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Role of School Principals in Integrating Technology into the Teaching–Learning Process

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ABSTRACT

Purpose of the study: The present study explored the role of Sri Lankan school principals in integrating technology into the teaching–learning process across diverse educational contexts. It examined how principals provide leadership, support, and direction for technology use in schools, while also identifying the challenges they face and the factors that influence their efforts.

Methodology: A qualitative research design was adopted, using semi-structured interviews with ten school principals from Sinhala, Tamil, and English medium schools across four districts in Sri Lanka. Data were analyzed using thematic analysis

Main Findings: The findings reveal that principals play multiple roles as facilitators, enablers, and advocates of technology integration. They support initiatives such as STEM education and encourage teachers' use of digital tools; however, their leadership is often constrained by the absence of a clear technological vision, limited resources, inadequate infrastructure, teacher resistance, and insufficient awareness of technology-related policies. These challenges vary between urban and rural schools and across different language-medium contexts

Novelty/Originality of this study: This study contributes to the understanding of school principals' roles in leading technology integration in Sri Lankan schools. It highlights both leadership practices and contextual constraints and offers practical insights to strengthen principals' capacity to support effective and equitable technology-enhanced teaching and learning.

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1. INTRODUCTION

Integration of technology into the teaching and learning process is vital. It is an added benefit in the current digital world. Therefore, students in the 21st century must be equipped with 21st-century skills [1]. Education, in developing countries like Sri Lanka, is considered a key weapon in national development. Hence, to support socio-economic development in Sri Lanka, students' digital competencies are essential. To achieve this goal, school principals' leadership plays a key role in the school context. Silva and Amaradasa [2] note that principals who reinforce digital innovation can improve educational quality. Students who acquire digital skills that enable them to compete globally are at a distinct advantage when it comes to securing employment. However, many Sri Lankan schools face challenges in technology integration. For instance, teachers often face

diverse barriers when attempting to use technology effectively in the teaching and learning process. In this regard, leaders of schools such as school principals can help or hinder this process.

Recent studies indicate that principals often fail to prioritize and support teachers in tech integration [3]-[5]. Lack of resources, leadership vision, and the technological skills of school principals, as well as the need to become change agents to create a positive culture in tech integration, can be identified as key issues. Moreover, professional development for school principals is an essential supportive mechanism to enhance their leadership role in technology integration [6].

Principals in Sri Lanka are often reluctant to provide resources and consistent support for technology integration [7], [2]. Although the National Education Commission emphasizes the importance of managing ICT, most classrooms are still led by traditional teacher-centered methods [8]. Therefore, strong leadership is needed to create a technology-enhanced classroom setting. Most Sri Lankan research in the area focuses on teachers' skills in technology integration and the school principal's role in technology integration is under-researched and less clearly understood. The principal's leadership role is recognized as having a significant impact on students' technological skills by international studies. Yet, Sri Lankan research has not studied comprehensively the challenges, strategies, or unique contexts of school principals' efforts to integrate technology into the teaching and learning process. This can be identified as an important gap in the country's technology integration scenario in diverse educational settings.

Variations in the Sri Lankan educational landscape can be seen when considering differences in urban and rural areas, language divisions between Sinhala and Tamil medium schools, and inequality in digital resources within schools. This diverse context in Sri Lankan education poses a significant challenge for school principals when they attempt to lead technology integration in schools. These realities should be considered by national ICT policies as they will negatively impact such efforts in schools. The COVID-19 pandemic highlighted this issue. According to the Ministry of Education [9], only about 60% of students can access online learning. This emphasizes the digital divide and underscores the urgent need for strong leadership. Without effective leadership, technology integration occurs primarily in better-resourced schools, leaving areas where it is most needed severely under-resourced.

Considering the above context, the study is directed by three key questions: How do principals shape technology adoption in varied school environments? What challenges arise in this process? And what leadership strategies can enhance effective technology integration? Furthermore, this study explores the manner in which principals reinforce technology adoption, the obstacles they face, and the methods they use to overcome the challenges they face in their leadership roles in Sinhala and Tamil medium schools. The study highlights specific challenges and provides practical recommendations to enhance educational equity and quality through better technology integration in the teaching and learning process. Therefore, it provides new insights into principal leadership in a developing country like Sri Lanka, and aims to strengthen technology integration through effective leadership roles.

Despite growing international research on technology leadership in schools, a significant gap exists in understanding how principals in developing countries, particularly Sri Lanka, navigate technology integration within diverse and resource-constrained educational contexts. While international studies have established that principal leadership significantly impacts technology adoption [3]-[6], [10], [11], most research originates from developed countries with adequate infrastructure and policy support [12]-[14]. Research in Sri Lankan contexts has predominantly focused on teachers' ICT competencies and barriers to technology use [7], [8], with limited attention to the principal's strategic role in leading technology integration. Furthermore, existing studies have not adequately examined how contextual variations, such as urban-rural disparities, language-medium differences (Sinhala, Tamil, English), and resource inequalities, shape principals' technology leadership practices and challenges [15], [16]. This represents a critical knowledge gap, as effective technology integration strategies cannot be directly transplanted from developed to developing contexts without considering local realities, structural constraints, and cultural factors that fundamentally shape leadership practices [17], [18].

This study addresses this gap with both novelty and urgency. The novelty lies in its contextualized examination of principal technology leadership across diverse Sri Lankan school settings, specifically analyzing how principals adapt their leadership strategies in response to varying resource levels, geographic locations, and language-medium contexts. The urgency of this research emerges from three key factors. First, the COVID-19 pandemic exposed a significant digital divide, with only 60% of students able to access online learning [9], underscoring the need for strong technology leadership. Second, national initiatives such as the Smart School project have made substantial investments in digital infrastructure, yet schools continue to face implementation challenges [19], indicating the need to examine leadership practices. Third, as the country works toward broader socio-economic development through education, developing students' 21st-century digital competencies has become essential [1], [20], placing principals' technology leadership at the forefront of policy priorities. Therefore, the primary objective of this study is to examine the challenges faced by school principals in Sri Lanka within diverse contexts when they attempt to integrate technology into the teaching-learning process, and

to identify effective strategies and systemic supports necessary to strengthen their leadership role in achieving equitable and sustainable technology integration across varied school settings.

2. LITERATURE REVIEW

2.1 Technology Leadership as a Context-Dependent Practice

Educational technology Educational technology plays a key role in enhancing schools' teaching learning process. In this regard, the leadership of principals is pivotal for the effective use of technology [21]-[23]. Diverse leadership roles which are most often dependent on the local situation may support or hinder technology integration. Therefore, research should be focused on the specific contexts where technology integration is adopted.

The effective integration of Information and Communication Technology (ICT) into the curriculum is a pivotal responsibility for school principals, whose digital leadership strategies are foundational to institutional success amidst rapid technological transformation [6], [24], [25]. Researchers agree that principals must adopt a multifaceted approach characterized by strategic vision, organizational restructuring, and relational support [26]-[28]. Key strategies employed to promote ICT adoption include the purposeful integration of technology for communication, administrative efficiency, and instruction [29]-[31]. Furthermore, principals actively engage as "systems designers" by addressing technological resource deficits, lobbying governmental bodies, seeking external sponsorship, and acquiring essential hardware to build reliable infrastructure [30], [32]. This focus on resource acquisition is often coupled with efforts to develop staff capacity through professional development (PD), reinforcing the principal's role as an "empowering leader" [33]-[35].

However, principals' efforts are consistently undermined by pervasive barriers that span both technical and human domains [36]. The most frequently cited obstacles involve inadequate technological infrastructure, such as unreliable internet connectivity and insufficient ICT hardware, which seriously impair teachers' ability to integrate technology successfully [37], [29], [16]. Beyond material deficits, a significant challenge is the digital skills gap among teaching staff and, critically, teacher resistance to change, often stemming from a perceived lack of competency, fear of increased workload, or comfort with outdated traditional pedagogies [33], [38]-[40]. While some studies emphasize the importance of principals modeling technology proficiency as a critical response to staff resistance [41], [42], other contexts highlight a systemic failure: novice principals frequently lack adequate pre-principalship leadership training, leaving them ill-equipped to navigate the complexities of 21st-century educational environments [43], [44]. Moreover, when PD opportunities are inconsistent or lack a needs-based assessment, they fail to enhance the requisite skills effectively [45], [30]. Therefore, while leaders adopt tactical responses like resource acquisition and providing sporadic training, the literature suggests that achieving sustainable digital transformation requires addressing the more fundamental, systemic issues of policy coherence, resource equity, and continuous leadership capacity building aligned with rigorous competency models [33], [46].

Previous studies on technology leadership and integration have focused on providing equipment and training. For example, Jackson [3] suggested that principals should ensure schools have the correct hardware and provide training workshops. However, recent research describes technology leadership as a more complex phenomenon. It now includes establishing a clear vision, supporting professional development, and leading digital transformation that aligns with the school culture [47], [48]. Hallinger [21] found that strong instructional leaders help teachers use technology more effectively. Dexter and colleagues [22] pointed out that shared leadership roles encourage teachers to use digital tools. These current studies emphasize the principal's leadership in how technology is used for teaching and learning.

In developed countries, technology leadership is considered to involve clear planning, continuous training, and group work [22]. Better infrastructure is a strong support for principals in creating a digital learning environment. In developing nations, limited resources, bureaucracy and disparities between policy and practice, have made principals' workloads very heavy in relation to technology integration [17], [18]. For instance, the Turkish Fatih project was backed by strong policy but was a failure when it was implemented because the plans did not match with the schools' contexts [49]. Some studies show that strong principal leadership can develop teachers' confidence and skills, which is a great support to overcome resistance towards integrating technology in the teaching learning process [17], [18], [49].

In many schools, certain leadership practices are connected with good outcomes. Continuous training, clear vision, change management skills, and the utilization of limited resources are included in these leadership practices [50], [51]. When school principals connect technological projects to the school's main objectives, teachers tend to support their implementation. Continuous professional development is essential for technology

integration. Therefore, successful leaders are paying more attention to providing learning opportunities through guidance, teamwork, and changes rather than workshops [6]. Effective leaders who face obstacles in tech integration show clear advantages step by step and celebrate small successes [48]. Schools with limited resources use innovative strategies such as flexible timetables, shared tools, and collaboration to mitigate resource constraints [52].

While international research on the technology integration efforts of school principals is growing, Sri Lankan studies remain scarce in this field of education. Most teachers' skills and training are not related to technology integration in the teaching and learning process. Moreover, the application of leadership skills is also under-researched. Furthermore, in Sri Lanka, there are vast disparities in access to digital resources in technology integration between urban and rural schools and this is a barrier to effective integration. Also, flexible leadership models are needed to address these issues. Yet, limited research is found on how school principals manage the challenges they face in technology integration. Recent projects such as the Smart School project and the Sipnena Smart STEM Schools programme, have invested in infrastructure and training for technology integration in Sri Lankan schools [19]. However, there are still reported issues with infrastructure maintenance, managing limited resources, and changing teaching methods. National policy documents such as the National Education Commission's ICT integration framework have recognized the importance of leadership but offer little practical guidance for school principals on technology integration [8].

2.2 Epistemological and Methodological Framing

This study used an exploratory qualitative approach grounded in contextualist epistemology. As Braun and Clarke [53] note, qualitative research is useful for exploring topics that are not well understood and involve complex, context-dependent meanings. On the other hand, contextualist research does not seek universal laws. Instead, in this instance, it examines how individual principals interpret their experiences, while also considering the influence of broader social, institutional, and policy factors [53]. However, this approach balances viewing principals' actions as fixed traits with the idea that all meaning is shaped by society. It also recognizes that principals face real-world challenges, such as limited budgets, outdated infrastructure, and institutional structures like policy rules and school hierarchies, which can hinder their actions.

The selection of a qualitative design over quantitative approaches is directly informed by the research questions. Qualitative data is significant to gain insight into how and why principals navigate technology integration, and necessitate detailed accounts of their practices, decision-making processes, and adaptive strategies within specific contexts. Although quantitative surveys can measure the frequency of certain practices, they are insufficient for capturing contextual nuances. Thematic analysis, as described by Braun and Clarke [53], offers a rigorous yet adaptable method for identifying and interpreting patterns of meaning across diverse contexts. Therefore, the qualitative approach supports both data-driven insights and the theory-informed interpretation used in the study. More importantly, thematic analysis does not require the imposition of pre-existing theoretical frameworks. Instead, in this study, it allows themes to emerge from principals' own accounts while maintaining alignment with explicit epistemological positions, specifically contextualism.

This study addresses the existing evidence gap by examining principals' leadership practices in navigating technology integration in the teaching learning process within the diverse school contexts of Sri Lanka. The research provides novel contextual insights into an under-researched area in education in a developing country and establishes a foundation for future research and policy development.

2.3 Theoretical Framework: Leadership for Technology Integration

The current study draws on educational leadership theory focused primarily on school principals. It employs Hallinger's [21] distinction between instructional and transformational leadership and further incorporates distributed leadership [22] and systems thinking [47]. These theoretical frameworks elucidate how principals facilitate technology integration in schools, especially in the face of limited resources in diverse contexts in Sri Lanka.

Instructional leadership emphasizes practical solutions in enhancing the teaching learning process of schools. Moreover, these practices include providing infrastructure, organizing professional development, and monitoring implementation progress in technology integration. In contrast to instructional leadership, transformational leadership establishes a shared vision, motivates staff, and shapes school culture. It encourages teachers to integrate technology as a form of pedagogical innovation rather than mere compliance [48], although both leadership styles are essential for effective technology integration. Instructional leadership establishes foundational conditions; transformational leadership sustains meaningful and innovative use.

Distributed leadership extends these concepts by allocating responsibility for technology adoption among principals, teachers, and support staff [22]. Schools that foster peer mentoring and collaborative practices

often achieve more robust and sustained technology integration, especially in resource-constrained environments. In such contexts, distributed leadership emerges out of necessity, and yet, it consistently yields increased teacher engagement and adaptability.

Systems thinking [47] situates leadership within a broader context. This includes policy, institutional structures, and societal influences. Moreover, leadership actions are shaped and sometimes constrained by factors such as policy regulations, professional development availability, and resource allocation. Sustainable technology integration requires alignment among principals' competencies and vision, school resources, national policy frameworks, and societal support.

This study synthesizes these theoretical perspectives into a model with three core elements. These elements are capacity, defined as resources and infrastructure; vision, referring to explicit objectives for technology use in instruction; and agency, encompassing principals' commitment and adaptability. Technology leadership is most effective when these components are aligned and reinforced by systemic support for an effective technology integration. This framework helps to understand both effective practices and challenges principals face in diverse school contexts.

3. RESEARCH METHOD

3.1 Research Design

The study used an exploratory qualitative research design to examine how school principals support technology integration in the teaching learning process in diverse Sri Lankan school contexts. This approach is well-suited to exploring topics that have not been widely studied yet. Moreover, it encourages new insights and allows researchers to look at complex issues from different perspectives [54]. Qualitative research in this context helps gather detailed accounts of principals' actions, viewpoints, and the challenges they face when introducing technology into the teaching and learning process. The flexible nature of qualitative methods also made it possible to look more closely at factors like language differences, differences between urban and rural schools, and limited resources which affect technology integration. All these factors are connected with the leadership role of school principals.

After completing data collection, the subsequent phase involved data analysis, which was conducted using Braun and Clarke's [53] six-phase thematic analysis approach. Thematic analysis is defined as 'a method for identifying, analysing and reporting themes within data' [53]. Unlike other methods which are tied to specific theoretical frameworks, such as grounded theory or interpretative phenomenological analysis, thematic analysis is epistemologically flexible and accessible within a qualitative research approach. This makes it ideal for exploring under-researched areas, where diverse contextual factors require systematic, yet adaptable analysis [53]. The thematic analysis method enabled the identification of patterns across principals' accounts of technology integration. It also maintained sensitivity to contextual variations. This was critical for understanding how leadership operates differently in diverse contexts like resource-rich versus resource-constrained schools, urban versus rural contexts, and linguistically diverse settings.

3.2 Research Procedures

The study employed a systematic process consisting of six sequential stages, ensuring methodological rigor, transparency, and alignment with the exploratory qualitative approach. The research process is illustrated in Figure 1.

Stage 1: Research Planning and Design: The research problem and questions were established, an appropriate qualitative design was selected, and a comprehensive literature review informed the theoretical framework and identified knowledge gaps. Ethical considerations were addressed, and the research protocol was finalized.

Stage 2: Instrument Development: A semi-structured interview guide was developed based on the literature and theoretical foundations, addressing five key areas of principals' technology leadership. The instrument was pilot tested with two principals, and minor refinements were made to enhance clarity and coherence.

Stage 3: Participant Recruitment and Sampling: Principals were recruited through convenience sampling using professional networks and email invitations. Information sheets outlining the study's purpose and ethical procedures were provided, and ten principals representing diverse school contexts consented to participate.

Stage 4: Data Collection: Semi-structured interviews were conducted either in person or online, using the participants' preferred language. All interviews were audio-recorded with permission and supported by field notes. Verbatim transcription was completed to ensure accuracy and early data familiarization.

Stage 5: Data Analysis: Thematic analysis was carried out following Braun and Clarke's [53] six-stage approach. Manual coding, color-coding, and margin annotations were used to identify and refine themes. Regular team discussions ensured analytical rigor and consistency across the dataset.

Stage 6: Interpretation and Reporting: Themes were interpreted in relation to the theoretical framework and existing scholarship. Findings were synthesized to address the research questions and highlight implications for policy and practice. The final manuscript was drafted, reviewed, and revised for publication.

Throughout all stages, the research team-maintained reflexivity and safeguarded participant confidentiality through coded identifiers and secure data storage.

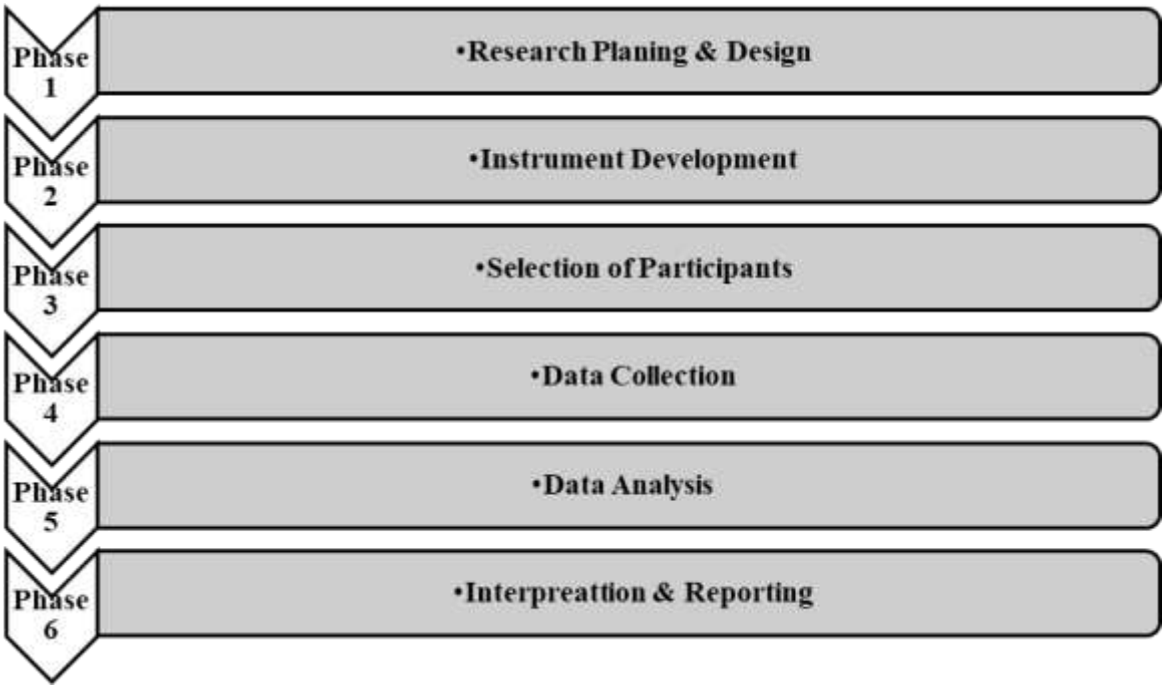

Figure 1. Research Procedure Flowchart

3.3 Participants and Sampling

The researchers employed convenience sampling in the study, targeting participants who were both accessible and willing to participate [55]. This method was essential due to the challenges of reaching Sri Lankan school principals during the study period. We enlisted ten principals representing Sinhala-medium (7), Tamil-medium (2), and English-medium (1) schools across four districts: Kalutara (4), Galle (3), Colombo (2), and Nuwara Eliya (1).

Although the sample size of ten is rather modest, it aligns with exploratory qualitative research that emphasizes depth over breadth. Braun and Clarke [53] note that qualitative studies require sufficient data to achieve thematic saturation, a point at which no new themes emerge. For under-researched topics, this typically occurs with 6 to 20 participants, depending on data richness and diversity [53]. Our ten principals each completed 45 to 60-minute semi-structured interviews, generating approximately 7 to 10 hours of audio data---adequate for comprehensive thematic analysis. The group spanned both well-resourced (1AB schools) and under-resourced (Type 2 and 3) schools, urban and rural settings, and principals with 1 to over 15 years of experience. While most were from urban and Sinhala-medium schools, a limitation addressed later, the sample still provided a robust foundation for examining varied leadership experiences and contexts.

All ten principals possessed postgraduate qualifications, such as a PGDE, B.Ed., M.Ed., or a postgraduate diploma in educational management. The group comprised six women and four men, with most aged over 41 years and five aged 50 years or above. Half had served as principals for over 15 years. Their expertise and experiences in the field offered substantial insights into leadership in technology integration and the challenges encountered.

3.4 Data Collection

The researchers conducted semi-structured interviews to capture principals' perspectives on leadership roles, technology adoption, teacher support, implementation challenges, and alignment with national educational policies. This format ensured that all participants responded consistently while allowing the exploration of emerging topics. As Braun and Clarke [53] note, qualitative interviews balance structured guidance and flexibility to probe deeper insights. Researchers conducted interviews in person or online, according to each participant's preference. Each session lasted 45--60 minutes. To foster openness, we used participants' preferred

languages: Sinhala for nine, Tamil for one, or code-switching with English. With consent, we recorded all interviews and transcribed them verbatim. The researchers transcribed the interviews using standard writing rules. They ensured they captured everything said and reflected the speakers' intentions through careful punctuation. This process helped us get to know the data well. Braun and Clarke [53] say this is an important first step in thorough thematic analysis. Each transcript was also checked against the original recordings to ensure accuracy before starting analysis.

3.5 Data Analysis

Interview transcripts were analyzed using thematic analysis following Braun and Clarke's [53] six-phase approach. This process is described below:

Phase 1: Familiarization with the Data. The researcher repeatedly read all transcripts, searching for meanings, patterns, and points of interest. Initial codes and analytic ideas were noted during this phase, as recommended by Braun and Clarke [53]. This immersion was essential. It enabled understanding the depth and breadth of principals' accounts before formal coding began.

Phase 2: Generating Initial Codes. Coding began with a thorough review of all data to identify features of interest, both explicit and underlying. Codes captured key aspects of principals' practices and perspectives [53]. Following Braun and Clarke's [53] guidance, coding included the surrounding context. Data extracts were coded more than once when needed. Coding was done manually, using color-highlighting and margin notes on printed transcripts.

Phase 3: Searching for Themes. Once all data were coded, the researcher collated codes into potential themes and organized initial codes into broader patterns. The researcher used mind-mapping and visual organization to sort codes into theme-piles, considering relationships between codes and hierarchical levels (main themes and sub-themes) [53]. This phase generated candidate themes representing principals' leadership roles, vision articulation, implementation strategies, challenges, and policy engagement.

Phase 4: Reviewing Themes. Themes were refined through two levels of review. Level 1 involved reviewing coded data extracts for each theme to ensure internal coherence (the extracts within a theme fit together well) and consistency (the extracts relate to each other and the theme) [53]. The researcher read all collated extracts and checked whether they formed coherent patterns around a central idea. Level 2 involved reviewing themes against the entire data set. The researcher re-read certain transcripts to verify the themes' validity and to identify any missed data relevant to themes [53]. This recursive process (a repeated back-and-forth between steps) ensured that the themes accurately reflected meanings across the data set.

Phase 5: Defining and Naming Themes. Once a satisfactory thematic map emerged, the researcher defined each theme by identifying its essence and determining what aspects of the data it captured [53]. Clear definitions kept themes from being overly broad or internally diverse. The researcher identified sub-themes, where appropriate, to structure complex themes and reveal hierarchies of meaning. The researcher chose concise theme names to convey each theme's content to readers immediately.

Phase 6: Producing the Report. In the final phase, the researcher wrote an analysis, selected vivid and compelling data extracts to illustrate analytical claims, and embedded extracts within an analytic narrative that interpreted beyond mere description [53]. As Braun and Clarke [53] emphasize, extracts illustrate and support analysis that transcends specific content, helping make sense of data patterns in relation to research questions and existing literature.

Throughout the analysis, the researcher maintained a reflexive stance and documented analytic decisions and epistemological assumptions. Following Braun and Clarke's [53] guidance, assumptions were made explicit. This analysis operated within a contextualist epistemology, which views knowledge as produced in relation to specific social and cultural contexts. It recognized that principals' meanings are shaped by institutional contexts (the rules and norms of their organizations) and material constraints (practical limits or physical resources), while also acknowledging their agency, which is their capacity to make choices in navigating these contexts.

3.6 Ethical Considerations

Ethical approval was not required for this study as it did not involve sensitive personal data or interventions. All participants provided informed consent, and participation was entirely voluntary. Identifiers were removed to ensure confidentiality, and data were stored securely on password-protected devices accessible only to the research team.

3.7 Participant Profile

The study included ten principals with diverse demographic and professional characteristics (see Table 1). Representing four districts, Kalutara (4), Galle (3), Colombo (2), and Nuwara Eliya (1), the sample comprised seven principals from Sinhala-medium schools, two from Tamil-medium schools, and one from an English-medium school. The participant pool reflects a slight underrepresentation of non-Sinhala institutions. Gender distribution was relatively balanced, with six female and four male principals. Most participants were over 41 years old, with five aged 50 years or above. Also, their professional experience ranged from 1 to over 15

years, with half having served as principals for more than 15 years. Convenience sampling in the study, targeting participants who were both accessible and willing to participate [23]. This method was essential due to the challenges of reaching Sri Lankan school principals during the study period. We enlisted ten principals representing Sinhala-medium (7), Tamil-medium (2), and English-medium (1) schools across four districts: Kalutara (4), Galle (3), Colombo (2), and Nuwara Eliya (1).

Table 1. Participants Profile

Participant ID	District	Medium	Gender	Age Group	Experience as a Principal	School Type	Urban /Rural	Professional Qualifications
Case 1	Kalutara	Sinhala	Male	50+	15+	1AB	Urban	PGDE
Case 2	Galle	Sinhala	Female	41-50	1-5	1AB	Urban	PGDE
Case 3	Galle	Sinhala	Female	30-40	6-10	Type 3	Rural	PGDE
Case 4	Kalutara	Sinhala	Male	50+	15+	Type 3	Rural	B.Ed.
Case 5	Galle	Sinhala	Male	50+	15+	1AB	Urban	PGD in EM
Case 6	Kalutara	Sinhala	Female	50+	15+	Type 3	Urban	PGDE & PGD in EM
Case 7	Colombo	English	Female	41-50	6-10	1AB	Urban	M.Ed.
Case 8	Kalutara	Sinhala	Male	50+	15+	1AB	Urban	B.Ed.
Case 9	Colombo	Tamil	Female	41-50	1-5	1AB	Urben	M.Ed.
Case 10	Nuwara Eliya	Tamil	Female	41-50	1-5	1AB	Urben	M.Ed.

Note: PGDE = Postgraduate Diploma in Education; PGD in EM = Postgraduate Diploma in Educational Management; B.Ed. = Bachelor of Education; M.Ed. = Master of Education

The sample included seven well-resourced 1AB schools and three less-resourced Type 3 schools, comprising eight urban and two rural institutions, which suggests a modest urban bias. All participants held advanced qualifications such as a PGDE, B.Ed., M.Ed., or postgraduate diplomas in education management, underscoring their professional expertise. This diversity, while not exhaustive, provided a robust foundation for exploring the multifaceted role of principals in technology integration.

4. RESULTS

The analysis found five main themes that show how Sri Lankan school principals handle the challenges of bringing technology into their schools. These themes reveal both the strengths and limits of school leadership in different settings and suggest that broader systems and local conditions matter more than individual leadership flaws or strengths.

Theme 1: Principal Leadership Roles and Strategic Vision: Principals viewed their roles as supporting technology, but strategies varied. Most are centered on practical tasks like providing equipment, training, and managing resources, rather than defining a technology vision. For example, Case 6 supplied tools for technology integration while Case 1 handled teacher training. A few, such as Case 5, fostered learning between experienced and novel teachers. Few principals had a specific technology vision: six included technologies in general school goals, but only three (Cases 5, 7, and 10) made it central to their interventions. For instance, Case 10 planned professional development workshops for teachers to closely integrate technology, showing advanced planning.

Urban, well-funded schools linked technology with better infrastructure, while rural, less-resourced schools focused on immediate issues. Clear technology goals were set more often by principals with leadership training, not necessarily by those with more resources. This supports Hallinger's [9] view that instructional leaders manage resources, while transformational leaders build vision and culture in technology integration. Most principals matched the first leadership style, while a few adopted the second through teamwork.

Theme 2: Implementation Initiatives and Perceived Impact: Despite some challenges, principals attempted to implement creative initiatives, though sustainability varied. Smartboards were the most common resource, sometimes implemented school-wide (Case 2) or used selectively. Case 5's STEM program and Case 10's resource bank got students more involved in the teaching learning process with effective technology integration. Principals noticed increased student motivation due to the use of technology. Case 6 observed, "Students like this technology a lot." But as Case 1 noted, "It is difficult to provide resources to every child." Well-resourced schools used technology widely, while others did so selectively. Unequal access reflects the

'equity paradox', where small gains can actually widen gaps. Therefore, broad, policy-level solutions, not just school-level actions, are needed to ensure fairness.

Theme 3: Teacher Support Strategies and Resource Management: Teacher support approaches varied. Well-equipped schools organized training and learning spaces. For instance, Case 5 planned professional workshops with experienced teacher-led sessions. In resource-poor schools, support was informal; sometimes, teachers helped each other, or external help was sought. Principals also encouraged collaboration, especially with older staff. Case 7 noted, "peer subject teachers develop their lesson plans together." Such structures improved teacher confidence and collective ownership. Shared leadership also proved valuable. Schools with teacher involvement saw broader engagement, regardless of resources. Transformational leaders empowered teachers, while instructional leaders managed tasks.

Theme 4: Implementation Barriers and Adaptive Strategies: Principals encountered resource shortages, weak infrastructure, and staff hesitancy, especially among older teachers. Examples include malfunctioning tablets, lack of electricity, and slow internet. Principals responded with adaptive scheduling, teacher collaboration, and community partnerships. These solutions were resourceful but often unstable and reliant on personal networks. Principals with more resources could focus on things like keeping staff motivated and maintaining equipment, but those with fewer resources faced bigger problems they could not fix alone. This contrast reveals that leadership by itself cannot solve deep-rooted inequalities; even strong leaders need good policies and fair resource distribution to make lasting changes.

Theme 5: Policy Engagement and External Support: Most principals said they did not know much about national ICT policies and instead, followed general Ministry instructions or local plans. Only Case 10 used specific frameworks like e-Thaksalawa and ICT in the Education Master Plan. Another key contrast was in the sources of outside help for resources. For instance, most support came from donors, private groups, or alumni, not from government programs. Without policy clarity, principals improvised. Strict rules like a 'WhatsApp ban' hindered innovation in technology integration into the teaching learning process. Even well-resourced leaders had limited knowledge of national frameworks on tech integration. Lack of actionable policy, not resistance, limited principals. Existing policies lacked practical tools and training. Most principals responded reactively. Effective technology integration requires vision, clear policy, resources, and accountability.

Taking all five themes together, these findings reveal that while most Sri Lankan principals focus on managing resources, training, and infrastructure, only a few demonstrate transformational leadership by setting clear goals, sharing responsibilities, and encouraging innovative technology use. Shifts in schools depend more on principal adaptability and training than resources alone. Persistent challenges such as weak policy support and unequal infrastructure access limit principals' efforts to create lasting change. Overall, the results highlight that successful technology integration in schools requires strong leadership, clear policy, ongoing learning, and equitable resource distribution.

5. DISCUSSION

5.1 Theoretical Framework: Hallinger's Instructional vs. Transformational Leadership

Technology leadership among Sri Lankan school principals is divided into instructional and transformational roles, following Hallinger's [9] framework. Instructional leaders provide hardware, organize training, manage resources, and ensure technology use. Seven out of ten principals adopt mainly this approach. It ensures that technology is available but rarely changes teaching culture or vision. In contrast, transformational leaders build a shared vision, encourage responsibility, support teacher initiatives, connect technology to school goals, and commit to advancing learning [24].

Turning to transformational leadership, only three principals (Cases 5, 7, 10) demonstrated clear transformational dimensions. Case 5 articulated an explicit STEM vision, fostered peer learning across generations, and built innovation through collaborative structures. Case 7 emphasized collaborative planning, delegated leadership among subject teachers, and positioned technology as a pedagogical tool rather than as equipment. Case 10 translated national policy into concrete innovation, scaled successful initiatives, and engaged with broader systemic frameworks.

All three principals who showed transformational leadership worked in well-resourced urban schools, raising a central question: Does transformational leadership depend on abundant resources, or can it develop with limited means? The evidence reveals both scenarios. While ample resources ease technology initiatives, limited resources can foster innovation through collaboration and peer support. It is noteworthy here that transformational leadership is uncommon because it rarely develops without intentional support [25]. Professional development is essential; otherwise, most principals default to instructional management. Transformational technology leadership, therefore, must be deliberately cultivated, not left to chance.

5.1.2 The Conceptual Model: Principal Technology Leadership in Resource-Constrained Contexts

Based on the five themes, a new model emerges: Principal technology leadership occurs where three key factors, capacity, vision, and agency, converge. This model suggests that effective leadership combines

practical resources, a forward-looking vision, and the capacity to adapt and lead. Principals and policymakers should consider how each factor influences technology outcomes and aims to strengthen all three for sustained improvement.

Capacity means having the necessary resources, such as equipment, internet access, funding, and time for professional development. Vision involves clearly defining how technology supports teaching and school improvement, aligning with national goals. Agency refers to each individual principal's willingness and ability to adapt, innovate, and lead change, even in the face of challenges.

In the well-resourced schools (Cases 1, 5, 7, 8), capacity is high, but vision development is often lacking, leading to technology use without transformative intent. Agency is not strongly challenged in these settings due to fewer resource problems.

In the less resourced schools (Cases 3, 4, 9), limited capacity pushes principals to innovate. They create partnerships, peer learning, and new uses for resources. Still, these solutions are fragile because they depend on people and networks that policies or staff changes can disrupt. The primary solution remains aligning vision, capacity, and agency. Achieving this alignment requires three system-wide supports:

- Clear national policy frameworks (addressing current "policy silence")
- Equitable resource distribution (enabling capacity in under-resourced schools)
- Systematic professional development (cultivating vision and transformational practice)

When these three factors are misaligned, principals merely react to challenges instead of leading real change. Even skillful principals cannot sustain transformational efforts without clear policies, sufficient resources, and ongoing leadership training. Thus, lasting technology leadership requires system-wide commitment to align these elements.

These patterns across cases are synthesised in Table 2, which compares the alignment of capacity, vision, and agency across well-resourced, under-resourced, and model schools.

Table 2. Summary of Findings across Cases: Alignment of Capacity, Vision, and Agency

Factor	Well-Resourced Urban (Cases 1, 5, 7, 8)	Under-Resourced Rural (Cases 3, 4, 9)	Model Case (Case 10: Urban + Transformational)
Capacity	High (abundant equipment, infrastructure, funding)	Low (minimal equipment, infrastructure gaps, budget constraints)	High
Vision	Mixed: mostly embedded, not explicit except in Cases 5, 7	Embedded; limited articulation due to survival focus	Explicit technology-centered vision
Agency	Moderate: problem-solving within structures; limited pressure for innovation	High: necessity-driven adaptation; creative partnerships; peer networks	High: deliberate alignment of policy, innovation, resource management
Leadership Type	Primarily Instructional (resource management, training)	Mixed Instructional + Necessity-Driven Transformational	Emergent Transformational (vision-aligned, distributed, policy-engaged)
Implementation Pattern	Systematic but not pedagogically integrated; technology as add-on	Ad-hoc but sometimes creative; sustainability challenges	Scaled; aligned to policy; demonstrates sustainability potential
Key Barrier	Lack of coherent vision; limited transformational practice	Structural constraints (policy gaps, resource scarcity); agency constrained by capacity limits	Nonsignificant; serves as a model
Policy Engagement	Superficial; general Ministry directives	Minimal; no explicit frameworks	Active engagement with e-Thaksalawa; translation into innovation
Implication	Capacity alone does not guarantee transformational leadership; vision requires explicit	Capacity constraints create systemic barriers beyond individual principal agency; policy-level intervention necessary	Vision + policy alignment + strategic resource management can drive transformational practice in urban contexts; transferability to rural contexts depends on capacity

cultivation	investment

5.2 In-depth Analysis: The Policy-Practice Gap as a Systemic Leadership Constraint

Theme 5 revealed that although national ICT policies such as the NEC Master Plan, e-Thaksalawa, and the Smart School project are in place, they lack clear implementation structures, principal training, and accountability systems. Instead of active resistance, there is a lack of guidance, so principals are left to figure things out on their own. In Case 10, when policies were clear and easy to access, the principal was able to put them into practice. On the other hand, when Ministry instructions were unclear, principals had to make decisions based on their own judgment instead of using evidence-based guidance.

This issue is especially important when considering transformational leadership. Without strong policy support, principals are unable to clearly define a vision for technology or explain how they utilize resources. Their authority becomes limited to solving immediate problems. The lack of a clear policy also indicates insufficient investment in training principals to lead technology integration. Without training, research-based advice, or opportunities to learn from peers, principals tend to react to problems as they arise instead of planning ahead.

The way external support is organized also shows that the system is not well aligned. Donor programs, private partners, and alumni groups operate independently of government efforts, resulting in a patchwork that is unsustainable. In Case 10, the principal successfully utilized several outside resources, but this success was limited to that one case and not integrated into the larger system. This shows that while principals can be innovative, real progress depends on the whole system working together. Policy-level intervention is therefore prerequisite for school-level leadership effectiveness. Principals cannot transform technology practice without:

I. Clear national frameworks guiding implementation with specific operational guidance.
II. Equitable resource allocation ensuring capacity across school types.
III. Systematic professional development cultivating vision and transformational practice
IV. Accountability mechanisms linking school efforts to national objectives and providing feedback loops.

Fullan [26] suggests that lasting educational change depends on aligning systems. When individual efforts are not supported by clear policies, fair resources, and strong capacity building, improvements tend to remain isolated. In Sri Lanka, principals demonstrate strong adaptability, yet they operate within a system characterized by policy gaps, unequal resources, and limited investment in leadership development. Addressing these issues is essential for technology integration to succeed on a larger scale.

5.3 Emerging Insight: The "Innovation Paradox" in Constrained Contexts

An unexpected finding was that resource constraints sometimes encouraged innovation instead of holding it back. In Cases 9 and 10, principals used community partnerships, alumni networks, and repurposed resources in creative ways. Because they did not have standard solutions, they had to improvise. This led to inventive approaches. Still, this kind of innovation is fragile. Many solutions relied on personal relationships and informal networks, which made them vulnerable to changes in staff, policies, or funding. For example, the partnership in Case 9 could end if the community liaison left or priorities changed. The innovations in Case 10, while impressive, remained confined to the school level and did not extend more widely.

This suggests that while leadership ingenuity can mitigate systemic constraints, it cannot replace them. Sustainable technology integration requires that innovative practices be institutionalized. Specifically, this should be achieved through policy, training, and resource allocation, rather than through relying on individual principal commitment or fortuitous partnerships. While the presence of innovation in constrained contexts is encouraging, its fragility underscores the need for systemic support.

5.4 Cross-Context Comparison: Developed vs. Developing Country Contexts

Research from developed countries shows that technology leadership works best with a clear vision, ongoing professional development, and teamwork, all of which must be supported by reliable infrastructure. In contrast, principals in developing countries face additional challenges, including limited resources, bureaucratic hurdles, and discrepancies between policy and practice. For instance, the Turkish Fatih project [16] is a good example: even with strong policy goals, it struggled because plans at the top did not match with what was happening in schools; this mirrors the findings of this Sri Lankan study as well.

International evidence also shows that strong principal leadership, especially when it builds confidence and skills, can help overcome teacher resistance. Slowly, such leadership can change practices even when resources are limited. In other words, leadership can sometimes compensate for system weaknesses, although the effectiveness of this approach varies by context. The findings from this study support and add to the existing evidence, indicating that Sri Lankan principals demonstrated adaptability and commitment. Furthermore, with the right policy support, professional development, and fair resource distribution, transformational technology leadership is indeed possible in developing countries. The goal is not for developing countries to match the resources of developed ones. Instead, they must encourage leadership that aligns with the local context and

complement it with smart policies and targeted investments to achieve meaningful and effective technology integration.

5.5 Theoretical Insights

The findings map onto educational leadership theory, which distinguishes instructional (task-focused) from transformational (vision-focused) leadership. Most principals demonstrated instructional leadership, which, although necessary, is insufficient for sustainable technology adoption. The three principals showing transformational dimensions (Cases 5, 7, 10) shared a key characteristic. They deliberately articulated technology visions and cultivated distributed responsibility among teachers. This suggests that transformational technology leadership emerges through deliberate cultivation, rather than from mere resource abundance.

The study created a model that brings together three key factors: capacity (having enough resources), vision (clear teaching goals), and agency (the principal's commitment and flexibility). For technology leadership to work well, these factors need to be in balance. This requires support from good policies, fair resource sharing, and professional development. In well-resourced urban schools, despite having plenty of resources, there was a lack of focus on vision, which limited significant changes. In rural schools with fewer resources, the lack of capacity created problems that principals could not solve on their own. On the other hand, Case 10 demonstrated that when resources, a clear vision, and policy support converged, the most advanced innovations occurred. Even then, however, these innovations remained local.

The most important finding was system-wide barriers. Principals were held back more by the overall environment than by their own skills. Without clear national plans, enough professional development focused on technology, fair resource distribution, and coordinated outside support, even the most capable principals could only make small, local improvements. They could not lead bigger changes.

6. CONCLUSION

This study examined the challenges faced by school principals in Sri Lanka within diverse contexts when they attempt to integrate technology into the teaching-learning process. The findings reveal that principals navigate technology integration through varied leadership approaches, primarily adopting instructional leadership roles focused on resource management and infrastructure provision, while only a minority demonstrate transformational leadership characterized by clear vision articulation and distributed responsibility. The principal challenges identified include limited resources, inadequate infrastructure, teacher resistance, and most critically, a significant policy-practice gap resulting from unclear national implementation frameworks and insufficient professional development opportunities. These challenges are exacerbated by contextual disparities between urban and rural schools, language-medium divisions, and unequal resource distribution across school types. The study demonstrates that while individual principal capacity and innovation are necessary, they are insufficient without systemic support. Effective and equitable technology integration across Sri Lankan schools requires clear policy frameworks, equitable resource distribution, systematic professional development targeting transformational leadership competencies, and coordinated implementation mechanisms that align capacity, vision, and agency at both school and system levels.

Future research should adopt longitudinal designs to track how principals' technology leadership evolves over time, particularly following targeted professional development interventions or policy reforms, to identify the most effective pathways for developing transformational technology leadership in resource-constrained contexts. Additionally, research incorporating multiple stakeholder perspectives—including teachers, students, and community members—would provide a more comprehensive understanding of how principal leadership translates into actual classroom practice and student learning outcomes, thereby strengthening the evidence base for policy and practice recommendations.

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