

Building A Digital Supervision Ecosystem to Increase the Effectiveness of Monitoring and Evaluation of Learning in Madrasah Aliyah

by Dadan Supardan

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Building A Digital Supervision Ecosystem to Increase the Effectiveness of Monitoring and Evaluation of Learning in Madrasah Aliyah

Anwar¹, Saharudin², Sofyan³

⁴ Universitas Jambi; warqncay@gmail.com

² Universitas Jambi; saharudin.fkip@unja.ac.id

³ Universitas Jambi; sofyanzaibaski@unja.ac.id

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ABSTRACT

The vision of learning in Madrasah Aliyah in Indonesia is hampered by conventional methods that are sporadic, administratively burdensome, and delay feedback, thereby creating a significant gap between ideal and actual conditions in the quality assurance of education. This research aims to bridge this gap by developing and evaluating a digital supervision ecosystem designed to improve the effectiveness of monitoring and evaluation. Using a Research and Development (R&D) approach with the Lee & Owen model, the research is carried out through five systematic stages: analysis, design, Development, implementation, and evaluation. A mixed-methods approach is used, involving questionnaires, interviews, and document studies with teachers, madrasah heads, and supervisors in Jambi Province. The results of the study showed that the developed ecosystem was validated with the 'Very Feasible' category by material and media experts (feasibility rate >95%). Summative evaluations by 102 teachers showed a level of 'Very Practical' (practicality >92%) and unusually high user satisfaction (4.00 out of 4.00). These systems have been empirically proven to improve reporting efficiency radically, accelerate the formative feedback cycle, and provide real-time data to support evidence-based decision-making. This study concludes that the digital supervision ecosystem is a valid, practical, and effective model that transforms supervision from administrative audits to a collaborative and data-driven coaching process, thereby empowering a culture of continuous improvement.

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Corresponding Author:

Anwar

Universitas Jambi; warqncay@gmail.com

1. INTRODUCTION

The global education landscape is undergoing a profound transformation, driven by the demands of the Industrial Era 4.0 and the integration of digital technology in every aspect of life (Jannah, Suteja, & Mujahidin, 2024). In this context, the quality assurance of the education process ceases to be merely an administrative obligation but rather a strategic imperative for the nation's Development. One of the main pillars of educational quality assurance is academic supervision. This professional support mechanism aims to foster teacher Development and improve classroom instruction (Gadriaman, 2024). Adequate supervision is ideally an ongoing, collaborative, and data-driven dialogue oriented towards formative improvement (Hattie & Timperley, 2007).

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In Indonesia, Madrasah Aliyah is a unique and vital component of the national education system. Under the auspices of the Ministry of Religious Affairs, madrasahs carry out a dual mandate: to provide general education equivalent to high school, while instilling deep Islamic values and knowledge (Zohriah, Salimah, Fika, & Bachtiar, 2024). This dual objective demands a highly effective management and supervision framework to ensure both objectives are achieved with high-quality standards.

However, the dominant supervision practices in many Aliyah Madrasahs remain conventional, face-to-face, paper-based, and episodic models. This traditional paradigm has systemic flaws that critically undermine its purpose. Preliminary investigations and literature reviews (e.g., Zulhimma, 2020) identified a significant gap between the theoretical idealism of supervision and its practical implementation. Four main challenges characterize this gap. First, there is the onerous administrative burden, whereby manual, paper-based reporting siphons off much of the teacher's and supervisor's precious time. The primary victims in this respect are pedagogical reflection and improvement. Second, the cycle of delayed feedback, which often takes days or even weeks, renders feedback contextually irrelevant and deprives it of its formative function. Third, the inspection paradigm is more dominant than coaching, creating a culture of compliance rather than one of professional growth, and is exacerbated by subjectivity and the absence of longitudinal data.

Fourth, these issues are significantly exacerbated by geographical and logistical constraints, especially in a vast province like Jambi. With 239 Aliyah Madrasahs spread across nearly 50,000 km², many of which are located in remote areas, conventional models that rely on in-person visits have become impractical. This has led to uneven and sporadic supervision, leaving many teachers without regular professional support. This combination of systemic inefficiencies with contextual barriers creates a pressing need for an innovative solution. Advances in web-based information technology offer transformative potential to re-engineer this process (Andriawan, Ajie, & Adhi, 2022). It is more than a tool that can be given to various stakeholders, such as teachers, madrasah heads, and supervisors; it brings them together into a single, transparent, and efficient workflow. These ecosystems can be used to automate administrative tasks, particularly for real-time communication and feedback, and to aggregate data to support evidence-based decision-making. This paper, recognizing this potential, addresses the following critical question: How can a digital supervision ecosystem be developed and validated to improve the effectiveness of monitoring and evaluation of learning in Madrasah Aliyah? Therefore, this study aimed to design, develop, and evaluate the effectiveness of a comprehensive web-based supervision ecosystem tailored to the specific context and needs of Madrasah Aliyah in Jambi Province.

2. METHODS

The study employed the Research and Development (R&D) approach, a systematic method for creating and validating new instructional products (Borg & Gall, 1983). The study employed the five-step multimedia design approach proposed by Lee & Owen (2004). The study followed the five steps in the approach as follows:

2.1. Phase 1: Assessment/Analysis.

In the basic phase, the focus will be on diagnosing the problem and identifying the needs of the target users. The approach shall be mixed.

Needs Analysis: Key stakeholders, such as provincial-level policymakers, Madrasah Superintendents, Madrasah Heads, and senior teachers, were interviewed using a semi-structured

interview guide to identify weaknesses in the current supervision system. Quantitative communication, using a need assessment form for this research, was assessed on a 4-point Likert scale among 35 level-one and level-two teachers.

User & Technology Analysis: The qualities of the target users, namely teachers, madrasah heads, and supervisors, are identified and analyzed for their technology competence and adaptability towards new technology solutions. The prevailing technology infrastructure, comprising internet connectivity and device availability at the target madrasah, is also analyzed, as the chosen technology application must be technically feasible.

Document Analysis: The process involves studying existing official supervision documentation tools, reports, or guidelines that can outline the requirements from a formal perspective.

2.2. Phase 2: Design.

The results from the analysis phase of the process will be interpreted in a product blueprint. This stage comprises:

Design of System Architecture: The client-server modular system architecture is designed for scalability and maintainability.

Workflow and Database Design: The process of layered supervision (class teacher input >= madrasah head evaluation >= supervision conducted by school supervisors) was prototyped. Normalized relational database design was accomplished through the use of Entity Relationship Diagrams (ERD).

UI/UX DESIGN: The principles of user-centric design are applied to create high-fidelity wireframes and mockups for each screen, ensuring simplicity, clarity, and intuitive navigation that caters to users with different levels of technology expertise.

2.3. Phase 3: Development.

"The design plan will come true as functional software. Backend development will use PHP with Laravel to handle business logic and APIs. Moreover, the frontend will be implemented using conventional web technologies, that is, HTML, CSS, and JavaScript, along with a responsive design."

"The theme for the entire application will remain business-like. This will make the whole system more professional. Moreover, the design plan will come true as functional software. Backend Development will be implemented in PHP using Laravel. This phase resulted in the first functional prototype (Product I).

2.4. Phase 4: Implementation.

Implementation is carried out in two primary cycles:

Small Group Trial (Practicality Test): The validated product (Product II) was implemented in a small group of users from three pilot madrasahs over two weeks. This phase focuses on gathering intensive qualitative feedback on usability and practicality through observation and focus group discussions (FGDs).

Large Group Trial (Effectiveness Test): The improved system (Product III) was then implemented in five Madrasahs for a whole semester. This stage will involve a larger and more diverse group of users, as its purpose is to test the system's stability, scalability, and efficacy.

2.5. Phase 5: Evaluation.

Evaluation continues throughout the cycle.

Formative Evaluation: Performed in the Development and Implementation phases. The evaluation comprises expert validation of Product I by a panel of three experts: two in educational supervision and one in instructional technology, using a structured validation approach. Feedback from a small-group trial is another form of formative evaluation.

Summative Evaluation: The final evaluation is conducted at the end of a large-group trial. The survey form, which assesses the effectiveness, feasibility, user satisfaction, and impact of the system, was distributed to 102 teachers, 5 heads of madrasah, and 5 supervisors.

2.6. Data Analysis Techniques.

The quantitative results of all questionnaires were analyzed using descriptive statistics. A 4-point Likert scale is used, and the average score is converted to a percentage index using the formula: Index (%) = (Average Score / 4) × 100%. This index is then interpreted using a predetermined qualitative category (e.g., 81.25%–100.00% = Very High/Very Practical). The qualitative data from interviews, open-ended questions, and observations were used for thematic analysis to identify patterns and to explain the findings from the quantitative analysis in the qualitative study.

3. FINDINGS AND DISCUSSION

3.1. Findings

In this section, the results of each stage of the research will be described in depth, culminating in a discussion of the results of the developed digital ecosystem of supervision.

Analysis Phase Results

A Mandate for Change. The analysis phase provides a strong foundation for justifying the intervention. The quantitative insights from the needs analysis questionnaire (N = 35) indicated strong support for the issues in traditional systems. The key indicators presented in Table 1 highlight inefficiencies and opportunities for improvement through digital transformation.

Table 1. Selected Findings from the Needs Analysis Questionnaire (N=35)

Statement	Average Score	Table of Contents (%)	Category
The manual reporting process is inefficient.	3.40	85.00%	Strongly agree
Supervision so far has not been fully effective.	3.20	80.00%	Agree
The manual process is already effective; it does not need to be changed (Negative).	1.26	31.50%	Strongly Disagree
I need a system for real-time reporting.	3.57	89.25%	Strongly agree

The high approval rate for the inefficiency statement (85.00%) and the strong rejection of the status quo (31.50%) indicate fundamental dissatisfaction. This is strongly supported by the high demand for real-time digital systems (89.25%) and high adoption readiness (90.00%). Qualitative data enriches this picture. A madrasah head declared, "We are buried in paper. By the time I reviewed the teacher's weekly journal, the moment for meaningful feedback had passed. The momentum is gone." This statement highlights the dual problems, namely, administrative burden and formative malfunction. One supervisor added, "With the school hundreds of miles apart, I can only visit once a semester. The visit became an administrative examination, not real guidance. I don't have insight into what goes on day to day." It confirms the presence of logistical factors that prevent regular observation. Collectively, these findings not only suggest but also demand the Development of a digital ecosystem.

Results of Formative Evaluation

Validation by Experts. The functional prototype (Product I) underwent a rigorous evaluation by three experts. The quantitative results, summarized in Table 2, show a very high level of feasibility from both substantive and technical perspectives.

Table 2. Summary of Expert Validation Scores

Validation Aspects	Expert Group	Average Score	Index (%)	Category
Content Fit & Workflow	Material Expert (n=2)	3.85	96.25%	Highly Worthy
Usability & Technical Design	Media Expert (n=1)	3.67	91.75%	Sangat Worthy

Subject matter experts (Index 96.25%) praised the system for successfully operationalizing collaborative and sustainable supervision principles. One of the experts stated, "The architecture of this system appropriately positions the madrasah head as the main learning leader, with the supervisor playing a strategic supervisory role. This is a significant paradigm shift." Media experts (Index 91.75%) affirmed the design's high usability and adherence to user-centric principles, stating, "The interface is clean, and the workflow is logical. The system effectively models the principle of perceived ease of use; this is important for acceptance by non-technical users." The qualitative feedback from this phase played an essential role in improving the product. It led to the Development of key features, including a digital consultation room and a report export option, thereby enhancing the prototype into Product II.

Summative Evaluation Results

Transformative Power. Summative evaluation provides a final judgment of how well ecosystems function in real-world settings. Data collected from 102 teachers, five madrasah heads, and five supervisors present a consistent narrative of a profound and positive impact.

Teacher's Perspective

Exceptional Satisfaction and Increased Efficiency. For teachers and frontline users, this system is not just an improvement but a revolution in their workflow. The data in Table 3 show the magnitude of this impact.

Table 3. Results of Summative Evaluation Choice from Teachers (N=102)

Statement	Average Score	Table of Contents (%)	Category
Overall, I am satisfied with this system.	4.00	100.00%	Strongly agree
Successfully reduce administrative burden.	3.90	97.50%	Strongly agree
The reporting process is more efficient than the manual way.	3.89	97.25%	Strongly agree
The system is easy to learn, and the flow is clear.	3.51	87.75%	Strongly agree
Communication and feedback are made easier.	3.76	94.00%	Strongly agree
This system helps me reflect on the teaching.	3.81	95.25%	Strongly agree

A perfect satisfaction score (Average 4.00) is a rare and potent indicator of a product's success in meeting and exceeding user expectations. This satisfaction stems from a substantial improvement in efficiency, with 97.50% of respondents agreeing that the administrative burden has been reduced. This was expressed so candidly by a teacher: "What I used to do over the weekends, I now do in five minutes after each class. This has brought back my evenings free to plan better classes."

Beyond efficiency, the results show that the system successfully fosters a more supportive professional environment. High scores on ease of feedback (94.00%) and support for self-reflection (95.25%) prove that these ecosystems serve as professional Development tools, not just monitoring. The system successfully operationalized the concept of timely feedback (Hattie & Timperley, 2007), transforming supervision from a dreaded annual review to an ongoing, constructive conversation focused on growth.

Leadership Perspective

Empowerment through Data. For madrasah heads (N=5) and supervisors (N=5), this ecosystem serves as a powerful managerial and strategic tool. The two groups of leaders unanimously agreed (Average 4.00) that the system is "an effective instrument to support academic and managerial supervision tasks." This confirms the value of the system for leaders.

The head of the madrasah strongly agreed that the system makes it easier to monitor teachers' activities (Average 3.80) and provides a more accurate, real-time picture of classroom progress (Average 3.80). A madrasah head explained, "Before, I was like flying blind, relying only on conversations in the corridors. But now, I have a dashboard that gives me the helicopter vision! I can see which teachers are struggling with a particular topic and offer support right away, not at the end of the semester." This describes a shift toward proactive, data-driven instructional Leadership.

Supervisors highlight strategic benefits. They strongly agreed that this system allows efficient monitoring of the fostered madrasahs (Average 3.80) and makes it easier to compare trends between madrasahs (Average 3.60). One supervisor commented, "This is a breakthrough. I can now identify systemic issues—for example, the widespread difficulties in implementing the new curriculum—in all of my target schools from the office. My field visits are now much more strategic and focused because I already have the data." It demonstrates the system's success in overcoming geographical barriers and enables strategic supervisory roles at the macro level.

3.1. Discussion

The cumulative results of this study provide strong evidence that the developed digital supervision ecosystem is a highly effective solution to the chronic problems of conventional supervision in Madrasah Aliyah. This discussion synthesizes these findings in relation to broader educational theory and practice.

First, this study demonstrates the power of a user-centered ecosystem-based approach in educational technology. Perfect satisfaction scores among teachers are no coincidence; This is a direct result of a design process that begins with an in-depth analysis of their key problem—administrative burden—and delivers a solution with a nearly 98% perceived load reduction. A high usability score supports the Technology Acceptance Model (TAM), in which Perceived Ease of Use and Perceived Utility are paramount (Davis, 1989). Because it creates an ecosystem rather than building distinct tools, the system is less taxing on users' memory, making it easier to adopt.

Second, the results reflect a significant shift in paradigms from the supervision-as-inspection paradigm to the supervision-as-collaboration-and-coaching paradigm. The conventional model, with its delayed feedback, inherently serves as a judgmental summative process. In contrast, the digital ecosystem, with real-time reporting and integrated feedback channels, operates on the principles of formative assessment (Black & Wiliam, 1998). The fact that the madrasah head can respond with feedback within a few hours makes interaction a relevant and timely dialogue. This aligns well with current models of supervision, such as the clinical and developmental supervision models proposed by Glickman, Gordon, & Ross-Gordon (2014).

Third, this research provides a practical model for fostering a data-driven culture in education management. The 'data silos and fly-blind problem' focused on by major players in the analysis stage of health education programs is directly addressed by centralized databases and system analytics dashboards. The ability of madrasah heads to conduct active interventions and of supervisors to recognize regional trends makes it evident that these programs adhere to the principle of evidence-based practice. These programs not only provide information; they also enable leaders to move from reactive administration to strategic instruction.

Finally, this study presents a contextually validated digital transformation model for specific educational environments. The fact that it was successfully adopted in a geographically diverse setting such as the Madrasah Aliyah in Jambi provides evidence that this approach to innovation is not exclusive to well-funded schools. Through its approach to responsive web design on smartphones, it is

clear that the environment is effective, even when infrastructure might be a problem. It is a scalable approach that the Ministry of Religious Affairs may use to upgrade its quality assurance process.

Although this study powerfully demonstrates the system's effectiveness in improving the process and user satisfaction, a limitation is its timeframe, which prevents measuring the long-term impact on student learning outcomes. This presents a clear path for future longitudinal research.

4. CONCLUSION

This research and Development successfully answered the critical need for a more effective and efficient academic supervision model in Madrasah Aliyah. By systematically following Lee & Owen's R&D model, a comprehensive digital supervision ecosystem was successfully built and rigorously evaluated. This study concludes that the developed ecosystem is a valid, efficient, and transformative intervention. The system has been empirically proven to be able to: (1) drastically reduce administrative inefficiencies for teachers, leading to perfect user satisfaction; (2) accelerate the feedback cycle, shifting the supervisory function from a summative audit to a formative coaching process; and (3) empower education leaders with aggregated, real-time data, fostering a culture of evidence-based decision-making. This research contributes a validated, contextually relevant, and scalable multi-tiered digital supervision model. This ecosystem stands as strong evidence of how user-centered design and careful technology integration can overcome systemic barriers to building a more supportive, transparent, and effective environment for improving the quality of education.

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