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Research Article

Edification-Based Leadership Development: Integrating Behavioral and Managerial Design Change Future-Ready Elementary Schools Principals in Urban and Rural Settings

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ABSTRACT

Purpose of the study: This study investigates how elementary school principals in urban and rural settings develop future-ready leadership through integrating behavioral and managerial design change dimensions within an edification-based framework to address digital transformation challenges in Indonesian elementary education.

Methodology: A mixed exploratory qualitative design with component analysis was employed, using structured observations and interviews with contrasting questions. Ten elementary school principals from Bandung City and West Bandung Regency were selected via purposive sampling. Data were analyzed using ATLAS.ti software through systematic thematic coding of non-numerical textual data.

Main Findings: Urban schools in Bandung City demonstrated higher digital adaptability, innovative supervision, and active professional development supported by adequate infrastructure and collaborative culture. Rural schools in West Bandung Regency exhibited conventional leadership patterns constrained by limited technology access. Two integrated leadership stages emerged: Behavior Design Change (digital leadership, open-mindedness, efficacy, foresight) and Managerial Design Change (network, digital organization, transition management, digital transformation, innovation strategy).

Novelty/Originality of this study: This study introduces an edification-based leadership development framework integrating behavioral and managerial design change dimensions specifically for elementary school principals. It advances existing knowledge by providing empirical evidence of urban–rural digital leadership disparities in Indonesia and offering a contextualized, culturally-responsive model for developing future-ready school leaders.

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1. INTRODUCTION

The future is filled with uncertainties experienced collectively across societies and institutions, including education [1]. Predictive thinking and future-oriented planning have become essential strategies for individuals and organizations seeking to navigate these uncertainties proactively [2]. In the educational context,

this translates into an imperative for school leaders to develop the capacity to anticipate change rather than merely react to it. Future-oriented leadership has therefore emerged as a critical competency for school leaders, characterized by a visionary mindset, digital competence, openness to change, and strong leadership efficacy [3] [4], [5]. These qualities enable leaders to anticipate and respond to rapid societal and technological shifts that are fundamentally reshaping educational systems worldwide [6]. The ability to manage the psychological demands of uncertainty, including institutional anxiety and collective apprehension toward change, further distinguishes effective future-ready leaders from those who remain reactive [7].

Despite this urgency, Indonesian elementary schools face persistent structural challenges in cultivating future-ready leaders. Educational orientation remains largely traditional, focused on academic achievement and workforce entry rather than building adaptive capacity for future complexity [8] [9]. Although information technology has been widely introduced into school environments, its integration into school leadership remains limited to operational and administrative functions rather than supporting the relational and transformational leadership dynamics that 21st-century education demands [10]. A further challenge lies in the misalignment between leadership efficacy and digital competence, which creates tangible gaps in decision-making capacity and organizational innovation among school principals [11]. School leaders also frequently experience tension between bureaucratic compliance and professional autonomy, constraining their capacity for adaptive and responsive decision-making [12]. At the same time, rapid technological change creates further confusion in aligning institutional culture with evolving behavioral expectations [13]. These compounding pressures collectively reveal the urgent need for a structured and contextually grounded leadership development approach [14].

A critical misalignment exists between digital access and leadership efficacy in Indonesian elementary schools. Leadership efficacy, encompassing the decision to engage in specific tasks, the effort committed to their completion, and the persistence shown in overcoming challenges, remains underdeveloped in practice [15]. Although digital tools and computer-based systems are increasingly available and have demonstrated value in enhancing instructional leadership capacity [16], [17], many principals have not systematically leveraged these resources to strengthen organizational learning or teacher professional development [18], [19]. The persistent separation between digital data management and leadership decision-making processes remains a structural gap in many schools [18]. Leaders who fail to position themselves within ongoing organizational change risk falling behind institutionally and professionally [20], while the absence of structured frameworks for navigating the behavioral and managerial dimensions of digital change leaves leadership development fragmented and insufficiently responsive to local context [21]. Digitization has become an organizational necessity, yet sustainable transformation depends on leaders who are equipped to guide a generation of digitally competent members through deliberate and empathetic processes of change [22].

Existing studies have predominantly examined behavioral dimensions of school leadership, such as open-mindedness, efficacy, and digital literacy [23], [24], or managerial dimensions, such as organizational change and information management [25], [26], in isolation. No study to date has proposed an integrated, edification-based framework that systematically combines both behavioral and managerial design change stages specifically for elementary school principals operating in contrasting urban and rural contexts within Indonesia. This gap is consequential: without an integrative model, leadership development efforts remain partial and fail to address the full spectrum of competencies required for navigating digital transformation across diverse educational settings.

Elementary schools remain crucial sites for shaping society and addressing the complexities of societal transformation [27], [28], yet they receive comparatively less scholarly attention in leadership development research than secondary or tertiary institutions. The gap between urban and rural school contexts further compounds this challenge: while digital technologies are increasingly pervasive, their adoption in schools depends heavily on local infrastructure, institutional readiness, and the quality of school leadership [29]. Effective leaders in this context must continuously draw upon the experiences of others and their own achievements to build leadership efficacy and meaningfully connect with a digitally-native generation of students and teachers [29], [30]. Without sustained processes and empathetic, forward-thinking leadership, digital transformation risks generating workforce anxiety and encouraging over-reliance on automated systems rather than cultivating genuine organizational capacity for learning and growth [31], [21].

This study, therefore, aims to investigate how elementary school principals in urban and rural settings develop future-ready leadership by integrating behavioral and managerial design change dimensions within an edification-based framework. By drawing on qualitative data from ten principals across Bandung City and West Bandung Regency, this research seeks to construct a contextually grounded model that advances understanding of how Indonesian elementary schools can respond more effectively to the demands of digital transformation and future-oriented educational leadership. Research Question, How do elementary school principals in urban and rural settings develop future-ready leadership through the integration of Behavior Design Change and Managerial Design Change within an edification-based framework, and what contextual factors shape this process in contrasting educational environments?

2. RESEARCH METHOD

This research uses a mixed exploratory qualitative method [32] with component analysis, which seeks to identify specific characteristics within each internal structure by contrasting elements across distinct contexts. Component analysis in this study refers to the systematic examination of behavioral and managerial dimensions of leadership development, comparing their manifestation across urban and rural elementary school settings. The research was conducted through selected observations and interviews with contrasting questions designed to elicit comparative insights between Bandung City (urban) and West Bandung Regency (rural) contexts. This method provides flexibility in data collection and analysis, enabling the researcher to adapt inquiry strategies based on emerging patterns [33].

Data collection proceeded in two sequential stages: first, structured observations of principals' work environments, leadership practices, and technology use patterns; second, in-depth interviews to explore principals' perspectives, decision-making processes, and reflections on leadership development. Both observation and interview data served as the primary instruments to determine the research focus, select informants, assess data quality, and interpret findings for a deeper understanding of the research context [34]. This research was conducted in elementary schools across regions with diverse social and economic characteristics. The selection of research locations was based on the strategic representation of contrasting school conditions: urban schools in Bandung City and rural schools in West Bandung Regency. This purposeful contrast was designed to capture comprehensive variation in the development of principal leadership for building future-ready educational organizations.

The study's population comprises elementary schools in Bandung City and West Bandung Regency, with schools serving as the analysis units and school principals serving as the observation units. A total of 10 principals were selected as respondents using purposive sampling [34]. The purposive sampling criteria included: (1) principals with a minimum of three years of leadership experience in their current school; (2) principals actively involved in decision-making and implementing educational policies; (3) principals overseeing schools with varying levels of technology infrastructure; and (4) equal representation from urban (n=5) and rural (n=5) settings to ensure contextual balance. This sampling approach enabled focused examination of principals who possess substantial experience navigating organizational change and digital transformation in their respective contexts.

This study investigates two integrated conceptual dimensions within the edification-based leadership framework: Behavior Design Change and Managerial Design Change. Behavior Design Change encompasses four components: (1) digital leadership-principals' capacity to integrate digital tools into leadership practices; (2) open-mindedness, willingness to embrace change, and consider diverse perspectives [34]; (3) efficacy-confidence in achieving desired leadership outcomes; and (4) foresight-ability to anticipate future challenges and opportunities. Managerial Design Change comprises five components: (1) internet network-infrastructure and connectivity readiness; (2) digital organization-institutional capacity for technology integration; (3) transition management-strategic approaches to guiding organizational change; (4) digital transformation-systemic integration of digital processes; and (5) innovation strategy-deliberate efforts to foster creativity and continuous improvement.

These dimensions were operationalized through interview protocols and observational frameworks that examined how principals articulate, demonstrate, and reflect upon each component in their daily leadership practice. Data collection instruments were designed to capture both explicit manifestations (observable behaviors, documented policies) and implicit dimensions (underlying beliefs, tacit decision-making processes) of each component. The interview protocols and observational frameworks used in this study were developed internally by the research team based on the theoretical framework of Behavior Design Change and Managerial Design Change. The conceptual dimensions and their operational indicators were derived from existing literature on digital leadership [23] [21], leadership efficacy [15] [35], organizational transformation [22], and future-oriented leadership [6] [3]. The interview protocol was structured around open-ended questions that allowed principals to articulate their experiences with technology integration, organizational change processes, and leadership development strategies in their own words.

Data were collected through two complementary methods: structured observations and semi-structured interviews. Structured observations documented principals' leadership behaviors, technology use patterns, and organizational routines within their school environments. Semi-structured interviews, guided by contrasting questions, elicited principals' reflections on decision-making, change management, and digital leadership development. Both methods were applied uniformly across all dimensions to enable triangulation of data sources. The alignment between each research dimension, its indicators, the data collection method employed, and the corresponding instrument is presented in Table 1.

Table 1. Data Collection Instrument Grid

Dimension	Component	Indicators / Focus	Data Collection Method	Instrument	Data Source
Behavior Design Change (BDC)	Digital Leadership	Integration of digital tools into leadership practices; use of data for decision-making; facilitation of digital communication and collaboration	Observation + Interview	Observation checklist; semi-structured interview protocol	10 Elementary School Principals *Urban (n=5)* Bandung City *Rural (n=5)* West Bandung Regency
	Open-Mindedness	Willingness to embrace change; openness to diverse perspectives; receptivity to innovation and experimentation	Observation + Interview	Observation checklist; semi-structured interview protocol (contrasting questions)	
	Efficacy	Confidence in achieving desired leadership outcomes; persistence in overcoming organizational challenges; task engagement in digital initiatives	Observation + Interview	Observation checklist; semi-structured interview protocol	
	Foresight	Capacity to anticipate future challenges and opportunities; strategic vision for digital transformation; long-term planning orientation	Observation + Interview	Observation checklist; semi-structured interview protocol (future-oriented questions)	
	Internet Network	Physical connectivity and bandwidth availability; principals' ownership of digital accounts (email, social media); participation in digital professional communities	Observation + Interview	Site observation checklist; semi-structured interview protocol	
Managerial Design Change (MDC)	Digital Organization	Institutional capacity for technology integration; routinization of digital practices; readiness of staff and school systems for digital operations	Observation + Interview	Observation checklist; semi-structured interview protocol	
	Transition Management	Strategic orchestration of organizational change; stakeholder communication and trust-building; securing buy-in for digital initiatives from teachers, parents, and the community	Observation + Interview	Observation checklist; semi-structured interview protocol (contrasting questions)	
	Digital	Progress in digitizing	Observation	Observation	

Dimension	Component	Indicators / Focus	Data Collection Method	Instrument	Data Source
	Transformation	documents and workflows; process automation and optimization; overall integration of digital systems in school management	+ Interview	checklist; semi-structured interview protocol	
	Innovation Strategy	Deliberate efforts to foster creativity and continuous improvement; existence of formal professional learning communities; mechanisms for sharing and scaling innovations	Observation + Interview	Observation checklist; semi-structured interview protocol	

To ensure content validity and contextual appropriateness, the instruments underwent iterative refinement during the initial phase of data collection. Following the first two interviews, the research team reviewed the clarity and comprehensiveness of questions, adjusting phrasing to better align with the terminology and contexts familiar to Indonesian elementary school principals. This iterative refinement process is consistent with established practices in qualitative inquiry, where instruments evolve in response to emerging insights from the field [34]. The final protocol demonstrated sufficient depth and flexibility to elicit rich, contextually grounded data across both urban and rural settings.

Data collection followed a systematic multi-stage process. Stage 1 involved preliminary site observations to understand the physical and organizational context of each school, including technology infrastructure, administrative processes, and leadership work routines. Stage 2 consisted of semi-structured interviews with each principal, utilizing contrasting questions to probe differences between current practices and desired future states, as well as between urban and rural leadership challenges. Interview durations ranged from 60 to 90 minutes, and all sessions were audio-recorded with participant consent and subsequently transcribed verbatim. Stage 3 included follow-up observations to triangulate interview data with observable leadership behaviors and organizational practices. The complete methodological process followed a systematic five-stage sequence, as illustrated in Figure 1. This flow encompasses research design, purposive sampling, sequential data collection through observations and interviews, and systematic coding using ATLAS.ti software, and trustworthiness validation strategies.

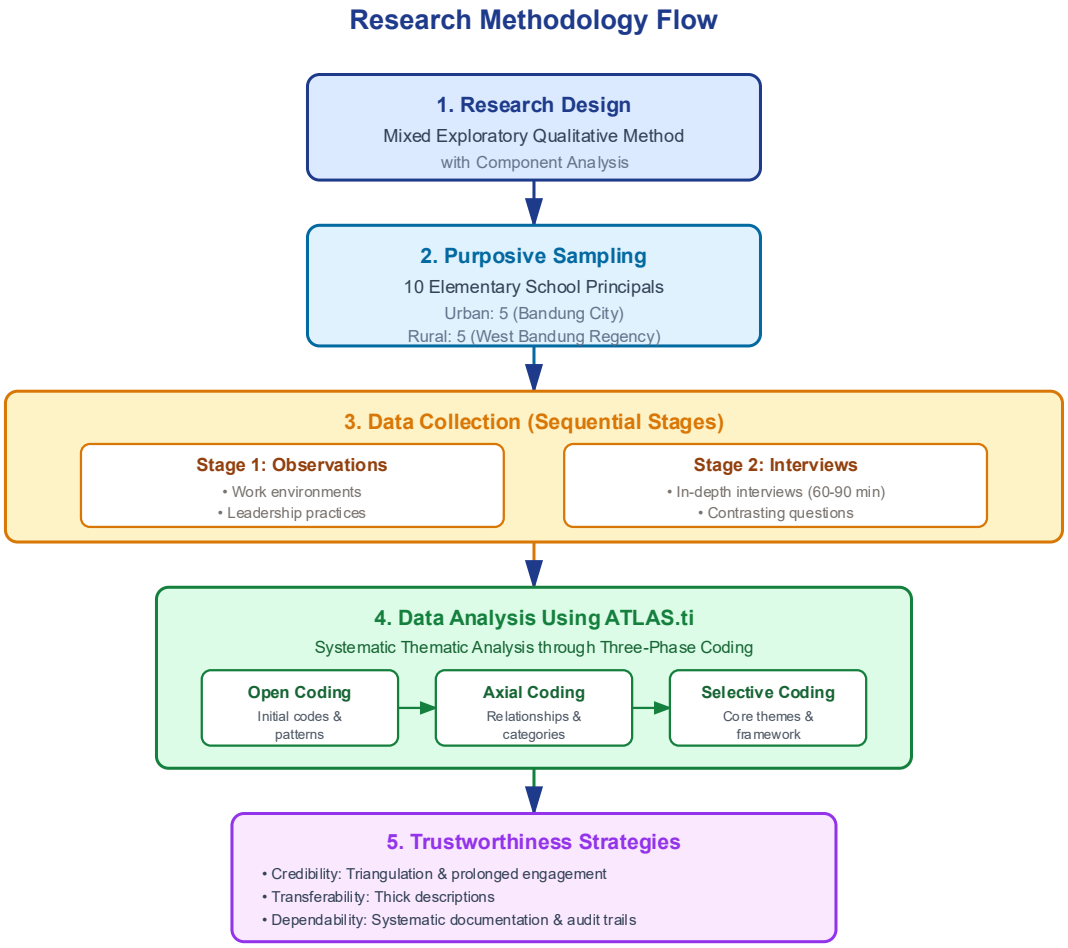

Figure 1. Research Methodology Flow: Sequential Stages from Research Design to Trustworthiness Validation

As shown in Figure 1, the five-stage methodological sequence was designed to ensure systematic and rigorous data collection and analysis. Each stage builds progressively on the previous one, from research design through to trustworthiness validation, reflecting the coherence and transparency of the qualitative inquiry process adopted in this study.

To enhance the accuracy and depth of analysis, this study utilized ATLAS.ti software throughout the data analysis process. ATLAS.ti, specifically designed to analyze unstructured non-numerical textual documents, facilitates comprehensive qualitative research through systematic thematic analysis [36]. The software supports the development of analytical frameworks based on key research questions and enables efficient coding of essential elements within interview transcripts and observational field notes [37]. The analysis proceeded through three iterative phases: (1) open coding, in which initial codes were generated from raw data to identify recurring concepts and patterns; (2) axial coding, during which relationships between codes were examined to develop higher-order categories aligned with the Behavior Design Change and Managerial Design Change dimensions; and (3) selective coding, wherein core themes were refined and integrated into a coherent framework linking behavioral and managerial components of leadership development. Throughout this process, ATLAS.ti facilitated the systematic identification of thematic patterns, the discovery of relationships between data categories, and the interpretation of factors influencing the studied phenomena. This analytical approach enabled the research to remain adaptive and responsive to real conditions observed in both urban and rural school contexts [37]. To ensure trustworthiness in this qualitative study, multiple strategies were employed. Credibility was established through triangulation of data sources (interviews, observations, and document analysis where available) and prolonged engagement with participants to develop rapport and verify emerging interpretations. Transferability was addressed by providing thick descriptions of contexts, participants, and findings, enabling readers to assess applicability to other settings. Dependability was ensured through systematic documentation of data collection and analysis procedures, including audit trails maintained within ATLAS.ti that recorded all coding decisions and analytical memos. Confirmability was strengthened by grounding interpretations in direct evidence from transcripts and field notes, and by engaging in reflexive memoing throughout the research process to acknowledge researcher perspectives and potential biases [34]. This study

employed qualitative approaches to rigor rather than quantitative measures of validity and reliability, as the research focus was on understanding contextual meanings and processes rather than measuring predefined variables with standardized instruments.

3. RESULTS AND DISCUSSION

To provide a more structured overview of the research findings, a findings map was constructed using ATLAS.ti to illustrate the comparison of leadership practices between elementary schools in Bandung City and West Bandung Regency (Figure 2). This map captures key indicators, including principals' strategies, supporting factors, inhibiting factors, and patterns of teacher performance improvement across both regions. Through the visualization in Figure 2 below, readers can more easily comprehend the similarities and differences that emerge in implementing leadership practices and efforts to enhance the quality of education in each context.

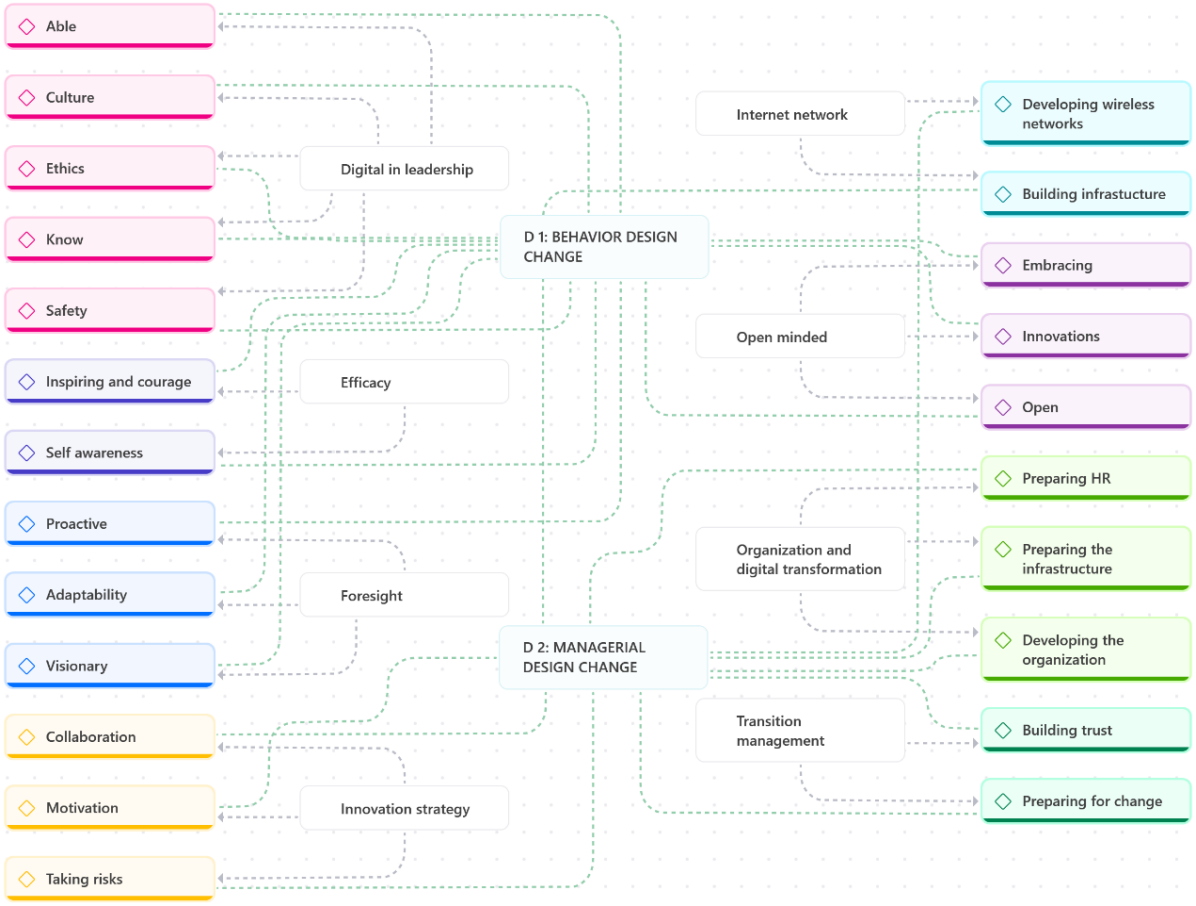

Figure 2. Coding Result Use ATLAS. ti Software

Based on the findings map presented in Figure 2 and the integrated framework presented in Figure 3, there are distinct differences in characteristics between elementary schools in Bandung City and West Bandung Regency regarding leadership implementation and teacher performance improvement. Elementary schools in Bandung City demonstrate a greater adaptability to technology use, innovative supervision, and active teacher participation in various professional development programs. Supporting factors in Bandung City include well-equipped facilities, education-oriented regional policies, and a strongly established culture of collaboration. Nevertheless, challenges remain, such as resistance from some teachers to change and the ongoing need to enhance digital-based leadership competencies.

On the other hand, elementary schools in West Bandung Regency are still predominantly characterized by conventional leadership patterns with limited utilization of technology. Although school communities in this region demonstrate strong cohesion and a high spirit of collaboration, various structural barriers, such as limited facilities and infrastructure, minimal access to technology, and the administrative burden on school principals, pose significant challenges to improving teacher performance. Furthermore, the limited availability of continuous training programs also slows the adaptation process to the demands of 21st-century leadership. Overall, the findings indicate that although there is a shared spirit of improvement in both regions, elementary schools in Bandung City show a higher readiness to adopt technology-based leadership approaches compared to

those in West Bandung Regency. This difference highlights the importance of developing human resource capacity strategies that are tailored to the local context and specific needs. Furthermore, all research findings presented in Figure 2 are organized according to the Behavior Design Change (digital leadership, open-mindedness, efficacy, foresight) and Managerial Design Change (internet network, transition management, digital organization, digital transformation, innovation strategy) themes that constitute the main analytical framework of this study.

Integrated Framework: Behavior Design Change and Managerial Design Change

Building schools capable of facing the challenges of change and development of information technology requires systematic progression through two integrated stages: Behavior Design Change and Managerial Design Change, as illustrated in Figure 3. This framework demonstrates how behavioral readiness and managerial infrastructure must co-evolve to enable sustainable digital transformation in elementary schools.

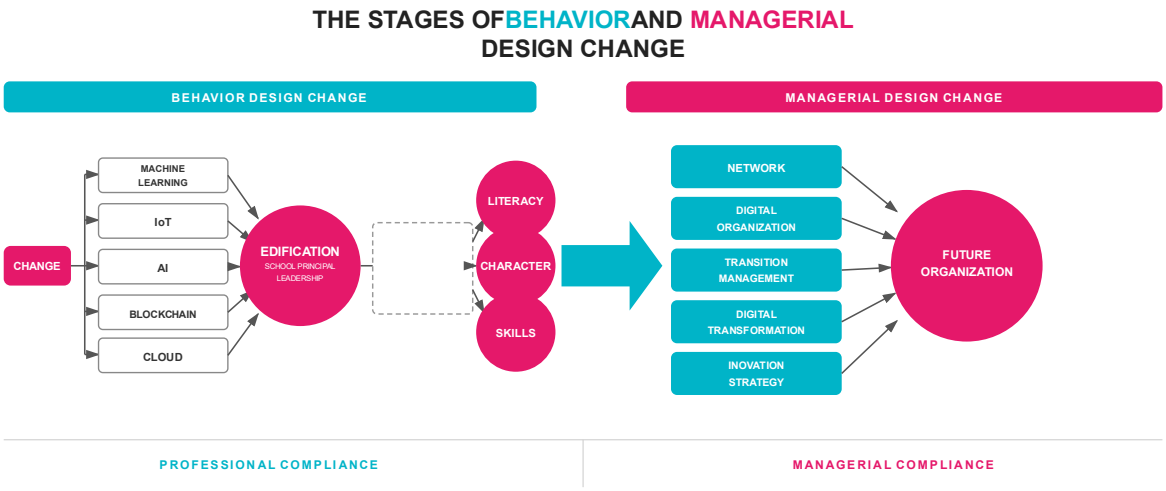

Figure 3. Stage of Behaviour and Managerial Design Change Toward Future Organization

Figure 3 illustrates that the two stages, Behavior Design Change and Managerial Design Change, are not sequential but interdependent, with each dimension reinforcing the other in a continuous developmental cycle. This integrated structure is central to understanding how urban and rural principals navigate digital transformation differently, as elaborated in the following discussion.

The conceptual distinction between behavioral and managerial dimensions proved essential for understanding the urban-rural disparities identified in this study. Urban principals in Bandung City demonstrated stronger integration across both dimensions, whereas rural principals in West Bandung Regency faced challenges primarily in the managerial dimension despite possessing behavioral readiness and commitment to change. This pattern suggests that behavioral competencies alone are insufficient without corresponding managerial infrastructure and support systems.

Behavior Design Change: Building Individual and Collective Capacity

The Behavior Design Change dimension, detailed in Figure 4, encompasses the developmental progression through four critical components that principals must cultivate to lead future-ready schools. Edification serves as the foundational principle underlying this dimension. Edification is the process of developing deep thinking and understanding abilities, which can be cultivated through active learning [38]. In the context of leadership, this process leads to the strengthening of the moral, spiritual, and intellectual dimensions of both individuals and institutions [39]. A leader who possesses edification will consistently seek opportunities to enhance the capacity and potential of their organization's members. Edification arises from a deep spiritual awareness, which enables a leader to interpret experiences, values, and life purposes more effectively. Leadership grounded in edification fosters the development of adaptive learning within the organization, allowing each member to continuously grow and sustain optimal performance.

The four developmental stages within the Behavior Design Change dimension, namely digital leadership, open-mindedness, efficacy, and foresight, are depicted sequentially in Figure 4, demonstrating how each component builds upon the previous to cultivate a comprehensive behavioral foundation for future-ready leadership.

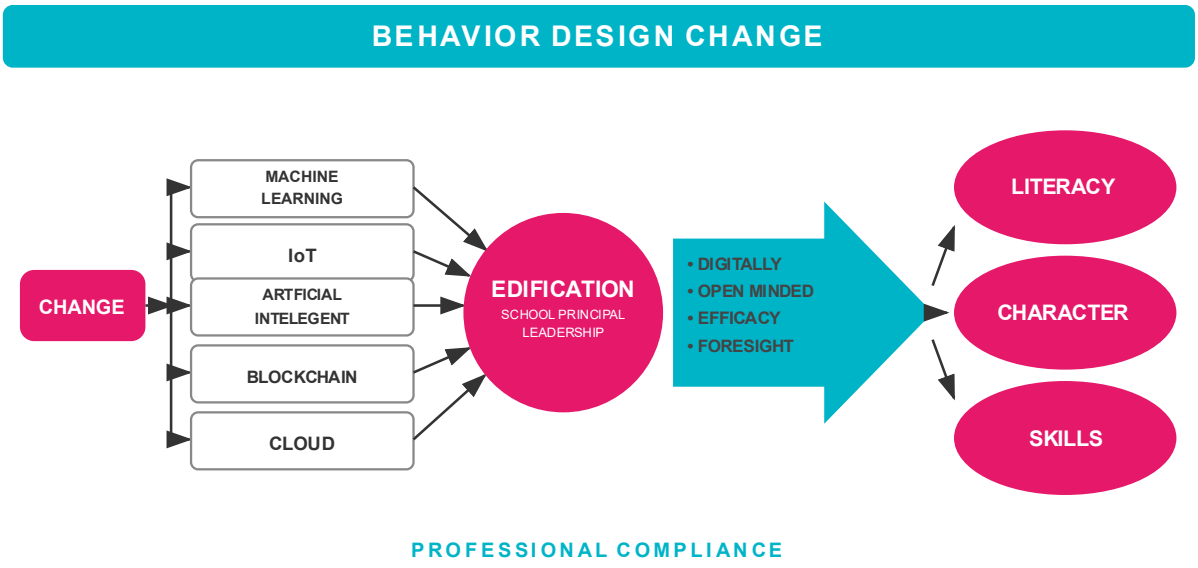

Figure 4. Behavior Design Change Stages

As depicted in Figure 4, the progression from digital leadership through open-mindedness, efficacy, and foresight reflects an ascending trajectory of behavioral readiness. This staged development was evident in the interview data, with urban and rural principals demonstrating different levels of advancement across these four components, as discussed below.

Furthermore, edification-based leadership also encompasses the utilization of adaptive technologies and the strengthening of learning resources to integrate tools and human resources, requiring the development of strategies to support the sustainability of technology as a key instrument in organizational transformation [30]. As a result, healthy competition will emerge, and edification will become systematically embedded within the organizational culture. The essence of edification lies in the appreciation of others. This makes edification an essential leadership skill for building a strong team and organizational culture. In the modern era, organizational members no longer seek merely transactional work relationships; they desire meaningful roles and recognition for their contributions. Therefore, leaders must be able to instill a sense of meaning in each individual's presence within the organization, viewing it as a long-term investment that transcends purely material interests.

The four components of Behavior Design Change, digital leadership, open-mindedness, efficacy, and foresight, emerged clearly in the interview data, though with notable differences in depth and integration across urban and rural contexts. Digital leadership competencies were more advanced among urban principals, who articulated sophisticated understandings of how technology enables communication, collaboration, and data-informed decision-making [40] [41]. Rural principals, while recognizing the importance of digital tools, often described technology adoption in more instrumental terms, focused on basic administrative functions rather than transformational leadership practices. This finding aligns with Hallinger et al. (2017) [23], who demonstrated that principals' self-efficacy significantly influences their capacity to implement instructional innovations and develop teacher commitment [42].

Open-mindedness, the willingness to embrace change and consider diverse perspectives, manifests differently across contexts. Urban principals operated within environments where innovation was normalized and expected, facilitating openness to experimentation. Rural principals demonstrated strong intrinsic openness and commitment to improvement, but faced institutional and resource constraints that limited their capacity to translate openness into implemented change. This pattern resonates with Bridge (2021) [2], who emphasized that readiness for the future requires not only an individual mindset but also environmental conditions that support predictive thinking and future-oriented planning.

Leadership efficacy, principals' confidence in their ability to achieve desired outcomes, showed pronounced urban-rural variation. Urban principals drew upon more extensive repertoires of successful technology integration experiences, providing stronger foundations for efficacy beliefs. Rural principals, despite demonstrating resilience and commitment, had fewer concrete success experiences to draw upon, potentially constraining efficacy development. As Guarana and Avolio (2022) and Karakose et al. (2024) [15] [43] noted, leadership efficacy develops through iterative cycles of experience, reflection, and environmental feedback; when structural conditions limit opportunities for success, efficacy development becomes more challenging regardless of principals' intrinsic capabilities [44].

Foresight, the capacity to anticipate future challenges and opportunities, was articulated by principals in both contexts, though with different time horizons and levels of specificity. Urban principals tended to describe

longer-term visions and more detailed strategic plans for digital transformation. Rural principals expressed aspirations for future development but often focused on more immediate challenges related to infrastructure and resource constraints. This finding underscores the importance of addressing basic capacity needs as a prerequisite for enabling principals to engage in long-term strategic thinking.

Managerial Design Change: Building Organizational Infrastructure

The Managerial Design Change dimension, illustrated in Figure 5, encompasses five components that provide the structural foundation necessary for sustainable digital transformation. This dimension addresses the systemic and organizational conditions that enable or constrain behavioral leadership competencies.

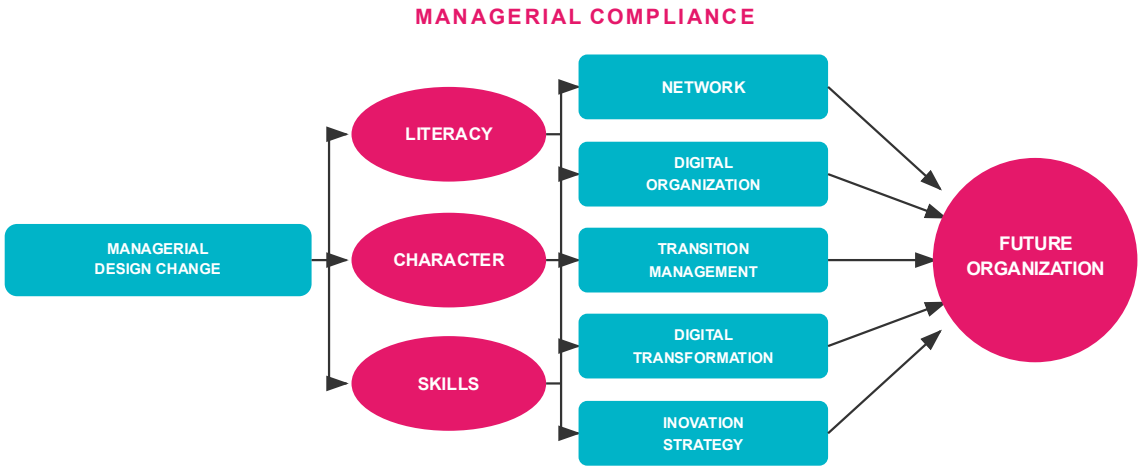

Figure 5. Stages of Managerial Design Change

Figure 5 presents the five-component structure of Managerial Design Change, showing how internet network, digital organization, transition management, digital transformation, and innovation strategy collectively form the organizational infrastructure that either enables or constrains behavioral leadership competencies. The following discussion examines how each component manifested across urban and rural school contexts.

Internet network infrastructure emerged as a fundamental differentiator between urban and rural contexts. Urban schools benefited from reliable, high-speed connectivity that enabled synchronous collaboration, cloud-based resource sharing, and real-time communication with district administrators and peer principals. Rural schools faced frequent connectivity issues, bandwidth limitations, and inadequate device provisioning that constrained principals' ability to leverage digital tools for leadership purposes. This infrastructure gap extends beyond technical specifications to encompass principals' ownership of internet-based networks, including email accounts, social media presence, and participation in digital professional communities. Urban principals demonstrated more sophisticated use of multiple digital platforms to build and maintain professional networks, whereas rural principals often relied on face-to-face communication due to connectivity constraints.

Digital organization, the institutional capacity for technology integration, requires readiness among both principals and organizational members, adequate physical and digital infrastructure, and transformed service delivery processes [45] [46] [47]. Urban schools showed more advanced development across these three components, with established routines for digital communication, shared expectations around technology use, and ongoing investment in capacity building. Rural schools, while demonstrating strong interpersonal relationships and collaborative cultures, had not yet institutionalized digital practices to the same extent, relying more heavily on traditional face-to-face coordination mechanisms.

Transition management, the strategic orchestration of organizational change processes, proved particularly challenging in rural contexts where principals balanced competing demands from multiple stakeholders with limited support structures [48]. Effective transition management requires building communication channels and trust with teachers, parents, and community members to secure buy-in for digital transformation initiatives. Rural principals described this process as more time-intensive and requiring more intensive relationship-building efforts compared to their urban counterparts, who benefited from established district-level support systems and professional development resources.

Digital transformation encompasses systematic changes across multiple organizational dimensions: digitizing documents and processes, organizing digital content for collaborative access, increasing automation, streamlining workflows, and enhancing overall effectiveness and efficiency [49]. The findings revealed that urban schools had progressed further through these stages, having moved beyond basic digitization toward process optimization and integration. Rural schools remained focused primarily on foundational digitization

efforts, constrained by limited technical support and training resources. This finding confirms patterns identified by Karakose et al. (2021) [50], who found persistent separation between digital data management and leadership decision-making even when technology is available.

Innovation strategy, the deliberate cultivation of creativity and continuous improvement, is manifested through different mechanisms in urban and rural contexts. Urban schools demonstrated more formalized innovation processes, including structured professional learning communities, designated innovation leaders, and systematic mechanisms for sharing best practices. Rural schools exhibited strong collaborative cultures and willingness to experiment, but lacked formal structures for scaling and sustaining innovations. Both contexts emphasized the centrality of collaboration for change, recognizing that digital transformation cannot be accomplished by principals working in isolation.

Theoretical Integration: Extending Digital Leadership Theory

The central finding that urban-rural disparities reflect not merely technological access but bigger differences in the integration of behavioral and managerial dimensions extends existing digital leadership theory in important ways. Wang et al. (2024) [3] emphasized that future-oriented leadership requires a visionary mindset integrated with digital competence and openness to change. This study demonstrates that such integration cannot be assumed or imposed uniformly across contexts; rather, it develops through sustained interaction between individual leadership efficacy and institutional infrastructure. The edification-based framework proved particularly valuable for interpreting these dynamics, revealing how principals' aspirations for meaningful organizational transformation interact with contextual enablers and constraints to shape development trajectories.

The findings also corroborate and extend Langer (2018) [21] and Tasker-Mitchell and Attoh (2019) [22], who argued that digital transformation requires sustained processes rather than quick remedies, and that future organizations depend on leaders capable of guiding digitally competent members through empathetic change processes. This study adds contextual nuance by showing that in resource-constrained settings, transition management and digital transformation often stall not due to principals' unwillingness but due to structural deficits in network infrastructure and institutional support. This challenges deficit-oriented narratives that attribute slower digital adoption solely to leadership inadequacies, instead highlighting the role of systemic inequities.

These findings carry important practical implications for policy makers, school district administrators, and leadership development programs. First, efforts to cultivate future-ready leadership must address behavioral and managerial dimensions simultaneously and in an integrated fashion. Professional development programs that focus exclusively on building principals' digital competencies without addressing infrastructure constraints, or that provide technology without supporting leadership efficacy development, are unlikely to achieve sustainable transformation. The two-stage framework presented in Figures 3, 4, and 5 provides a roadmap for designing integrated interventions that combine targeted skill development with infrastructure investment and ongoing mentoring support. Second, the pronounced urban-rural disparities documented in this study call for differentiated support strategies tailored to local contexts. Rural schools require not only infrastructure investment but also policy frameworks that reduce administrative burdens on principals, create regional professional learning communities to overcome geographic isolation, and recognize unique assets such as strong community cohesion that rural contexts offer. Urban schools, while better resourced, face distinct challenges, including teacher resistance to change and the need to sustain innovation momentum; these contexts benefit from strategies that institutionalize collaborative cultures and embed continuous improvement processes into school routines. Third, the edification-based framework suggests that leadership development initiatives should emphasize meaningful organizational transformation and values-driven leadership alongside technical skill building. Programs that help principals articulate clear visions for future-ready schools, connect digital transformation to core educational purposes, and build trust with teachers and communities are more likely to generate sustained commitment than those focused narrowly on technology adoption [27] [29].

This study's findings must be interpreted in light of several limitations. First, the sample size of ten principals, while appropriate for in-depth qualitative inquiry, limits the generalizability of findings to broader populations. The purposive sampling approach prioritized contextual variation over statistical representativeness. Second, the study's geographic focus on Bandung City and West Bandung Regency may not reflect conditions in other urban-rural pairs within Indonesia or in other national contexts. Third, reliance on self-reported interview data introduces potential social desirability bias. Although observational data and the systematic coding analysis presented in Figure 2 provided triangulation, more systematic behavioral observation would strengthen confidence in findings. Fourth, the cross-sectional design captures leadership development at a single point in time, limiting insights into how competencies evolve over extended periods.

The novelty of this study lies in its introduction of an edification-based leadership development framework that systematically integrates behavioral and managerial design change dimensions specifically for elementary school principals. Unlike prior studies that examined behavioral dimensions, such as open-

mindedness, efficacy, and digital literacy, or managerial dimensions, such as organizational change and information management, in isolation, this study demonstrates their interdependence within a single, coherent model. By providing empirical evidence of urban-rural digital leadership disparities in Indonesia and offering a contextualized, culturally-responsive model for developing future-ready school leaders, this study advances existing knowledge beyond generic approaches to digital leadership. The edification principle, emphasizing the moral, spiritual, and intellectual dimensions of leadership as a foundation for adaptive learning within the organization, further distinguishes this framework from purely technical approaches to digital leadership.

Several promising directions for future research emerge from these findings. First, longitudinal research tracking principals' development trajectories over multiple years would provide insights into how behavioral and managerial competencies co-evolve and what factors sustain or erode leadership efficacy over time. Second, comparative research extending this framework to other contexts would test transferability and identify boundary conditions. Third, intervention research testing specific strategies for accelerating future-ready leadership development would address practical needs while advancing theory. Randomized or quasi-experimental designs could compare the effectiveness of different professional development models, with particular attention to interventions tailored to resource-constrained rural settings. Fourth, quantitative research employing validated instruments could test structural relationships among edification, leadership efficacy, digital competence, and organizational outcomes. Finally, research examining teachers' and students' perspectives on principals' digital leadership would provide complementary evidence beyond principals' self-reports.

4. CONCLUSION

This study demonstrates that future-ready leadership in Indonesian elementary schools develops through the systematic integration of two mutually reinforcing dimensions: Behavior Design Change, encompassing digital leadership, open-mindedness, efficacy, and foresight, and Managerial Design Change, comprising network infrastructure, digital organization, transition management, digital transformation, and innovation strategy. The findings from ten principals across Bandung City and West Bandung Regency confirm that neither dimension alone is sufficient: behavioral competencies without adequate managerial infrastructure produce unrealized aspirations, while infrastructure investments without leadership efficacy fail to generate meaningful organizational transformation. Contextual factors shape this integration decisively. Urban principals benefited from reliable connectivity, supportive regional policies, and established collaborative cultures, enabling stronger integration across both dimensions. Rural principals, despite possessing commitment, community cohesion, and collaborative spirit, faced structural constraints, including limited infrastructure, heavy administrative burdens, and inadequate professional development access that restricted their capacity to translate openness into implemented digital transformation. Based on these findings, this study proposes the Edification-Based Leadership Development Framework as a new conceptual contribution to educational leadership theory. This framework positions edification, the cultivation of moral, spiritual, and intellectual capacity to cultivate adaptive learning and meaningful organizational transformation, as the foundational principle integrating behavioral readiness and managerial infrastructure. Unlike prior models that treat these dimensions separately, this framework demonstrates their interdependence and offers a culturally-responsive, context-sensitive model for developing future-ready school leaders in digitally transforming educational environments.

The implications of this study are threefold. For policymakers, technology provision alone is insufficient; effective policy must integrate infrastructure investment with leadership capacity development and differentiated strategies that recognize the distinct assets and constraints of urban and rural contexts. For school district administrators, the two-stage framework provides a practical diagnostic tool for sequencing professional development interventions that build both individual efficacy and institutional readiness simultaneously. For principals themselves, the edification-based framework offers a values-driven foundation for leading digital transformation as a meaningful, human-centered process rather than a purely technical undertaking, fostering adaptive learning and sustainable organizational growth across diverse educational settings.

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AUTHOR CONTRIBUTIONS

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CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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