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Web-Based Student Attendance and Assignment Management System Using N8N and WhatsApp OTP

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Abstract: The management of student attendance and assignment submissions through WhatsApp-based online learning remains fragmented, resulting in administrative challenges and limited data integration. **Objective:** This study aimed to develop and evaluate a web-based attendance and assignment management system integrating WhatsApp One-Time Password (OTP) authentication, N8N workflow automation, and Google Sheets at STMIK Mercusuar. **Method:** An applied system development approach using the Pressman Prototype methodology was employed. Data were collected through observation, interviews, and literature review, while system functionality was evaluated using Black Box Testing. **Findings:** The developed system integrated student and lecturer authentication, attendance session management, attendance recording, assignment submission, and centralized data recapitulation through seven automated workflows. Testing covered 14 functional scenarios, of which 11 were reported as Valid and three as Invalid, requiring clarification of the testing classifications. **Implications:** The system provides a practical framework for integrating academic administration processes through workflow automation, potentially reducing fragmented manual procedures. **Originality:** This study contributes an integrated architecture combining WhatsApp OTP authentication, N8N workflow orchestration, and Google Sheets-based data management for WhatsApp-supported online learning.

Keywords: Academic Information System; Attendance Management; N8N Workflow Automation; WhatsApp OTP; Web-Based System.

INTRODUCTION

Digital transformation in higher education has encouraged the adoption of information technology to improve the effectiveness of academic administration, particularly in managing student attendance and assignment submissions. However, the implementation of academic information systems remains challenging due to differences in technological adoption and user preferences in teaching and learning activities. This situation has been observed at Sekolah Tinggi Manajemen Informatika dan Komputer (STMIK) Mercusuar, where an institutional e-learning platform providing centralized attendance and assignment management facilities is already available but has not been consistently utilized by all

lecturers. Based on preliminary observations, several online teaching and learning activities are still conducted through WhatsApp because of its accessibility, familiarity, and convenience for communication between lecturers and students. Consequently, attendance recording and assignment submission are frequently managed separately through manual procedures, potentially resulting in data entry errors, delayed recapitulation, and difficulties in monitoring academic activities. From a business process management perspective, integrating previously fragmented activities into structured and automated workflows can support more systematic process execution and monitoring (Dumas et al., 2018). These conditions highlight the need for an integrated digital system capable of automating user authentication, attendance recording, assignment submission, and data recapitulation through a centralized web-based interface.

Previous studies on the digitalization of academic administration have demonstrated the relevance of web-based attendance systems for managing student attendance records. Handayani discussed the development of a web-based lecture attendance information system integrated with cloud services (Handayani, 2021). Febrianto developed a web-based student attendance information system using the Waterfall methodology (Febrianto, 2021), whereas Rahman applied the Prototype methodology in developing a student attendance system (Rahman et al., 2025). These studies illustrate different approaches to digitalizing attendance management. In addition, van der Aalst established a theoretical foundation for analyzing and monitoring information system processes through event data, highlighting the importance of systematic process recording and evaluation (Aizah, 2024). Nevertheless, the reviewed attendance system studies do not specifically establish an integrated architecture combining attendance recording, assignment submission, automated lecture session management, and centralized data recapitulation for learning activities conducted through WhatsApp. This limitation motivates the development of a unified system that accommodates existing communication practices while supporting automated academic administration.

Another group of studies has focused on WhatsApp Gateway, service integration, and digital authentication technologies. Aizah examined the implementation of a web-based attendance system using WhatsApp Gateway (Aizah, 2024), while Susanto discussed webhook and API automation in a real-time student attendance information system (Susanto, 2023). Al Kaamil investigated automated identity verification in relation to service completion time and transaction error rates (Al Kaamil, 2025). From a technical

perspective, M'Raihi specified the Time-Based One-Time Password algorithm, providing a standardized reference for time-dependent authentication codes (M'Raihi et al., 2011). More recent digital identity guidance from the (National Institute of & Technology, 2025a, 2025b) emphasizes authentication assurance, authenticator management, and the security requirements associated with digital authentication mechanisms. Furthermore, the OWASP Foundation provides application security verification requirements relevant to authentication and web application security controls (Foundation, 2025). Although these references establish important foundations for authentication and system security, they do not independently demonstrate the security of WhatsApp-delivered OTP implementations. Therefore, integrating WhatsApp OTP into an academic information system requires appropriate validation mechanisms and functional evaluation to support reliable user authentication.

The third category of previous research concerns workflow automation and API integration for information management processes. Wibowo discussed the efficiency of system workflow integration using N8N (Wibowo, 2024), while Ramadhani investigated the application of N8N and artificial intelligence in chatbot development for automated data analysis and reporting (Ramadhani, 2025). Hasanuddin examined REST API development for the WeShare application as an approach to application service integration (Hasanuddin, 2022). From a technical standpoint, Fielding established HTTP semantics governing communication between clients and servers (Fielding et al., 2022), providing a fundamental reference for web-based API interactions. Meanwhile, Google documents the operational quotas and request limitations of the Google Sheets API, which must be considered when designing applications that depend on spreadsheet-based data storage. These studies and technical references demonstrate the relevance of workflow orchestration, API communication, and service integration in modern information systems. However, the reviewed literature does not specifically establish an integrated implementation of N8N workflow automation, WhatsApp OTP authentication, student and lecturer validation, lecture session management, attendance recording, assignment submission, and Google Sheets-based storage for WhatsApp-supported online learning. This integration requirement forms the specific development focus of the present study.

Based on the identified practical problems and research gaps, this study aims to design, develop, and evaluate a web-based student attendance and assignment management system by integrating N8N as a workflow automation engine and WhatsApp One-Time Password

(OTP) as a user authentication mechanism for online learning activities at STMIK Mercusuar. Specifically, the study seeks to develop an authentication mechanism for students and lecturers using Node.js and WhatsApp-web.js; automate user validation, lecture session management, attendance recording, assignment submission, and data recapitulation through N8N; and integrate Google Sheets as a centralized data storage platform using the Google Sheets API and Google Drive API. The system is developed using the Pressman Prototype methodology, supported by Unified Modeling Language (UML) for system modeling and Black Box Testing for functional evaluation. (Google) The primary contribution of this study is the implementation of an integrated system architecture that combines a web-based interface, WhatsApp OTP authentication, N8N workflow automation, and centralized data storage to support academic activities that have not fully utilized the institution's existing e-learning platform.

This study is based on the argument that integrating a web-based interface, WhatsApp OTP authentication, and N8N workflow automation can establish a more structured mechanism for managing student attendance and assignment submissions than separate manual recording procedures. WhatsApp OTP is expected to support user verification through registered WhatsApp numbers, while N8N enables automated execution of system logic, user validation, lecture session management, attendance recording, and assignment submission through API integration. Furthermore, Google Sheets is expected to facilitate centralized data storage and attendance recapitulation accessible to lecturers. Accordingly, the proposed system is expected to perform its primary functions, including authentication, session management, attendance recording, assignment submission, and data recapitulation, in accordance with predefined functional requirements. This expectation is evaluated through Black Box Testing using representative system operation scenarios. Therefore, the study focuses on establishing the functional feasibility of the proposed technological integration, while quantitative improvements in processing efficiency, data accuracy, and authentication security require additional empirical evaluation before such benefits can be conclusively established.

RESEARCH METHOD

The unit of analysis in this study was a web-based student attendance and assignment management system developed to support online teaching and learning activities conducted through WhatsApp at Sekolah Tinggi Manajemen Informatika dan Komputer (STMIK)

Mercusuar, Bekasi, Indonesia. The research focused on the development and functional evaluation of an integrated information system involving two primary user groups, namely students and lecturers. The system consisted of a web-based interface developed using HTML, CSS, and JavaScript; an authentication mechanism utilizing Node.js and WhatsApp-web.js; a self-hosted N8N workflow automation engine; and Google Sheets as the centralized data storage platform. The system was designed to manage student and lecturer authentication, attendance session activation and termination, attendance recording, assignment submission, attendance recapitulation, and WhatsApp number updates. The integration of these components constituted the principal technical object examined in this study.

This study employed an applied system development approach using the Pressman Prototype methodology. This approach was selected because the functional requirements of the proposed system were initially identified through an understanding of existing academic administration problems and could be progressively refined during system development. The prototyping approach allowed the system architecture, operational workflows, and user interface to be developed and evaluated incrementally according to the identified requirements. System modeling was conducted using Unified Modeling Language (UML), including Use Case Diagrams, Activity Diagrams, Sequence Diagrams, and Class Diagrams, while the user interface was designed using Balsamiq. The implementation utilized Node.js version 20.20.1 and WhatsApp-web.js for WhatsApp-based OTP services, N8N version 2.8.4 in a self-hosted environment for workflow automation, and the Google Sheets API and Google Drive API for data integration through a Google Cloud service account. This development approach was intended to produce a functional prototype that could be evaluated against the operational requirements of online academic activities.

The research utilized primary and secondary information sources relevant to the existing attendance and assignment management processes. Primary information was obtained from observations of online teaching and learning activities conducted through WhatsApp at STMIK Mercusuar, particularly the procedures used to record student attendance, distribute and collect assignments, and prepare attendance recapitulations. Information concerning operational requirements was also obtained through interviews with lecturers and students, as described in the research methodology. Secondary information was obtained from scientific literature, books, and relevant technical

documentation concerning web-based attendance systems, digital authentication, workflow automation, API integration, and prototype-based software development. Technical references were used to support the selection and integration of the technologies employed in the proposed system. These information sources provided the basis for identifying functional requirements and determining the system components required to support automated academic administration.

Data collection was conducted through observation, interviews, and literature review. Observation was carried out by examining the existing attendance and assignment submission procedures during WhatsApp-based online learning activities, including the manual recording and recapitulation processes. Interviews with lecturers and students were intended to identify operational difficulties and determine the functional requirements of the proposed system. The literature review involved examining relevant scientific publications and technical references to establish the conceptual and technological foundations of the system. The information obtained from these activities was used to formulate system requirements and develop the prototype. The system development process included designing the system architecture, modeling user interactions and operational processes using UML, preparing interface designs using Balsamiq, and implementing the required functions through the integration of the web interface, WhatsApp OTP authentication, N8N workflows, and Google Sheets-based data storage.

Data analysis was conducted through functional evaluation using the Black Box Testing method, which assessed system behavior based on predefined input conditions and expected outputs without examining the internal source code. The evaluation covered 14 functional testing scenarios involving student and lecturer authentication, registered and unregistered WhatsApp numbers, expired OTP verification, attendance submission during active and inactive sessions, lecturer-controlled attendance session management, attendance recapitulation, mandatory field validation, automatic session termination, WhatsApp number updates, and assignment submission. The testing results were analyzed by comparing the actual system responses with the expected functional requirements. The evaluation also considered the execution status of the seven N8N workflows developed for OTP verification, session management, attendance recapitulation, attendance recording, session and history verification, WhatsApp number updates, and scheduled session termination. Functional conformity was determined based on whether each tested operation produced the expected response under the specified conditions. The analysis was limited

to functional system performance and did not include quantitative comparisons of processing time, error reduction, or authentication security against the previous manual procedures.

RESULT

System Implementation and Architecture

The development process resulted in a web-based student attendance and assignment management system integrating WhatsApp One-Time Password (OTP) authentication, N8N workflow automation, and Google Sheets-based data storage. The system was developed to support online teaching and learning activities conducted through WhatsApp at STMIK Mercusuar. The implemented system provides two primary user interfaces for students and lecturers, each with different access privileges and operational functions. Students can authenticate using registered WhatsApp numbers, record attendance during active lecture sessions, and submit assignments. Meanwhile, lecturers can activate and terminate attendance sessions, monitor attendance records, and access attendance recapitulation through a centralized dashboard.

The system architecture consists of several interconnected components responsible for user interaction, authentication, workflow execution, and data storage. The web interface was developed using HTML, CSS, and JavaScript, while Node.js and WhatsApp-web.js were employed to facilitate OTP delivery through WhatsApp. N8N functions as the central workflow automation engine, coordinating user validation, OTP verification, lecture session management, attendance recording, assignment submission, and data recapitulation. Google Sheets serves as the centralized data storage platform through integration with the Google Sheets API and Google Drive API. The overall system architecture is presented in Figure 1.

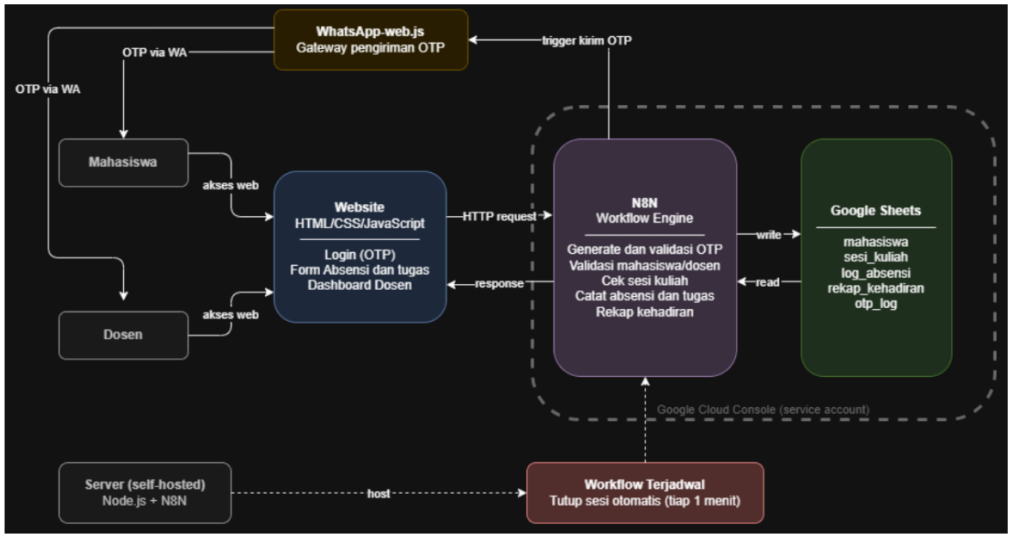

Figure 1. General Architecture of the Web-Based Attendance and Assignment Management System

Figure 1 illustrates the integration of the web interface, WhatsApp authentication service, N8N workflow automation engine, and Google Sheets database. The system processes requests submitted by students and lecturers through the corresponding automated workflows. Attendance and assignment information is subsequently recorded in the centralized storage platform. In addition, the architecture incorporates a scheduled workflow that automatically terminates attendance sessions when the predefined time limit has elapsed.

WhatsApp OTP Authentication Implementation

The authentication mechanism was implemented using WhatsApp OTP to verify registered students and lecturers before granting access to the system. During the authentication process, users enter their registered WhatsApp numbers through the web interface. The system subsequently sends an OTP through WhatsApp-web.js, and users submit the received verification code for validation.

The submitted OTP is processed through N8N, which retrieves the relevant verification information from Google Sheets and evaluates the authentication request according to the configured validation conditions. The workflow also distinguishes between login requests and WhatsApp number update requests. Depending on the request type, the system accesses the corresponding student or lecturer records and performs the required validation or modification. The authentication result is returned to the web

application through the Respond to Webhook node. The implemented authentication workflow is presented in Figure 2.

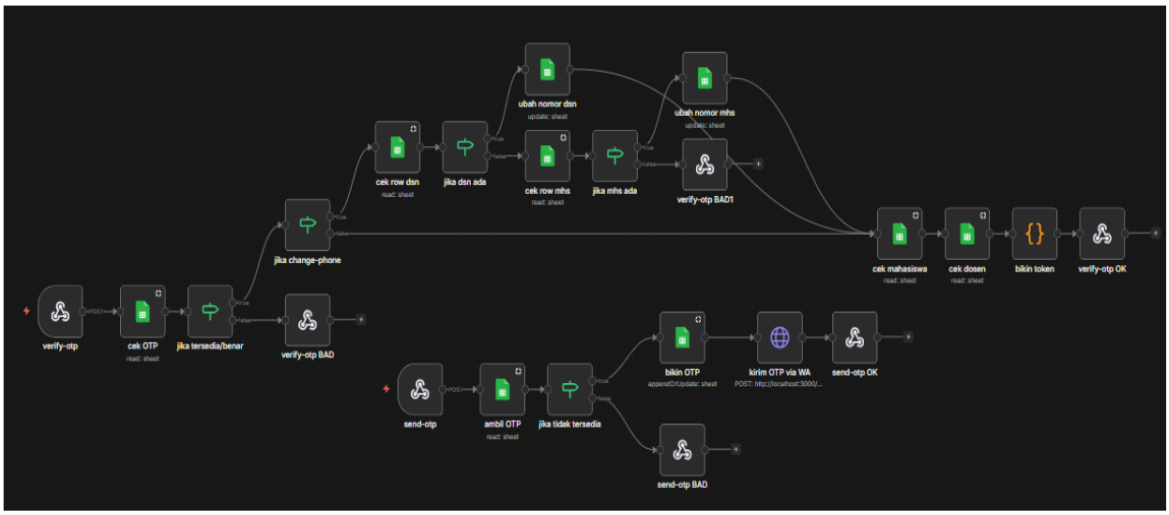

Figure 2. OTP Verification Workflow Implemented in N8N

Figure 2 presents the sequence of automated operations involved in OTP verification, including webhook-based request handling, verification data retrieval, conditional validation, user record processing, and response generation. These operations enable authentication requests to be processed automatically through the N8N workflow engine without requiring manual verification by academic administrators.

Attendance and Assignment Workflow Implementation

The implemented system consists of seven automated workflows supporting its principal operational functions. These workflows include OTP verification, attendance session management, attendance recapitulation, attendance recording, session and attendance history verification, WhatsApp number updates, and scheduled session termination. Each workflow processes specific requests and interacts with the corresponding records stored in Google Sheets.

During attendance operations, lecturers can activate attendance sessions for their assigned courses. Students can access the attendance interface and submit attendance information while the corresponding session remains active. The system also provides assignment submission functionality during active sessions. Attendance and assignment data are processed through the configured workflows and recorded in Google Sheets.

Furthermore, lecturers can retrieve and monitor attendance information through the web-based dashboard.

An additional scheduled workflow automatically terminates attendance sessions when the configured time limit is reached. This functionality prevents attendance sessions from remaining active beyond their designated duration. Based on the reported implementation results, all seven workflows were executed successfully, with the N8N execution records displaying a Succeeded status.

Functional Testing Results

Functional testing was conducted using the Black Box Testing method to evaluate the system's behavior under predefined operational scenarios. The evaluation comprised 14 testing scenarios covering student and lecturer authentication, OTP verification, attendance session management, attendance submission, assignment submission, attendance recapitulation, mandatory field validation, automatic session termination, and WhatsApp number updates.

Table 1. Reported Black Box Testing Results

No.	Testing Scenario	Reported Result
1	Student login using a registered WhatsApp number and correct OTP	Valid
2	Student login using an unregistered WhatsApp number	Invalid
3	Lecturer login using a registered WhatsApp number and correct OTP	Valid
4	Lecturer login using an unregistered WhatsApp number	Valid
5	Verification using an expired OTP	Valid
6	Student attendance submission during an active session	Valid
7	Student attendance submission outside an active session	Invalid
8	Lecturer activates an attendance session for an assigned course	Valid
9	Lecturer terminates an active attendance session	Invalid
10	Lecturer accesses the attendance recapitulation dashboard	Valid
11	Student accesses the attendance form without completing mandatory fields	Valid
12	Automatic session termination through the scheduled workflow	Valid
13	User updates the registered WhatsApp number through the dashboard	Valid
14	Attendance recording and assignment submission during an active session	Valid

Note: The reported results are reproduced from the original manuscript. The classification criteria for Valid and Invalid require clarification by the authors.

The results presented in Table 1 indicate that 11 scenarios were classified as Valid and three scenarios were classified as Invalid. The scenarios reported as Invalid involved student login using an unregistered WhatsApp number, attendance submission outside an active session, and lecturer-controlled termination of an active attendance session. However, the original testing documentation does not explicitly define whether Invalid represents successful rejection of an unauthorized operation or failure to meet the expected functional requirements. Therefore, the reported classifications cannot independently establish the overall functional success rate of the system.

DISCUSSION

Integration of Web-Based Academic Administration and Workflow Automation

The implementation demonstrates the technical feasibility of integrating a web-based academic administration interface, WhatsApp OTP authentication, N8N workflow automation, and Google Sheets-based storage within a unified system architecture. This integration addresses the operational fragmentation identified in the existing attendance and assignment management procedures at STMIK Mercusuar, where several online learning activities are conducted through WhatsApp and academic records are managed separately.

The findings are conceptually consistent with previous research on web-based attendance systems. Handayani discussed cloud-integrated attendance management (Handayani, 2021), while Febrianto and Rahman examined attendance system development using different software engineering methodologies (Febrianto, 2021; Rahman et al., 2025). Unlike implementations focusing primarily on attendance recording, the present system combines attendance management, assignment submission, lecturer-controlled session management, and automated data recapitulation within a single workflow-driven architecture.

From a business process management perspective, the integration reflects the principle of coordinating related operational activities through structured information flows (Dumas et al., 2018), the present findings establish the implementation of this architecture rather than quantitatively demonstrating its superiority over the previous manual procedures.

WhatsApp OTP Authentication and System Security

The implementation of WhatsApp OTP provides an authentication mechanism based on verification codes delivered to registered WhatsApp numbers. This approach is relevant to the operational context of STMIK Mercusuar because WhatsApp is already used as a communication medium in several online learning activities.

The implementation is related to previous studies on WhatsApp Gateway and automated identity verification, including (Aizah, 2024; Al Kaamil, 2025). Nevertheless, successful implementation of OTP authentication should not automatically be interpreted as evidence of superior system security.

Digital authentication security depends on several factors, including OTP expiration, prevention of code reuse, verification attempt limitations, protection of authentication records, and secure management of user sessions. These considerations are consistent with the authentication and security requirements described in NIST SP 800-63B-4 and OWASP ASVS 5.0.0.

The present study reports functional OTP verification but does not provide a comprehensive security assessment. Therefore, additional security testing would be required to determine the system's resistance to unauthorized access, replay attempts, and other authentication-related threats.

N8N Workflow Automation and Centralized Data Management

The implementation of seven automated workflows demonstrates the use of N8N as a centralized workflow orchestration engine for coordinating academic administration processes. These workflows manage authentication, attendance sessions, attendance recording, assignment submission, recapitulation, and scheduled session termination.

The implementation is conceptually related to (Wibowo, 2024), who examined workflow integration using N8N, and Ramadhani (2025), who investigated N8N-based automation for data analysis and reporting. The present study extends the application context of workflow automation to academic administration by combining multiple operational functions within a web-based system.

The use of Google Sheets provides a centralized storage mechanism accessible through API integration. However, spreadsheet-based storage introduces technical considerations related to API request limits, concurrent access, data consistency, and scalability. These

factors become increasingly relevant as the number of users, attendance transactions, and assignment records increases.

Although the N8N execution records reportedly displayed Succeeded status for the implemented workflows, successful execution does not necessarily demonstrate complete data integrity or long-term operational reliability. Additional testing involving concurrent users, repeated transactions, network interruptions, and API failures would strengthen the technical evaluation.

Interpretation of Functional Testing Results

The Black Box Testing results provide preliminary evidence regarding the implementation of the system's functional requirements. The 14 reported scenarios cover major operations, including authentication, attendance recording, session management, assignment submission, and administrative functions.

However, the interpretation of the testing results requires particular attention. Three scenarios were classified as Invalid, while the original manuscript stated that all scenarios produced the expected results. This discrepancy creates uncertainty regarding the actual functional performance of the system.

For negative testing scenarios, such as login attempts using unregistered WhatsApp numbers or attendance submission outside an active session, successful rejection may represent correct system behavior. Nevertheless, the status of such tests should be determined by comparing the actual output with the predefined expected output, rather than by classifying the input itself as valid or invalid.

The lecturer-controlled session termination scenario also requires clarification because an Invalid classification could indicate a functional defect if the system failed to terminate an active session as intended. Consequently, a revised testing matrix containing expected outputs, actual outputs, and Pass/Fail classifications is necessary before concluding that all functional requirements have been satisfied.

Research Contributions and Limitations

The principal contribution of this study is the development of an integrated web-based attendance and assignment management architecture combining WhatsApp OTP authentication, N8N workflow automation, and Google Sheets-based data storage. The

system provides an implementation model for coordinating academic administration activities conducted alongside WhatsApp-based online learning.

The study also demonstrates the application of workflow automation to multiple academic functions, including user authentication, lecture session management, attendance recording, assignment submission, and data recapitulation. This integration constitutes the primary technical contribution of the research within the operational context of STMIK Mercusuar.

Nevertheless, several limitations must be acknowledged. First, the evaluation focuses primarily on functional testing and does not include quantitative measurements of processing efficiency, time savings, or data entry error reduction. Second, the study does not report systematic security testing of the WhatsApp OTP mechanism. Third, system scalability, concurrent access performance, and resilience to external service interruptions have not been evaluated. Finally, the interpretation of several Black Box Testing results remains uncertain because the original test classifications do not clearly distinguish between expected rejection and functional failure.

Future research should address these limitations through quantitative performance evaluation, security testing, concurrency testing, and integration with the institution's existing e-learning platform. Such evaluations would provide stronger empirical evidence regarding the operational effectiveness, reliability, and scalability of the proposed system.

CONCLUSION

This study successfully developed a web-based student attendance and assignment management system integrating WhatsApp One-Time Password (OTP) authentication, N8N workflow automation, and Google Sheets-based data storage to support online teaching and learning activities at STMIK Mercusuar. The implemented system provides integrated functions for student and lecturer authentication, attendance session management, attendance recording, assignment submission, and attendance recapitulation through a centralized web-based interface. Seven automated workflows were implemented to coordinate these operations, with the reported N8N execution records indicating successful workflow execution. Functional evaluation was conducted using Black Box Testing across 14 operational scenarios covering the system's principal features. However, three scenarios were classified as Invalid in the original testing results, requiring clarification of the classification criteria before overall functional conformity can be

conclusively established. These findings demonstrate the feasibility of implementing an integrated workflow-driven academic administration system while highlighting the importance of clearly defined functional testing criteria.

The primary scientific contribution of this research lies in the development of an integrated system architecture that combines web-based academic administration, WhatsApp OTP authentication, N8N workflow orchestration, and Google Sheets-based data management within a unified operational framework. Unlike conventional approaches that manage attendance recording and assignment submission through separate procedures, the proposed architecture coordinates multiple academic functions through interconnected automated workflows. The study provides an applied implementation model for utilizing low-code workflow automation technologies to support academic administration in educational environments where WhatsApp remains an important communication platform. Furthermore, the integration of automated session management, authentication workflows, and centralized data recording offers a technical foundation for future development of interoperable academic information systems. The contribution is therefore primarily architectural and implementation-oriented rather than evidence of a newly established authentication algorithm or quantitatively demonstrated improvement in system performance.

Several limitations should be acknowledged. First, the evaluation was primarily limited to functional testing and did not include quantitative comparisons of processing time, administrative efficiency, or data entry error rates between the proposed system and existing manual procedures. Second, the study did not conduct comprehensive security testing of the WhatsApp OTP authentication mechanism, including resistance to unauthorized access, OTP replay attempts, and session-related vulnerabilities. Third, system scalability, concurrent user performance, data consistency, and resilience to external service interruptions were not systematically evaluated. In addition, the interpretation of several Black Box Testing results requires further clarification to establish the functional success of all tested scenarios. Future research should incorporate quantitative performance measurements, systematic security assessments, concurrency and reliability testing, and integration with the institution's existing e-learning platform. These improvements would provide stronger empirical evidence regarding the operational effectiveness, security, and scalability of the proposed system.

DECLARATIONS

Artificial Intelligence (AI) Use Statement

The authors acknowledge the use of ChatGPT (OpenAI) to assist in manuscript preparation, academic language refinement, structural organization, and revision of the Introduction, Research Method, Results, Discussion, Conclusion, and Abstract sections. The AI tool was used to improve the clarity, coherence, and academic presentation of the manuscript. AI assistance did not involve generating experimental data, conducting original system testing, or independently verifying the reported research findings. All AI-assisted content must be critically reviewed and verified by the authors, who retain full responsibility for the accuracy, scientific validity, originality, ethical compliance, and final content of the manuscript.

Author Contributions Statement

Adi Kalasa: Conceptualization, Methodology, Software, Investigation, Data curation, Formal analysis, Writing – original draft.

Juwari: Conceptualization, Methodology, Validation, Supervision, Writing – review & editing.

Karno Diantoro: Validation, Visualization, Supervision, Writing – review & editing.

All authors have read and approved the final version of the manuscript and agree to be accountable for their respective contributions and the integrity of the published work.

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Conflict of Interest Statement

The authors declare that they have no financial, professional, institutional, or personal conflicts of interest that could have influenced the design, conduct, analysis, interpretation, or reporting of this study.

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