage is automation, which involves the design and implementation of sophisticated computer systems to complete previously manual library tasks, ensuring structured and efficient information management. Automation in library science can be defined as the design and implementation of increasingly sophisticated computer systems to complete tasks previously performed manually in libraries (Reitz, 2004). Library automation is the design and implementation of increasingly sophisticated computer systems to complete tasks previously performed manually in libraries. A library automation system is a computer application tool for library activities, particularly those characterized by the use of large databases, with predominantly textual content, and with key features related to the storage, retrieval, and presentation of information (Pendit, 2008).

As part of implementing LIS principles—particularly preservation, organization, and accessibility—this digitization project opens up the possibility of interdisciplinary research collaboration. To support this effort, this research specifically selected the Senayan Library Management System (SLiMS) version 9 Bulian. SLiMS is a proven, open-source library automation software widely used in educational institutions in Indonesia (Ibrahim et al., 2023). SLiMS supports essential features such as cataloging, digital metadata management, and, most

importantly, access reporting, making it highly suitable for automating the management of Jangka Jayabaya and Kitab Anasir in an efficient and standardized manner.

The use of local and open-source automation software like SLiMS to manage cultural heritage, also derived from local wisdom (macapat manuscripts), raises an important narrative regarding information sovereignty. This move goes beyond mere content preservation; it affirms local control over the means of disseminating intellectual heritage. By utilizing domestically developed technology optimized for the needs of religious higher education institutions (PTKI), UIN Salatiga can mitigate reliance on large repository models often centered on Western standards. This step affirms the institution's role not only as a custodian but also as an active publisher of its own cultural heritage.

Furthermore, the widespread adoption of SLiMS in Indonesia facilitates the easy replication of this R&D model across the PTKI network. The potential for standardizing metadata and access protocols among Islamic institutions through the SLiMS ecosystem represents a strategic effort to address the fragmented nature of Indonesian manuscript studies. If implemented collectively, this model has the potential to create a national union catalog (using features like the Union Catalog Server or Nayanes provided by SLiMS, if fully developed) for Indonesian manuscripts.

Previous research examining the digitization and preservation of ancient manuscripts and manuscripts has been conducted. Such studies include "Manuscript Digitization as an Effort to Preserve and Save Information: A Case Study at the Radya Pustaka Museum in Surakarta" (Prastiani & Subekti, 2017) and "Preservation of Ancient Manuscript Collections (Manuscripts) in Digital Forms at the National Library of the Republic of Indonesia: A Study at the Library Materials Preservation and Media Transfer Center" (Putra & Widya, 2023). However, those studies focused more on the digitization process as an effort to preserve manuscripts, while this study develops a manuscript digitization process as an effort to increase manuscript utilization. Furthermore, this study also discusses the process of automating digital manuscripts as a continuation of the manuscript digitization process.

Ultimately, this research is not only an applied research activity in the fields of information management, digital conservation, and library automation, but also aims to create a sustainable digital-based manuscript collection management model within the PTKI environment, opening opportunities for philological collaboration, and supporting the comprehensive preservation of Nusantara's intellectual heritage.

RESEARCH METHOD

This research employed the Research and Development (R&D) method, or the ADDIE model. The ADDIE model was chosen because its goal is to develop an applicable product through five main stages: Analysis, Design, Development, Implementation, and Evaluation (Sukmadinata, 2015). The manuscript automation system utilizes SLiMS, and its effectiveness and validity were then tested in an operational context at the Integrated Laboratory of Islamic Thought at UIN Salatiga.

Data collection was conducted to obtain comprehensive information regarding the condition of the manuscripts, system requirements, the development process, and utilization results. Direct observations were made of two key manuscripts, Jangka Jayabaya and Kitab Anasir, to understand the physical condition of the manuscripts (degree of damage, material type, format). These observations were crucial for determining technical specifications and

Standard Operating Procedures (SOPs) pre-digitization. Prior to photography, the manuscripts were cleaned using a soft brush, and all personnel involved were required to wear masks and gloves to minimize the potential for dust or skin irritation. This procedural action implicitly validated the safest and most ethical methods for handling artifacts, ensuring that digital conservation efforts did not cause damage to the physical artifacts.

Structured interviews were conducted with the management of the Islamic Thought Laboratory and lecturers teaching related courses to gather information on the manual manuscript management procedures and to determine the functional requirements of the automation system. The results of these interviews served as the basis for developing two types of Standard Operating Procedures (SOPs):

Qualitative analysis focused on interpreting the entire Research and Development process, from the pre-digitization stage to system implementation. The steps in developing the automation system were described in detail to evaluate procedural effectiveness and any challenges encountered. Interviews, expert validation by philologists, and documentation studies were used to validate the SOPs.

Descriptive quantitative analysis focused on comparing utilization metrics. Data from the SLiMS Access Report was analyzed to measure improvements in access effectiveness and efficiency, particularly in terms of simultaneous access capabilities and the 28-day utilization period.

The R&D approach, which utilized data triangulation, combined automated system logs (SLiMS) with user perceptions (Google Forms), with 112 respondents (four philology classes), resulting in strong external validity. This demonstrates that the developed system (automation) not only technically increases manuscript utilization (as seen in the access logs), but is also perceived as effective by users.

RESULT AND DISCUSSION

The development phase of the manuscript automation product involved a series of processes, from infrastructure preparation and archival-quality digitization to the implementation of an information system based on SLiMS 9 Bulian.

Results

In the analysis phase, a preliminary study began with interviews with laboratory staff and lecturers of related courses to understand the manual manuscript review workflow and the specific needs of users, particularly in the translation process, which requires repeated access. Observations of two manuscripts, Jangka Jayabaya and Kitab Anasir, confirmed their fragile and vulnerable physical condition, emphasizing the need for digitization as a preventative conservation measure.

The next phase was Design. Based on the needs analysis, a detailed Standard Operating Procedure (SOP) was developed, covering manuscript handling, equipment specifications, and the digitization system and workflow to achieve the required archival quality. This SOP included protocols for manuscript hygiene and safety, including the mandatory use of masks and gloves during handling to minimize dust contamination and irritants. The digitization process was designed with an emphasis on digital fidelity, a philological prerequisite for academically valid digital copies.

The next stage is development. To achieve archival quality (high resolution and accurate detail), adequate technical equipment is used, including a full-frame mirrorless SONY a7iii camera. This camera is positioned on a copy stand mounted on a modified manuscript review table with a scanning glass. This modified table with a scanning glass element is designed to provide a flat and stable support, thus preventing distortion when photographing the manuscript page by page, while also maintaining the physical integrity of the manuscript binding during the photography process by performing color and graphic calibration of the digital manuscript. Furthermore, calibration is performed using a standard color chart to ensure that the color reproduction in the digital image (surrogate) is completely accurate and matches the physical condition of the manuscript. This color accuracy is crucial, as philologists often rely on differences in ink color (for example, red ink for rubrication or emphasis) for proper textual analysis. The final digitization results are a high-resolution master file (TIFF format) for long-term preservation purposes, and an access file (PDF or compressed JPEG format) for upload to the automation system.

The next step is the installation of the automation system. SLiMS 9 Bulian was installed online. The installation process ensured that minimum technical requirements were met, including PHP 8.3 and MySQL 5.7. The installation was performed on a temporary hosting platform (as a prototype) connected to the campus network and accessible from outside. Once the system was ready, an in-depth cataloging of the Jangka Jayabaya and Kitab Anasir manuscripts was conducted in the SLiMS bibliography module. This process involved identifying physical metadata (based on initial codicological observations) and descriptive metadata (author, subject, language, macapat songs used, and their values).

The implementation phase involved uploading digital files and linking them to bibliographic records, which can be found through the SLiMS Online Public Access Catalog (OPAC). Outreach was provided to the academic community, particularly students and lecturers of Philology and Islamic Studies courses, on how to access digital manuscripts through the automated system connected to the online network.

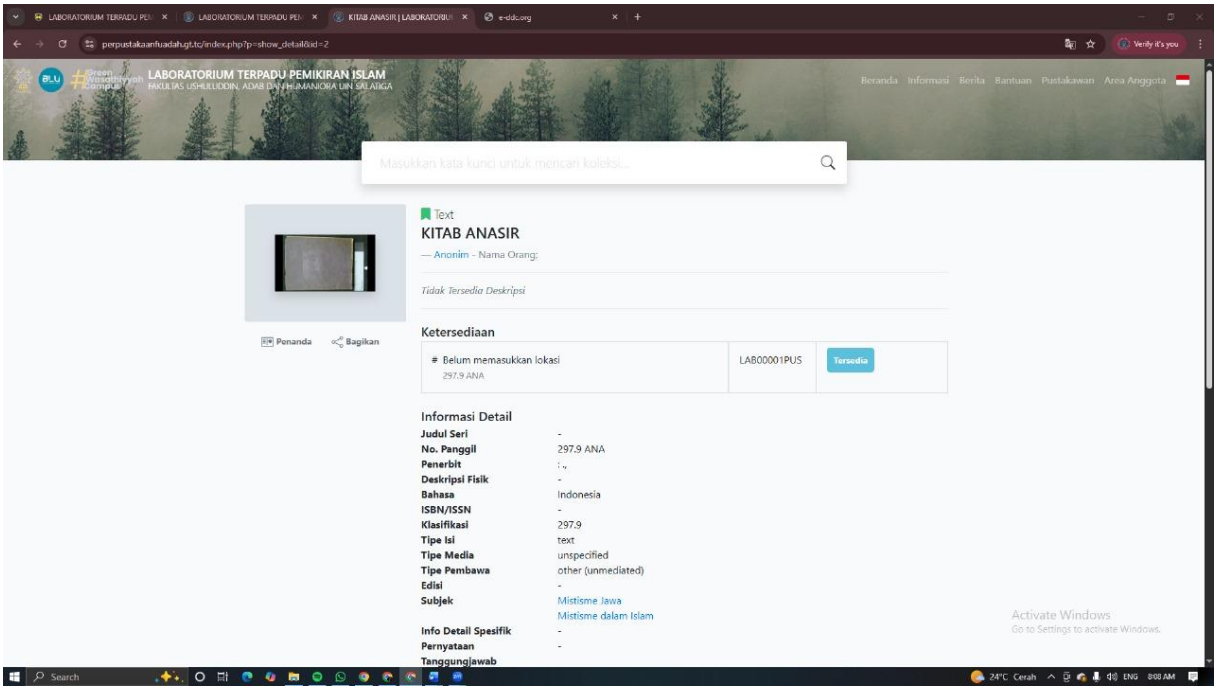


Figure 1. Digital manuscript of the Anasir Book in the SLiMS automation system
Source: https://perpustakaanfuadah.gt.tc/index.php?p=show_detail&id=2

At the Evaluation stage, post-implementation utilization measurements are carried out by monitoring access levels in two ways, namely SLiMS log data analysis and user surveys (Google Form). Data obtained from the SLiMS 4 Access Report shows a very clear increase in effectiveness in terms of simultaneous access. Previously, translation studies on these two manuscripts had to be carried out alternately by one or two researchers. After automation, for 28 (twenty eight) days SLiMS records and is able to serve 17 to 32 simultaneous accesses at the same time for text study and literacy purposes.

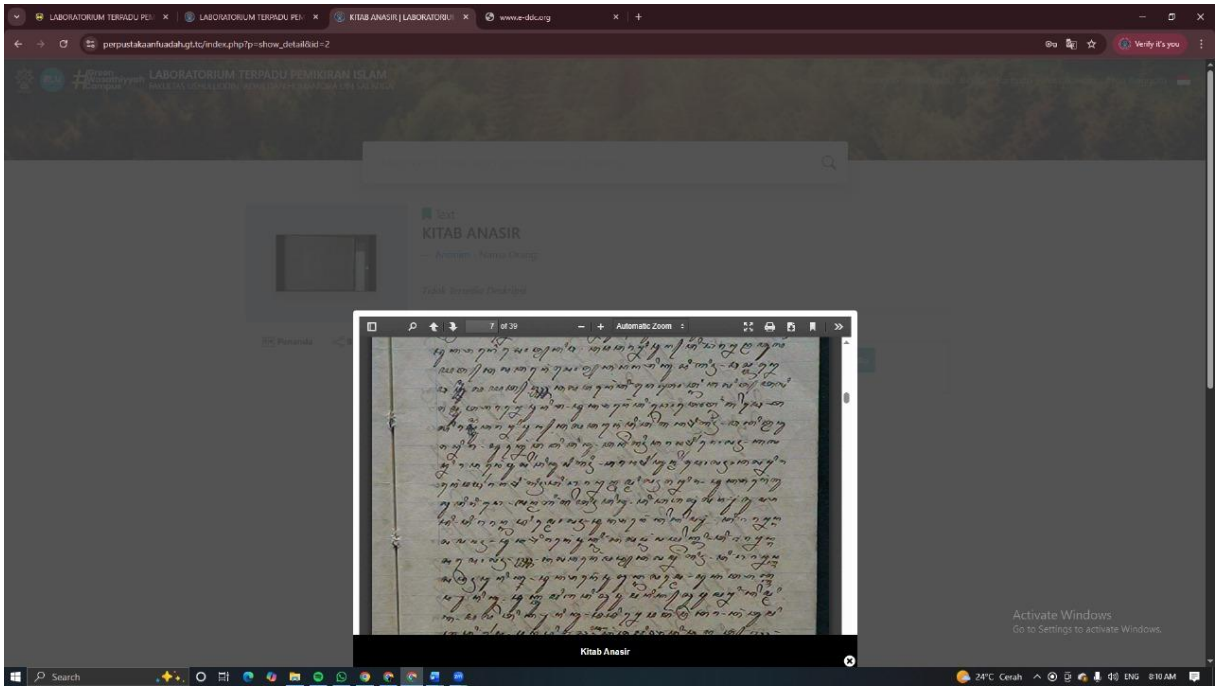


Figure 2. Digital manuscript of the Anasir Book in the SliMS automation system
Source: https://perpustakaanfuadah.gt.tc/index.php?p=show_detail&id=2

The system's ability to manage a surge in simultaneous access from one user to 17-32 users simultaneously represents a measurable Return on Investment (ROI) from the digitalization process. This metric provides empirical evidence of increased utilization capacity that is far more robust than simple qualitative statements. Based on data from a Google Form survey of 112 respondents (four philology classes) and SLiMS access time logs, manuscript utilization appears to occur 24 hours a day, 7 days a week. This is due to the system's online nature and ubiquitous accessibility. This contrasts sharply with previous usage, which was limited to the Islamic Thought Laboratory's business days and hours.

While initial results were very positive, the success of serving up to 32 simultaneous accesses indicates significant pressure on the still-temporary hosting infrastructure. Given the large size of the manuscript master files (TIFFs), SLiMS's ability to handle this access requires robust infrastructure support, indicating the need for a transition to a cloud solution or institutional dedicated server to maintain and scale the quality of this service.

Discussion

The effectiveness of the Jangka Jayabaya and Kitab Anasir manuscripts after digitization and automation has shown a dramatic increase. Quantitative data from SLiMS access reports demonstrates a high number of simultaneous accesses, ranging from 17 to 32 users

simultaneously utilizing the digital collection for translation studies. This phenomenon is impossible in conventional systems. This increased simultaneous access capacity directly facilitates collaborative and collective work by the research team, lecturers, and students at UIN Salatiga, allowing the translation and textual analysis processes to be completed in parallel and more quickly.

Furthermore, user survey data and system logs confirm that access is now possible 24 hours a day, without being bound by the physical working days and hours of the laboratory. This flexibility essentially overcomes geographical and temporal constraints, which are crucial for supporting research collaboration across time and regions, including serving academics from different time zones. This increased utilization is not simply a numerical increase, but a reflection of fundamental improvements in academic efficiency. The digitization process has successfully transformed a previously static and fragile collection into a dynamic and highly accessible information resource.

The following is a comparative table summarizing significant differences in utilization effectiveness indicators:

Table 6.1. Comparison of Manuscript Utilization Effectiveness Indicators (Pre- and Post-SLiMS Automation)

Effectiveness Indicators	**Pre-Automation (Manual) Condition**	**Post-Automation Condition (SLiMS)**
Simultaneous Access Capacity	1-2 people, rotated	17-32 people (based on SLiMS access reports)
Access Time Span	Limited to physical work hours and days	24 hours a day, 7 days a week (online)
Risk of Physical Damage	Very high due to repeated direct contact	Significantly reduced, minimal physical contact
Speed of Translation Assessment	Slow, requiring queues and limited	Highly efficient, can be done in parallel

Another important implication of digitization is the benefit of preventative conservation. By shifting the majority of textual study needs to digital surrogacy, the vulnerability to potential physical damage to manuscripts is substantially reduced. The physical contact typically involved in textual study (opening, turning pages, touching) is minimized, directly extending the lifespan of the original manuscripts.9

Financially, reducing physical handling also has strategic value in an institution's long-term budget planning. Efficient digital handling delays the need for expensive curative restoration. This shifts conservation costs from a large, periodic expense (restoration) to an ongoing operational cost (maintenance of digital infrastructure). This model offers a more manageable fiscal solution for the PTKI administration.

Digitization also acts as an information rescue. Even if the physical manuscripts are completely destroyed due to disasters or inevitable natural degradation, the intellectual content of the Jangka Jayabaya and Kitab Anasir manuscripts remains permanently documented and accessible, ensuring the continuity of the legacy of Indonesian Islamic thought. While digitization offers massive access and conservation benefits, discussions must critically acknowledge the limitations of digital surrogacy, particularly in the context of more in-depth

philological studies. The use of digital manuscripts through automated systems cannot be applied to manuscript analysis using a codicology approach.

Codicology analysis, which encompasses the study of the physical materiality of manuscripts—such as paper type, watermarks or countermarks, binding methods, and surface texture—requires direct physical interaction. Digital images, even high-quality ones, cannot fully replicate the tactile or visual sensations obtained by viewing watermarks through paper. Therefore, the role of physical manuscripts in the UIN Salatiga Laboratory has shifted. Original manuscripts now serve as conservation artifacts and primary objects for codicology and authentication studies. Digitization should be understood as an effective substitute for access for mass textual studies (translations), but not a replacement for the physical artifacts themselves. Collection management policies should accommodate scheduled and strictly controlled physical access for codicology specialists only.

Despite the success of this research in its implementation and initial effectiveness testing, significant obstacles must be overcome to ensure the scalability and long-term digital persistence of manuscripts. The primary technical constraint lies in the currently limited infrastructure capacity. This development research used a temporary domain and hosting service for the prototype stage. This directly impacts database (DB) capacity. Shared hosting services typically impose database size limits (e.g., 3 GB to 6 GB). Given that archival-quality digital master files (TIFF format) are very large, and each bibliographic record must link to these files, limited DB capacity poses a serious barrier to future scaling of the digital manuscript collection. If UIN Salatiga's manuscript collection grows, the risk of the database being suspended due to exceeding usage limits is very high.

The use of temporary infrastructure also raises critical issues regarding digital persistence. LIS best practices, particularly for cultural heritage, require a permanent and stable URL (Uniform Resource Locator). Temporary hosting is vulnerable to downtime or configuration changes, which threatens the continued availability of the data.

These limitations highlight that while SLiMS is highly effective as an Integrated Library System (ILS) for access and reporting, it requires the support of a more mature institutional repository architecture (e.g., a dedicated server or a synchronized cloud storage solution) to fulfill the functions of a true digital archive at scale.

Table 6.2. Analysis of SLiMS 9 Bulian Automation Infrastructure Constraints and Long-Term Solutions

Infrastructure Constraints	**Long-Term Implications**	**Recommended Strategic Solutions**
Limited Database Capacity (3 GB–6 GB)	Hinders collection scalability; unable to accommodate large TIFF archive master files.	Migration to a dedicated server or institutional cloud hosting with large-scale storage and database capacity.
Temporary Domain and Hosting	Risks database downtime and suspension; threatens the persistence and integrity of digital archive URLs.	Use of a permanent static domain and IP address; integration with the official UIN Salatiga Institutional Repository (IR).
Codicology Requirements	Limits manuscript authentication research	Implementation of very strict and scheduled physical access

	(codicology) to digital access only.	standard operating procedures (SOPs), specifically for codicology purposes.

The transition to 24/7 access significantly increases the utilization and maximizes public benefits from UIN Salatiga's cultural heritage. However, this increased access demands greater ethical responsibility from the institution. Policies must be developed to regulate digital rights management (DRM) and watermarking on accessible copies to protect the intellectual property of the collection, while ensuring open access and adequate access for academic research purposes. The effectiveness of a digital system is ultimately closely linked to the robustness of the institutional policy framework that supports it.

CONCLUSION

This research and development has successfully developed and implemented a manuscript automation system that has proven to increase the effectiveness of utilizing the valuable Jangka Jayabaya and Kitab Anasir collections at the Integrated Laboratory of Islamic Thought at UIN Salatiga. This effectiveness is empirically documented through SLiMS Access Report data, which shows a substantial increase in simultaneous access capacity, reaching 17 to 32 users simultaneously for transliteration studies, a previously impossible feat. Furthermore, accessibility has expanded to 24/7, significantly reducing the risk of physical damage to manuscripts due to repeated manual handling, while offering vital preventative conservation benefits. The implementation of SLiMS 9 Bulian, supported by strict digitization SOPs, has successfully shifted the burden of most textual studies to the digital realm.

SUGGESTION

UIN Salatiga needs to formulate a comprehensive policy regarding the academic limitation that in-depth codicological analysis still requires physical access. Furthermore, technical constraints such as limited database capacity, temporary hosting, and domain persistence are key challenges that must be overcome to ensure long-term system scalability and maintain the achieved service quality..

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