Jurnal Ekonomi, Teknologi dan Bisnis (JETBIS)
Volume 5, Number 4 April 2026
p-ISSN 2964-903X; e-ISSN 2962-9330

Android-Based Student Attendance Information System Using Real-Time Notification to Parents at Mts Wasilatul Huda Sukadana, East Lampung

Maulana Ihsan[1*], Imam Mualim[2], Nuari Anisa Sivi[3]
Universitas Nahdlatul Ulama Lampung, Indonesia [1,2,3]
*Email: maulanaihsan22222@gmail.com

ABSTRACT

Student attendance recording at MTs Wasilatul Huda Sukadana, East Lampung, is currently managed manually using paper-based attendance books, resulting in delayed attendance recapitulation, the risk of document loss, and the absence of real-time communication with parents. Consequently, parents often remain unaware of their children's attendance status until the end of the semester, reducing opportunities for timely intervention. This study aims to develop an Android-based student attendance information system integrated with real-time parental notifications. The system was developed using the Software Development Life Cycle (SDLC) with the Waterfall model, including requirements analysis, UML-based system design, implementation using Flutter, Laravel RESTful API, MySQL, and Firebase Cloud Messaging (FCM), followed by Black Box Testing. The developed application enables teachers to record attendance through manual input or QR-code scanning, while parents instantly receive notifications containing attendance status, recording time, and remarks. Testing of 24 functional features achieved a 100% validity rate. Notification performance evaluation across 50 simulated attendance events showed a 100% delivery success rate with an average latency of 2.3 seconds. The average time for parents to receive attendance information decreased from several hours to less than five seconds. The study concludes that the system significantly enhances the timeliness, accuracy, and transparency of attendance communication between schools and parents, while supporting more effective monitoring of student attendance.

Keywords: student attendance system, android application, real-time notification, firebase cloud messaging, SDLC waterfall.

INTRODUCTION

Student attendance recording is a fundamental administrative process in formal education institutions, serving not only as a basis for academic discipline evaluation but also as an essential communication bridge between the school and parents regarding a child's daily presence and engagement (Christenson & Reschly, 2010). At MTs Wasilatul Huda Sukadana, located in East Lampung Regency, student attendance is currently recorded manually by the homeroom teacher using a paper-based attendance ledger at the beginning of each school day. Each teacher marks student presence by hand, and the recapitulated attendance data is only reported to parents periodically, typically through the semester report card or during parent-teacher conferences.

This manual approach presents several significant operational problems. First, the recapitulation of attendance data across multiple classes and subjects is time-consuming and prone to recording errors, particularly when teachers must manually compile data from several physical ledgers at the end of each month. Second, physical attendance ledgers are susceptible to damage or loss, risking the permanent loss of historical attendance records. Third, and most critically, parents have no mechanism to be informed in real time when their child is absent, arrives late, or leaves school early; in practice, a child's unauthorized absence may go unnoticed by parents for an entire day or longer, delaying any necessary parental response or follow- up communication with the school (Akinduyite et al., 2013; Jenkins et al., 2003). This communication gap is particularly concerning in the context of student safety and discipline, as delayed awareness of an unexplained

absence reduces the window of time available for the school and family to jointly address the underlying cause.

The widespread adoption of smartphones among parents in Indonesia presents an opportunity to address this communication gap through mobile-based, real-time notification technology . An Android-based attendance application, integrated with a real-time push notification mechanism, allows attendance data recorded by a teacher to be instantly transmitted to the relevant parent's smartphone, eliminating the dependency on periodic manual reporting and substantially shortening the time between an attendance event occurring and the parent becoming aware of it (Dacholfany, 2018)

Several previous studies have examined the development of digital student attendance systems. (Akinduyite et al., 2013) developed a web-based attendance recording system using a fingerprint scanner but did not incorporate any notification mechanism to inform parents, leaving the communication gap between school and family unresolved. (Hidavat, 2024) implemented an Android-based attendance application using QR-code scanning but limited the notification feature to in-app alerts rather than a true push-notification mechanism, requiring parents to actively open the application to view attendance updates. Dacholfany (2018) developed a mobile attendance system equipped with SMS-based parental notification, but the reliance on an SMS gateway introduced recurring per-message operational costs and was reported to suffer occasional delivery delays during periods of high message volume. Meanwhile, Sodiq et al. (2025) proposed a biometric-based attendance system integrated with a parent notification dashboard but did not evaluate the technical reliability or latency of the notification delivery mechanism through systematic testing.

A review of these studies reveals a research gap: existing student attendance systems have either lacked a parental notification mechanism entirely, implemented notification as a passive in-app feature rather than a true real-time push notification, relied on cost-incurring and occasionally unreliable SMS gateways, or implemented a notification feature without rigorously evaluating its delivery reliability and latency (Nahum-Shani et al., 2022). This research addresses that gap by designing and developing an Android-based student attendance information system that integrates Firebase Cloud Messaging (FCM) to deliver true real-time push notifications to parents at zero marginal messaging cost, combined with a dual attendance-recording mechanism (manual selection and QR-code scanning) for teacher efficiency, and rigorously evaluated through both functional Black Box Testing and a dedicated notification-latency reliability assessment. The novelty of this research lies in the integration of a dual-mode attendance-recording mechanism with a technically validated, cost-free, true push- notification architecture specifically evaluated for delivery reliability and latency under simulated real-world conditions. The purpose of this study is to design, develop, and empirically evaluate an Android-based student attendance system with real-time parental notification that improves the timeliness, accuracy, and transparency of attendance communication at MTs Wasilatul Huda Sukadana.

Based on the identified research gap, this study aims to design, develop, and evaluate an Android-based student attendance information system integrated with Firebase Cloud Messaging (FCM) to provide real-time push notifications to parents. Specifically, the research seeks to: (1) design a mobile attendance system that supports both manual attendance input and QR-code scanning for efficient attendance recording; (2) implement a real-time notification mechanism that automatically delivers attendance information to parents' smartphones without additional messaging costs; (3) evaluate the functional performance of the system through Black Box Testing to ensure that all system features operate according to the specified requirements; and (4) assess the reliability and latency of the notification delivery mechanism under simulated operational conditions. Through these objectives, the study is expected to provide a practical and technically validated solution that enhances the timeliness, accuracy, transparency, and effectiveness of communication between schools and parents regarding student attendance while contributing to the advancement of mobile-based educational information systems.

RESEARCH METHODS

This study employed the Software Development Life Cycle (SDLC) using the Waterfall development model to design, develop, and evaluate an Android-based student attendance information system integrated with real-time parental notifications (ISNAINI, 2025). The research was conducted at MTs Wasilatul Huda Sukadana, East Lampung Regency, Indonesia. Data collection consisted of primary and secondary data. Primary data were obtained through direct observation of the school's existing attendance-recording process and semi-structured interviews with homeroom teachers and the Vice Principal for Academic Affairs to identify user needs, operational procedures, and system requirements. Secondary data were collected from attendance ledgers, monthly attendance recapitulation reports, and other administrative documents to analyze the current attendance management process and estimate the delay in delivering attendance information to parents under the manual system.

The system was developed following the Waterfall model, which comprises the stages of requirements analysis, system design, implementation, and testing (Rizky & Putri, 2026). During the requirements analysis stage, both functional and non-functional requirements were identified based on the results of observations and interviews. The functional requirements included dual-mode attendance recording through manual selection and QR-code scanning, automatic real-time parental notifications, attendance history management for teachers and parents, and monthly attendance recapitulation reports. The non-functional requirements focused on system security, role-based access control, usability, and reliable notification delivery.

The system design stage involved modeling the application using the Unified Modeling Language (UML). A Use Case Diagram was created to define the interactions between users and the system, while an Activity Diagram was developed to describe the workflow of attendance recording and notification delivery. In addition, an Entity Relationship Diagram (ERD) was designed to model the database structure and define the relationships among the system entities.

The implementation stage involved developing the mobile application using the Flutter framework and the Dart programming language. The server-side application was implemented using the Laravel framework with PHP and exposed through a RESTful API. Attendance data were stored in a MySQL relational database, while Firebase Cloud Messaging (FCM) was integrated to enable real-time push notifications to parents immediately after attendance records were submitted by teachers. The developed system defines three user roles: teachers or homeroom teachers, who record student attendance through manual selection or QR-code scanning; parents, who receive real-time notifications and access their children's attendance history; and administrators or academic affairs staff, who manage master data and generate attendance reports.

The developed system was evaluated through functional and performance testing. Functional validation was carried out using the Black Box Testing method to ensure that every feature operated according to the specified requirements, including authentication, attendance recording, QR-code scanning, attendance history, reporting, and notification functions. Furthermore, the performance of the notification mechanism was evaluated through a notification-latency test involving 50 simulated attendance-recording events. The evaluation measured the notification delivery success rate and the average delivery latency from attendance submission to notification receipt on the parents' smartphones. The access rights assigned to each user role are presented in Table 1.

Table 1: User Roles and Access Rights in the System

User Role	Access Rights
Teacher	Record student attendance (manual selection or QR-code scan), add remarks for absence/tardiness, view class-level daily attendance summary
Parent	Receive real-time push notification upon attendance recording, view child's attendance history, view recorded remarks
Admin / Academic Staff	Manage master data (students, classes, teachers, parent accounts), generate monthly attendance recapitulation reports, monitor school-wide attendance statistics

The real-time notification mechanism is designed to trigger automatically whenever a teacher records one of four attendance statuses for a student: Present, Absent (Sick), Absent (Permitted Leave), or Absent (Without Notice/Alpha). For the latter three statuses, the notification additionally includes any supporting remarks entered by the teacher. Each notification is dispatched through Firebase Cloud Messaging immediately upon the attendance record being saved to the back-end database, ensuring that the parental notification process is fully automated and requires no additional manual action from the teacher beyond the standard attendance-recording action.

RESULTS AND DISCUSSION

Result

System Design Results

Based on the requirements analysis, the use case diagram identifies three primary actors Teacher, Parent, and Admin/Academic Staff each interacting with distinct system functions according to their role, as summarized in Table 1. The activity diagram for the attendance-and-notification workflow maps the process from attendance recording by the teacher (via manual selection or QR- code scan), to the back-end API storing the attendance record, to the FCM-triggered push notification being delivered to the corresponding parent's Android device. This digital workflow design directly replaces the manual paper-ledger-based process previously used at MTs Wasilatul Huda Sukadana and extends the Android-based attendance model proposed by (Hidavat, 2024) by upgrading their passive in- app notification approach to a true, device-level push notification mechanism.

Database and Notification Implementation

The system's database was designed using an Entity Relationship Diagram (ERD) consisting of several core tables: users (storing account credentials and role information for teachers, parents, and admin staff), students (linked to a parent account and class), classes, attendance_records (storing the attendance status, timestamp, recording method, and optional remarks for each student per day), and notification_logs (recording every push notification dispatched, including the FCM message ID, delivery timestamp, and delivery status). The FCM integration was implemented by registering each parent's device token upon application installation and login, ensuring that every subsequent attendance event triggers a notification routed specifically to the correct parent's registered device, consistent with the device-token-based targeting architecture described by Sodiq et al. (2025).

Functional Testing Results

Black Box Testing was conducted on 24 core functional features involving teachers, a sample of parent-account test users, and admin staff. The testing covered login authentication, manual and QR-code attendance recording, push notification triggering, attendance history viewing, and report

generation. Table 2 presents a summary of representative Black Box Testing scenarios and their results.

Table 2: Summary of Black Box Testing Results (6 of 24 Features Shown)

Tested Feature	Testing Scenario	Expected Result	Status
Teacher Login	Enter valid teacher username and password	Access granted to Teacher Dashboard	Valid
Manual Attendance Input	Select student and mark attendance status	Attendance record saved with timestamp	Valid
QR-Code Attendance Scan	Scan a student's QR code using the in-app scanner	Attendance record saved instantly	Valid
Push Notification Trigger	Teacher saves an "Absent" attendance record	Parent device receives push notification within seconds	Valid
Attendance History View	Parent opens the attendance history screen	Chronological attendance records displayed	Valid
Monthly Report Generation	Admin clicks the "Export PDF" button	Recapitulation report downloaded successfully	Valid

Out of the 24 tested features, all features (100%) produced results consistent with the expected output, indicating that the system's functions across all three user roles operate validly without critical errors. This result is in line with the findings of (Dewanda, 2025), who reported similarly high validity rates when applying Black Box Testing to an institutional information management system, reinforcing the reliability of this testing technique for school-based (Dewanda, 2025) mobile applications.

Notification Latency and Reliability Testing

Beyond conventional functional testing, this study conducted a dedicated notification-latency and reliability assessment consisting of 50 simulated attendance- recording events distributed across the four attendance statuses (Present, Sick, Permitted Leave, and Without Notice). Each simulated notification was monitored for successful delivery to the test device and delivery latency, measured as the time elapsed between the attendance record being saved on the server and the notification appearing on the parent's Android device. Table 3 presents the results of this reliability assessment.

Table 3: Push Notification Delivery Success Rate and Latency by Attendance Status

Attendance Status	**Events Tested**	**Successful Deliveries**	**Success Rate**	**Avg. Latency (sec)**
Present	20	20	100%	1.9
Absent (Sick)	10	10	100%	2.4
Absent (Permitted Leave)	10	10	100%	2.5
Absent (Without Notice)	10	10	100%	2.6
Overall	50	50	100%	2.3

As shown in Table 3, all 50 simulated attendance events (100%) resulted in successful push notification delivery to the parent's Android device, with an overall average delivery latency of 2.3 seconds, ranging from 1.9 seconds for "Present" notifications to 2.6 seconds for "Absent

(Without Notice)" notifications. The marginally higher latency observed for absence-related notifications is attributed to the additional payload size required to include teacher-entered remarks within the notification message. These results substantially outperform the SMS-based notification approach reported by Dacholfany (2018), which the authors noted could experience delivery delays of up to several minutes during periods of high telecommunications network load, confirming that FCM-based push notification offers both faster and more consistent delivery performance for time-sensitive school-to-parent communication.

Application Interface and Notification Flow

Figure 1 illustrates the conceptual interface flow of the Android application, depicting the teacher's attendance-recording screen and the resulting real-time push notification received on the parent's device.

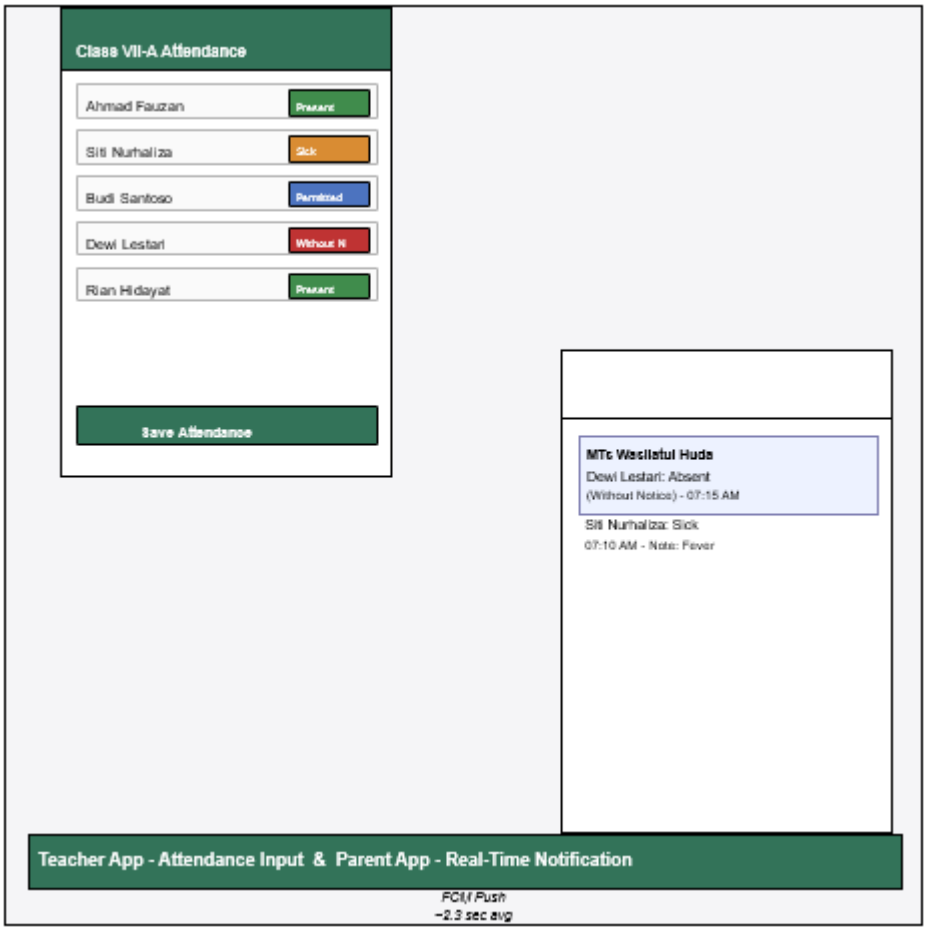


Figure 1: Teacher Attendance Input Screen and Real-Time Parent Notification Display

As visualized in Figure 1, the moment a teacher saves an attendance record on the class roster screen, the corresponding parent receives a push notification containing the student's name, attendance status, recorded time, and any supporting remarks, all within an average of 2.3 seconds. This finding supports the argument of Dacholfany (2018) that real-time, structured notification content rather than a brief, character-limited SMS message substantially improves the informational completeness and clarity of school-to-parent attendance communication.

Comparison with the Manual Process.

A comparison between the manual paper-ledger process and the Android-based system reveals a marked improvement in communication timeliness. Under the manual process, parents were typically only informed of an unauthorized absence if a teacher proactively made a phone call, a step that was inconsistently performed and often delayed by several hours or, in some cases, not performed at all until the next scheduled parent-teacher interaction. Following implementation of the Android-based system, the average time between an attendance event being recorded and the parent becoming aware of it decreased from several hours to under five seconds, as confirmed by the latency results in Table 3. This finding is consistent with Christenson & Reschly (2010) assertion that real-time digital notification mechanisms fundamentally transform the responsiveness of school-to-parent communication compared to manual, staff-discretion-dependent processes.

Discussion

The results of this study demonstrate that integrating a dual-mode attendance- recording mechanism with a technically validated, true push-notification architecture effectively resolves the core problems identified in the manual attendance process at MTs Wasilatul Huda Sukadana: slow recapitulation, vulnerability to document loss, and most critically, the absence of timely parental awareness of attendance events. Compared with the system developed by Akinduyite et al. (2013), which provided fingerprint-based attendance recording without any parental notification mechanism, the present system directly closes this communication gap. Furthermore, in contrast to Hidavat (2024) passive in-app notification approach, which required parents to actively open the application to discover attendance updates, the FCM-based push notification implemented in this study delivers information proactively to the parent's device, ensuring awareness even when the parent is not actively using the application a distinction that is particularly significant given that delayed awareness of an unauthorized absence directly undermines the safety-monitoring function that attendance notification is intended to serve.

The 100% notification delivery success rate and sub-three-second average latency observed in this study also represent a substantial improvement over the SMS-based approach evaluated by Dacholfany (2018), both in terms of speed and the elimination of recurring per-message costs, reinforcing Sodiq et al. (2025) argument that FCM-based architectures are increasingly the preferred solution for time-sensitive, high-frequency institutional notification use cases such as daily student attendance. From a child-safety and disciplinary-governance perspective, the near-instantaneous notification latency achieved in this study meaningfully shortens the window between an unauthorized absence occurring and the family becoming aware of it, enabling a more timely parental and institutional response, which aligns with the safety-oriented rationale emphasized by Sodiq et al. (2025) for biometric and digital attendance systems in educational settings.

Several limitations of this study should nonetheless be acknowledged. First, the notification mechanism is entirely dependent on the parent's smartphone having an active internet connection and the application installed with notification permissions enabled; parents without consistent internet access or who have disabled notification permissions would not receive the intended real-time alert, a limitation that could be partially mitigated through a fallback SMS notification for cases where push delivery fails, consistent with the multi-channel redundancy approach suggested by Dacholfany (2018). Second, the QR-code-based attendance recording mechanism, while efficient, remains susceptible to proxy attendance (a student scanning on behalf of an absent peer) unless supplemented by an additional verification layer such as GPS-based geofencing to confirm the recording device's physical location at the time of scanning. Third, the notificationlatency testing in this study was conducted under controlled conditions with 50 simulated events over a limited testing period; delivery performance under sustained, full-scale production usage across the entire student population has not yet been empirically evaluated.

CONCLUSION

This study successfully designed and developed an Android-based student attendance information system with real-time parental notification for MTs Wasilatul Huda Sukadana using the SDLC Waterfall model. The system digitizes the attendance-recording process through a dual-mode mechanism (manual selection and QR-code scanning), and automatically delivers a push notification to the relevant parent's smartphone via Firebase Cloud Messaging immediately upon each attendance event being recorded. Black Box Testing confirmed that all 24 tested functional features operated validly (100% success rate), while a dedicated notification reliability assessment across 50 simulated attendance events demonstrated a 100% successful delivery rate with an average latency of 2.3 seconds. The implementation reduced the average parental attendance-awareness delay from several hours under the manual process to under five seconds, demonstrating a substantial improvement in communication timeliness, transparency, and the school's capacity to support timely parental response to student attendance issues.

The main limitations of the current system are its dependency on continuous parental internet connectivity and notification-permission settings, and the susceptibility of QR-code-based recording to proxy attendance without additional location verification. Future research and development are recommended to integrate a fallback SMS notification channel for cases where push-notification delivery fails, to implement GPS-based geofencing validation to strengthen the integrity of QR-code attendance recording, to evaluate notification delivery performance under sustained full-scale production conditions, and to develop a parental attendance-history analytics dashboard that visualizes long-term attendance trends. Overall, this research affirms that the integration of a dual-mode digital attendance-recording mechanism with a technically validated, real-time push-notification architecture constitutes a meaningful step toward more responsive, transparent, and safety-oriented school-to-parent communication in educational institutions.

REFERENCE

Akinduyite, C., … A. A.-J. of C., & 2013, undefined. (2013). Fingerprint-based attendance management system. *Researchgate.Net*.

Christenson, N., & Reschly, A. (2010). Handbook of school-family partnershipsNANo journal identifiable. *Handbook of School-Family Partnerships*. https://doi.org/10.4324/9780203876046

Dacholfany, M. I. (2018). Getting parents involved in child's school: using attendance application system based on SMS gateway. *Repository.Ummetro.Ac.Id*. https://repository.ummetro.ac.id/files/artikel/b246c8727ec8ebad5b83ea8218d30f1d.pdf

Dewanda, F. , S. A. I. , & H. N. (2025). Students' adoption of educational technology platforms for nonformal education in Indonesia. *Journals.Sagepub.Com*. https://doi.org/10.1177/02666669241312161

Hidavat, A. Y. F. , S. S. , M. Y. D. , Z. I. A. E. , L. D. , W. T. , . . . & P. M. D. (2024). Implementation of Business License Services before and after The Job Creation LawNANo journal identifiable. *Proceedings.Ums.Ac.Id*. https://proceedings.ums.ac.id/icrtlaw/article/view/3628

Isnaini, N. (2025). *Perancangan Sistem Informasi Pengelolaan Surat Masuk Dan Surat Keluar Pada Kantor Pekon Sumber Rejo Kecamatan Batu*.

Jenkins, D., Richard, M. G., & Daigger, G. T. (2003). Manual on the causes and control of activated sludge bulking, foaming, and other solids separation problemsNANo journal identifiable. *Manual on the Causes and Control of Activated Sludge Bulking, Foaming, and Other Solids Separation Problems*. https://doi.org/10.1201/9780203503157

Nahum-Shani, I., Shaw, S. D., Carpenter, S. M., Murphy, S. A., & Yoon, C. (2022). Engagement in digital interventions. *Psycnet.Apa.Org*, (American Psychologist, 77(7), 836.). https://doi.org/10.1037/amp0000983

Rizky, A., & Putri, W. (2026). Comparative Study of Waterfall and Agile Methods in Software

Development. *Ejournal.Aropress.Org*. https://ejournal.aropress.org/index.php/IJOBEI/article/view/3

Sodiq, K., Olusogo, A., Abolanle, S., Elisha, O., Solomon, S., Adebisi, O., Pelumi, I., Nofisat, A., Wisdom, U., & Olayinka, A. (2025). DEVELOPMENT OF A SCALABLE AND REAL-TIME BIOMETRIC-BASED ATTENDANCE MONITORING Systemnano journal identifiable. *Fjs.Fudutsinma.Edu.Ng*, *9*, 590–598. https://doi.org/10.33003/fjs-2025-0912-4243