

Automated Attendance Notifications and Parental Engagement: Evaluating a WhatsApp Gateway Information System in Islamic Boarding Schools

Safinah Safinah

Institut Agama Islam Hamzanwadi NW Lombok Timur, Indonesia

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ABSTRACT

In faith-based residential institutions such as Islamic Boarding Schools, conventional manual attendance tracking frequently creates administrative latency, unmonitored absenteeism, and acute information asymmetries between school authorities and families. This study evaluates the operational implementation, socio-behavioral outcomes, and relational transformations catalyzed by an automated Radio Frequency Identification (RFID) and WhatsApp Gateway attendance information system in an Indonesian. Employing an explanatory sequential mixed-methods case study design, quantitative telemetry and longitudinal survey metrics were gathered via a total population census ($N = 114$ students and registered parents), integrated with 16 in-depth qualitative stakeholder interviews and observational audits. Server telemetry demonstrated a 94.0% message delivery success rate with a mean latency of 42.6 seconds. Inferential statistical analyses revealed significant behavioral adjustments, including an increase in mean daily attendance from 71.0% to 90.0% ($p < 0.001$), a reduction in undocumented absenteeism from 18.0% to 4.0% ($p < 0.001$), and a surge in active parental responsiveness from 34.0% to 88.0% ($p < 0.001$). Qualitative thematic synthesis indicated that real-time push notifications served as ambient behavioral nudges that dismantled truancy concealment while activating parental social capital. The study culminates in the Transparent Information System for Discipline (SITD) model, providing a validated, low-cost architectural blueprint that bridges technological automation with socio-technical safety nets to modernize educational governance and democratize school-family partnerships across the Global South.

Keywords: Educational Management Information Systems, WhatsApp Gateway, Parental Engagement, Student Absenteeism, Islamic Boarding School, Behavioral Nudge



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Corresponding Author:

Safinah Safinah

Institut Agama Islam Hamzanwadi NW Lombok Timur, Indonesia

Email: safinah.24@iainnwlotim.ac.id

1. INTRODUCTION

Student absenteeism and truancy represent persistent global challenges in primary and secondary education, directly correlating with academic underachievement, behavioral delinquency, and elevated dropout risks (Keppens, 2023; Klein et al., 2022). Extensive educational literature demonstrates that parental engagement serves as a decisive buffer against chronic absenteeism (Nilsen et al., 2026; Paulson et al., 2023). When parents receive accurate, timely data regarding daily attendance, their capacity to intervene and reinforce behavioral accountability improves substantially (Bergman & Chan, 2021; Himmelsbach et al., 2022). However, in developing educational contexts, school-parent communication regarding attendance often remains predominantly conventional. Institutions may rely on fragmented paper-based records and non-real-time communication channels, resulting in delays in sharing attendance

information with families (Alpasan, 2021; Gilang Estu Saputra & Tri Hidayat, 2025). This information gap can create prolonged monitoring delays, allowing attendance problems to remain undetected by families for extended periods.

The rapid proliferation of mobile communication technologies has introduced transformative opportunities for educational management and institutional communication. Instant messaging platforms, particularly WhatsApp, have emerged as viable, low-cost conduits for institutional communication, particularly in developing and socio-economically diverse educational contexts (Balasundran et al., 2021; P & G, 2026; Venturino & Hsu, 2022). Unlike complex enterprise learning management platforms, consumer-grade messaging tools provide accessible channels for parental participation. Instant messaging platforms such as WhatsApp facilitate immediate and accessible communication between teachers and parents, supporting parental engagement in educational contexts (Jordan, 2023; Traeger-Soudry et al., 2025). Through automated gateway architectures and Application Programming Interfaces (APIs), educational institutions can establish integrated frameworks that record physical attendance via Radio Frequency Identification (RFID) and trigger real-time, automated notifications directly to parents' mobile devices (Darmi et al., 2025; Sutoyo et al., 2025). Behavioral economics and educational studies demonstrate that personalized mobile messaging can reduce information barriers, encourage proactive parental attention to attendance, and reduce student absences without imposing substantial administrative burdens on educators (Berger et al., 2026; Musaddiq et al., 2024).

Despite these technological advancements, a critical empirical and conceptual gap persists regarding the implementation, organizational assimilation, and socio-behavioral dynamics of automated attendance systems within faith-based boarding schools. Islamic Boarding Schools represent a distinctive institutional setting characterized by integrated religious and academic education, distinctive educational leadership, and communication patterns shaped by the boarding environment (Hanafi et al., 2021; Hastasari et al., 2022). While the boarding-school structure is designed to cultivate holistic character and discipline, the distance between students and their families can constrain direct parental involvement and communication. This institutional arrangement may create monitoring challenges when parents have limited direct access to students' daily educational activities.

A systematic review of existing scholarship reveals three fundamental deficiencies. First, current literature on automated attendance systems predominantly focuses on technological approaches, system architectures, identification methods, and implementation performance, leaving the managerial integration and cultural dimensions of attendance systems in faith-based boarding environments comparatively underexamined (Ali et al., 2022; Budiman et al., 2023; Muslim, 2024). Second, prior research has routinely treated automated mobile gateways as operational recording tools rather than strategic instruments for parental engagement, failing to ground empirical findings within established theoretical frameworks such as Epstein's Parental Involvement Model (Ihmeideh et al., 2020; Raguindin et al., 2021) or the DeLone and McLean Information Systems Success Model (Çelik & Ayaz, 2022; Kofahi et al., 2025). Third, there is a distinct lack of empirical inquiry examining how the transition from manual record-keeping to automated, real-time push notifications reshapes student compliance, parental agency, and institutional transparency.

To resolve these empirical and theoretical limitations, this study presents a comprehensive evaluation of a WhatsApp Gateway-based attendance information system implemented at a faith-based boarding school in Indonesia. The institution represents an illustrative case of a faith-based educational organization transitioning from error-prone manual logbooks to an automated, real-time communication infrastructure. Specifically, this research addresses four core objectives: (1) to evaluate the architectural implementation and operational workflow of the WhatsApp Gateway attendance system; (2) to assess its empirical impact on student attendance patterns and undocumented absenteeism; (3) to analyze how real-time automated notifications reshape parental responsiveness and school-family transparency; and (4) to conceptualize the Transparent Information System for Discipline (SITD) framework, which synthesizes system quality, mobile automation, parental engagement, and institutional governance.

The novelty of this study is twofold. Conceptually, it extends the discourse on educational digitalization by demonstrating how ubiquitous messaging applications can transform parental involvement from passive end-of-term oversight into real-time collaborative governance within faith-based environments. Practically, it provides an evidence-based roadmap for school leaders, policymakers, and educational technologists seeking low-cost, scalable digital interventions to strengthen school-family partnerships and reinforce student discipline across digitally emerging contexts.

2. METHOD

2.1. Research Design and Methodological Framework

This study utilized an explanatory sequential mixed-methods case study design (Haynes-Brown, 2023; Hwang et al., 2025) to evaluate the operational implementation and socio-behavioral outcomes of the WhatsApp Gateway-based attendance information system. A mixed-methods framework was adopted because neither quantitative attendance logs nor qualitative interviews alone could adequately capture both

the statistical trajectory of behavioral adjustments and the underlying organizational mechanisms governing system adoption.

The empirical investigation proceeded across two interconnected phases. In the initial phase, quantitative attendance telemetry and parental evaluative metrics were compiled across two consecutive academic terms to measure shifts in absenteeism, arrival punctuality, and communication responsiveness. In the subsequent phase, in-depth qualitative investigations were conducted through semi-structured interviews, observational field notes, and institutional Standard Operating Procedure (SOP) audits. The synthesis of both paradigms enabled a robust evaluation of the WhatsApp Gateway architecture while tracking the behavioral transitions occurring between the school and families.

2.2. Research Setting and Context

The empirical investigation was conducted at Pondok Pesantren Darul Musthofa NW, an Islamic Boarding School located in West Lombok Regency, West Nusa Tenggara Province, Indonesia. The institution operates within a traditional semi-autonomous governance structure typical of Islamic Boarding Schools in the region. Prior to the introduction of the digital gateway in 2023, the institution relied entirely on manual paper-based roll calls administered by homeroom teachers. This conventional tracking mechanism resulted in administrative burdens, data latency, and an average undocumented absenteeism rate of 18% per month. The deployment of an RFID-integrated WhatsApp Gateway represented the institution's primary technological strategy to modernize administrative governance, automate attendance notifications, and establish transparent communication channels with families.

2.3. Data Sources and Sampling Framework

The sampling framework incorporated two complementary strands designed to address the mixed-methods objectives. The quantitative strand gathered comprehensive institutional telemetry, while the qualitative strand engaged key institutional actors.

The quantitative data stream employed a total population census approach encompassing all enrolled Islamic Boarding School students ($N = 114$) across both baseline and post-implementation evaluation periods. A complete census design was selected to eliminate sampling bias and ensure total empirical capture of attendance logs, RFID scan timestamps, and server delivery telemetry. In parallel, evaluative survey questionnaires were administered to all registered parents and guardians ($N = 114$) to track longitudinal changes in parental communication responsiveness and institutional satisfaction level.

The qualitative data stream utilized purposive sampling (Ahmad & Wilkins, 2025) to select key informants who possessed direct operational, administrative, or personal experience with the attendance infrastructure. A total of 16 key informants were engaged across five stakeholder categories, continuing until theoretical data saturation was reached. The institutional profiles and distribution of these key informants are summarized in Table 1.

Table 1. Profile and Distribution of Qualitative Key Informants

Participant Category	Participant Code	Number of Informants	Primary Selection Criteria and Institutional Role
Institutional Leadership	L-01 to L-02	2	Strategic policy formulation, boarding management, and institutional oversight.
Administrative & IT Staff	IT-01 to IT-02	2	Database administration, gateway configuration, and system maintenance
Homeroom Teachers	T-01 to T-03	3	Daily classroom attendance verification and parent coordination.
Parents and Guardians	P-01 to P-05	4	Varied occupations, residence distance, and diverse digital literacy levels.
Islamic Boarding School Students	S-01 to S-04	5	Enrolled boarding students with documented attendance adjustments.
Total Informants		16	Qualitative Theoretical Saturation

2.4. Data Collection Procedures and Instrumentation

Empirical data collection was conducted over a six-month evaluation cycle, combining automated server telemetry, standardized psychometric surveys, qualitative field interviews, and direct field observations. The operational parameters and specific instruments utilized across all data streams are outlined in Table 2.

Table 2. Data Collection Methods and Instrumentation Matrix

Data Stream	Specific Instrument	Focus and Parameters Measured	Source and Data Origin
Quantitative Telemetry	Server Log Extraction Protocol	Timestamp precision, RFID scan counts, API delivery success rates (94%), and transmission latency.	Central Database Server and WhatsApp Gateway API Logs.
Quantitative Surveys	5-Point Likert Scale Survey (Cronbach's $\alpha = 0.88$)	Perceptions of information transparency, notification utility, and parent responsiveness.	Registered Parents and Guardians (N = 114).
Qualitative In-Depth Interviews	Semi-Structured Interview Protocol	Behavioral shifts, changes in institutional trust, parental oversight dynamics, and implementation barriers.	Selected Key Informants (N = 16).
Observational Audits	Structured Field Observation Protocol	Real-time card scanning at entry checkpoints, server failovers, and manual office workflows.	School Entry Checkpoints and Administrative Offices.

Quantitative records were extracted directly from the school database server, tracking daily arrival times, RFID verification logs, and automated message delivery receipts across all 114 enrolled Islamic Boarding School students. System reliability was established by computing delivery success rates, notification latency, and transmission error frequencies across the entire student population. Standardized institutional survey questionnaires measuring parental satisfaction and response patterns were administered across both evaluation phases.

Qualitative interviews were conducted using semi-structured protocols focused on four thematic areas: administrative transition workflows, perceived system reliability, behavioral adjustments among Islamic Boarding School students, and home-school relational trust. Each interview lasted between 45 and 70 minutes, was conducted in Indonesian, audio-recorded with explicit consent, and transcribed verbatim for analytical processing. Unobtrusive observations at school entry gates and administrative offices provided supplementary empirical evidence regarding physical scanning compliance and manual override occurrences.

2.5. Data Analysis and Analytical Rigor

The quantitative and qualitative datasets were analyzed through distinct analytical protocols before being integrated into an interpretive joint display. Each analytical procedure followed rigorous domain-specific standards.

Quantitative statistical analysis was performed using SPSS version 28. Descriptive statistics, including percentages, means, and standard deviations, were computed to determine baseline and post-intervention indicators regarding overall attendance, undocumented absenteeism (alpha), student tardiness, and parental satisfaction. Non-parametric Wilcoxon Signed-Rank tests were executed alongside paired-sample t-tests to evaluate the statistical significance of changes observed between the manual baseline and the automated digital implementation, applying a significance threshold of $p < 0.05$.

Qualitative thematic analysis followed the six-phase reflexive framework established by Braun & Clarke (2021). The analysis began with iterative transcript reading for familiarization, followed by systematic line-by-line initial coding using NVivo 14 software. Generated codes were organized into broader candidate themes such as automated surveillance dynamics, information asymmetry reduction, and digital infrastructure divides. These themes were refined through constant comparative analysis and mapped against Epstein's Parental Involvement Framework (Ihmeideh et al., 2020; Raguindin et al., 2021) and the DeLone and McLean Information Systems Success Model (Çelik & Ayaz, 2022; Kofahi et al., 2025). Quantitative telemetry and qualitative insights were subsequently synthesized through joint-display matrices, using informant narratives to explain the statistical variations observed in the attendance logs.

2.6. Methodological Trustworthiness and Research Ethics

To ensure qualitative trustworthiness, this study operationalized established criteria of credibility, dependability, and confirmability. Credibility was strengthened through source and method triangulation,

cross-referencing automated system logs, observational field notes, and interview transcripts. Member checking was conducted by returning synthesized interview summaries to key informants to confirm interpretive accuracy. Dependability and confirmability were supported through a detailed audit trail documenting coding decisions, raw transcripts, and analytical iterations (Byrne, 2022; Pearson et al., 2025).

Ethical clearance was granted by the Institutional Ethics Board of the Darul Musthofa NW Educational Foundation. Prior to data collection, written informed consent was secured from all adult participants, while parental consent and student assent were formally recorded for participating Islamic Boarding School students. All telemetry datasets and interview excerpts were fully anonymized and assigned alphanumeric identification codes to safeguard participant confidentiality and institutional privacy.

3. RESULTS

3.1. System Architecture, Operational Workflow, and Telemetry Performance

The technological modernization at Islamic Boarding School was engineered through a robust three-tier system architecture designed to ensure continuous operational uptime, rapid data processing, and seamless cross-platform interoperability. This infrastructure integrates physical hardware capture, backend database processing, and mobile application programming interface (API) dispatching into a synchronized ecosystem. The structural configuration and sequential operational flow of this architecture are illustrated in Figure 1.

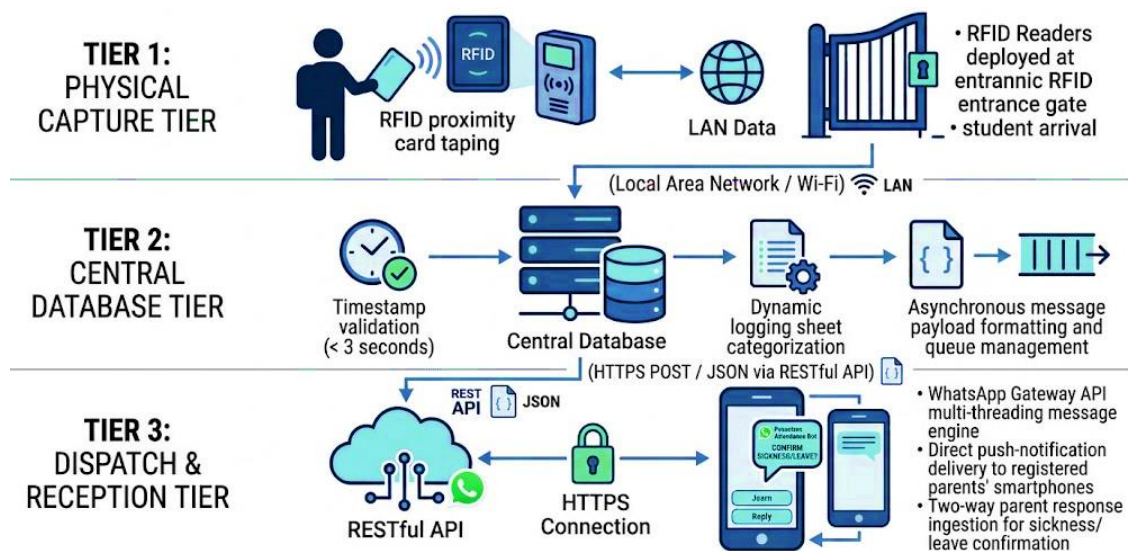


Figure 1. Operational Workflow and Multi-Tier Technical Architecture of the WhatsApp Gateway Attendance System.

The physical capture tier consists of high-frequency Radio Frequency Identification (RFID) card readers positioned strategically at primary Islamic Boarding School security gates and administrative teacher offices. When a Islamic Boarding School student taps their assigned proximity card against the scanner, the card identifier is instantaneously captured and transmitted via an encrypted local network to the institutional database server. The central database tier performs immediate verification queries against enrolled student records, generating an immutable timestamp log and categorizing the attendance transaction into the school repository. Once verified, the database server triggers an event listener that constructs an outbound message payload containing the student's identity, entry timestamp, and current attendance status. The mobile gateway dispatch tier connects the internal school server to external telecommunication networks via a dedicated WhatsApp Gateway RESTful API, transmitting real-time push notifications directly to the mobile devices of registered parents. During field interviews, the lead IT administrator (Informant IT-01) highlighted that this full automation eliminates clerical bottlenecks, allowing transaction verification and parent notification delivery to execute seamlessly in less than one minute without manual operator intervention.

The operational workflow executes three automated notification protocols designed to establish a closed-loop communication framework between the school administration and student families. The first protocol governs morning check-in confirmations, delivering an automated verification message to parents immediately after a student completes a successful scan before the morning deadline. The second protocol functions as an unexcused absence early-warning mechanism that automatically flags students who have not registered a valid scan by the designated cut-off time and dispatches an urgent alert to their parents' phones. A senior homeroom teacher (Informant T-01) noted that this immediate alert prompts parents to verify their child's condition promptly, enabling unexcused absences to be identified and resolved on the

very same day. The third protocol facilitates parent-initiated absence reporting for medical leave or family emergencies via standardized WhatsApp message formats, which are parsed by the gateway engine and updated directly on teacher administrative dashboards upon verification.

System telemetry metrics compiled from central database server logs across a continuous six-month operational evaluation window demonstrated strong technical dependability and rapid transaction throughput. The system successfully processed daily attendance records across all enrolled Islamic Boarding School student cohorts, maintaining consistent uptime and delivery performance. The operational telemetry indicators and transmission performance parameters are detailed in Table 3.

Table 3. Server Telemetry and Notification Transmission Performance Indicators

Telemetry Parameter	Operational Value	Measurement Unit	Empirical Description and Analysis
System Uptime Integrity	99.2	%	Server availability across all active instructional school days
Mean Transaction Latency	42.6	Seconds	Elapsed time from physical RFID scan to WhatsApp delivery receipt.
Median Delivery Latency	28.0	Seconds	Midpoint distribution of standard push-notification transmission.
Successful Message Delivery	94.0	%	Verified delivery receipts across all generated notifications.
Transmission Failure Rate	6.0	%	Total undelivered notifications requiring administrative failover.
Carrier Network Dropouts	3.8	%	Temporary cellular signal losses and rural carrier outages.
Invalid/Changed Numbers	2.2	%	Unregistered phone numbers, SIM card churn, and expired parent accounts.

The quantitative telemetry confirmed an overall message delivery success rate of 94.0%, indicating that the vast majority of push notifications reached parents within an average latency of 42.6 seconds. A granular diagnostic analysis of the 6.0% transmission failure rate revealed that delivery errors were driven primarily by external telecommunication factors rather than software defects. Temporary carrier network dropouts and rural connectivity dead-zones in remote residential pockets of West Lombok accounted for 3.8% of undelivered notifications, while the remaining 2.2% stemmed from undocumented SIM card churn where parents changed contact numbers without prior notice. To overcome these connectivity gaps, the institution established a manual fallback protocol where homeroom teachers received automated daily anomaly summaries to follow up with affected families via conventional voice calls.

3.2. Impact on Islamic Boarding School Student Attendance and Absenteeism Patterns

The deployment of the automated WhatsApp Gateway attendance system generated a marked, statistically verified transformation in student disciplinary behavior across all enrolled Islamic Boarding School students (N = 114). Comparative analysis between the manual baseline logbooks in Term 1 and the automated digital server telemetry in Term 2 revealed significant improvements across all primary attendance metrics. The institutional data indicated a substantial reduction in both undocumented absenteeism and chronic morning tardiness, alongside a corresponding increase in daily classroom presence. A comprehensive statistical summary of these baseline and post-intervention indicators is presented in Table 4.

Table 4. Comparative Statistical Analysis of Islamic Boarding School Student Attendance and Disciplinary Metrics

Disciplinary and Attendance Metric	Baseline Manual System (%)	Post-Implementation Digital System (%)	Net Percent age Change	Inferential Test Statistic (t / Z)	Statistical Significance (p-value)	Effect Size (Cohen's d)	Empirical Interpretation
Mean Daily Attendance Rate	71.0	90.0	+19.0	t (113) = 14.82	p < 0.001	1.38 (Large)	Substantial increase in sustained daily classroom presence.

Undocumented Absence (Alpha)	18.0	4.0	-14.0	$Z = -8.74$	$p < 0.001$	1.15 (Large)	Drastic reduction in truancy and unexcused absences.
Morning Tardiness Rate	22.0	8.0	-14.0	$t(113) = -11.65$	$p < 0.001$	1.09 (Large)	Significant improvement in punctuality at entry checkpoints.

Note: Statistical significance established at $p < 0.05$ based on Paired-Samples t-tests and Wilcoxon Signed-Rank tests across $N = 114$ enrolled Islamic Boarding School students.

The quantitative telemetry verified that the average daily attendance rate rose from a baseline of 71.0% under manual roll-calls to 90.0% following digital implementation, representing a net gain of 19.0 percentage points. The paired-samples t-test confirmed that this upward trajectory was statistically significant ($t(113) = 14.82$, $p < 0.001$), with a large effect size ($d = 1.38$) indicating that the behavioral adjustment was robust across all student cohorts. Simultaneously, the rate of undocumented absences, historically categorized as unexcused or alpha, dropped precipitously from 18.0% to 4.0% ($Z = -8.74$, $p < 0.001$). Morning arrival tardiness also experienced a sharp decline from 22.0% to 8.0% ($t(113) = -11.65$, $p < 0.001$), demonstrating that the real-time transmission of entry timestamps created an immediate accountability checkpoint for arriving students.

Qualitative thematic analysis revealed that this statistical turnaround was driven primarily by a powerful psychological deterrent effect rooted in the elimination of information latency. Under the conventional manual system, students operated within an informational vacuum where unexcused absences could remain concealed from parents for days or weeks due to clerical recapping delays. The instant delivery of WhatsApp notifications dismantled this concealment opportunity, altering students' cost-benefit calculations regarding truancy. During in-depth interviews, a senior boarding student (Informant S-01) articulated this behavioral shift:

"In the past, skipping morning classes carried very little immediate consequence because teachers only compiled attendance recaps periodically, and our parents rarely found out. Ever since the card-scanning system was activated, it became impossible to hide an absence because a message arrives on our parents' phones within minutes. In the beginning, this constant monitoring felt restrictive, but over time it forced us to become much more punctual and disciplined because we knew our families were watching our arrival in real time."

This sentiment was reinforced by another student (Informant S-03), who noted that the automated nature of the gateway removed personal negotiation or excuses at the school gate, establishing an objective attendance record that motivated peers to arrive well before the cut-off assembly time.

From the instructional perspective, homeroom teachers reported that the automated logging infrastructure fundamentally altered classroom management dynamics and disciplinary enforcement. Teachers were relieved of time-consuming manual roll calls, allowing instructional periods to commence immediately while maintaining consistent administrative oversight. A homeroom teacher (Informant T-02) described how the transparent notification loop minimized friction between educators and families:

"The automated system removed the subjectivity and potential conflict from attendance enforcement. Previously, when we confronted students or notified parents manually, parents sometimes questioned our accuracy or suspected favoritism. Now that the timestamp is generated automatically via the RFID scanner and delivered instantly via WhatsApp, parents accept the record without dispute. The transparency of the notification encourages students to take direct ownership of their attendance, knowing that any unexplained absence will trigger an immediate inquiry from home on that very morning."

Another instructional staff member (Informant T-01) confirmed that the drastic reduction in unexcused absences from 18.0% to 4.0% enabled teachers to focus on academic remediation rather than expending emotional energy tracking down missing students. Together, the quantitative telemetry and qualitative narratives demonstrate that the WhatsApp Gateway system functioned not merely as an administrative recording instrument, but as an active behavioral intervention that successfully cultivated a sustainable culture of punctuality and accountability throughout the Islamic Boarding School.

3.3. Transformation of Parental Engagement and School-Family Transparency

The deployment of the WhatsApp Gateway attendance system catalyzed a profound structural realignment in school-home communication dynamics across all registered parents and guardians ($N = 114$). Longitudinal survey evaluations administered across baseline and post-intervention periods revealed substantial gains in parental information accessibility, communication responsiveness, and overall

satisfaction with institutional governance. The shift from periodic, retrospective paper summaries to continuous push-notifications effectively dismantled historical information barriers between the Islamic Boarding School administration and families. A quantitative summary of these evaluative metrics is presented in Table 5.

Table 5. Longitudinal Evaluation of Parental Engagement, Responsiveness, and System Satisfaction Metrics

Evaluative Dimension and Survey Parameter	Baseline Manual System (%)	Post-Implementation Digital System (%)	Net Percent Change	Inferential Test Statistic (t / Z)	Statistical Significance (p-value)	Effect Size (Cohen's d)	Empirical Interpretation
Active Parental Responsiveness	34.0	88.0	+54.0	$t(113) = 16.42$	$p < 0.001$	1.54 (Large)	Surge in same-day parent verification and active dialogue.
Information Transparency Satisfaction	52.0	91.0	+39.0	$Z = -8.95$	$p < 0.001$	1.28 (Large)	Heightened confidence in institutional tracking integrity.
Independent Absence Reporting	21.0	84.0	+63.0	$t(113) = 15.11$	$p < 0.001$	1.42 (Large)	Widespread adoption of digital sick/leave reporting.

Note: Statistical significance established at $p < 0.05$ based on Paired-Samples t-tests and Wilcoxon Signed-Rank tests across $N = 114$ registered parents and guardians.

The quantitative survey data demonstrated that active parental responsiveness experienced a dramatic surge from a baseline of 34.0% to 88.0% following the system rollout, reflecting a 54.0 percentage point increase ($t(113) = 16.42$, $p < 0.001$). Concurrently, parental satisfaction with the transparency of attendance data escalated from 52.0% to 91.0% ($Z = -8.95$, $p < 0.001$), confirming that automated messaging successfully addressed family expectations for reliable, real-time institutional information. Independent parental absence reporting also rose sharply from 21.0% to 84.0%, indicating that families transitioned from passive observers into active participants in administrative compliance.

Qualitative thematic analysis revealed that this quantitative transformation was anchored in a fundamental role shift among parents, who evolved from passive end-of-term recipients of administrative reports into proactive daily partners in behavioral monitoring. Under the conventional manual system, parents operated under considerable informational detachment, often learning of attendance infractions weeks after occurrences. The instant delivery of WhatsApp notifications provided continuous visibility, enabling parents to exercise timely oversight regardless of occupational mobility or geographical distance. During field interviews, a working parent (Informant P-01) described this operational convenience:

"The instant WhatsApp notifications allow us to monitor our child's daily school attendance even while we are occupied with full-time agricultural and trade work. Previously, we were completely unaware if our child failed to reach class in the morning, finding out only at the end of the term. Receiving an arrival confirmation directly on our phones before eight in the morning provides immense peace of mind and allows us to intervene immediately if an unexpected alert appears."

This perspective was corroborated by another guardian (Informant P-02), who emphasized that the system enriched emotional connectedness and reciprocal trust between families and resident educators:

"Since the school initiated automated WhatsApp notifications, I feel far more connected to my child's daily routine at the Islamic Boarding School. When an absence alert is triggered, I no longer have to wait days to clarify the issue; I can immediately message the homeroom teacher to confirm my child's health status. This open communication channel makes us feel like valued partners in our child's character development rather than outsiders."

The institutional leadership recognized this communication evolution as a vital component of modern faith-based governance and moral stewardship. Rather than viewing technological surveillance as an administrative imposition, leadership framed information transparency as an ethical obligation to parental trust. The Principal of Darul Musthofa NW (Informant L-01) articulated this philosophical alignment during executive interviews:

"For many years, faith-based boarding institutions operated on an implicit assumption of unconditional institutional trust, where parents handed over their children with minimal daily visibility into administrative tracking. However, modern educational governance demands transparency and shared accountability. Implementing this WhatsApp Gateway is our institutional response to that moral responsibility. By keeping parents informed in real time, we transform administrative tracking into a collaborative partnership that upholds institutional integrity."

In addition to enhancing communication symmetry, the platform significantly reduced administrative friction through its bidirectional reporting architecture. Parents utilized standardized WhatsApp message templates to submit official medical leave or emergency permission requests directly to the database, eliminating the need for physical paperwork or unverified telephone calls.

Notwithstanding these widespread operational achievements, the study uncovered several structural and socio-technical challenges that complicated universal adoption. Approximately 12% of parents initially experienced technological friction stemming from low-specification mobile devices, intermittent cellular coverage across rural pockets of West Lombok, and limited digital literacy among elderly guardians. The 6.0% message transmission failure rate documented in the telemetry logs underscored the persistent reality of the digital divide in rural educational settings. A parent from a remote rural sub-district (Informant P-04) recounted these initial hurdles:

"At the beginning, I had difficulty understanding the automated notifications because I rarely use a smartphone for anything other than basic phone calls, and our home area frequently experiences cellular network dropouts. In the first few weeks, I was confused about how to reply or confirm when my child was unwell."

To address these socio-technical vulnerabilities, the Islamic Boarding School administration instituted proactive remediation mechanisms. The IT department established a dedicated technical helpdesk that conducted digital literacy onboarding sessions for parents during weekend visiting days, assisting families with phone configuration, notification reading, and bidirectional reporting protocols. Furthermore, a complementary manual failover protocol was codified into institutional Standard Operating Procedures (SOPs), ensuring that homeroom teachers received automated daily anomaly digests to follow up with digitally disconnected families via direct telephone calls or home visits. This dual-track approach ensured that technological automation augmented, rather than marginalized, vulnerable parent demographics, reinforcing equitable governance and sustaining high satisfaction across the entire boarding school community.

3.4. Mixed-Methods Data Integration and the SITD Conceptual Model

The integration of quantitative telemetry logs, psychometric survey data, and qualitative informant narratives provided a holistic understanding of how automated mobile gateways reshape institutional dynamics in faith-based educational settings. In accordance with explanatory sequential mixed-methods principles, the quantitative metrics established the statistical trajectory and magnitude of behavioral changes, while the qualitative themes illuminated the social, psychological, and organizational processes underlying those metrics. To synthesize these multi-layered empirical findings, a joint-display integration matrix was developed, juxtaposing quantitative indicators against qualitative evidence, underlying theoretical dimensions, and strategic managerial implications. The integrated results of this mixed-methods synthesis are detailed in Table 6.

Table 6. Joint-Display Integration Matrix of Quantitative Telemetry, Qualitative Thematic Findings, and Strategic Managerial Implications

Quantitative Metric and Trajectory	Qualitative Thematic Evidence	Theoretical Grounding and Dimension	Strategic Managerial Implication
Attendance Telemetry • Attendance: 71% to 90% ($p < 0.001$) • Alpha: 18% to 4% ($p < 0.001$) • Tardiness: 22% to 8% ($p < 0.001$)	Students experience an immediate psychological deterrent effect due to zero information latency, eliminating opportunities to conceal unexcused absences from families.	Deterrent and Compliance Dynamics (Foucauldian Panopticism and Behavioral Nudge Theory)	Replaces subjective disciplinary enforcement with an automated, objective, and transparent attendance baseline.
System Reliability Telemetry • Delivery Success: 94.0% • Mean Latency: 42.6 sec • Transmission Failure: 6.0%	Automated message queuing eliminates administrative bottlenecks, though rural connectivity dead-zones and phone	Information System Quality (DeLone & McLean IS Success Model: System & Info Quality)	Establishes low-cost mobile architectures with complementary manual safety nets for digitally vulnerable families.

	number churn require manual failover procedures.		
Parent Engagement Surveys	Parents shift from passive end-of-term observers to daily proactive partners, experiencing heightened emotional peace of mind and institutional trust.	Parental Social Capital (Epstein's Framework of Parental Involvement: Type 2 Communicating)	Democratizes institutional transparency and fosters collaborative, bidirectional school-family co-parenting.
• Responsiveness: 34% to 88% ($p < 0.001$) • Transparency: 52% to 91% ($p < 0.001$) • Absence Reporting: 21% to 84%			
Institutional Governance	Leadership and homeroom teachers utilize real-time attendance data to facilitate rapid academic remediation and reinforce institutional moral stewardship.	Institutional Accountability (Data-Driven Good Islamic Boarding School Governance)	Transforms traditional unconditional trust into accountable, transparent, and data-informed educational stewardship.
• Administrative Overhead: Reduced • Disciplinary Inquiries: Resolved same-day			

The convergence of these mixed-methods findings demonstrates that technological automation does not operate in isolation. Instead, system performance, parental agency, student compliance, and institutional governance interact dynamically to establish a self-reinforcing ecosystem of accountability. To formalize these multidimensional relationships into a transferable theoretical framework, this study conceptualized and validated the Transparent Information System for Discipline (SITD) model. The structural configuration and operational logic of the SITD model are illustrated in Figure 2.

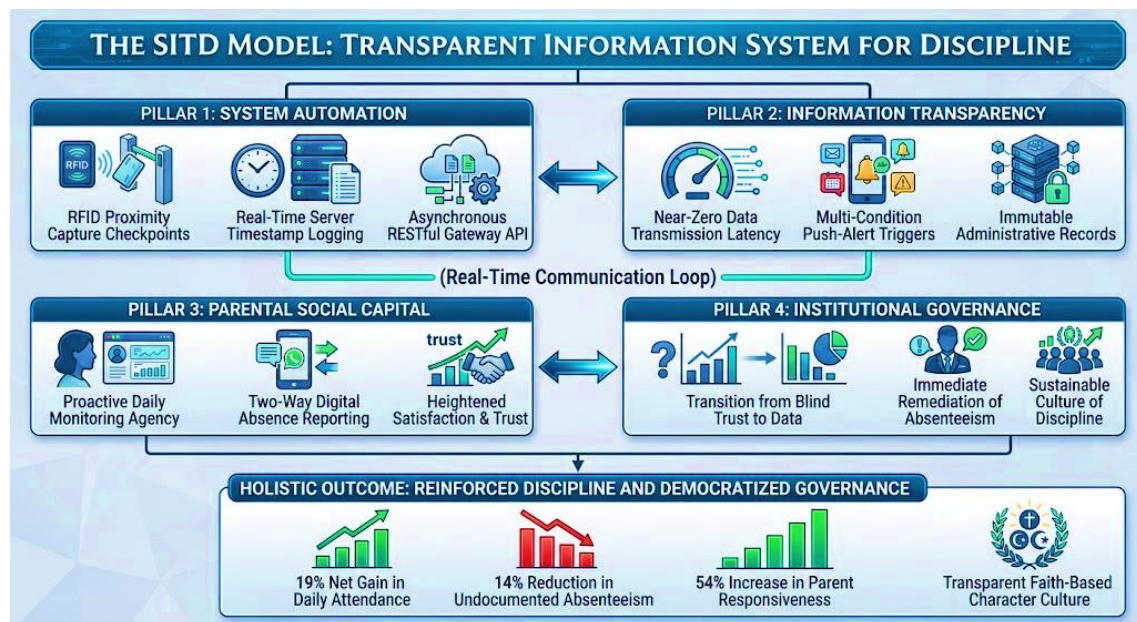


Figure 2. The Transparent Information System for Discipline (SITD) Conceptual Framework for Faith-Based Educational Governance.

The SITD framework is anchored in four interconnected pillars that collectively transform school administration from a passive, retrospective tracking mechanism into a dynamic, proactive governance ecosystem.

The first pillar, System Automation, encompasses the hardware-software infrastructure responsible for physical transaction capture and processing. By deploying high-frequency RFID scanners at school perimeter entry points and linking them to a local server engine via asynchronous RESTful APIs, this pillar eliminates manual roll-call burdens, mitigates human clerical errors, and guarantees system uptime across instructional cycles.

The second pillar, Information Transparency, addresses the temporal and cognitive dimensions of data dissemination. Operating with an average delivery latency of 42.6 seconds, the system dispatches

automated push-notifications under three specific operational triggers, including arrival confirmations, morning unexcused absence early-warnings, and verified medical leaves. This rapid transmission eradicates historical information asymmetry, ensuring that student attendance records become instantly accessible to all primary stakeholders.

The third pillar, Parental Social Capital, operationalizes Epstein's foundational model of school-family partnerships, specifically Type 2 communication mechanisms (Gaspar & Sahay, 2025; Mocho et al., 2025). By leveraging WhatsApp as an accessible mobile medium that requires no specialized hardware or advanced digital literacy, the system empowers parents to exercise meaningful oversight regardless of occupational mobility or geographical distance. The availability of bidirectional reporting tools allows families to co-manage attendance compliance actively, elevating parental responsiveness from 34.0% to 88.0% and fostering authentic home-school collaboration.

The fourth pillar, Institutional Governance Accountability, conceptualizes the administrative and ethical realignment of the boarding school organization. The integration of objective, immutable server logs transforms institutional culture from an outdated reliance on unconditional trust into an evidence-based model of moral stewardship. Homeroom teachers and school leaders are equipped with actionable, real-time telemetry that enables immediate intervention for at-risk students, permanently suppressing undocumented absenteeism from 18.0% to 4.0%.

In synthesis, the SITD model demonstrates that the sustainable cultivation of student discipline in faith-based boarding schools is not achieved through punitive surveillance alone. Rather, long-term behavioral compliance and institutional excellence emerge when automated technology acts as a transparent bridge, mobilizing parental social capital and aligning institutional governance toward shared educational accountability.

4. DISCUSSION

4.1. Ubiquitous Mobile Affordance and Information Systems Success in Resource-Constrained Settings

The operational viability of the WhatsApp Gateway attendance system in the Islamic Boarding School environment provides crucial theoretical insights into educational technology adoption within resource-constrained environments. Within the DeLone and McLean Information Systems Success Model (Alfaki, 2021; Rahmatullah et al., 2025; Salisu et al., 2025), these findings suggest that sustained user satisfaction and parental trust may be influenced by the quality of the system and the information it provides. Unlike complex enterprise Learning Management Systems (LMS) and proprietary school portals, integrating attendance tracking into a familiar messaging platform can leverage existing user familiarity, accessibility, and mobile communication affordances (Durgungoz & Durgungoz, 2022; Jordan, 2023; Mulyono et al., 2021). By substituting clerical roll calls with automated proximity logging and instant message dispatching, the platform delivers verifiable temporal currency without imposing cognitive or financial burdens on families, effectively democratizing institutional communication across diverse socio-economic strata.

Furthermore, sustaining digital automation within peri-urban educational settings necessitates a conceptual shift from techno-deterministic solutions toward socio-technical resilience. While automated pipelines streamline administrative workflows with high computational precision, digital systems in emerging economies remain exposed to structural infrastructure vulnerabilities, including mobile network outages and user churn (Karimi et al., 2026; Mihale-Wilson et al., 2026; Ribeiro et al., 2024). The sustained effectiveness of the Islamic Boarding School attendance architecture was supported by anchoring automated server telemetry within institutional safety nets, where automated notifications were reinforced by manual teacher follow-up procedures (Alfredo et al., 2024; Colonna, 2024). This hybrid configuration demonstrates that digital transformation in faith-based schooling succeeds not by displacing human agency, but by establishing an adaptable framework that guarantees communication equity and safeguards digitally vulnerable households from institutional alienation.

4.2. Deconstructing Disciplinary Mechanics: Behavioral Nudges versus Digital Panopticism

The pronounced transformation in student attendance trajectories highlights the potential behavioral influence of automated communication when examined through the framework of Behavioral Nudge Theory (Mac Iver et al., 2022; Motz et al., 2021; Zgonnikov et al., 2024). In traditional educational governance, students frequently operate within information frictions arising from delayed reporting, where attendance problems may remain less visible to families for extended intervals (Bergman & Chan, 2021; de Walque & Valente, 2023). By compressing transaction delivery into near real-time telemetry, the WhatsApp Gateway operates as an ambient cognitive nudge that can influence attendance-related behavior. The automated alert reduces the opportunity for prolonged absenteeism by providing timely visibility to families, establishing an accountability loop that can discourage absenteeism and promote proactive attendance behavior (Blondeel et al., 2024; Brade, 2023).

However, the behavioral mechanics of real-time attendance telemetry also invite critical scrutiny through the conceptual lens of the Foucauldian digital panopticon (Capodivacca & Giacomini, 2024; Dai et al., 2025). When algorithmic monitoring permeates daily routines, the persistent awareness of

institutional and parental visibility may induce conscious self-surveillance, encouraging students to internalize disciplinary compliance and regulate attendance-related behavior (Motz et al., 2021; Williamson, 2021). While critical sociologists caution that pervasive data tracking risks reducing educational spaces to punitive surveillance regimes (York, 2021), the socio-cultural context of the Islamic Boarding School reframes this regulatory infrastructure through the Islamic pedagogical traditions of *ta'dīb* (character refinement) and *riyāḍah* (spiritual and behavioral discipline) (Hastasari et al., 2022). Within this faith-based ecosystem, automated tracking does not function merely as an oppressive instrument of control, but operates as a developmental scaffold where externally mediated punctuality is progressively cultivated into authentic personal accountability, moral integrity, and communal responsibility.

4.3. Reconfiguring School-Family Synergy: Social Capital and Bidirectional Agency

The reconfiguration of home-school communication dynamics observed in this study extends the operational boundaries of Epstein's foundational Parental Involvement Framework, particularly within the domain of Type 2 Communicating (Gaspar & Sahay, 2025; Mocho et al., 2025). In traditional educational management, school-to-home interactions frequently default to episodic, deficit-oriented encounters characterized by unidirectional institutional decrees and retrospective term reports (Beeli et al., 2024). By deploying an asynchronous WhatsApp Gateway that integrates verified absence confirmation protocols, the institutional communication architecture shifts from a reactive administrative formality to an interactive, bidirectional partnership. This bidirectional capability activates latent parental social capital, transforming families into proactive co-managers of student conduct rather than passive recipients of administrative outcomes. Parents are afforded immediate institutional agency, enabling them to initiate legitimate absence reporting, verify health-related leaves, and maintain continuous contact with resident educators without navigating intimidating administrative hierarchies.

This communicative transformation reflects a significant sociological evolution within Islamic Boarding School governance, transitioning from the traditional doctrine of *tawfīd* toward an era of participatory accountability. Historically, faith-based boarding institutions operated on a culture of institutional trust, wherein families entrusted substantial aspects of student moral and academic upbringing to the custodial authority of religious leaders while living apart from their children (Buanaputra et al., 2022; Ginanto et al., 2021). The deployment of transparent mobile notifications does not erode this foundational spiritual trust; rather, it recalibrates institutional legitimacy by harmonizing pastoral care with contemporary expectations of information transparency. Furthermore, by embedding this bidirectional bridge within a ubiquitous messaging platform rather than specialized portals, the system facilitates accessible informational communication for parents across diverse socioeconomic and occupational background (Aviva & Simon, 2021; Mulyono et al., 2021). Consequently, the integration of low-friction mobile technology democratizes parental engagement, demonstrating that transparency and faith-based institutional stewardship can symbiotically reinforce collective responsibility for student development.

4.4. Theoretical Contributions and Transferability of the SITD Conceptual Model

The formulation of the Transparent Information System for Discipline (SITD) framework offers a distinct theoretical contribution to the scholarship on Educational Management Information Systems (EMIS) and educational leadership in developing contexts. Historically, EMIS literature has maintained an instrumental orientation, evaluating administrative software predominantly through technical metrics of data throughput, server capacity, and procedural compliance while treating the human and social dimensions as secondary externalities (El Mazbouh et al., 2025; Valbø & Sanner, 2024). The SITD model bridges this theoretical bifurcation by formalizing the dynamic interdependence among system automation, temporal information transparency, parental social capital, and institutional governance accountability. By demonstrating that algorithmic logging operates as a social and relational catalyst rather than a passive digital repository, this framework enriches the DeLone and McLean Information Systems Success Model (Çelik & Ayaz, 2022; Kofahi et al., 2025) and expands Epstein's school-family partnership theory (Ihmeideh et al., 2020; Raguindin et al., 2021). The model illustrates that sustainable student discipline and institutional integrity in faith-based schooling emerge not from top-down technological coercion, but through an integrated architecture that converts operational telemetry into collaborative domestic agency and transparent institutional stewardship (Addi-Raccach, 2024).

Beyond its immediate conceptual value, the SITD model possesses substantial empirical transferability and organizational scalability across diverse educational ecosystems in the Global South (Bawa & Bawa, 2025; Timmis & Valladares-Celis, 2026). Thousands of Islamic Boarding Schools, Madrasahs, and rural residential academies throughout Southeast Asia, South Asia, and Sub-Saharan Africa navigate comparable structural constraints, including modest institutional operating budgets, variable telecommunication stability, and heterogeneous parental digital literacy. Rather than prescribing cost-prohibitive proprietary enterprise software that often precipitates adoption failure, the SITD framework provides a pragmatic, low-friction blueprint that leverages ubiquitous mobile messaging architectures supported by socio-technical failover protocols (Ojha & Yadav, 2023). Consequently, the model offers

educational administrators and policymakers a transferable roadmap for modernizing administrative oversight, democratizing institutional transparency, and fostering sustainable community engagement without requiring exorbitant capital investment or exacerbating existing digital inequities.

5. CONCLUSION

This study evaluated the operational assimilation, behavioral consequences, and relational transformations catalyzed by an automated RFID and WhatsApp Gateway attendance system in an Islamic Boarding School context. By synthesizing quantitative server telemetry with qualitative stakeholder narratives, the empirical findings demonstrate that low-cost, ubiquitous mobile messaging architectures can effectively dismantle historical information asymmetries in resource-constrained educational environments. The operationalization of the Transparent Information System for Discipline (SITD) framework substantiates that technological interventions achieve optimal efficacy when system automation converges with temporal information transparency, activating parental social capital and fostering institutional accountability. Rather than functioning as an oppressive digital panopticon, real-time push notifications serve as ambient behavioral nudges that cultivate sustainable habits of punctuality, eliminate unexcused absenteeism, and elevate parental engagement from retrospective observation into proactive, collaborative stewardship.

From a managerial and policy perspective, this investigation offers actionable insights for educational administrators and policymakers seeking to modernize administrative governance across the Global South. Educational institutions operating under budgetary constraints should prioritize leveraging ubiquitous, consumer-grade communication platforms over cost-prohibitive proprietary enterprise portals, thereby minimizing digital learning curves and eliminating adoption friction for families across diverse socioeconomic strata. Furthermore, institutional leaders must recognize that technological automation requires structured socio-technical safety nets. Administrative workflows should incorporate formalized Standard Operating Procedures (SOPs), including automated anomaly digests and manual outreach mechanisms, to safeguard digitally vulnerable households from systemic exclusion caused by rural connectivity deficits or mobile number churn. Religious education authorities and educational ministries can utilize the SITD model as a scalable framework for policy initiatives aimed at modernizing madrasah and boarding school governance while democratizing institutional transparency.

Despite these theoretical and empirical contributions, several institutional limitations delineate the boundaries of this research and highlight directions for future inquiry. As an explanatory sequential single-site case study, the empirical context was bounded within a single Islamic Boarding School in West Nusa Tenggara, which limits statistical generalizability across differing cultural, theological, or geographic educational settings. Additionally, this investigation focused on immediate attendance compliance and parental responsiveness over a six-month evaluation window, leaving the long-term internalization of moral discipline and academic performance trajectories unexamined. Future research trajectories should pursue multi-site comparative studies across diverse public, private, and faith-based residential academies in Southeast Asia and other emerging economies. Longitudinal designs tracking student behavioral retention post-graduation, alongside granular cost-benefit analyses and algorithmic fairness assessments of mobile educational systems, would substantially advance the global discourse on educational management information systems.

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