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Digital Heritage Knowledge Governance for Islamic Higher Education: A Stakeholder-Oriented WebGIS for Historic Mosques in Central Java

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ABSTRACT

Historic mosques carry valuable Islamic cultural knowledge, but their historical, architectural, and spatial records often stay scattered across separate sources. This condition weakens the ability of educational and heritage stakeholders to organize and reach that knowledge. This study developed a stakeholder-oriented WebGIS for the digital heritage knowledge governance of historic mosques in Central Java. It applied Research and Development through the Design Science Research Methodology, moving from needs assessment, field observation, and GPS-based mapping to system development, implementation, and user evaluation. Data were examined descriptively using frequencies, percentages, field verification, and functional assessment. Historical information was the content most respondents wanted, chosen by four of six participants, while five of six regarded interactive mapping as important or very important, and easy navigation ranked as the leading function. The resulting WebGIS joined hierarchical geographic navigation with historical, architectural, and visual records, and an AI-assisted feature was integrated as a supporting analytical layer. Preliminary users reported no negative assessments, though most ratings stayed moderately positive. These results imply that a mosque WebGIS can serve educational institutions as knowledge-governance infrastructure that strengthens heritage information management and widens access to Islamic cultural knowledge.

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INTRODUCTION

Historic mosques hold a central place among Indonesia's built heritage, since they carry religious meaning together with centuries of interaction between Islam, vernacular architecture, and local community life. In Central Java, this heritage is dense and historically layered, yet much of what documents it stays scattered across archival records, scholarly studies, photographs, and community memory. That fragmentation creates a practical problem for the institutions meant to steward this knowledge, because information that cannot be located, linked, or updated is difficult to teach, research, or conserve. Studies of Javanese Islamic architecture confirm that mosque forms preserve distinctive spatial arrangements and construction traditions shaped by long cultural adaptation (Hamdani et al., 2022; Sholihah et al., 2024). Built heritage also stays vulnerable to deterioration and to the slow loss of historical records when documentation is neither systematic nor sustained (Santos et al., 2023). The core issue is therefore not an absence of records but the limited capacity of conventional documentation to organize and share them.

Recent scholarship has moved toward treating heritage conservation as an information-intensive process rather than physical protection alone. Research on heritage digitization shows that digital technologies now support documentation, visualization, and dissemination, though their adoption remains uneven and fragmented across platforms (Salleh & Bushroa, 2022). Digital heritage work has begun to extend records beyond static archives toward interactive and multimodal services (Fan et al., 2022), and GIS has become well suited to linking spatial and non-spatial heritage data within one architecture (Liu et al., 2024; Simou et al., 2022). Web-based applications widen this further by turning heritage databases into interactive services for researchers, agencies, and the public (Hidalgo-Sánchez et al., 2024). More recently, artificial intelligence has expanded the field toward conservation assessment, classification, and other data-intensive tasks (Harisanty et al., 2024). Together these studies frame heritage as organized, accessible knowledge rather than isolated documentation.

A gap remains once these strands are placed side by side. GIS-oriented heritage systems manage spatial inventory, visualization, and risk assessment well, yet they rarely begin from the documented information needs of the institutions that will use them (Liu et al., 2024; Santos et al., 2023; Simou et al., 2022). AI-oriented studies, in turn, concentrate on image classification, architectural-element recognition, and feature extraction, largely apart from spatial management (Haznedar et al., 2023; Siountri & Anagnostopoulos, 2023; Tan et al., 2024; Carvalho Ottoni & Cordeiro Ottoni, 2025). Research on Indonesian mosques stays focused on architectural form and cultural meaning rather than on the digital infrastructure that would make such knowledge searchable and current (Handoko et al., 2024; Sholihah et al., 2024). No study reviewed here builds a publicly accessible WebGIS that treats mosque documentation as stakeholder-driven knowledge governance for educational institutions. The novelty of this study lies in that combination of user-grounded design, spatial-historical integration, and governance framing.

This study set out to develop and evaluate a stakeholder-oriented WebGIS for the digital heritage knowledge governance of historic mosques in Central Java. Its specific aims were to identify the information and functional needs of prospective users, to translate those needs into a hierarchical spatial system linking location with historical, architectural, and visual records, and to assess the resulting prototype through preliminary user evaluation. The work extends existing GIS and AI heritage scholarship by grounding system design in documented needs rather than assumed ones, and by framing the product as a managed knowledge resource for Islamic higher education (Hidalgo-Sánchez et al., 2024; Liu et al., 2024; Moreno et al., 2022). Its relevance is both academic and practical, since it offers a replicable model for organizing dispersed heritage knowledge and a usable platform for teaching, research, and institutional documentation. In this way it connects heritage informatics with the concerns of educational management.

The central argument of the study is that a mosque WebGIS becomes most valuable when it is understood as knowledge governance rather than cartography. The analysis therefore focuses on how stakeholder needs can be surfaced, how those needs shape the structure of spatial and historical records, and how a hierarchical interface makes that knowledge accessible to educational users. An AI-assisted component is included as a supporting analytical feature, integrated at the architectural level and left for later validation, so the study does not overstate its role (Harisanty et al., 2024). Attention stays on the design logic that connects user needs, structured records, and public access within a single environment. The sections that follow describe the research method used to develop and evaluate this system, then present the findings and their implications for heritage knowledge governance in educational settings.

RESEARCH METHOD

This study employed a Research and Development (R&D) approach operationalized through the Design Science Research Methodology (DSRM), because its principal output is a technological artifact intended to solve an information-management problem rather than to test a hypothesis, and design science provides a systematic sequence of problem identification, objective formulation, artifact development, demonstration, and refinement (Carter et al., 2022; Gregor & Zwikael, 2024). A mixed descriptive design was adopted, combining qualitative procedures for identifying stakeholder needs, documenting historical and architectural characteristics, and interpreting field observations, with quantitative procedures for summarizing the user-needs survey, spatial coordinate data, and post-development user evaluation. The developed artifact consisted of a WebGIS interface for spatial visualization and an AI-assisted component for limited data processing, reflecting integrated digital-heritage practices and emerging AI applications in cultural heritage (Liu et al., 2024; Santos et al., 2023; Mishra & Lourenço, 2024; Ottoni & Ottoni, 2025). The study was conducted in Central Java Province, Indonesia, selected for its rich Islamic architectural heritage and numerous historic mosques relevant to cultural-heritage documentation (Sholihah et al., 2024), and followed six DSRM stages: problem identification, requirements definition, design and development, implementation and demonstration, user evaluation, and product refinement, as summarized in Table 1.

Table 1. Design Science Research stages and corresponding research activities

DSRM Stage	Research Activity	Output
Problem identification	Literature review, field observation, preliminary needs survey	Identified heritage-information gaps and user requirements
Requirements definition	Analysis of functional and non-functional needs	Functional and non-functional system specifications
Design and development	WebGIS and spatial-database construction; AI-component integration	Functioning WebGIS prototype
Implementation and demonstration	Public deployment and demonstration with actual mosque data	Operational system at the hosting domain
User evaluation	Post-development questionnaire with prospective users	Preliminary descriptive user feedback
Product refinement	Interpretation of feedback for subsequent improvement	Recommendations for further development

Data were collected through six complementary techniques aligned with the DSRM stages: literature and document review, structured field observation, GPS-based coordinate recording, photographic documentation, a prospective-user needs survey, and a post-development evaluation questionnaire. Historical and architectural information was obtained from scholarly and institutional sources, while structured field observation documented each mosque's identity, physical characteristics, surrounding environment, and location. Geospatial data were recorded through GPS-based field measurement and verified against actual site locations, so that the coordinates were treated as field-verified rather than survey-grade data, consistent with integrated heritage-GIS practices (Liu et al., 2024; Santos et al., 2023). Historic-mosque sites and participants for both the needs assessment and the post-development evaluation were selected through criterion-based purposive sampling—sites according to historical significance, verifiable location, identifiable architectural characteristics, accessibility, and data availability, and participants from relevant stakeholder groups including students, researchers, heritage managers, government officers, and community members. This sampling strategy was intended to capture diverse expectations regarding system content, functionality, accessibility, and usefulness rather than to achieve statistical population representation. The AI-assisted component was integrated at the architectural level only, without an independent labeled dataset, and was therefore not evaluated for classification or prediction performance (Mishra, 2024; Ottoni, 2025).

User-needs and evaluation data were analyzed descriptively using frequencies and percentages, with raw response counts reported alongside percentages to avoid overstating results drawn from small samples. The validity of heritage and spatial data was supported through source triangulation, field verification, and administrative-consistency checks. System functionality was assessed through the successful operation of the mapping, hierarchical-navigation, and information-retrieval features, whereas practicality was interpreted from user perceptions of accessibility, processing speed, interface quality, and satisfaction. Effectiveness was limited to perceived usefulness, since no experimental or comparative testing was conducted, and the System Usability Scale (SUS) was not applied because the evaluation relied on a researcher-developed instrument. The AI-assisted component was assessed only at the level of functional integration; standardized usability testing, geospatial-accuracy assessment, and independent AI-performance validation are accordingly identified as necessary directions for future research. Table 2 summarizes the alignment between each research objective, its data source, and the corresponding analysis technique.

Table 2. Alignment of research objectives, data sources, and analysis techniques

Research Focus	Data Source	Analysis Technique
User information and functional needs	Prospective-user needs survey	Descriptive frequencies and percentages
Heritage and spatial data validity	Documents, field observation, GPS records	Source triangulation and field verification
System functionality	Deployed WebGIS prototype	Functional operation assessment
System practicality	Post-development evaluation questionnaire	Descriptive interpretation of user perceptions
Perceived effectiveness	Post-development evaluation questionnaire	Descriptive analysis of perceived usefulness

RESULT AND DISCUSSION

Result

Analysis Stage

The analysis stage was conducted to identify prospective users and to determine the information and functional requirements to be incorporated into the historic-mosque mapping system. The preliminary survey involved six respondents representing potential users of the system. After consolidating duplicate entries in the respondent categories, four respondents (66.7%) were students, one respondent (16.7%) was a researcher, and one respondent (16.7%) was a member of a religious community. The respondent composition indicates that the initial needs assessment was dominated by users from an academic background, particularly students.

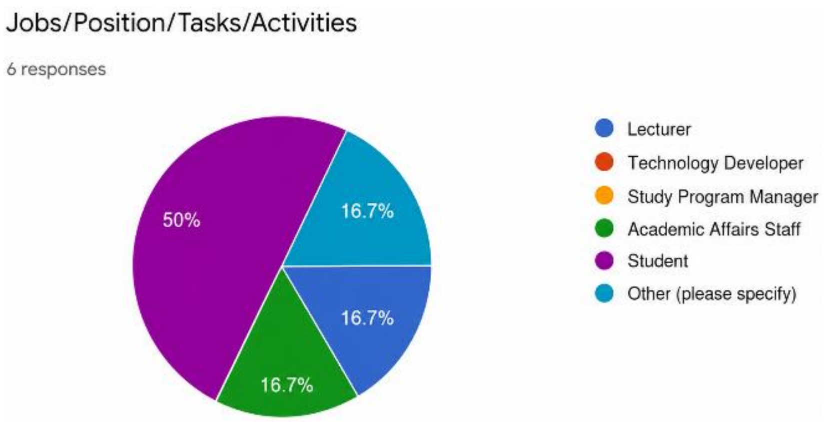

Figure 1. Mapping System Requirements

As shown in Figure 1, students were the largest group, accounting for 4 of the 6 respondents (66.7%). Researchers and members of religious communities each accounted for one respondent (16.7%). The preliminary survey therefore captured user expectations primarily from prospective academic users, while also including limited representation from research and religious-community stakeholders.

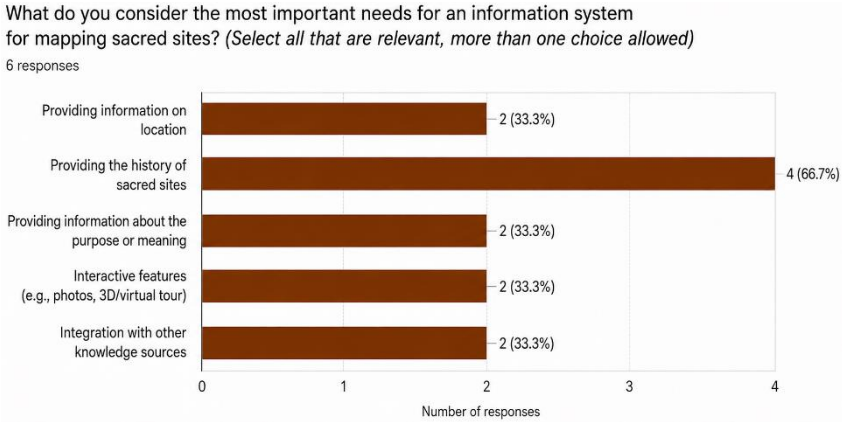

Figure 2. Information Needs for the Ancient Mosque Mapping System

The second component of the survey examined the types of information respondents expected to obtain from the proposed system. The questionnaire allowed respondents to select multiple options. As shown in Figure 2, historical information was the most frequently selected requirement, chosen by 4 of the 6 respondents (66.7%). Information on site locations was selected by two respondents (33.3%), information concerning religious celebrations or events by two respondents (33.3%), interactive facilities such as maps or virtual tours by two respondents (33.3%), and links to other religious resources by two respondents (33.3%). The result showed that historical information was the most frequently requested content component of the proposed system.

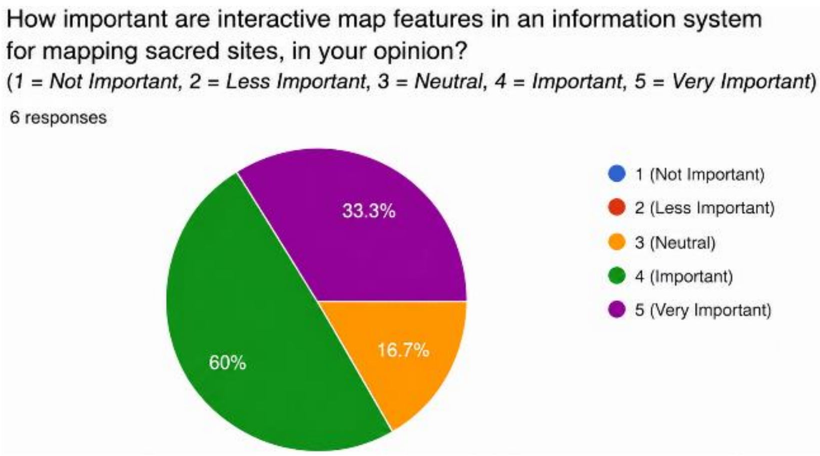

Figure 3. Perceived Importance of the Interactive Mapping Feature

The importance of an interactive mapping feature was assessed on a five-point scale ranging from 1 (not important) to 5 (very important). As shown in Figure 3, three respondents (50.0%) rated the interactive map as important (score 4), two respondents (33.3%) rated it as very important (score 5), and one respondent (16.7%) selected the midpoint of the scale (score 3). None of the respondents selected scores 1 or 2. Thus, five of the six respondents (83.3%) considered the interactive mapping function either important or very important.

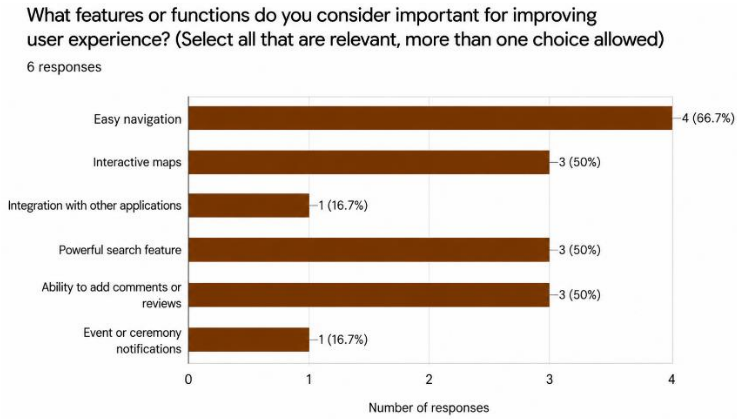

Figure 4. Priority Functions of the Ancient Mosque Mapping System

Respondents were also asked which functions should be prioritized to improve their experience when using the system. As presented in Figure 4, easy navigation was the most frequently selected function, reported by four respondents (66.7%). An interactive map, a strong search function, and the ability to contribute comments or content were each selected by three respondents (50.0%). Integration with other applications and notifications concerning events or celebrations were each selected by one respondent (16.7%). These findings were subsequently used to determine the primary functional requirements of the developed system, particularly the provision of historical information, interactive geographic visualization, straightforward navigation, search functionality, and accessible site-level information.

Design and Development Stage

Based on the results of the needs assessment, the system was designed as a web-based geographic information platform that integrates spatial visualization with descriptive information about historic mosques. The developed system consisted of two principal components: a user-facing WebGIS interface and a data-processing layer. The WebGIS interface was designed to allow users to navigate geographic areas and retrieve information associated with individual mosque sites. In contrast, the processing layer managed the spatial and descriptive information used by the system. The geospatial component organized heritage information according to geographic and administrative levels. Location data were incorporated into the system together with available photographs, historical descriptions, and architectural information for the documented mosques. Rather than presenting mosque records as an isolated textual database, the system connected each record to a geographic location, enabling users to access heritage information through map-based interaction.

The geographic navigation structure was developed hierarchically. Users initially accessed a national-level map of Indonesia. They could subsequently navigate to Central Java, then to regency or municipality areas, to more specific local areas, and finally to individual mosque locations. The resulting navigation sequence can be represented as:

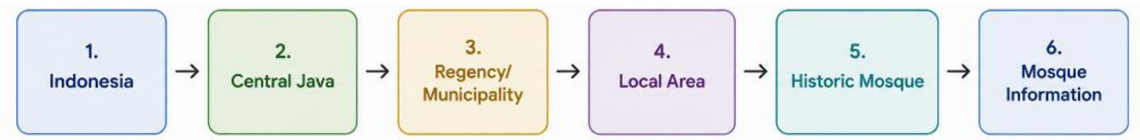

Figure 5. Hierarchical Navigation Flow of the Historic Mosque WebGIS

This hierarchical design allowed increasingly detailed information to be displayed as users moved from a broader geographic scale to an individual heritage site. An AI-assisted component was also incorporated into the system architecture to support the processing of selected image and spatial information. The developed prototype was configured to support functions for recognizing architectural patterns and processing mosque-related visual information. In the current development cycle, however, the result concerns the integration of the AI-assisted component into the system rather than the independent validation of AI classification or prediction performance. No separate model-performance results are therefore reported in this section. The output of the design and development stage was a functioning WebGIS prototype that contained spatially organized mosque information and provided progressive access from regional mapping to individual site records.

Implementation Stage

Following the development stage, the WebGIS platform was deployed in a public web-hosting environment and made accessible at https://situs-suci.uinsalatiga.ac.id/. The implementation results are presented in Figure 6-10, which illustrates the system's progressive navigation from the national level to an individual historic mosque record.

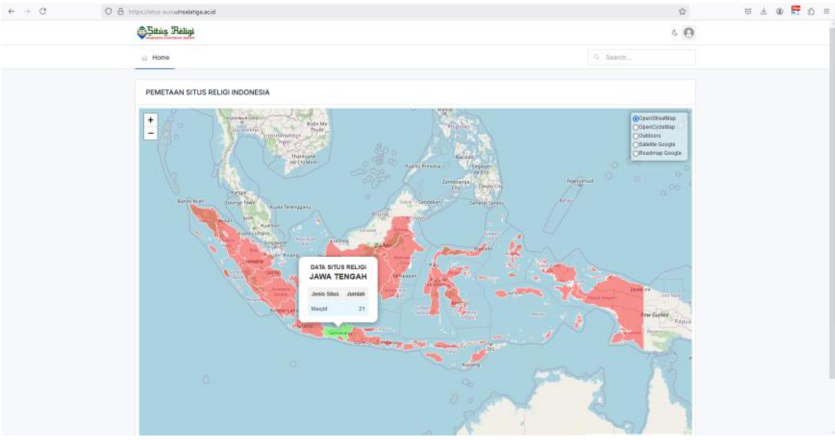

Figure 6. Map of Indonesia

As shown in Figure 6, the main interface displays a map of Indonesia, providing the system's initial geographic context. Central Java serves as the principal study area and is visually differentiated from other geographic areas. The national interface functions as the first level of the system's hierarchical spatial navigation.

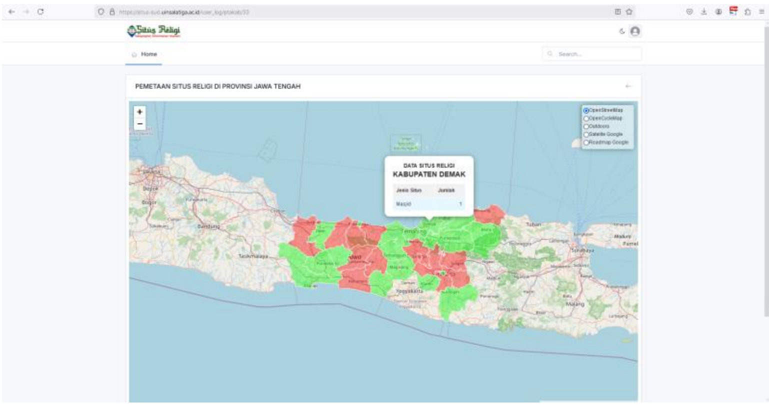

Figure 7. Map of Central Java

Selecting Central Java directs users to the provincial interface shown in Figure 7. At this level, the system displays the administrative areas within Central Java and distinguishes areas according to the availability of documented historic-mosque records. Users can therefore move from the national map to a more focused representation of the study area.

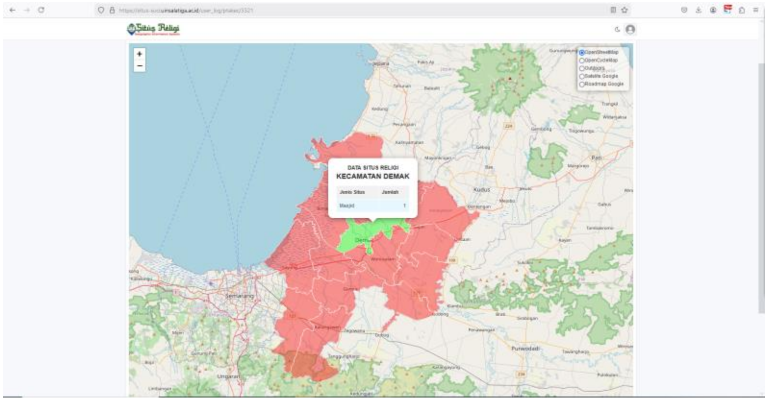

Figure 8. Map of Regencies/Cities in Central Jawa

Further selection of an administrative area produces the regency or municipality-level visualization shown in Figure 8. The system subsequently displays more detailed local administrative areas and enables users to continue navigating toward the location of an individual mosque. This progressive geographic structure prevents all heritage-site information from being displayed simultaneously and instead presents data according to the user's selected spatial level.

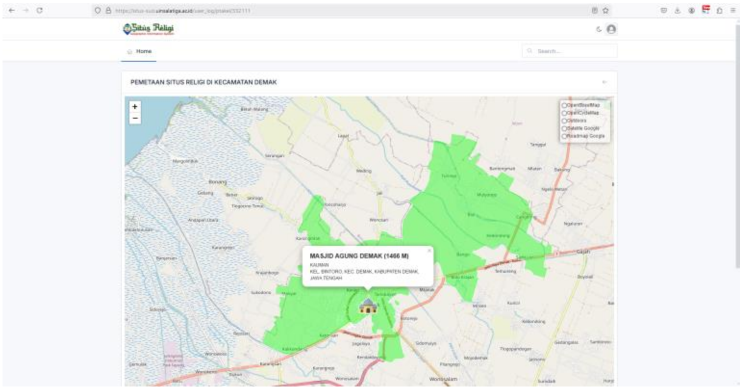

Figure 9. Location of the Great Mosque of Demak Within a Regency in Central Java

Figure 9 presents an example of mosque localization within a selected administrative area. In the illustrated case, the system identifies the location of the Great Mosque of Demak (*Masjid Agung Demak*) through a map marker positioned within the relevant geographic area. The marker links the mosque's geographic location to the descriptive information stored in the system.

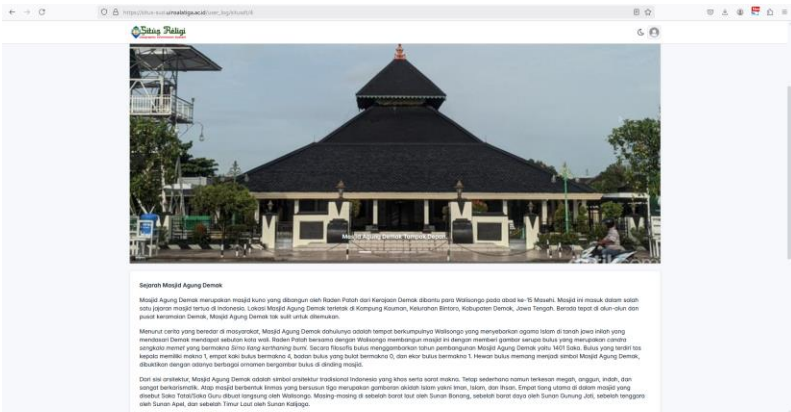

Figure 10. Detail Page of an Individual Historic Mosque

When the mosque location is selected, users are directed to the detailed information page shown in Figure 10. The page contains a photograph of the mosque accompanied by textual information describing the site. This interface represents the final level of the navigation process, where geographic exploration is connected with site-specific historical information. The implementation stage therefore produced an operational navigation sequence in which users can move from a national map to provincial, local-administrative, mosque-location, and individual-site information levels. The implemented system also demonstrated that geographic information and descriptive heritage content could be accessed through a single web-based interface.

Evaluation Stage

After the system had been implemented, a post-development user evaluation was conducted to obtain preliminary responses regarding system access, processing speed, interface quality, satisfaction, overall suitability, and the perceived relevance of the information provided. The evaluation involved two respondents who accessed and used the developed system before completing the questionnaire. The results are summarized in Figure 11-16.

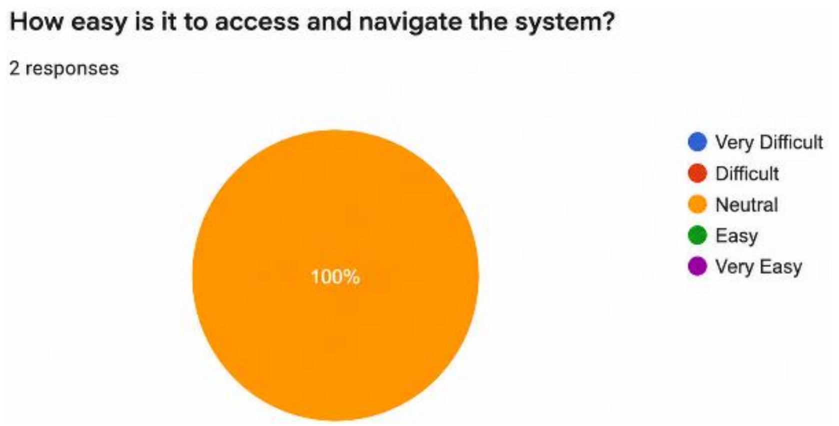

Figure 11. Ease of Access to the System

For ease of access, both respondents (100%) selected fairly easy (*cukup mudah*), as shown in Figure 11. Neither respondent selected easy or very easy, and no respondent reported difficulty in accessing the system. The result therefore places both responses at the middle-positive level of the five-category accessibility scale.

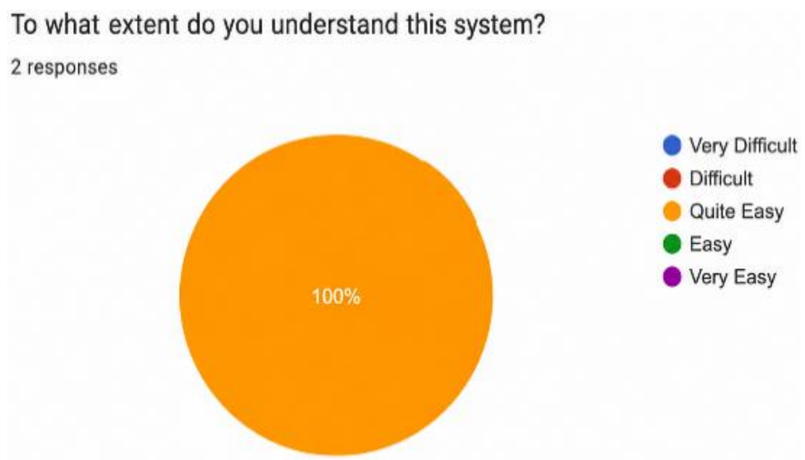

Figure 12. System Processing Speed

A similar response pattern was observed for system processing speed. As presented in Figure 12, both respondents (100%) rated the system as fairly fast (*cukup cepat*). No responses were recorded for fast or very fast, nor were responses recorded for either of the slower categories.

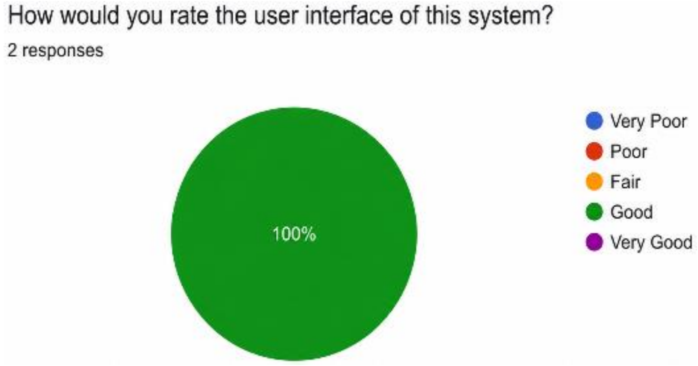

Figure 13. Assessment of the User Interface

The user interface received a more positive assessment. Figure 13 shows that both respondents (100%) rated the interface as good. No respondent rated the interface as very good, while none selected fair, poor, or very poor. Within the available response categories, the interface therefore received a consistently positive rating from both participating users.

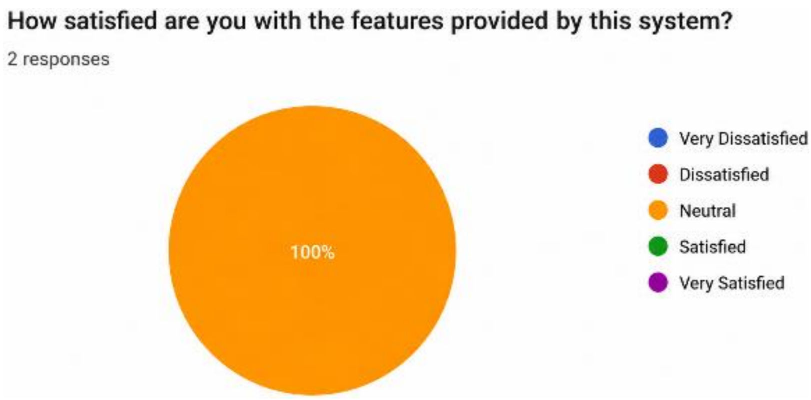

Figure 14. Satisfaction With the System Features

For satisfaction with the available system features, both respondents selected fairly satisfied (*cukup puas*), accounting for 100% of the responses shown in Figure 14. Neither respondent reported being dissatisfied, although neither selected the higher categories of satisfied or very satisfied.

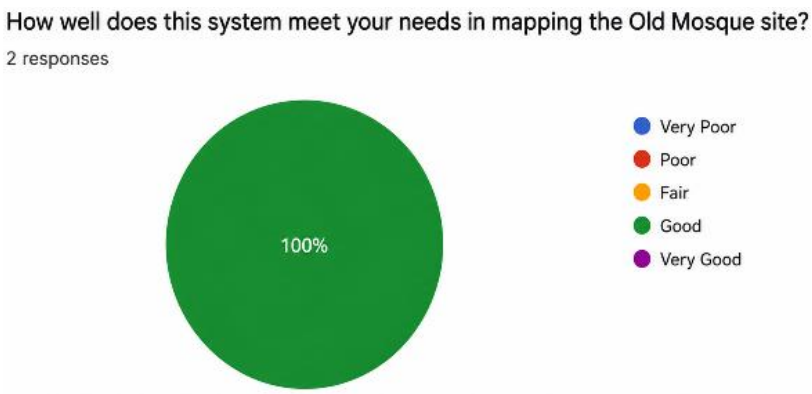

Figure 15. Overall Suitability of the System

The fifth indicator examined whether the developed system fulfilled users needs for mapping historic mosque sites. As presented in Figure 15, both respondents (100%) rated the system as good. No respondent selected very good, fair, poor, or inadequate. This item produced the same response pattern as the user-interface assessment.

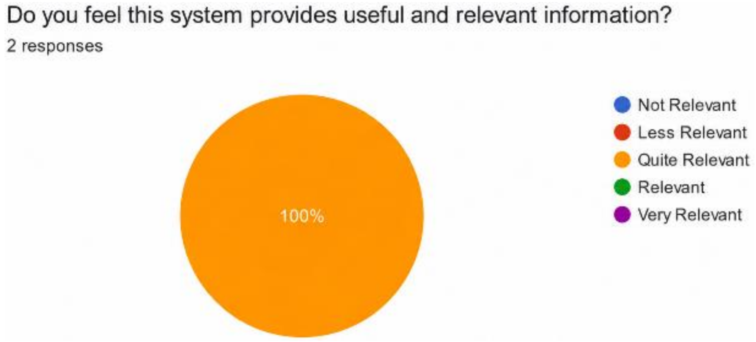

Figure 16. Usefulness and Relevance of the Information Provided

Finally, respondents assessed whether the information presented by the system was useful and relevant. As shown in Figure 16, both respondents (100%) selected fairly relevant (*cukup relevan*). Neither respondent selected relevant or very relevant, while no responses were recorded in the less relevant or not relevant categories.

Across the six evaluation indicators, the two respondents provided no negative ratings. The highest categorical ratings were recorded for user-interface quality and overall system assessment, both of which were rated good by 100% of respondents. Ease of access, processing speed, feature satisfaction, and information relevance were consistently rated at the intermediate positive category (fairly easy, fairly fast, fairly satisfied, and fairly relevant, respectively). Because the post-development evaluation involved only two respondents, these results are presented as preliminary descriptive user responses to the developed prototype rather than as evidence of population-level system acceptance or effectiveness.

The development process resulted in a publicly accessible WebGIS prototype that incorporated the principal functions identified during the preliminary needs assessment. The system provides hierarchical geographic navigation, visualization of historic-mosque locations, access to individual mosque records, and integration of geographic and descriptive heritage information within a single web-based environment. The post-development evaluation provided preliminary evidence that the two participating users were able to access and assess the system without reporting negative responses across the six evaluated dimensions.

Discussion

The first finding shows that prospective users did not treat the historic-mosque mapping system as a tool for locating buildings. They expected it to serve as an integrated source of heritage knowledge. Historical information was the content most respondents requested, most rated interactive mapping as important or very important, and easy navigation ranked as a clear priority. This expectation matches recent GIS-based heritage research, which now treats geospatial platforms as information-management environments that connect location, descriptive attributes, visual records, and historical knowledge rather than as static maps (Liu et al., 2024; Santos et al., 2023; Simou et al., 2022). Read through an educational-management lens, the finding reframes what the system is for. In institutions such as Islamic higher education, the primary need is not spatial representation but the organization and retrieval of scattered knowledge. The practical implication follows directly: heritage digitalization in educational settings should start from what users need to know before its technical features are fixed.

The developed WebGIS turned these requirements into a hierarchical environment that links the national, provincial, regency or municipality, local, and individual-mosque levels with historical and visual information. This result agrees with Hidalgo-Sánchez et al. (2024), who showed that WebGIS can bring geographically distributed cultural assets into a single interactive service, and with Fan et al. (2022), who argued that digital heritage documentation gains value when its information can be reorganized for different user-oriented services. It also fits the wider digitization pattern described by Salleh and Bushroa (2022), in which heritage technologies move past documentation toward interpretation and access. Seen from educational management, the hierarchical structure puts into practice what Safari et al. (2025) describe as the move from fragmented files toward integrated and retrievable databases. The system therefore behaves as a managed knowledge resource, not simply a digital map.

The post-development evaluation gives preliminary evidence that the WebGIS was usable for the participants, though the pattern of responses also shows that the prototype has not yet reached a strong level of user experience. Neither evaluator gave a negative rating, and both rated the interface and the overall system positively. Even so, access, processing speed, satisfaction, and information relevance stayed in the middle positive categories rather than the highest ones. This gap matters, because WebGIS usability depends on more than the system being available. Users have to read spatial interfaces, move through them efficiently, and retrieve information without much difficulty (Unrau et al., 2022). The result echoes Usman and Bolaji (2023), who hold that effective adoption of a digital system rests on both infrastructure and user adaptation, and Indra et al. (2025), whose technology, people, and process framework places human readiness and management alongside technical quality. The practical message is that the interface needs further refinement. The theoretical one is that adoption in educational institutions grows out of the interaction between what the technology affords and how users experience it, not from the technology by itself.

The AI-assisted component sets the system apart, but its role should be read as functional integration rather than proven predictive performance. Current heritage research shows that artificial intelligence and computer vision can help specialists identify deterioration and architectural features from images (Mishra & Lourenço, 2024), and that AI methods combined with GIS can support heritage assessment (Moreno et al., 2022). These lines of work fit the broader movement reported by Harisanty et al. (2024), in which AI use in heritage now spans conservation assessment, visualization, databases, and preservation support. The present system joins that movement by placing AI inside a mosque-focused geospatial environment. Unlike the benchmarked studies, however, it has not established classification accuracy or predictive performance on an independent dataset. Its contribution therefore lies in system-level integration of GIS and AI, not in algorithmic quality. From a management standpoint, AI should stay an assistive decision-support function, and any conservation or educational decision should wait for dataset expansion, expert supervision, and independent validation.

The heritage value of the platform reaches beyond information management, because historic mosques are living cultural resources whose architecture carries social, religious, and local identity. Hamdani et al. (2022) found that historic mosque architecture in Central Java is bound up with the practices of surrounding communities, Sholihah et al. (2024) showed that Javanese religious architecture holds sacred, social, and cultural functions at once, and Handoko et al. (2024) traced how such architecture reflects the ongoing meeting of Islamic principles and local tradition. These studies back the present finding that historical information has to travel with geographic visualization. Locating a mosque without conveying its history and cultural setting would strip much of the system's informational worth. For educational institutions, this contextual knowledge is what gives the platform its pedagogical value, since it offers one place where spatial, historical, and visual information can be met together and used for teaching, academic inquiry, and institutional documentation.

Taken together, the findings mark this study's main contribution as a move from digital mapping toward digital heritage knowledge governance within Islamic higher education. The proposed model starts from stakeholder information needs, converts them into structured spatial and historical records, opens those records through WebGIS, and lays the technical groundwork for later AI-assisted analysis, as summarized in Figure 17. It builds on prior GIS research that stresses information integration and stakeholder access (Hidalgo-Sánchez et al., 2024; Liu et al., 2024), and it complements educational-management scholarship showing that durable digital transformation depends on how technology, people, organizational processes, and information governance work together (Indra et al., 2025; Safari et al., 2025). The theoretical contribution is to position historic-mosque WebGIS as a stakeholder-oriented knowledge-governance infrastructure rather than a mapping application. The practical contribution is a replicable framework that educational institutions, researchers, cultural authorities, and communities can use to organize and reach Islamic architectural heritage knowledge. Because the evaluation sample was small, these contributions remain developmental potential that future implementation studies should test with broader stakeholder groups.

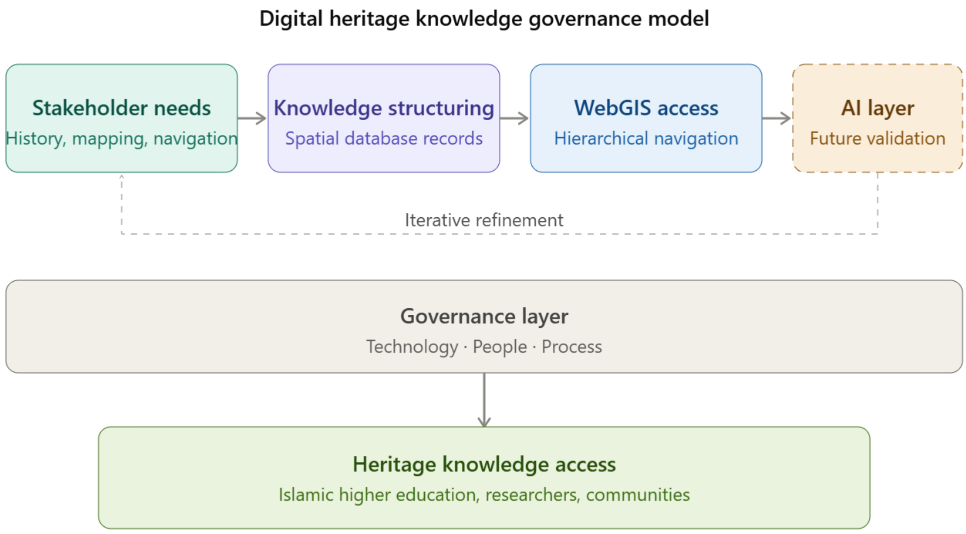

Figure 17. Synthesis model of stakeholder-oriented digital heritage knowledge governance

CONCLUSION

This study developed and evaluated a stakeholder-oriented WebGIS for the documentation of historic mosques in Central Java, yet several limitations qualify its findings and mark the work as a first development cycle rather than a finished system. The needs assessment and post-development evaluation each drew on a small purposive sample, so the responses describe preliminary user impressions and cannot indicate broader acceptance. The evaluation also relied on a researcher-developed instrument instead of a standardized usability measure, which limits comparison with other systems. The AI-assisted component was integrated at the architectural level only and was not tested for classification or predictive accuracy, and the spatial data were field-verified rather than surveyed to measurement-grade standards. Future research should therefore involve larger and more diverse stakeholder groups, apply validated usability instruments, and conduct formal geospatial-accuracy testing. Building an annotated image dataset would allow proper validation of the AI component, while longitudinal study could examine how sustained use affects heritage documentation, education, and conservation practice over time.

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