

Optimizing Infrastructure and Digital Technology to Improve Academic Services: The Role of School Principal Leadership

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ABSTRACT

Objective: This study aims to analyze how educational facilities, digital technology, and principal leadership are integrated to enhance academic services in public elementary schools. **Method:** A qualitative multisite case study design was employed in two public elementary schools in East Java, Indonesia. Data were collected through interviews, observations, and documentation involving principals, teachers, administrative staff, and school committee members. Data were analyzed through within-site analysis using open, axial, and selective coding, followed by cross-site analysis using the constant comparative method. **Results:** The findings reveal that the effectiveness of academic services is determined not merely by the availability of facilities but by schools' ability to optimize and integrate educational resources with digital technology through strategic leadership. Schools with different levels of facility availability were able to provide effective academic services through resource optimization strategies, digital transformation, and adaptive instructional leadership. **Novelty:** Theoretically, this study extends the application of the Resource-Based View in educational management by integrating digital leadership and facilities management. Practically, the findings provide a basis for developing more effective and sustainable educational facility management policies to improve academic service quality.

INTRODUCTION

This study investigates the optimization of educational facilities and infrastructure to improve academic services through the strategic role of digital technology and school leadership in public elementary schools. Academic service quality has become one of the key indicators of educational effectiveness in the digital era, as schools are increasingly expected to provide learning environments that are effective, inclusive, and responsive to students' needs [1], [2]. Previous studies have demonstrated that educational facilities, digital technologies, and school leadership significantly contribute to improving educational quality and learning outcomes [2], [3], [4], [5]. Furthermore, the rapid development of digital technologies has transformed the way schools deliver academic services, making the integration of physical infrastructure, digital resources, and leadership increasingly important [6], [7].

Despite extensive research on educational infrastructure, digital learning, and school leadership [2], [3], [4], [5], a significant knowledge gap remains regarding how these three dimensions are integrated as a unified strategy to improve academic services, particularly in public elementary schools. Existing studies tend to examine educational facilities, digital technology, or school leadership separately, while research investigating their combined influence remains limited [1], [8], [9]. Moreover, most previous studies

have employed single-site designs, limiting the understanding of how different school contexts shape resource utilization, digital transformation, and leadership practices [9]. This gap is particularly relevant in the context of Indonesian elementary schools, where disparities in infrastructure quality and digital readiness remain evident.

Bibliometric evidence further highlights the growing importance of digital school leadership. Science mapping studies indicate a substantial increase in digital leadership publications after 2019, with publication output peaking in recent years [7], [10], [11]. However, the literature still focuses primarily on digital leadership, teachers' digital competencies, and technology integration, while studies that simultaneously examine educational facilities, digital technology, and academic services within a school leadership framework remain scarce. Consequently, there is a need for a more comprehensive investigation into how educational facilities and digital technologies can be optimized through strategic school leadership to enhance academic services.

This study aims to fill this gap by examining how educational facilities, digital technology, and principal leadership are integrated to improve academic services in public elementary schools through a multisite case study approach. Specifically, the study addresses the following research questions: (1) How are educational facilities and infrastructure utilized to support academic services in public elementary schools? (2) How is digital technology integrated into learning processes and school services? and (3) How do principals optimize the use of educational facilities and digital resources to improve academic services? By integrating the Resource-Based View (RBV), Digital Leadership Theory, and Instructional Leadership Theory, this study contributes to the development of educational management literature by proposing an integrative model that links educational facilities, digital transformation, and school leadership. In addition, the findings provide practical implications for school leaders, educational administrators, and policymakers in designing more effective and sustainable strategies for improving academic service quality.

Literature Review

A review of the literature published during the last decade (2015–2025) reveals diverse perspectives regarding the factors influencing academic service quality in schools. The Resource-Based View (RBV) emphasizes that organizational performance depends not merely on the availability of resources but on the ability to manage valuable, rare, inimitable, and organized resources effectively [12]. From this perspective, educational facilities, digital technologies, and leadership capabilities can be regarded as strategic resources that contribute to school effectiveness when utilized optimally. In contrast, Digital Leadership Theory argues that educational improvement increasingly depends on school leaders' ability to integrate technology into organizational vision, culture, and decision-making processes [13]. Meanwhile, Instructional Leadership Theory highlights the central role of principals in directing teaching and learning processes through curriculum development, academic supervision, and capacity building for teachers [2], [5].

Although these theoretical perspectives provide valuable insights, recent empirical studies demonstrate fragmented approaches to understanding academic service improvement. Research on educational facilities has primarily focused on the relationship between physical learning environments and student outcomes [3], [14], while studies on digital transformation have emphasized technology integration, digital competencies, and student engagement [1], [4], [15]. Other studies have concentrated on the influence of school leadership on organizational effectiveness and educational innovation [2], [5], [16]. Consequently, educational facilities, digital technologies, and school leadership are often examined as separate constructs despite their potential interdependence in shaping academic services.

A critical analysis of the literature identifies three major research gaps. First, previous studies predominantly focus on individual dimensions of educational improvement, such as infrastructure, digital technology, or leadership, without examining their integration as a comprehensive strategy for enhancing academic services [1], [8], [9]. Second, most studies employ single-site designs, limiting the understanding of how different organizational contexts influence resource utilization, digital transformation, and leadership practices, thereby reducing the transferability of findings across educational settings [9], [17]. Third, despite the rapid growth of digital school leadership research, bibliometric evidence indicates that limited attention has been given to the simultaneous interaction among educational facilities, digital technology, and academic service quality within a unified school leadership framework [7], [10], [11]. These gaps remain theoretically significant because educational service quality is increasingly shaped by the interaction of physical resources, digital innovation, and leadership capacity.

To address these limitations, this study adopts an integrative perspective that combines Resource-Based View, Digital Leadership Theory, and Instructional Leadership Theory to explain how educational facilities, digital technology, and principal leadership interact in improving academic services. The novelty of this study lies in the development of an integrative conceptual model that links educational infrastructure, digital transformation, and school leadership within a multisite case study design. By comparing two public elementary schools with different resource conditions, organizational characteristics, and management strategies, this study provides a more comprehensive understanding of best practices in optimizing educational resources and academic services. Furthermore, the literature review process was conducted systematically through the identification, selection, evaluation, and synthesis of relevant studies published between 2015 and 2025, following the principles of transparency and rigor recommended in contemporary literature review practices.

RESEARCH METHOD

Research Design

This study employed a qualitative approach using a multisite case study design involving two public elementary schools in East Java, Indonesia. To maintain the focus

of analysis on the characteristics and management practices developed at each research location, the two schools are referred to as Site 1 and Site 2. A multisite case study was selected to provide an in-depth understanding of how educational facilities and infrastructure are optimized to improve academic services through the integration of digital technology and principal leadership, while also enabling cross-site comparisons to identify similarities, differences, and emerging patterns across contexts. The study focused on three aspects: (1) the utilization of educational facilities and infrastructure to support academic services, (2) the implementation of digital technology in learning and school services, and (3) principals' leadership strategies in optimizing educational resources.

The study was conducted in two public elementary schools located in East Java, Indonesia. Data collection was carried out during the 2025 academic year. The selected sites represented different resource conditions, organizational characteristics, and management strategies, allowing for comparative analysis of educational facility utilization, digital transformation practices, and leadership approaches in improving academic services.

Research Target/Subject

Research participants were selected based on their involvement in the management and utilization of educational facilities and academic service delivery. The participants consisted of 2 principals, 12 teachers, 4 administrative staff members, and 4 school committee members from both research sites. Principals were selected because of their strategic role in planning, managing, and making decisions related to educational facilities and academic services. Teachers were included due to their direct involvement in utilizing facilities and digital technologies in classroom instruction. Administrative staff and school committee members were selected to provide information regarding administrative support, facility management, and stakeholder participation in school development.

Participant selection was conducted through purposive sampling based on participants' experience, knowledge, and involvement in educational facility management, digital technology utilization, and academic services. To obtain richer and more comprehensive information, snowball sampling was subsequently employed by asking key informants to recommend additional participants who possessed relevant knowledge related to the research focus.

Research Procedure

The study followed several sequential stages. First, preliminary observations and document reviews were conducted to identify the characteristics of each research site. Second, data were collected through interviews, observations, and documentation. Third, data analysis was carried out individually within each site (within-site analysis) to identify themes and patterns related to educational facility utilization, digital technology integration, and leadership practices. Finally, cross-site analysis was conducted to compare findings across sites and develop broader interpretations and conceptual propositions regarding academic service improvement.

Instruments and Data Collection Techniques

The researcher served as the primary research instrument in collecting and interpreting qualitative data. Data were obtained from principals, teachers, administrative staff, school committee members, and supporting documents through three complementary techniques: in-depth interviews, observations, and document analysis.

In-depth interviews were conducted to explore participants' experiences, perceptions, and practices regarding educational facility management, digital technology integration, and school leadership. Observations were undertaken to examine the actual utilization of facilities, learning environments, and digital technologies in educational activities. Documentation studies involved the analysis of school reports, policy documents, facility inventories, digital learning records, and other relevant materials to strengthen and triangulate the findings.

Data analysis technique

Data analysis was conducted in two stages: within-site analysis and cross-site analysis. During the within-site analysis, interview transcripts, observation notes, and documentary evidence were analyzed using a hierarchical coding process consisting of open coding, axial coding, and selective coding. Open coding was used to identify significant concepts emerging from the data. Axial coding was then employed to organize related codes into broader categories and themes. Subsequently, selective coding was conducted to identify a core category that integrated all major themes and explained the relationships among educational facilities, digital technology, and principal leadership in improving academic services.

After the completion of within-site analysis, cross-site analysis was performed using the constant comparative method to systematically compare findings across the two sites. The analysis was further strengthened through pattern matching and explanation building techniques to identify similarities, differences, and relationships among educational facility utilization, digital technology integration, and leadership practices. The results were synthesized into cross-site propositions and an integrative conceptual model of academic service improvement.

Trustworthiness

The trustworthiness of the study was ensured by applying the criteria proposed by Lincoln and Guba (1985), namely credibility, transferability, dependability, and confirmability. Credibility was established through source triangulation, methodological triangulation, member checking, and prolonged engagement in the field. Transferability was enhanced by providing rich and detailed descriptions of the research context, enabling readers to assess the applicability of the findings to other settings. Dependability was maintained through systematic documentation and auditing of the research process, from data collection to interpretation and conclusion drawing. Confirmability was achieved by maintaining detailed records of field notes, interview transcripts, analytical decisions, and supporting documents, allowing the findings to be traced back to their empirical sources [18].

RESULTS AND DISCUSSION

Result

The multisite analysis revealed that the optimization of educational facilities and infrastructure was not determined solely by the availability of resources but also by schools' ability to manage, utilize, and integrate those resources into academic services. Cross-site findings generated three major themes: (1) the utilization of educational facilities and infrastructure to support academic services, (2) the implementation of digital technology in learning and school services, and (3) principals' leadership strategies in optimizing educational facilities.

Utilization of Educational Facilities and Infrastructure to Support Academic Services

The findings indicate that both schools utilized available educational facilities to support academic services. Site 1 possessed relatively more comprehensive facilities, including adequate classrooms, a functional library, Chromebooks, teacher laptops, LED televisions in every classroom, and stable internet access. In contrast, Site 2 had sufficient basic facilities but faced limitations in classroom capacity, instructional media, teaching aids, and library functions.

Interview data demonstrated that effective academic services were maintained despite differences in facility availability. The principal of Site 1 stated:

"We strive to ensure that all school facilities are used to support learning. The library, Chromebooks, LED TVs, and internet access are not only available but are routinely integrated into teaching and learning activities." (P-S1)

Similarly, a teacher from Site 1 explained:

"The availability of LED TVs and Chromebooks enables teachers to present learning materials more effectively and create engaging learning experiences for students." (T-S1)

In Site 2, the principal emphasized adaptive resource utilization:

"We maximize the facilities that we have. Although our resources are not as complete as those of other schools, classrooms, the library, and learning equipment are continuously utilized to support academic activities." (P-S2)

This perspective was reinforced by a teacher from Site 2:

"Although instructional media are still limited, we continuously optimize the available resources so that learning activities can run effectively and students can still receive meaningful learning experiences." (T-S2)

The interview findings indicate that both schools viewed educational facilities not merely as physical assets but as strategic resources that must be continuously aligned with instructional needs. Although Site 1 possessed relatively more complete facilities, the effectiveness of academic services was achieved through systematic utilization rather than simple resource availability. Conversely, Site 2 demonstrated that resource limitations did not necessarily hinder academic service delivery when schools adopted adaptive utilization strategies and prioritized the effective use of existing facilities. These findings suggest that the value of educational facilities lies not only in their quantity or condition but also in schools' capacity to manage, maintain, and integrate them into teaching, learning, and academic support activities.

Table 1. Comparison of Educational Facilities and Infrastructure Across Research Sites

Facilities	Site 1	Site 2
Classrooms	Adequate and fully supportive of learning activities	Adequate but limited for some activities
Library	Fully functional learning resource center	Multifunctional learning space
Chromebooks	Available	Available
Teacher Laptops	Available	Limited availability
LED Televisions	Available in every classroom	Not available
Projectors/LCDs	Available	Available
Internet Access	Stable and highly supportive	Available with limited utilization
Learning Media	Relatively complete	Limited
Teaching Aids	Relatively complete	Limited

Implementation of Digital Technology in Learning and School Services

The findings revealed that digital technology has become an integral component of academic service delivery in both schools. Site 1 utilized LED televisions, Chromebooks, teacher laptops, projectors, internet access, and various digital learning resources extensively, while Site 2 employed similar technologies with more limited intensity due to resource constraints.

The principal of Site 1 explained:

"We schedule Chromebook use to ensure equal access for all classes. These devices are used for digital assessments, information searching, and project-based learning." (P-S1)

A teacher from Site 1 added:

"Students become more actively engaged when digital media are integrated into learning because they can directly access learning materials and interact with diverse educational resources." (T-S1)

Meanwhile, a teacher from Site 2 noted:

"Although the number of devices is limited, we organize shared use and collaborate with colleagues so that technology-based learning can still be implemented effectively." (T-S2)

The principal of Site 2 further stated:

"We continue encouraging technology integration even though our facilities are not yet fully adequate. What matters most is how available technology can be utilized optimally." (P-S2)

The findings demonstrate that successful digital integration depends not only on the quantity of technological resources but also on schools' strategies for utilizing them effectively.

Table 2. Digital Technology Implementation Across Research Sites

Aspect	Site 1	Site 2
Digital Learning	High	Moderate
Chromebook Utilization	Intensive	Periodic
Projector Use	Routine	Routine
Digital Learning Resources	Intensive	Intensive
Internet Access	Optimal	Moderately Optimal
Digital Assessment	Implemented	Implemented
Digital Academic Administration	Implemented	Implemented
Technology Integration in Learning	High	Moderate

Principals' Leadership Strategies in Optimizing Educational Facilities

The findings indicate that principals played a central role in optimizing educational facilities and infrastructure. Their responsibilities included planning facility needs, organizing resource utilization, supervising implementation, maintaining facilities, and encouraging technology-based educational innovation.

The principal of Site 1 explained:

"Every facility procurement plan is directed toward supporting more effective learning and strengthening the use of digital technology in the school." (P-S1)

A teacher from Site 1 commented:

"The principal consistently encourages teachers to innovate and maximize the use of available facilities to make learning more engaging." (T-S1)

The principal of Site 2 emphasized resource management:

"We must be creative in managing the available facilities so that all students continue to receive optimal learning services." (P-S2)

This statement was supported by a teacher from Site 2:

"Although facilities are still limited, the principal continuously seeks solutions so that available resources can be used effectively to support learning." (T-S2)

These findings indicate that principals serve as key actors in linking educational facilities and digital technology with academic service improvement. While Site 1 emphasized innovation and digital transformation, Site 2 focused on resource optimization and teacher empowerment. Despite these differences, both schools demonstrated adaptive leadership aimed at improving academic service quality.

Table 3. Principals' Leadership Strategies in Optimizing Educational Facilities

Leadership Aspect	Site 1	Site 2
Facility Planning	Highly Active	Active
Digital Development	High	Moderate
Supervision	Routine	Routine
Facility Maintenance	Programmed	Programmed
Innovation in Resource Utilization	High	High

The cross-site analysis indicates that principal leadership functions as a key enabling factor that allows schools to maximize available resources despite differences in facility availability and organizational conditions.

Cross-Site Analysis

To obtain a more comprehensive understanding of the similarities, differences, and recurring patterns across the two research sites, a cross-site analysis was conducted. The analysis synthesized findings from Site 1 and Site 2 concerning educational facility utilization, digital technology integration, and principal leadership practices. The results of the cross-site analysis are presented in Table 4.

Table 4. Cross-Site Analysis Matrix

Theme	Site 1	Site 2	Cross-Site Synthesis
Utilization of Educational Facilities and Infrastructure	Educational facilities were relatively complete and systematically integrated into learning activities through the use of Chromebooks, LED televisions, internet access, and library resources.	Educational facilities were more limited, but available resources were continuously optimized to support learning and academic services.	Academic service effectiveness was influenced more by schools' ability to optimize available facilities than by the quantity of facilities owned.
Digital Technology Integration	Digital technology was extensively utilized for learning, assessment, information access, and school administration.	Digital technology was implemented through shared device usage, teacher collaboration, and adaptive resource management despite limited infrastructure.	Successful digital transformation depended on strategic utilization of technology and organizational support rather than technological availability alone.
Principal Leadership Strategies	Leadership focused on innovation, digital transformation, facility development, and continuous improvement of learning quality.	Leadership emphasized resource optimization, teacher empowerment, collaboration, and	Principal leadership functioned as a strategic driver that connected educational resources and digital technology

Theme	Site 1	Site 2	Cross-Site Synthesis
		adaptive problem-solving.	to academic service improvement.

As shown in Table 4, both schools demonstrated different approaches to resource utilization based on their contextual conditions. Site 1 relied on relatively abundant facilities and digital infrastructure, whereas Site 2 emphasized adaptive strategies to overcome resource limitations. Nevertheless, both schools achieved effective academic services through strategic leadership and resource optimization. The cross-site analysis indicates that the interaction among educational facilities, digital technology, and principal leadership is more influential in improving academic services than the availability of facilities alone

Selective Coding Results

Following the within-site and cross-site analyses, the selective coding process was conducted to identify the core category that integrated all major themes emerging from the study. The results of the selective coding analysis are presented in Table 5.

Table 5. Selective Coding Results

Main Theme	Category
Utilization of Educational Facilities and Infrastructure	Resource Optimization
Digital Technology Integration	School Digital Transformation
Principal Leadership Strategies	Strategic Leadership
Core Category	Resource-Based Academic Service Optimization Through Strategic Leadership

The selective coding analysis revealed that the three major themes identified across both research sites were interconnected within a single core category, namely resource-based academic service optimization through strategic leadership. This finding indicates that improvements in academic services cannot be explained by educational facilities, digital technology, or leadership independently. Instead, academic service effectiveness emerges from the interaction among resource optimization, digital transformation, and strategic leadership practices. The core category also serves as the foundation for developing the conceptual model proposed in this study and provides an integrative explanation of how schools improve academic services despite differences in resource availability and organizational conditions.

Cross-Site Proposition

Based on the cross-site analysis and selective coding process, this study proposes that academic service quality is influenced more by schools' capacity to optimize and integrate educational resources through strategic leadership than by facility availability alone. The findings indicate that educational facilities, digital technology, and principal

leadership do not operate independently; rather, they function as interconnected elements within a unified system that supports academic service improvement.

The proposition further suggests that effective academic services emerge when school leaders are able to strategically align physical resources, digital technologies, and organizational capabilities with instructional goals. In schools with relatively abundant resources, leadership facilitates innovation and digital transformation, whereas in schools with more limited resources, leadership promotes adaptive strategies, collaboration, and resource optimization. Consequently, differences in facility availability do not necessarily lead to differences in academic service quality when schools possess the organizational capacity to maximize available resources through effective leadership.

This multisite proposition provides an integrative explanation of academic service improvement and serves as the theoretical foundation for the conceptual model developed in this study. Based on the cross-site proposition and selective coding results, an integrative conceptual model was developed to explain the relationship among educational facilities, digital technology, principal leadership, and academic service improvement, as presented in Figure 1.



Figure 1. Integrated Academic Service Optimization Model

Figure 1 illustrates the integrative conceptual model developed from the multisite analysis. The model demonstrates that academic service improvement is achieved

through the interaction of educational facilities and infrastructure, digital technology integration, and strategic principal leadership. Strategic leadership functions as the key mechanism that aligns and optimizes educational resources to support effective and sustainable academic services. The model further suggests that resource availability alone is insufficient to improve academic services unless it is supported by effective leadership and purposeful technology integration.

Discussion

Educational Facilities and Infrastructure as Strategic Resources for Academic Services

The findings demonstrate that the quality of academic services is influenced not merely by the availability of educational facilities but, more importantly, by the effectiveness of their utilization. This finding supports previous studies indicating that the quality of physical learning environments, educational infrastructure, and school facilities contributes significantly to student engagement, learning outcomes, and the overall effectiveness of educational services [3], [14]. However, the present study extends these findings by showing that schools with different levels of facility availability can achieve comparable levels of academic service effectiveness when resources are strategically managed and optimized.

From the perspective of the Resource-Based View (RBV), organizational advantage is derived not simply from possessing resources but from the ability to utilize valuable, rare, inimitable, and organized (VRIO) resources effectively [12], [19]. The findings indicate that educational facilities, digital technologies, and school management practices function as strategic resources that generate value when integrated into academic services. Site 1 optimized relatively abundant resources through systematic integration into learning activities, whereas Site 2 demonstrated adaptive resource utilization despite facility limitations. This finding reinforces the RBV proposition that organizational effectiveness depends more on resource management capabilities than on resource ownership alone.

The results also reveal why facility limitations did not necessarily hinder academic service quality. Both schools viewed educational facilities not merely as physical assets but as strategic resources continuously integrated into learning and school services. This adaptive utilization strategy enabled schools to maximize available resources according to instructional needs. Consequently, the study extends the application of RBV, which has traditionally been employed in business contexts, into elementary education by demonstrating that resource optimization can compensate for limitations in facility availability. Furthermore, the findings align with Krein (2025), who argues that technology influences not only instructional practices but also organizational decision-making and leadership processes [20].

Compared with Barrett et al. (2019), who emphasized the importance of school infrastructure quality for educational outcomes, this study suggests that academic service effectiveness is not always dependent on facility completeness. The ability to manage and optimize available resources appears equally important, thereby providing a broader understanding of educational facility management in resource-diverse school settings [3].

Digital Technology Integration and Academic Service Improvement

The findings indicate that digital technology has become an integral component of academic service delivery in both schools. This result is consistent with previous studies demonstrating that digital technology enhances student engagement, learning motivation, instructional interaction, and flexibility in accessing learning resources [4], [21]. Similarly, Faza and Lestari (2025) and Rodriguez-Segura (2022) argue that digital technologies expand access to learning resources while fostering self-regulated and self-directed learning [22], [23].

From the perspective of the Technology Acceptance Model (TAM), the use of Chromebooks, LED televisions, internet access, and digital learning resources suggests that teachers and students perceive technology as both useful and easy to use, thereby encouraging technology adoption in educational activities. More importantly, the findings support Digital Leadership Theory, which emphasizes that successful digital transformation depends not only on technology availability but also on leaders' ability to integrate technology into organizational vision, school culture, and instructional practices [8].

The present study demonstrates that digital technology was not implemented as an isolated initiative but as part of broader school strategies aimed at improving academic services. This finding highlights the role of digital leadership as a connecting mechanism between technological resources and their effective educational utilization. Consistent with Scherer et al. (2023), the results indicate that successful digital transformation depends less on the quantity of technological devices and more on schools' ability to integrate technology into teaching and learning processes.

A particularly important finding emerged from Site 2, where technology-supported learning continued despite limited digital resources. Through shared device usage, teacher collaboration, and adaptive resource management, the school successfully maintained technology-enhanced learning. This finding suggests that human and organizational factors exert greater influence on digital transformation than technological resources alone. In line with Digital Leadership Theory, principals acted as change agents who connected technological innovation with educational goals and organizational development. Consequently, this study extends existing digital leadership literature by demonstrating that sustainable digital transformation in elementary schools depends on organizational capacity, collaborative culture, and leadership commitment as much as technological readiness.

The findings also carry important policy implications. While many digitalization initiatives prioritize hardware provision, the results suggest that equal attention should be directed toward strengthening teachers' digital competencies, leadership capacity, and strategies for technology utilization. Therefore, educational digitalization policies should focus not only on technological infrastructure but also on the human and organizational dimensions that enable effective technology use.

Principal Leadership as a Catalyst for Resource Optimization

The findings confirm the central role of principals in optimizing educational resources and improving academic services. This result supports studies by Liu et al. (2021) and Bektaş et al. (2022), which identify school leadership as a critical factor influencing resource management effectiveness and educational quality [16], [24]. Similarly, Witthöft et al. (2025) found that principals with an open innovation mindset are more successful in promoting digital transformation through collaboration, knowledge sharing, and innovation-oriented school cultures [25].

From a strategic management perspective, principals in both schools demonstrated the implementation of planning, organizing, actuating, and controlling (POAC) functions in managing educational resources. These findings are highly consistent with Instructional Leadership Theory, which positions principals as instructional leaders responsible for directing all school resources toward improving teaching and learning quality [2], [5].

The study further demonstrates that principals contributed not only through administrative responsibilities but also as facilitators of innovation, drivers of digital transformation, and managers of strategic resources. At Site 1, leadership was oriented toward expanding digital innovation and technological infrastructure. In contrast, Site 2 emphasized resource optimization, flexible space utilization, and teacher empowerment. Despite these contextual differences, both principals exhibited adaptive leadership approaches focused on improving academic service quality.

The findings suggest that effective academic services are strongly influenced by principals' ability to coordinate, integrate, and develop available resources according to school needs. This result supports Leithwood et al. (2020), who argue that leadership is the most influential organizational factor affecting school effectiveness after teacher quality. More importantly, this study extends Instructional Leadership Theory by demonstrating that instructional leadership influences not only teaching practices but also the effectiveness of educational facility utilization and digital technology integration [5].

The findings also explain why schools with different resource conditions were able to achieve comparable academic service outcomes. Principals actively determined facility development priorities, promoted digital technology utilization, and fostered collaboration among teachers and stakeholders. As a result, schools could maintain effective academic services despite variations in resource availability. These findings indicate that adaptive and context-sensitive leadership serves as a critical mechanism linking educational facilities, digital transformation, and academic service improvement.

Cross-Site Synthesis and Theoretical Contribution

The cross-site analysis revealed a consistent pattern across both schools: academic service quality is shaped by the interaction among educational facilities, digital technology integration, and strategic school leadership rather than by any single factor. Although the two schools differed in resource availability and management strategies, both achieved effective academic services through adaptive resource utilization and

leadership practices. The cross-site matrix and selective coding analysis further identified a core category—resource-based academic service optimization through strategic leadership—which integrates all major themes of the study.

This finding leads to a multisite proposition that academic service quality is influenced more by schools' capacity to optimize and integrate educational resources through effective leadership than by facility availability alone. Consequently, the study contributes theoretically by proposing an integrative model linking educational infrastructure, digital transformation, and school leadership within a unified framework for academic service improvement.

The novelty of this study lies in the development of an integrative conceptual model that simultaneously connects educational facilities, digital technology, and principal leadership in explaining academic service improvement in elementary schools. Unlike previous studies that have examined these factors separately, the present study demonstrates that academic service effectiveness emerges from the synergistic interaction among physical resources, digital transformation, and strategic leadership. This contribution extends Resource-Based View, Digital Leadership Theory, and Instructional Leadership Theory by positioning them within a single explanatory framework for understanding educational service quality.

The findings are consistent with Mizova et al. (2026), who emphasize the importance of contextual and adaptive leadership in supporting digital transformation, and with DeMatthews et al. (2026), who argue that educational leadership in the digital era requires strategic competencies for managing technology in effective, ethical, and sustainable ways. Therefore, the study not only enriches educational management theory but also provides a conceptual foundation for future research examining the interaction among educational resources, digital transformation, and school leadership in improving academic service quality [26], [27].

Practical Contribution and Policy Implications

The findings also have important practical implications for educational leaders and policymakers. The results suggest that educational digitalization policies should focus not only on the provision of infrastructure and technological devices but also on strengthening schools' digital capacity, leadership competencies, and data-driven decision-making processes. The effectiveness of academic services was found to depend largely on schools' ability to strategically integrate available resources, technology, and leadership practices rather than on resource availability alone. Therefore, professional development programs for principals and teachers should emphasize digital leadership, technology integration, and strategic resource management. Furthermore, emerging technologies such as artificial intelligence (AI) have the potential to support educational administration, resource allocation, academic monitoring, and evidence-based decision-making when implemented within effective school leadership frameworks. These findings support the argument that sustainable educational transformation requires simultaneous investment in technological infrastructure, human capacity development, and leadership innovation [28], [29].

CONCLUSION

Fundamental Finding: This study demonstrates that the effectiveness of academic services is influenced not merely by the availability of educational facilities and infrastructure but by schools' ability to optimize and integrate physical resources, digital technology, and principal leadership into a coherent educational strategy. The multisite analysis revealed that schools with different levels of resource availability were able to maintain effective academic services through adaptive resource utilization, digital technology integration, and strategic leadership practices. **Implication:** The findings contribute theoretically by extending the application of the Resource-Based View (RBV) in educational management and by strengthening Digital Leadership Theory and Instructional Leadership Theory through an integrative model linking educational facilities, digital transformation, and school leadership in improving academic service quality. Practically, the study highlights the importance of balancing investments in educational infrastructure with the development of principals' digital leadership capacity and teachers' technological competencies to ensure sustainable improvement in academic services. **Limitation:** Despite these contributions, the study was limited to two public elementary schools and focused primarily on educational facilities, digital technology, and principal leadership, which may restrict the transferability of the findings to other educational contexts. **Future Research:** Therefore, future research is encouraged to involve a larger number of schools, employ mixed-methods or longitudinal designs, and examine additional factors such as school culture, teacher competence, stakeholder participation, and educational policy in order to provide a more comprehensive understanding of academic service improvement in the era of digital transformation.

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