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REIMAGINING SCHOOL EFFECTIVENESS IN THE DIGITAL ERA: THE MEDIATING ROLE OF TEACHERS' DIGITAL COMPETENCE IN DIGITAL INSTRUCTIONAL LEADERSHIP IN NIGERIA

Bernadine Ifenna Aronu[1], Theresa Stephen Gyang, PhD[2] & Prof. Timson I. Ndupuechi[3]
[1,2,3]*Department of Educational Foundations, University of Jos, Nigeria*
aronuifennabernadine@gmail.com

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ABSTRACT
The rapid digitalization of education has transformed the leadership responsibilities of school principals and redefined expectations for effective school management in the twenty-first century. As educational institutions increasingly adopt digital technologies to support teaching, learning, communication and administration, principals are expected to function as digital instructional leaders capable of guiding technology integration and fostering innovation. Despite growing investments in educational technologies, school effectiveness remains a concern in many developing countries, including Nigeria. This conceptual paper, based on a purposive narrative review of peer-reviewed literature published between 2017 and 2024 and accessed through Google Scholar, ERIC and ResearchGate, examines the relationship between digital instructional leadership and school effectiveness. It argues that teachers' digital competence serves as the critical mediating mechanism through which leadership practices influence educational outcomes, a claim grounded in Baron and Kenny's (1986) causal steps framework for mediation analysis. Drawing on Transformational Leadership Theory, Instructional Leadership Theory and the Technology Acceptance Model, the paper synthesizes contemporary literature on digital instructional leadership, teachers' digital competence and school effectiveness. The paper contends that principals who promote digital vision, instructional supervision, data-driven decision-making, effective communication and professional development are more likely to cultivate digitally competent teachers. Such competence enables teachers to integrate technology effectively into pedagogical practices, thereby enhancing instructional quality, student engagement, academic achievement and overall school effectiveness. The paper proposes a conceptual framework linking the three constructs, highlights implications for educational leadership and policy and calls for future empirical research to test the proposed mediation model in Nigerian secondary school contexts.

Keywords: Digital instructional leadership, teachers' digital competence, school effectiveness, educational technology, instructional leadership.

Introduction

The rapid advancement of digital technologies has fundamentally transformed educational systems across the globe, altering how schools are organized, how knowledge is transmitted and how leaders make decisions. The Fourth Industrial Revolution (4IR), characterized by artificial intelligence, big data, cloud computing and digital connectivity, has reshaped how teaching, learning and school administration are conducted in profound and irreversible ways. Educational institutions are increasingly adopting digital platforms to facilitate communication, instructional delivery, assessment and data management across all levels of education. As a consequence, schools are expected to prepare learners with the competencies required to function effectively in a technology-driven society (UNESCO, 2023). The COVID-19 pandemic exposed the depth of this transformation: schools with robust digital readiness continued learning remotely with relative success, while those that lacked it were left behind. This disparity underscored a critical insight — the ability to integrate technology is not incidental to school effectiveness but central to it. Nigeria's federal educational structure and the diversity of its school governance make this analysis especially urgent: policy frameworks exist at national and state levels, but implementation quality varies enormously from one institution to the next, leaving many schools poorly equipped for digital-era demands.

Despite considerable investment in educational technology across Nigerian secondary schools, the anticipated improvements in school effectiveness have not materialized uniformly. Three interrelated problems motivate this inquiry. First, many principals lack adequate grounding in digital instructional leadership, limiting their capacity to drive meaningful technology integration. Second, even where leadership capacity exists, teachers frequently lack the digital competence necessary to translate leadership intentions into effective classroom practice. Third, the scholarly literature in Nigeria has not yet produced a theoretically grounded framework articulating how these variables interact to produce school-level outcomes. This paper addresses all three problems by arguing that teachers' digital competence mediates the relationship between digital instructional leadership and school effectiveness. This claim draws explicitly on Baron and Kenny's (1986) causal steps framework, which holds that M mediates the X–Y relationship when X significantly predicts M, M significantly predicts Y and the direct effect of X on Y is attenuated when M is controlled. The paper applies this logic at a conceptual level, tracing each pathway through the available literature and proposing a framework testable in future empirical research.

The paper is organized as follows. Section One reviews digital instructional leadership, its dimensions and its relationship with school improvement. Section Two examines teachers' digital competence as a strategic organizational resource. Section Three reconceptualizes school effectiveness in the digital era. Section Four develops the mediation argument and proposes the conceptual framework. The paper concludes with implications for practice, policy and future research. By developing a locally relevant, theoretically grounded framework, the paper contributes to the growing literature on digital transformation in Nigerian education and provides a foundation for the empirical investigations that are urgently needed to guide evidence-based policy and professional practice in the country's secondary school system (Ogbeche et al., 2024).

Concept of Digital Instructional Leadership

The increasing integration of digital technologies into educational systems has necessitated a reconceptualization of instructional leadership. Digital instructional leadership refers to the capacity of school leaders to leverage digital technologies to improve teaching, learning, communication, decision-making and overall school performance. Unlike traditional

instructional leadership, which focuses primarily on curriculum supervision and classroom monitoring, digital instructional leadership incorporates technology-driven strategies that facilitate innovation and continuous improvement within schools (Okunlola, 2023). The shift toward digital instructional leadership is not merely additive; it is reconstitutive, requiring principals to revise their understanding of authority, expertise and improvement at a fundamental level. Whereas traditional instructional leaders derived authority partly from curriculum expertise, digital instructional leaders must also guide teachers through technological uncertainty while articulating a clear institutional vision for technology use. This dual demand makes the role significantly more complex and it is one for which most Nigerian principals have not yet been adequately prepared — a gap that this paper seeks to highlight and that policymakers should urgently address. Bush (2020) cautions that leadership models developed in Western systems do not always translate cleanly into developing-country governance structures, underscoring the need for contextually adapted frameworks for digital leadership in Nigeria.

A critical responsibility of digital instructional leaders is the development of a clear digital vision that aligns technology initiatives with educational goals. Digital vision refers to a leader's ability to articulate a future-oriented direction for technology integration and inspire stakeholders toward its achievement. Strategic planning involves designing policies, allocating resources and establishing implementation frameworks that support digital transformation within schools. Without a compelling and coherent digital vision, technology initiatives in schools tend to be fragmented: individual teachers adopt tools idiosyncratically, resources are allocated without clear priorities and the institution lacks a shared narrative about what technology is for. Research suggests that schools are more likely to achieve successful technology integration when leaders establish coherent digital visions and strategic priorities (OECD, 2021). A clearly articulated digital vision provides guidance for teachers, students and other stakeholders, ensuring that technology investments contribute meaningfully to instructional improvement rather than becoming isolated initiatives. In Nigerian secondary schools, strategic planning is particularly important because resource constraints require school leaders to make deliberate decisions about technology acquisition and utilization. Principals who lack a coherent digital vision cannot make these trade-offs intelligently, typically resulting in institutions that acquire technology without institutionalizing its effective use — a well-documented pattern in Nigerian public secondary schools.

Digital Communication and Supervision

Effective communication and instructional supervision are foundational responsibilities of school leaders and digital technologies have significantly transformed both. Digital communication involves the use of emails, learning management systems, social media platforms and virtual meeting tools to facilitate information sharing and collaboration within and beyond the school community. According to UNESCO (2023), digital communication systems have become indispensable for maintaining organizational effectiveness and supporting teaching and learning activities. Digital instructional leaders who foster collaborative digital cultures contribute to environments where professional learning and collective responsibility for school improvement are institutionalized rather than occasional. Instructional supervision has likewise been transformed: digital platforms enable principals to review lesson plans, analyze student performance data, monitor instructional delivery remotely and provide timely feedback to teachers — practices that Hallinger (2020) identifies as essential to effective instructional leadership. In digital environments, these supervisory functions can be performed with greater frequency and precision than traditional observation-based models allow, though effective digital

leaders must balance accountability with professional respect to avoid creating surveillance cultures that undermine teacher autonomy and trust. In Nigerian secondary schools, where class sizes are large and supervision opportunities are limited, these digitally enhanced supervisory tools represent a significant leverage point for improving instructional quality.

Data-Driven Decision Making and Professional Development Support

Data-driven decision-making has emerged as a defining characteristic of effective educational leadership in the digital era, shifting the basis of institutional judgment from intuition toward systematic analysis of student performance, teacher effectiveness and resource utilization. Digital instructional leaders utilize technological tools to collect, analyze and interpret educational data for planning and improvement purposes. The OECD (2021) notes that schools employing data-informed leadership practices are more likely to achieve improved educational outcomes. However, data-driven leadership carries risks: data can be misinterpreted, metrics can be gamed and the emphasis on measurable outcomes can narrow curriculum. Effective digital instructional leaders are therefore not merely data consumers but critical interpreters, distinguishing between what numbers reveal and what they conceal. Teachers' ability to integrate technology depends on opportunities for professional learning, making professional development support one of the most consequential dimensions of digital instructional leadership. The DigCompEdu framework identifies professional engagement and continuous learning as essential components of teacher digital competence (Redecker, 2017). Principals who invest in teachers' professional growth contribute to the development of digitally competent teaching workforces capable of responding to contemporary educational demands. In Nigerian secondary schools, where training budgets are often inadequate, effective digital leaders must creatively source non-budgetary opportunities including peer mentoring, professional networks and partnerships with universities and educational technology organizations.

Teachers' Digital Competence as a Strategic Resource

1. Concept and Framework of Teachers' Digital Competence

The success of digital transformation initiatives in education depends significantly on teachers' ability to utilize technology effectively for instructional purposes, making teachers' digital competence a strategic organizational resource rather than merely a personal professional attribute. Teachers' digital competence refers to the knowledge, skills, attitudes and professional dispositions required to use digital technologies confidently, critically and creatively in teaching, learning, assessment, communication and professional development activities (Redecker, 2017). The present paper adopts the DigCompEdu framework as its primary organizing lens because of its pedagogical focus and its emphasis on transformative rather than substitutive technology integration. This choice is made deliberately: the UNESCO ICT Competency Framework for Teachers (ICT-CFT) organizes competence around levels of adoption, while DigCompEdu focuses on pedagogical application — a distinction that aligns more closely with the school effectiveness outcomes of concern in this paper. DigCompEdu identifies six domains of teacher digital competence: professional engagement, digital resources, teaching and learning, assessment, empowering learners and facilitating learners' digital competence. These domains reflect a multi-dimensional conception of competence that resists reduction to technical skill alone, insisting instead that digital competence encompasses judgment, creativity and ethical reflection. The COVID-19 pandemic made the strategic importance of these competencies viscerally apparent: teachers with adequate digital competencies maintained instructional continuity, while those without struggled to deliver basic educational services, with

disadvantaged students disproportionately harmed by the inequality in teacher digital preparedness (UNESCO, 2023).

2. Dimensions of Teachers' Digital Competence

ICT operational competence refers to teachers' ability to use digital devices, software applications and technological systems reliably and confidently. This foundational competence is the prerequisite for all more sophisticated dimensions of digital teaching practice. According to Lucas et al. (2021), teachers' technological proficiency is influenced by both personal and contextual factors, with access to technology emerging as the most consistently significant predictor of proficiency. In Nigerian secondary schools, unequal access creates systematic disparities between urban and rural teachers, making operational competence an equity issue as much as a professional one. Digital communication competence involves the ability to use technology-mediated platforms — emails, virtual conferencing, discussion forums and learning management systems — to interact effectively with students, colleagues and parents. Zhao et al. (2021) found that digital communication skills are essential for effective teaching in technology-rich environments and are increasingly associated with perceived professional credibility. Digital content creation competence enables teachers to design, develop and share digital instructional materials tailored to learners' needs. Dogan et al. (2021) demonstrated that teachers' capacity to create digital materials significantly influences technology integration quality, with content creation training producing stronger gains than tool operation training alone. Data management competence involves the ability to collect, organize, interpret and apply educational data to instructional improvement. Digital pedagogical competence represents the apex of teachers' digital competence, involving the selection and design of technology-enhanced learning experiences that promote active learning, collaboration and critical thinking — and that transform rather than merely replicate traditional instruction (Hizam et al., 2021).

3. Strategic Importance of Teachers' Digital Competence

The increasing digitalization of education has elevated teachers' digital competence from a desirable attribute to a strategic organizational necessity. Teachers serve as the primary agents through which educational innovations are implemented within classrooms; consequently, the gap between digital leadership intentions and classroom digital practice is a function of teacher competence more than any other single variable. A critical insight that has been underemphasized in much of the literature is that teachers' digital competence is not a fixed personal trait but a dynamic and contextually embedded professional capability that can be developed, sustained, or eroded by the institutional environment in which teachers work. This insight is crucial for understanding the role of digital instructional leadership: principals do not merely select for digitally competent teachers; they create or destroy the conditions under which digital competence develops. From a school effectiveness perspective, teachers' digital competence represents a valuable organizational resource that can enhance instructional quality, improve student performance and support institutional innovation — provided that the institutional environment, shaped primarily by leadership, is conducive to its development and application (Lucas et al., 2021). Teachers with high levels of digital competence are more likely to adopt innovative teaching strategies, enhance student engagement, improve learning outcomes and contribute positively to school improvement efforts by modeling creative and critical uses of technology for colleagues and students alike. For school leaders in Nigeria, this means that investing in teacher digital competence is not a peripheral concern but the single most leverage-intensive investment available to improve school effectiveness in the digital era.

Rethinking School Effectiveness in the Digital Era

1. Conceptualizing School Effectiveness

School effectiveness refers to the extent to which a school successfully achieves its educational objectives through the optimal utilization of available resources and processes. Traditionally, it has been measured by student academic achievement, teacher performance, school climate and organizational efficiency. However, the increasing digitalization of education has expanded the concept to include schools' capacity to adapt to technological innovations and prepare learners for participation in a knowledge-based society (Hallinger, 2020). Contemporary schools operate in environments characterized by rapid technological change, evolving learner expectations and increasing demands for innovation, which means that effectiveness can no longer be assessed at a single point in time but must be understood as a dynamic, adaptive capability. Effective schools are not only those that produce favorable academic outcomes in a given year but also those that successfully integrate digital technologies into teaching, learning and administrative processes in ways that build institutional capacity for ongoing improvement. This broader understanding underscores the importance of leadership and teacher competencies as not merely inputs to educational processes but as constitutive elements of educational quality itself. The present paper adopts this expanded conception of school effectiveness and operationalizes it through five indicators: academic achievement and learning outcomes, teacher performance and instructional quality, school climate and organizational effectiveness, student engagement and retention and goal attainment. Each indicator is examined below in the context of digital transformation.

2. Indicators of School Effectiveness in the Digital Era

Academic achievement remains the most widely recognized indicator of school effectiveness and the integration of digital technologies has the potential to enhance it by providing access to diverse learning resources, facilitating personalized instruction and promoting active engagement through interactive and multimedia-rich experiences. However, the benefits of educational technology depend significantly on teachers' ability to integrate digital tools effectively into pedagogical practices, which returns analysis to the centrality of teacher competence as the mechanism through which technology investments produce learning outcomes (UNESCO, 2023). Teacher performance and instructional quality are fundamental determinants of educational quality and in digitally enabled learning environments they increasingly depend on teachers' ability to utilize technology to support learning processes in pedagogically intentional rather than incidentally technological ways. Investments in teacher development therefore contribute directly to improvements in instructional quality and overall school effectiveness. School climate, as the quality of relationships, norms and practices characterizing the school environment, is significantly shaped by the communicative and collaborative affordances of digital technologies when deployed under effective leadership (Sunday & Awodiji, 2023). Student engagement, documented as an important predictor of academic achievement and retention, is enhanced by digital tools that provide interactive, personalized and immediately responsive learning experiences — but only when teachers possess the competencies to harness these affordances deliberately (Ogbeche et al., 2024). Goal attainment in digitally driven schools increasingly depends on the alignment of leadership practices, teacher

competencies and technological resources, making a holistic and integrated approach to school improvement planning essential for sustained effectiveness.

Why Teachers' Digital Competence Mediates the Relationship Between Digital Instructional Leadership and School Effectiveness

The claim that teachers' digital competence mediates the relationship between digital instructional leadership and school effectiveness is grounded in the causal steps framework for mediation analysis developed by Baron and Kenny (1986). In their foundational paper, Baron and Kenny define a mediating variable as one that accounts for the relationship between a predictor and an outcome such that the predictor influences the mediator, which in turn influences the outcome. Applied to the present context, this framework requires demonstrating, at minimum at a conceptual level, three pathways: that digital instructional leadership significantly influences teachers' digital competence (path a); that teachers' digital competence significantly influences school effectiveness (path b); and that the direct relationship between digital instructional leadership and school effectiveness is attenuated when teachers' digital competence is controlled (path c to c'). The existing literature provides substantial conceptual and empirical support for each pathway. Principals who invest in professional development, facilitate technology access and create supportive digital cultures are consistently associated with higher levels of teacher digital competence. Teachers with higher digital competence consistently produce stronger instructional outcomes, higher student engagement and better school climate. And the leadership–effectiveness relationship is repeatedly found to operate indirectly through teacher-level variables rather than through direct principal-to-student pathways (Hallinger, 2020). Together, these bodies of evidence establish the plausibility of the mediation model and create a foundation for future empirical tests using structural equation modeling or Hayes's PROCESS macro in Nigerian secondary school populations.

How Principals Build Teachers' Digital Capacity and Why Teachers Function as Policy Translators

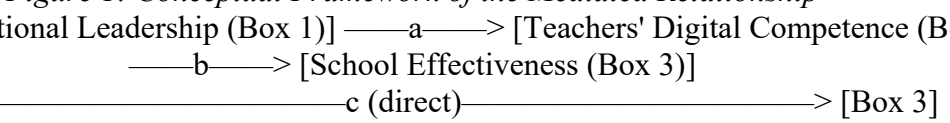
Although principals establish strategic direction and provide leadership for technology integration, they do not directly influence students' daily learning experiences. Their institutional impact must therefore flow through teachers — the final-mile implementers of institutional decisions. Teachers serve as the primary agents through whom leadership visions, resource investments and professional development opportunities are converted into the daily instructional interactions that directly shape student learning. The success of digital leadership initiatives consequently depends on teachers' capacity to translate leadership visions into effective classroom practices. Digital instructional leadership creates the enabling conditions for technology integration, but teachers' digital competence determines whether those conditions produce meaningful educational outcomes or merely expensive but educationally inert technological acquisitions. Alonge and Iwerebor (2023) demonstrated this dependency empirically in South-South Nigeria, finding that principal leadership effects on school outcomes were fully mediated by teacher professional behavior — a finding that, in the digital era, is increasingly synonymous with teacher digital competence. Principals contribute to teachers' digital capacity through several specific practices: providing access to professional development opportunities, facilitating mentoring relationships, allocating technological resources and promoting an institutional culture in which professional experimentation with digital tools is encouraged rather than penalized. Okunlola (2023) argues that effective digital leaders shape organizational readiness for technological transformation through precisely these practices,

building the human capacity that determines whether infrastructure investments translate into instructional improvement.

A Conceptual Framework for the Mediation Process

Based on the foregoing review, this paper proposes a conceptual framework grounded in Baron and Kenny's (1986) causal steps logic. The framework consists of three conceptually distinct components linked by theorized causal pathways. The first component, Digital Instructional Leadership, encompasses five dimensions: digital vision and strategic planning, digital communication and collaboration, digital instructional supervision, data-driven decision-making and digital professional development support. These dimensions represent the specific leadership practices through which principals are hypothesized to develop teachers' digital competence. The second component, Teachers' Digital Competence, encompasses five dimensions drawn from the DigCompEdu framework (Redecker, 2017): ICT operational competence, digital communication competence, digital content creation competence, data management competence and digital pedagogical competence. These dimensions represent the teacher-level capabilities through which leadership practices are translated into classroom practice and, ultimately, into educational outcomes. The third component, School Effectiveness, encompasses five indicators: academic achievement and learning outcomes, teacher performance and instructional quality, school climate and organizational effectiveness, student engagement and retention and goal attainment. The framework posits that Digital Instructional Leadership (Box 1) exerts a primary indirect effect on School Effectiveness (Box 3) through its influence on Teachers' Digital Competence (Box 2), with a secondary direct effect retained to reflect the partial mediation structure consistent with Baron and Kenny's (1986) model. This framework is intended as a testable model for future empirical research using survey instruments validated for Nigerian secondary school contexts.

Figure 1: Conceptual Framework of the Mediated Relationship



Implications for Educational Leadership and Policy

Principals should move beyond traditional administrative responsibilities and embrace digital instructional leadership practices that promote innovation, collaboration and continuous learning in ways that are visible and persistent rather than episodic and performative. This transition requires a fundamental reconfiguration of how principals understand their professional role: from administrators who manage compliance to instructional leaders who cultivate competence. Specifically, principals should prioritize the development of teachers' digital competence as a strategic component of their school improvement plans, treating it not as an optional professional development amenity but as a core institutional priority whose achievement is tracked and evaluated over time. Designing professional development programs that explicitly target the five dimensions of digital competence identified in this paper — from basic ICT operational skills to sophisticated digital pedagogical competence — is the most leverage-intensive investment a principal can make in improving school effectiveness (Hallinger, 2020). Principals who sustain this investment consistently are more likely to lead schools that improve continuously and that develop the institutional resilience necessary to adapt to future technological changes that cannot yet be anticipated.

Educational stakeholders should design professional development programmes that focus on both technological skills and their pedagogical applications, recognizing that the ultimate goal

is not technically proficient teachers but instructionally effective ones who use digital tools with confidence and creativity. Continuous training is necessary to ensure that teachers remain responsive to emerging technological trends and educational innovations; professional development for digital competence cannot be a one-time event but must be an ongoing, embedded feature of professional life. Effective programs should include peer coaching, collaborative lesson design, guided reflection on digital tool effectiveness and systematic analysis of student outcome data as evidence of competence development (Redecker, 2017). At the policy level, federal and state education ministries should incorporate digital instructional leadership competencies into principal professional standards and teacher licensing frameworks, making digital proficiency a criterion for selection, appraisal and salary progression. Technology acquisition policies should require accompanying human capacity development plans, ensuring that every infrastructure investment is linked to a specific professional development program. Policy frameworks should also address equity explicitly, directing disproportionate investment toward underserved rural and peri-urban schools where the technology gap is greatest and the potential gains from improved digital instruction are highest (UNESCO, 2023).

Conclusion

This paper has advanced three interconnected arguments about the relationship between digital instructional leadership, teachers' digital competence and school effectiveness in the Nigerian secondary school context. The first is conceptual: digital instructional leadership, teachers' digital competence and school effectiveness are each multi-dimensional constructs that require theoretically grounded frameworks for analysis and improvement. The second is structural: these constructs are causally linked in a mediation configuration in which teachers' digital competence transmits the effects of digital instructional leadership to school effectiveness outcomes, following the causal logic of Baron and Kenny (1986). The third is practical: this mediation structure has direct implications for how principals should lead, how professional development should be designed and how educational policy should be framed. The paper has synthesized a substantial body of international literature to support all three arguments while acknowledging the inherent limitations of a conceptual paper that draws primarily on research conducted outside Nigeria. The framework represents a starting point for a research agenda rather than a definitive account and its most important contribution may be the specification of what needs to be tested rather than what has already been proven. Ultimately, reimagining school effectiveness in the digital era requires educational stakeholders to recognize that technology alone does not transform schools; people do. Principals who cultivate digitally competent teachers are therefore more likely to lead schools that improve continuously and that thrive in an increasingly complex and technology-driven educational landscape. For Nigerian secondary schools, prioritizing the simultaneous development of digital instructional leadership and teachers' digital competence — through aligned policy, sustained professional development, adequate resourcing and coherent accountability frameworks — represents the most credible and sustainable pathway toward improved instructional quality, stronger student outcomes and greater organizational effectiveness (Bush, 2020).

Recommendations

1. Educational authorities must embed digital instructional leadership into principal selection criteria and performance reviews, treating it as a non-negotiable competency rather than an optional skill. Ongoing professional development should then be practice-embedded and co-designed with principals, with success measured by tangible gains in teacher digital skills and school-wide outcomes, not by workshop attendance alone.

2. Schools should prioritize sustained, pedagogy-first training that covers all DigCompEdu dimensions, moving beyond basic tool operation to transformative classroom integration. This development must be woven into daily routines via peer coaching and collaborative planning, with rigorous evaluation based on improved teaching practices and student achievement rather than mere participation counts.
3. National and state education ministries must craft policies that clearly define digital leadership and teacher competence as core drivers of school effectiveness, while mandating that technology purchases include robust human-capacity plans. These frameworks should explicitly target equity by channeling extra resources to under-served schools, ensuring that policy closes—rather than widens—the digital divide.
4. School leaders and teachers require systematic support to build data literacy, alongside accessible systems that present student performance clearly, enabling evidence-based instructional choices. Regular data-review cycles must be built into school governance calendars, creating predictable opportunities for teams to adjust teaching in response to real-time learning evidence.
5. Schools should forge long-term partnerships with universities and professional bodies to access specialized expertise beyond their internal capacity, structuring these alliances around shared accountability for teacher and student outcomes. These collaborations must include joint research agendas to empirically test the proposed mediation framework, generating the local, context-specific evidence that Nigerian policymakers urgently need to guide future investments and strategies.

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