



Smart School Leadership in Resource-Constrained Primary Education: An Empirical Case Study of Digital Transformation

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Abstract

The evolution of educational technology requires primary school leaders to navigate digital transformation, yet mainstream digital leadership frameworks often overlook the realities of under-resourced schools. This study investigates the operationalization of Smart School Leadership (SSL) within a resource-constrained primary school setting, examining how school administrators adapt leadership practices amid material and structural limitations. Employing a qualitative single-case study design, data were collected through semi-structured interviews, direct field observations, and institutional artifact analysis involving eight participants, including the school principal, instructional teachers, and administrative personnel at SD Negeri 1 Simbune, Indonesia. Data were analyzed using interactive qualitative condensation, thematic displays, and continuous verification. The findings reveal that SSL implementation operates through an adaptive, staged transition rather than a sudden digital overhaul. Leadership practices are strategically prioritized toward core administrative workflows, compliance database management, and basic data-driven decision-making to address foundational early-grade literacy and numeracy needs. Furthermore, internal social capital and informal distributed leadership structures, specifically peer-assisted mentoring led by tech-savvy junior educators, serve as critical compensatory mechanisms to bridge faculty digital literacy divides. However, persistent structural friction, including hardware scarcity, unstable internet connectivity, pedagogical inertia, and non-systemic external training programs, places a clear ceiling on advancing to fully integrated digital pedagogy. This study implies that policymakers must move beyond uniform technology mandates toward equity-focused infrastructure allocation and continuous, school-based professional development tailored to rural primary school contexts.

Keywords: Smart School Leadership, Digital Transformation, Educational Governance, Primary Education, Resource-Constrained Schools



Introduction

The evolution of digital technologies has fundamentally reconfigured institutional governance, pedagogical paradigms, and administrative operations across primary education systems worldwide (Alenezi, 2023; Okunlola, 2024a). Rather than functioning merely as auxiliary tools for classroom instruction, information and communication technology (ICT) integration has become a strategic necessity for enhancing school effectiveness, ensuring equity, and fostering 21st-century competencies among young learners (Ghamrawi & Tamim, 2023). Within this dynamic landscape, educational leadership serves as the primary mechanism determining whether digital initiatives achieve systemic integration or collapse into superficial adoption. School leaders are tasked with moving beyond conventional managerial duties to cultivate institutional cultures that embrace technological innovation, continuous professional learning, and data-informed decision-making (Rasdiana et al., 2024).

The concept of Smart School Leadership (SSL) has emerged as an integrative model designed to navigate these technological demands (Witthöft et al., 2025). Building upon established frameworks of transformational, instructional, and distributed leadership, SSL emphasizes the strategic alignment of digital infrastructure, human capital development, ethical governance, and collaborative decision-making within the educational ecosystem. Unlike traditional educational management, SSL requires principals to act as visionary catalysts who leverage digital ecosystems to streamline administrative workflows, personalize instructional practices, and foster professional learning networks (Reis-Andersson, 2024).

Prior research consistently demonstrates that effective digital leadership correlates with increased teacher self-efficacy, enhanced organizational agility, and improved academic outcomes (Ghamrawi & Tamim, 2023). In the context of primary education, where foundational cognitive and social-emotional competencies are established, the role of the principal is particularly influential. Primary school leaders must balance basic literacy and numeracy imperatives with digital modernization, ensuring that technological adoption remains pedagogically sound, inclusive, and developmentally appropriate (Hallinger, 2021).

The implementation of SSL relies on several core operational dimensions. Central to these is Data-Driven Decision-Making (DDDM), through which administrators utilize administrative and learning analytics to optimize resource allocation, diagnose learning gaps, and design targeted instructional interventions (Spiteri & Chang Rundgren, 2022). Furthermore, SSL prioritizes human capacity building through distributed network structures, empowering technological champions and digital coordinators to lead peer-assisted professional development. In well-resourced environments, these leadership practices foster sustainable educational innovation. However, when transferred to resource-constrained environments, the assumptions underpinning mainstream digital leadership models are frequently challenged by contextual realities (Nababan et al., 2021).

Despite the growing body of literature on educational technology and digital leadership, a significant analytical gap remains regarding how Smart School Leadership operates within under-resourced public primary schools (Aydin, 2023). Much of the extant scholarship on digital transformation reflects assumptions derived from affluent, highly developed urban educational systems. These normative models presuppose the presence of stable high-speed internet, 1:1 student-to-device ratios, specialized technical support personnel, and robust teacher digital literacy. Consequently, current theoretical frameworks often fail to explain how leadership behaviors are adapted, negotiated, and operationalized under conditions of severe material and structural scarcity.

In under-resourced primary education contexts, particularly across rural and semi-urban districts in developing nations, school principals encounter a complex web of structural challenges (Putri and Sary, 2025). These environments are frequently characterized by unstable network connectivity, hardware deficits, uneven teacher digital competence, and persistent cultural resistance to pedagogical change. While top-down policy mandates increasingly require public elementary schools to adopt centralized digital databases, online assessment platforms, and digital administrative workflows, the local institutional capacity to implement these directives remains constrained.

This disconnect creates a friction between policy expectations and institutional reality. Existing studies frequently document infrastructure shortages as isolated technical barriers (Okunlola, 2024b). However, few studies investigate the strategic adaptations school leaders employ to navigate these limitations. There is limited empirical evidence detailing how primary school principals strategically prioritize digital workflows, leverage informal social capital, and distribute leadership roles when formal technological support is absent.

Additionally, literature concerning the interaction between leadership orientation and teacher digital readiness in under-resourced primary settings remains fragmented (Aydin, 2023). Generic professional development programs often deliver theoretical instruction that fails to address the daily realities of resource-constrained classrooms. Without understanding the local mechanisms of peer mentorship, leadership facilitation, and context-specific capacity building, educational systems risk exacerbating educational inequities through top-down technology mandates. Therefore, empirical investigation is needed to capture the nuanced operational dynamics, structural enablers, and persistent barriers that define Smart School Leadership maturity in developing educational landscapes.

To address these empirical and theoretical limitations, this study provides an in-depth investigation of Smart School Leadership practices within a resource-constrained primary school setting. Situated at Sekolah Dasar Negeri (SDN) 1 Simbune, a public elementary school located in the Tirawuta District of East Kolaka Regency, Southeast Sulawesi, Indonesia, this research examines an institution navigating digital transition amid material limitations. SDN 1 Simbune serves as a critical case for understanding how school leaders adapt, implement, and sustain technology-based management practices within rural educational ecosystems.

The primary objective of this study is to examine the operationalization of Smart School Leadership in a resource-constrained primary school, identifying the systemic enablers and structural barriers that shape its implementation trajectory. Specifically, the study addresses two core research questions:

1. How do primary school leaders conceptualize, adapt, and operationalize Smart School Leadership practices across administrative, pedagogical, and data-driven governance dimensions within a resource-constrained educational environment?
2. What internal and external organizational factors act as systemic enablers or structural inhibitors in shaping the maturity and sustainability of Smart School Leadership implementation in this context?

To answer these questions, this study uses a qualitative case study research design. Data were gathered through semi-structured qualitative interviews, direct field observations, and artifact analysis involving the principal, instructional personnel, and administrative staff. This multi-source data collection allows for a rich contextual analysis of the socio-technical interactions and leadership behaviors within the school.

This study offers several distinct contributions to the international literature on educational management and technology integration. **Theoretical Contribution:** It expands current conceptualizations of Smart School Leadership by offering a model of resource-bounded digital adaptation. Rather than viewing digital transformation as a uniform process, this study demonstrates how leaders in under-resourced settings use adaptive prioritization and informal distributed networks to build organizational capacity. **Empirical Contribution:** It provides field-based qualitative evidence from a public elementary school in a developing nation, addressing the geographic and contextual imbalance in current educational technology research. **Practical and Policy Contribution:** The findings provide actionable insights for school administrators navigating technology adoption under material scarcity. Furthermore, it offers policymakers evidence on the necessity of aligning digital reform mandates with local school infrastructure and context-specific professional development.

Methods

Research Design

To investigate the operationalization of Smart School Leadership (SSL) in a resource-constrained primary education environment, this study adopted a qualitative, single-case study design. A

qualitative approach is particularly suitable for exploring complex organizational behaviors, contextual dynamics, and leadership practices in real-world educational settings where variables cannot be experimentally controlled. The single-case study design enables an in-depth, holistic examination of an institutional unit within its natural context, capturing the subjective experiences and strategic adaptations of key educational stakeholders. By focusing on a single elementary school navigating digital transition amid material scarcity, this research provides a nuanced understanding of the socio-technical dynamics and organizational mechanisms governing technology-mediated school leadership.

Data Sources

The study was conducted at Sekolah Dasar Negeri (SDN) 1 Simbune, located in the Tirawuta District of East Kolaka Regency, Southeast Sulawesi, Indonesia. This site was selected using purposeful intensity sampling, as the school presents a critical case of a public primary institution actively implementing digital leadership practices despite infrastructural and geographic limitations.

To ensure a comprehensive and representative understanding of SSL implementation, informants were selected through criterion sampling. Selection criteria included: Direct involvement in school-level strategic decision-making, administrative workflows, or technology-mediated instruction. Minimum of two years of professional experience at the study site. Representation across distinct institutional tiers (administrative leadership, senior teaching staff, early-career instructional staff, and administrative personnel). The final cohort comprised eight informants (N=8), consisting of the school principal (P1), five instructional teachers (T1 through T5), and two administrative staff members (A1 and A2). This selection allowed the research team to gather data across various operational perspectives within the school ecosystem.

Data Collection

Data generation relied on three complementary qualitative techniques: semi-structured interviews, direct field observations, and institutional artifact analysis. Combining these methods enabled data triangulation, which strengthened the empirical rigor and credibility of the findings.

Semi-Structured Interviews

Individual, semi-structured interviews served as the primary data collection method. An interview protocol was developed around four core theoretical dimensions of Smart School Leadership: digital vision and strategic planning, infrastructure and resource management, data-driven decision-making, and human capacity building. The semi-structured format provided a consistent framework across participants while allowing the interviewer to follow up on relevant, emerging insights. Interviews lasted between 45 and 75 minutes, were conducted in Bahasa Indonesia, and were audio-recorded with written informed consent. All audio recordings were subsequently transcribed verbatim for analysis.

Direct Field Observations

To complement self-reported interview data, the research team conducted non-participant field observations over a four-week period. Observational targets included monthly faculty administrative meetings, peer-led technology workshops, and classroom instructional activities involving digital media. Observations focused on leadership communication styles, digital tool utilization during meetings, peer interaction patterns, and operational workarounds developed during technological disruptions. Field notes were systematically logged using a standardized observational rubric.

Institutional Artifact Analysis

Documentary artifacts were collected and analyzed to verify administrative practices and corroborate interview statements. Collected documents included the school's annual strategic improvement plan, digital attendance records, official communication logs, teacher professional development schedules, student academic tracking spreadsheets, and national educational database (Dapodik) reporting files.

Instruments and Operationalization

The primary research instrument was the qualitative researcher, supported by semi-structured interview guides, observational protocol matrices, and document analysis checklists.

The interview guide was structured into four operational domains:

1. Strategic Leadership and Vision: Examining how the principal conceptualizes digital leadership, sets strategic priorities, and manages organizational change under resource constraints.
2. Data-Driven Governance: Investigating how administrative and learning analytics are collected, analyzed, and applied to guide resource allocation and student learning interventions.
3. Capacity Building and Social Capital: Assessing mechanisms for peer mentorship, professional development, and informal learning networks among teaching personnel.
4. Structural Enablers and Inhibitors: Identifying infrastructure deficits, cultural friction, and external policy factors that influence digital leadership execution.

Prior to field deployment, the instruments underwent content validation by two experts in educational leadership and qualitative methodology. A pilot interview was conducted with a primary school administrator from a non-participating school to refine question clarity and sequence.

Data Analysis

The qualitative data were analyzed using the interactive data analysis model developed by Miles, Huberman, and Saldana, which involves three concurrent streams of activity: data condensation, data display, and conclusion drawing/verification.

The analytical procedure followed a systematic coding process:

- Data Condensation: Verbatim interview transcripts, observational field notes, and document summaries were compiled into a centralized database. The text was analyzed line-by-line using open coding to identify initial empirical units. These initial codes were categorized using an inductive-deductive codebook aligned with the study's conceptual framework.
- Data Display: Condensed data were organized into thematic matrices and structured comparative tables. This visualization facilitated the identification of cross-cutting patterns, relationships between leadership behaviors and structural constraints, and variations across participant roles.
- Conclusion Drawing and Verification: Themes were interpreted to establish qualitative patterns explaining how SSL is adapted in resource-constrained environments. Conclusions were continuously checked against raw transcripts and field notes to ensure interpretive accuracy.

Trustworthiness

To evaluate the trustworthiness of the qualitative findings, this study applied Lincoln and Guba's evaluative criteria for qualitative research:

- Credibility: Achieved through data triangulation across multiple data sources (interviews, field observations, and document analysis) and participant roles. Member-checking was conducted by returning transcribed interviews and preliminary thematic summaries to all informants to verify that the interpretations accurately represented their experiences.
- Transferability: Supported by providing detailed descriptions of the research setting, participant selection criteria, local educational context, and institutional constraints. This enables researchers to evaluate the applicability of the findings to similar under-resourced primary education contexts.
- Dependability and Confirmability: Established through a documented audit trail detailing raw data, coding decisions, field notes, and analytical memos. Additionally, reflexive notes were maintained throughout the research process to monitor potential researcher bias and ensure that interpretations remained grounded in the empirical data.

Findings

The empirical findings of this study reveal that Smart School Leadership (SSL) at SD Negeri 1 Simbune is characterized by an adaptive, staged transition toward digital governance and technology-mediated instruction. The operationalization of SSL within this under-resourced primary school environment is structured around three core empirical domains: administrative digitization and data-informed decision-making, distributed social capital and informal capacity building, and structural friction alongside systemic bottlenecks.

Administrative Digitization and Data-Informed Decision-Making

The implementation of SSL at the study site is primarily anchored in the strategic digitization of administrative workflows and basic institutional management. School leadership prioritizes technology integration where immediate operational efficiencies can be realized (Table 1). Digital tools are routinely utilized to process student enrollment records, track daily attendance, manage financial accounting, and maintain compliance with the national educational database (Dapodik).

Informants noted that centralizing administrative operations into digital formats significantly reduced data redundancies and established a clear baseline for institutional accountability. As Principal (P1) stated:

"Our initial operational priority was to establish digital discipline in our administrative foundation. By digitizing student records and institutional reporting, we eliminated operational redundancies and created a baseline of accountability across administrative staff."

In parallel with administrative digitization, the leadership has introduced an emergent model of data-driven decision-making (DDDM). While advanced predictive learning analytics remain beyond the current infrastructure of the school, administrative and academic performance data are systematically leveraged to inform instructional planning. Diagnostic assessment results and quarterly academic tracking spreadsheets are analyzed during faculty meetings to pinpoint foundational gaps in early-grade literacy and numeracy.

Rather than relying on intuitive planning, this data-informed approach allows leadership to allocate targeted remedial instruction to specific grade levels. A senior teacher (T2) observed:

"In previous years, student learning difficulties were addressed based on general impressions. Now, the principal uses diagnostic test scores to show us exactly which reading competencies require additional instructional time."

Table 1: Emergent Dimensions of Smart School Leadership Implementation

Dimension	Operational Manifestation at School Level	Maturity Level
1. Administrative Digitization	Systematic digitization of <i>Dapodik</i> database, student enrollment, and core administrative record-keeping.	Proficient
2. Data-Driven Decision Making	Strategic use of academic tracking sheets and diagnostic test scores to target reading and numeracy remediation.	Emergent
3. Distributed Capacity Building	Peer-assisted technology mentoring and informal professional learning circles led by tech-savvy junior teachers.	Moderate
4. Adaptive Resource Management	Device pooling, hardware rotation schedules, and usage of personal hotspots to overcome network constraints.	Developing
5. Cultural Change Management	Fostering a participatory, change-oriented ethos to reduce generational resistance and technology anxiety.	Moderate

Distributed Social Capital and Informal Capacity Building

A central finding of this investigation is the school's reliance on distributed leadership structures to bridge digital literacy gaps among instructional staff. Recognizing that formal, externally organized professional development programs are often sporadic and detached from the realities of rural elementary schools, the principal leverages internal social capital to foster digital competence. Technologically proficient teachers, particularly junior faculty members, are formally empowered to serve as digital champions. The school principal facilitates peer-led workshops where these teachers provide practical guidance to senior colleagues on basic software operation, digital assessment design, and interactive learning media creation.

This informal, peer-assisted mentoring framework mitigates technological anxiety among senior staff members who might otherwise resist top-down technology mandates. A junior teacher (T4) explained: "Instead of formal lectures, we work one-on-one during free periods. I help senior teachers design digital quizzes and navigate educational software, while they mentor me in classroom management. This collaborative dynamic makes technology adoption far less intimidating for everyone involved."

The field observations corroborated these statements, showing regular peer interactions during non-instructional hours where teachers collectively troubleshoot hardware issues and refine digital lesson plans. By embedding capacity building within daily organizational routines, leadership maintains momentum in digital adoption despite the absence of external technical support specialists.

Structural Friction and Systemic Bottlenecks

Despite the strategic adaptations implemented by school leadership, the maturity of SSL practices remains constrained by significant structural friction (Table 2). The findings identify four major barriers that restrict the transition from administrative digitization to full, seamless digital pedagogy:

- **Infrastructural Scarcity:** Deficits in physical hardware and internet connectivity represent the most severe bottleneck. The school possesses a limited number of functional desktop computers and laptops, requiring hardware pooling and strict rotation schedules among classes. Furthermore, the absence of reliable school-wide internet coverage forces staff to rely on personal mobile hotspots to submit mandatory administrative reports or access online teaching resources.
- **Heterogeneous Digital Literacy:** A marked generational divide in digital fluency exists across the faculty. While early-career teachers display high self-efficacy with digital media, several senior educators struggle with basic computer operation, resulting in uneven technology integration across different grade levels.
- **Pedagogical Inertia and Resistance:** A subset of instructional staff exhibits entrenched reliance on traditional, teacher-centered methodologies. These teachers often express skepticism regarding the pedagogical value of digital tools, viewing technology integration as an added administrative burden rather than an instructional enhancement.
- **Non-Systemic Professional Development:** Official training programs provided by district authorities were frequently described as episodic, theoretical, and poorly aligned with the needs of resource-constrained primary schools.

As an administrative staff member (A1) remarked: "External training seminars often demonstrate advanced digital tools that require high-speed internet and interactive whiteboards. When we return to our school, where basic internet access is unreliable, much of what was taught cannot be applied without significant modification."

Table 2: Systemic Enablers and Structural Inhibitors of Smart School Leadership (SSL) Implementation

Dimension	Systemic Enablers	Structural Inhibitors
Institutional & Strategic Leadership	• Proactive leadership vision prioritizing digital governance. • Strong administrative commitment to digital transformation. • Adaptive decision-making tailored to local constraints.	• Over-reliance on individual leadership initiative without formal institutional frameworks. • Bureaucratic delay in policy execution at the school level.
Human Capital & Social Networks	• High motivation among early-career teachers acting as digital champions. • Collaborative peer-assisted mentoring networks. • Strong internal social capital compensating for formal training deficits.	• Heterogeneous digital literacy and generational skill divides. • Pedagogical inertia and psychological resistance to technological change. • Skepticism regarding the pedagogical value of digital tools.
Technical Infrastructure & Resources	• Resource pooling and organized hardware sharing protocols. • Strategic utilization of personal mobile hotspots for critical data submission.	• Acute deficit of functional hardware (computers, laptops, interactive media). • Unstable and limited internet connectivity in rural/semi-urban areas. • Absence of dedicated IT support specialists on-site.
External Policy & Professional Learning	• National educational mandates (e.g., <i>Dapodik</i> database system) driving compliance. • Top-down regulatory pressure legitimizing administrative digitization.	• Episodic, highly theoretical, and non-continuous external training programs. • Mismatch between centralized professional development and the realities of under-resourced schools.

Discussion

The global imperative for digital transformation in primary education has prompted widespread policy reforms aimed at embedding educational technology within administrative governance and pedagogical delivery (Alenezi, 2023; Okunlola, 2024a). Central to these initiatives is the concept of Smart School Leadership (SSL), a multidimensional framework that extends transformational, instructional, and distributed leadership paradigms by emphasizing technological fluency, data-driven decision-making, and strategic capacity building (Ghamrawi & Tamim, 2023; Rasdiana et al., 2024). However, much of the foundational scholarship on SSL rests on normative assumptions derived from affluent, highly resourced educational ecosystems. These frameworks presuppose high-speed connectivity, continuous technical support, and uniform teacher digital literacy (Witthöft et al., 2025).

To address this contextual imbalance, this study investigated two core research questions:

1. How primary school leaders conceptualize, adapt, and operationalize SSL practices within a resource-constrained primary school?
2. What systemic enablers and structural barriers govern the maturity and trajectory of SSL implementation in such environments?

The empirical granular analysis of leadership practices at Sekolah Dasar Negeri (SDN) 1 Simbune provides a nuanced counter-narrative to mainstream assumptions. The detailed examination of interview transcripts, field logs, and institutional artifacts reveals that SSL in resource-constrained primary schools functions not as a comprehensive, top-down overhaul, but rather as an adaptive, staged transition. Leadership practices are characterized by a selective prioritization of administrative digitization, basic data-informed governance, and distributed peer-assisted capacity building. These findings are discussed below across their theoretical, empirical, and practical dimensions.

A critical empirical finding of this investigation is the primary school leadership's strategic focus on digitizing core administrative operations, specifically student enrollment records, attendance logging, and compliance reporting for the national educational database (Dapodik). Granular field data demonstrate that administrators prioritized basic operational workflows where immediate efficiency gains could be achieved without requiring heavy infrastructure or advanced digital pedagogy.

This finding supports previous research by Reis-Andersson (2024) and Ridho et al. (2024), who observed that initial phases of educational technology integration in public schools are predominantly administrative rather than instructional. School leaders establish an operational baseline through administrative compliance before attempting complex pedagogical transformation. However, a deeper analysis of daily operational logs reveals an unexpected outcome regarding how technical constraints were navigated. Rather than being halted by severe infrastructure deficits, such as an absence of school-wide internet and hardware shortages, school staff routinely relied on personal mobile hotspots and structured device-pooling schedules to submit mandatory administrative reports.

This opportunistic reliance on personal resources to sustain institutional compliance contradicts the assumption in mainstream digital leadership models that structural deficits lead to administrative failure (Ghamrawi & Tamim, 2023). Instead, it shows that leadership commitment can motivate staff to find temporary workarounds for infrastructural gaps. While these informal workarounds demonstrate organizational resilience, caution must be exercised when interpreting them as long-term indicators of institutional maturity. Over-relying on staff goodwill and personal resources to offset systemic infrastructural deficits risks staff burnout and creates fragile administrative processes.

The detailed examination of faculty meeting minutes and student tracking sheets highlights an emergent model of Data-Driven Decision-Making (DDDM). The school principal utilized standardized diagnostic assessment scores in early-grade literacy and numeracy to guide faculty evaluations and allocate remedial instructional time. This result aligns with findings by Baxter et al. (2025) and Okunlola (2024a), who emphasized that effective digital leaders leverage learning data to shift organizational decision-making from intuition to evidence-informed strategies.

What makes this finding particularly notable is the granularity at which data were applied despite the absence of sophisticated learning analytics platforms or automated diagnostic

software. The school principal manually compiled basic spreadsheets to identify specific reading competencies that required targeted intervention. This supports the hypothesis proposed by Hallinger (2021), which suggests that the strategic utility of data in school improvement depends more on leadership analytical mindset and communicative clarity than on the technical complexity of the software used. Data-informed governance can take root in resource-constrained settings when leaders translate basic metrics into actionable instructional goals.

Granular analysis of peer interactions during non-instructional hours revealed a strong reliance on informal distributed leadership structures. To address the significant digital literacy gap across generational cohorts, the principal formally empowered early-career, tech-savvy teachers to act as internal digital mentors. These junior educators provided one-on-one technical assistance to senior colleagues, guiding them through basic software operation, digital quiz creation, and report generation.

This finding strongly supports distributed leadership theories advanced by Ruloff and Petko (2021) and Zhu and Engels (2022). These studies demonstrate that lateral knowledge-sharing networks reduce technological anxiety and foster collaborative innovation within schools. In under-resourced primary schools, internal social capital functions as a compensatory mechanism that counterbalances the absence of formal, district-funded technical support specialists. By establishing peer-assisted mentoring networks, leadership built localized capacity and mitigated psychological resistance among senior faculty members (Spiteri & Chang Rundgren, 2022).

Conversely, this reliance on internal social capital highlights a contradictory dynamic when compared with external professional development initiatives. Interview data revealed that official training programs provided by regional education authorities were frequently criticized by teachers as overly theoretical, episodic, and detached from the realities of rural schools. This disconnect aligns with critiques by Putri and Sary (2025) and Sari and Aydin (2023), who argued that top-down professional development often fails because it assumes uniform access to high-end digital infrastructure. Consequently, local peer mentorship proved far more effective in driving sustained technology adoption than centralized training seminars.

The findings of this study can be explained through the framework of resource-bounded adaptation. Educational leadership in developing, under-resourced contexts operates under constant friction between top-down policy mandates and local operational constraints (Nababan et al., 2021; Okunlola, 2024b). Centralized educational authorities mandate digital compliance and data submission through unified national platforms. However, they often fail to provide the corresponding technological infrastructure, high-speed internet, or context-specific training required to fulfill these expectations.

In response, primary school leaders adopt a pragmatic, staged approach to SSL. They prioritize high-visibility compliance requirements first, leverage internal social relationships to build basic digital skills, and deploy creative resource-sharing strategies to keep the school functioning. However, structural constraints impose a hard limit on digital leadership maturity. Without stable internet, adequate classroom hardware, and continuous technical support, even highly committed leaders struggle to advance from basic administrative digitization to true, technology-enhanced pedagogical innovation.

This study contributes to the international literature on educational management by offering a refined model of Smart School Leadership adapted for resource-constrained environments. It challenges normative, resource-intensive assumptions of digital transformation by demonstrating that SSL maturity in under-resourced contexts is driven by adaptive prioritization, informal distributed leadership, and localized social capital.

For primary school principals operating in similar under-resourced settings, these findings highlight the value of establishing peer-led digital mentoring networks. Rather than waiting for external technical support or expensive infrastructure upgrades, administrators can build internal capacity by identifying tech-savvy teachers and creating structured time for peer coaching. Furthermore, leaders should focus data-use on clear, high-priority foundational outcomes, such as early-grade literacy and numeracy, using simple analytical tools.

Policymakers must address the gap between centralized digital mandates and local infrastructure realities. Equity-focused resource allocation should prioritize basic hardware and stable internet access for rural primary schools. Additionally, centralized professional

development programs should shift away from standardized, one-time theoretical workshops toward continuous, school-based mentoring models that account for local operational constraints. While this study provides a detailed, granular examination of SSL operationalization within a single primary school, certain limitations should be acknowledged. As a qualitative single-case study, the empirical findings cannot be directly generalized to all primary education settings across different geographic regions or socio-economic contexts.

To build upon these insights, future research should consider the following directions. Conducting comparative multi-case studies across diverse rural, semi-urban, and urban public primary schools to map how different structural conditions influence SSL implementation strategies. Utilizing quantitative survey instruments to measure the statistical relationship between SSL dimensions, teacher digital self-efficacy, and student achievement metrics across a broader sample of primary schools. Carrying out multi-year longitudinal studies to track the long-term sustainability and developmental trajectory of peer-assisted digital mentoring networks as school infrastructure evolves over time.

Conclusion

This study investigated the operationalization of Smart School Leadership (SSL) within a resource-constrained primary school setting, examining how school administrators navigate digital transformation amid material and structural limitations. The empirical findings reveal that SSL in under-resourced elementary education operates through an adaptive, staged transition rather than an immediate, comprehensive digital overhaul. Leadership practices are strategically prioritized toward core administrative workflows, compliance reporting, and basic data-driven decision-making to address foundational instructional needs in early-grade literacy and numeracy. Furthermore, the study highlights how internal social capital and distributed leadership structures, particularly peer-assisted mentoring networks led by tech-savvy junior educators, serve as essential compensatory mechanisms that bridge generational digital literacy divides and ease technology-related anxiety among faculty.

However, the maturity and sustainability of SSL practices remain constrained by persistent structural friction. Deficits in physical hardware, unstable internet connectivity, pedagogical inertia, and non-systemic external training programs place a clear ceiling on advancing from administrative digitization to fully integrated digital pedagogy. These findings offer important implications for educational management and policy. For school leaders, the results underscore the value of cultivating informal distributed leadership and leveraging local peer coaching to build sustainable digital capacity. For policymakers, the study demonstrates the necessity of moving beyond uniform technology mandates toward equity-focused infrastructure distribution and continuous, context-specific professional development tailored to the operational realities of rural primary schools.

Ultimately, successful digital transformation in primary education depends not merely on the acquisition of technological artifacts, but on the presence of adaptive, human-centered leadership capable of navigating material scarcity. By fostering collaborative learning environments and aligning digital initiatives with local institutional capacity, school leaders can effectively leverage technology to enhance educational governance and promote equitable learning opportunities for young learners.

Ethics approval

The study was conducted in compliance with the Declaration of Helsinki. Informed consent was obtained from all individual participants involved in the study prior to data collection.

Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

Declaration of artificial intelligence use

This study used artificial intelligence (AI) tools and methodologies in the following capacities: Manuscript writing support: AI-based language models were employed to language refinement (improving grammar, sentence structure, and readability of the manuscript).

We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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