

REIMAGINING SCHOOL ADMINISTRATION, TEACHING, AND LEARNING THROUGH TECHNOLOGY INTEGRATION AND DIGITAL LEADERSHIP IN RIVERS STATE PUBLIC SECONDARY SCHOOLS

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ABSTRACT: The rapid advancement of digital technologies has significantly reshaped educational systems globally, creating new opportunities for improving school administration, teaching, and learning. In Rivers State public secondary schools, however, the effective integration of technology remains uneven due to challenges related to infrastructure, digital competence, leadership capacity, and policy implementation. This article examined how technology integration and digital leadership can reimagine and transform school administration, instructional practices, and learning outcomes in public secondary schools in Rivers State. The paper explored the extent to which school leaders utilize digital tools to enhance administrative efficiency, improve communication, and support data-driven decision-making. It also investigates how teachers incorporate technology into pedagogical practices to foster learner engagement, collaboration, and critical thinking. Furthermore, the study highlights the role of digital leadership in creating a shared vision for technology use, building staff capacity, and ensuring sustainable integration of educational technologies. Using relevant literature and contextual analysis, the article identifies key barriers to effective technology integration, including inadequate ICT infrastructure, limited professional development opportunities, and resistance to change among educators. It also emphasized the importance of strategic investment, supportive policy frameworks, and continuous training programs to strengthen digital competence among school leaders and teachers. The findings suggested that effective digital leadership is essential for driving successful technology integration in education. The paper concluded that reimagining school administration, teaching, and learning through digital innovation can significantly enhance educational quality and improve student outcomes in Rivers State public secondary schools.

Keywords: Digital Leadership, Technology Integration, School Administration, Teaching and Instruction.

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INTRODUCTION

Technology integration and digital leadership are reshaping education by improving administration, teaching and learning. In public secondary schools, these innovations are essential for enhancing efficiency, engagement and educational outcomes, and the rapid growth of digital technology has changed education worldwide, making technology integration essential

for preparing students for the demands of the 21st-century knowledge economy. Schools are now expected to use digital tools not only for teaching and learning but also for administration and communication. Effective schooling today is no longer measured only by buildings, textbooks, or curriculum content, but also by how well technology is used and how effectively school leaders guide that process. For developing countries such as Nigeria, technology-driven reform is especially important for improving access, quality, equity, and global competitiveness in education.

Globally, digital transformation in education increased rapidly during the COVID-19 pandemic, which exposed weaknesses in traditional school systems. International bodies such as UNESCO and the World Bank emphasized the need for resilient, technology-supported education systems that can continue learning during emergencies. As a result, attention has shifted from simply providing devices to building leadership capacity, institutional readiness, and sustainable technology use.

In Nigeria, policies such as the National Policy on Education (2014) and National Policy on ICT in Education (2013) recognized the importance of ICT in improving teaching, learning, and school management. However, implementation remains difficult, especially in public secondary schools. Common challenges include poor infrastructure, irregular electricity supply, weak internet access, and limited teacher training. These issues are also visible in Rivers State, where many schools operate under difficult economic and administrative conditions.

Technology integration goes beyond the use of computers or smartphones. It involves embedding technology into lesson planning, classroom instruction, assessment, communication, and decision-making. For this to succeed, school leadership must be visionary, innovative, and digitally competent. Digital leadership means creating a clear direction for technological use, promoting innovation, ensuring fair access, supporting staff training, and using data to improve decisions. School leaders therefore play a key role in turning national ICT policies into real school-level results.

Two theories help explain this relationship. Transformational Leadership Theory shows that effective leaders motivate others toward shared goals. Technology Acceptance Model explains that people adopt technology when they find it useful and easy to use. Together, these theories show how leadership style, teacher readiness, and institutional support affect successful technology adoption.

In public secondary schools in Rivers State, the impact of digital leadership on administration, teaching, and student engagement is still unclear. Some schools use digital record systems, online communication tools, and multimedia teaching resources, while others lag. There is limited evidence on how school leaders' digital skills directly influence educational outcomes in the State.

This paper therefore examines the impact of technology integration and digital leadership on school administration, teaching practices, and student learning in public secondary schools in Rivers State. It focuses on leadership strategies, infrastructure, teacher competence, and implementation challenges. The study aims to provide practical insights for policymakers, school administrators, and stakeholders seeking sustainable digital transformation in Nigeria and across sub-Saharan Africa.

THEORETICAL FRAMEWORK

Transformational Leadership Theory

Transformational Leadership Theory, first developed by Burns and expanded by Bass and Riggio, describes leaders who inspire people to go beyond self-interest for the good of the organisation. It has four dimensions: idealized influence, which means leading by example; inspirational motivation or sharing a compelling vision; intellectual stimulation, which encourages creativity and problem-solving; and individualized consideration, which involves supporting each person's growth. In schools, principals become change agents rather than just managers. This theory links to technology adoption in several ways. Regarding leadership influence on innovation, transformational leaders champion digital tools and push for their use. Schmitz and colleagues found that principals who practiced transformational leadership significantly increased technology use for challenging learning tasks, and intellectual stimulation empowers teachers to try blended learning or AI-assisted teaching. On teacher acceptance of ICT, by building trust, offering personalised support, and providing professional development, transformational leaders reduce resistance and foster positive attitudes toward technology, even in difficult environments. For institutional change, the theory drives whole-school transformation by aligning individual efforts with a shared vision of technology-enhanced education. In Rivers State, studies show transformational leadership correlates with better outcomes through improved resource mobilisation and cultural adaptation.

Technology Acceptance Model Theory

The Technology Acceptance Model, proposed by Davis, explains user acceptance of new technology based on two core ideas: perceived usefulness, or whether the technology helps someone do their job better, and perceived ease of use, or whether it is simple to use. Later versions added factors like social norms and support conditions. In relation to adoption of technology, positive perceptions of usefulness and ease of use drive actual use. This has been confirmed in Nigerian education, where teachers and lecturers who see ICT as helpful and straightforward are far more likely to adopt it. On leadership influence on innovation, school leaders shape teachers' perceptions through training and support, encouraging creative uses of technology beyond basic tasks. Regarding teacher acceptance of ICT, the model highlights individual-level barriers. In Rivers State public schools, low acceptance often comes from seeing technology as complex due to unreliable power and poor training, and leadership can improve these perceptions. For institutional change, widespread acceptance leads to new norms, policies, and infrastructure investments, embedding technology into daily school operations and aligning with Nigeria's National Policy on ICT in Education.

Systems Theory

Systems Theory in educational administration, rooted in the work of Von Bertalanffy, views schools as open, dynamic systems made of interconnected parts such as teachers, students, leaders, infrastructure, and curriculum, all of which interact with the outside environment including political, economic, and cultural forces. Key ideas include holism, which means the whole is greater than the sum of its parts; interdependence; feedback loops; and openness to change. This theory connects to technology adoption by emphasizing that successful ICT

integration requires all subsystems to work together. For example, infrastructure like power and devices must support teacher training and leadership policies; if one part fails, adoption suffers. On leadership influence on innovation, leaders act as system regulators who facilitate information flow, encourage subsystems to work together, and spread innovative practices across the school. Regarding teacher acceptance of ICT, teachers' attitudes are shaped by interactions with other parts of the system, such as administrative support and peer collaboration, creating a reinforcing cycle that either builds or weakens acceptance. For institutional change, transformation emerges from the whole system adapting to external pressures like national ICT policies or global digital demands. Schools in Rivers State can evolve holistically, moving from isolated computer labs to fully integrated digital ecosystems, provided feedback loops and environmental alignment are maintained.

Together, these three theories form a cohesive framework. Transformational Leadership Theory supplies the motivational and visionary driver, the Technology Acceptance Model addresses individual user perceptions and behaviours, and Systems Theory provides the overarching structural lens. This combination is especially powerful for studying technology integration in Rivers State public secondary schools, where leadership, teacher acceptance, and systemic coherence must all align to overcome local barriers such as erratic electricity and funding shortages. The framework will guide the study's research questions, instrument design, and interpretation of findings on how these elements interact to support or hinder sustainable ICT adoption.

CONCEPTUAL CLARIFICATIONS

Technology Integration in Education

Meaning and Dimensions

Technology integration in education means deliberately weaving digital tools into teaching, learning, and school operations to boost outcomes and meet learning goals (Consoli et al., 2023). It's not just about having devices or internet access. True integration happens when technology becomes a natural part of daily routines such as helping students build knowledge, work together, and show what they've learned (Mishra & Koehler, 2006). Effective integration changes teaching methods (e.g., shifting from teacher-led lectures to student-driven projects), while poor integration uses tech without real improvement, like projecting notes instead of encouraging hands-on exploration.

Several interconnected dimensions shape success such as technological dimension which includes reliable hardware, software, internet, power, and support, pedagogical dimension which involves using tech to support active, collaborative, and problem-based learning, moving lessons from passive listening to student-centered discovery, content dimension which involves choosing tools that fit subject goals, like virtual labs for science or digital maps for geography, rather than forcing mismatched apps (Mishra & Koehler, 2006), human/professional dimension, involving digital skills, confidence, and ongoing training for teachers and students, and equity and contextual dimension which addresses gaps in access based on location, income, gender, or infrastructure (e.g., frequent power cuts in the Niger Delta). Good integration must be inclusive and adaptive to local realities (Rodriguez-Segura, 2022). These dimensions interact; a weakness in one (like unreliable electricity) hurts the others. Quality is judged by positive impact on engagement and thinking skills, not just device counts.

Models of Technology Integration

Two helpful frameworks guide integration. The Technological Pedagogical Content Knowledge (TPACK) framework, developed by Mishra and Koehler (2006), posits that successful technology integration requires the dynamic intersection of three core knowledge domains: content knowledge, which represents subject-matter expertise; pedagogical knowledge, which covers teaching and learning methods; and technological knowledge, which involves understanding how to operate and apply digital tools. Their interplay creates holistic know-how for transformative teaching. For example, a biology teacher in Port Harcourt with strong content and teaching skills might use offline simulation apps on a shared laptop during power cuts, students observe cell division virtually, overcoming a lack of working microscopes.

The Substitution, Augmentation, Modification, Redefinition (SAMR) model, proposed by Puentedura (2013), offers a ladder for evaluating the degree of transformation that technology brings to tasks. Substitution replaces a tool with no functional change (typing vs. handwriting). Augmentation adds improvements (Google Docs with comments). Modification redesigns the task (individual essay becomes a group multimedia project). Redefinition enables entirely new, previously impossible tasks (global video collaboration with scientists). In an English class, students co-creating digital stories on Canva and sharing via WhatsApp is modification; live-streamed debates with partner schools would be redefinition. The two models complement each other: TPACK builds the knowledge base; SAMR guides decisions about transformation.

Technology Integration in Developing Countries

In developing nations, tech integration offers huge potential: mobile-first, low-bandwidth, offline solutions can leapfrog infrastructure limits and deliver quality education at scale (Rodriguez-Segura, 2022). Benefits include personalized learning, expanded access, and cost-effective resource sharing. Barriers include unreliable electricity, poor internet, weak teacher training, funding shortages, and equity gaps between urban/rural and public/private sectors (Jhuree, 2005). Success often depends on pragmatic fixes like public-private partnerships, solar-powered devices, and policies prioritizing teacher development and community involvement.

ICT Adoption in Nigerian Public Schools

Nigeria's National Policy on ICT in Education (Federal Ministry of Education, 2019) provides a solid framework with key goals including effective teaching/learning, critical thinking, and efficient administration. Focus areas cover training, infrastructure, research, financing, and monitoring. Yet adoption in public primary/secondary schools remains low to moderate. Usage is often limited to admin tasks or exam preparations (e.g., WAEC computer-based testing), not daily classroom transformation (Nwobodo & Udoka, 2025). Systemic issues include poor infrastructure, teacher digital illiteracy or resistance, funding gaps, and policy-execution mismatches (Federal Ministry of Education, 2019).

In Rivers State, especially public secondary schools around Port Harcourt, these challenges are stark. Evaluations show ICT tools exist, but integration is low, below acceptable benchmarks. Teachers often have decent personal tech skills but lack institutional support, regular training, reliable power, steady internet, enough devices, and tech staff (Iyab & Taiwo, 2025; Nwobodo & Udoka, 2025). Local hurdles include erratic electricity (worsened in the Niger

Delta), poor connectivity, high device costs, poor maintenance, and limited technical support. Urban schools in Port Harcourt do slightly better, but they rarely have fully functional computer labs. Positive examples exist where leaders partner with NGOs, NITDA, UBEC, or corporate CSR (e.g., oil companies) to install solar-powered labs or teacher training. A pragmatic teacher might download Khan Academy videos onto a USB drive in Port Harcourt and lead group discussions in a rural class without internet, an effective local adaptation. These conceptual foundations help us discuss technology integration in Rivers State and design targeted, context-sensitive interventions.

Digital Leadership

Digital leadership in education is the strategic process by which school leaders set direction, influence others, and drive sustainable changes using digital technologies to transform teaching, learning, administration, and school culture (Sheninger, 2014). It goes beyond mastering tools to include fostering a vision for digital transformation, promoting innovation, and ensuring equitable access. Unlike older concepts focused just on tool adoption, digital leadership emphasizes a symbiotic relationship between leaders and technology to anticipate change and empower stakeholders (Sheninger, 2014; Ghamrawi, 2022).

The concept evolved from early 2000s e-leadership (basic ICT integration) to a mature form by the 2010s that includes strategic vision and data-driven decisions (Sheninger, 2014). Post-pandemic research highlights digital leadership as essential for resilient, innovative schools, with growing emphasis on adaptability, digital citizenship, and inclusive change (Karakose, 2024; Obied, 2025).

Effective digital leaders show strong digital competence (tools, platforms, AI, data analytics). They cultivate a digital culture that promotes innovation, continuous learning, and risk-taking while maintaining ethics and privacy (Ghamrawi, 2022). Other traits include visionary planning, adaptability, advocacy for digital equity, and systemic governance. They prioritize empowerment over top-down mandates, fostering collaboration and a growth mindset.

Traditional leadership relies on hierarchy, directives, and face-to-face interactions, focusing on stability and compliance. Digital leadership is more collaborative, agile, and data-driven, using digital tools to respond to dynamic needs (The Technology Square, 2025). Traditional leaders maintain efficiency; digital leaders drive cultural shifts toward innovation and inclusive adaptation.

Globally, digital leadership drives equitable, innovative systems, with frameworks like the International Society of Technology Education (ISTE) standards emphasizing visionary culture and digital citizenship in well-resourced settings (Ghamrawi, 2022). In Nigeria, however, the context is shaped by infrastructure gaps, digital divides, and policy-implementation mismatches, making digital leadership more adaptive and resource-constrained (Okunlola, 2025a). Studies in Oyo State show principals meet basic ISTE competencies but struggle with systemic improvement due to unreliable power and limited connectivity. In Rivers State, similar realities apply: urban schools in Port Harcourt show emerging digital initiatives through NGO or CSR partnerships, while rural public schools lag due to erratic electricity and funding shortages (Ese, 2024; Sam-Kalagbor, 2024). Nigerian digital leadership thus emphasizes pragmatic adaptations, offline tools, teacher capacity building, infrastructure advocacy, rather than large-scale transformation. This local nuance makes digital leadership vital for sustainable progress in public schools, aligning national ICT policies with ground-level realities in places like Rivers State.

Digital Leadership Practices in Public Secondary Schools in Rivers State

Digital leadership refers to the ability of school leaders, particularly principals and administrators, to strategically utilize digital technologies to improve school administration, teaching effectiveness, and students' learning outcomes. In contemporary secondary education, leadership responsibilities now extend beyond traditional supervision to include technology visioning, digital capacity building, innovation management, and data-driven decision-making. In public secondary schools in Rivers State, digital leadership practices are gradually emerging as educational administrators respond to increasing demands for technology-supported teaching and institutional efficiency.

Development of Digital Vision and Strategic Planning

One of the core practices of digital leadership involves creating a clear technological vision that aligns school goals with national ICT-in-education policies. Effective principals articulate how technology should support instruction, assessment, communication, and school management. Research showed that principals' ability to establish an ICT vision significantly predicts teachers' technology integration and instructional innovation in secondary schools (Eze, 2025). School leaders who promote digital transformation such as introducing ICT implementation plans, encouraging digital lesson delivery, and supporting blended and technology-assisted learning environments, help teachers understand the educational value of technology rather than viewing ICT merely as equipment acquisition.

Digitalization of School Administration

Digital leadership also manifests through the modernization of administrative processes such as record keeping, communication, and performance monitoring. Studies conducted in secondary schools within Port Harcourt metropolis indicate increasing adoption of digital tools for school management, including electronic documentation, student data management, and internal communication systems (Ololube, 2024). These practices, electronic student records, digital attendance systems, online staff communication platforms and computer-based result processing, enhance administrative efficiency, transparency, and decision-making effectiveness.

Capacity Building and Professional Development of Teachers

A major responsibility of digitally competent school leaders is strengthening teachers' digital competencies through continuous professional development. Evidence from Rivers State shows that while teachers possess basic problem-solving digital skills, many lack competencies in digital communication, content creation, and online collaboration, thereby requiring sustained leadership-driven training programmes (Ololube, 2024).

Digital leadership practices such as organizing ICT workshops, peer mentoring programmes, encouraging participation in online training, and supervising technology-supported teaching practices are apt for teachers' professional development. Effective supervision and professional development significantly improve teachers' readiness for technology-driven classrooms in Rivers State secondary schools.

Promotion of Technology Integration in Teaching and Learning

Digital leaders actively encourage teachers to integrate technology into pedagogy to enhance learner engagement and academic performance. Empirical findings reveal that although ICT facilities exist in some public secondary schools in Rivers State, classroom integration remains relatively low due to inadequate infrastructure and institutional support (Nwobodo & Udoka, 2025). Digital leadership addresses this gap by monitoring ICT usage in classrooms, supporting multimedia teaching, promoting collaborative and student-centered learning, encouraging use of computers and smartphones for assignments. Studies further show that digital skills usage positively influences students' academic tasks and independent learning behaviours in Rivers State schools.

Data-Driven Decision Making

Modern school leadership increasingly relies on digital data systems for planning and evaluation. Digital leaders analyze academic performance records, attendance data, and instructional outcomes to guide school improvement strategies. Technology-supported leadership enhances organizational effectiveness by enabling evidence-based decisions, monitoring teacher performance, and improving accountability within schools (Salimon et al., 2025).

Creating a Culture of Innovation and Collaboration

Digital leadership goes beyond technology management; it involves fostering a culture that supports experimentation, collaboration, and innovation among teachers and students. School leaders influence teachers' motivation and job performance through supportive leadership behaviours and collaborative environments, which ultimately improve instructional delivery in public secondary schools in Rivers State (Ugwechi-Ishiaya & Imoh, 2026). Other leadership practices include encouraging teamwork using digital platforms, supporting innovative teaching methods and recognizing teachers who adopt ICT effectively.

Addressing Digital Infrastructure and Implementation Challenges

Digital leaders also function as problem solvers who manage contextual barriers such as erratic power supply, poor internet connectivity, limited ICT equipment, lack of technical support personnel. Research indicates that insufficient infrastructure remains a major constraint to sustainable technology integration despite moderate teacher ICT proficiency in Rivers State public schools.

Impact of Technology Integration and Impact on School Administration

The integration of digital technologies has profoundly reshaped school administration, shifting from manual systems to more efficient, data-driven approaches that enhance management in public secondary schools. Administrative burdens such as record management, stakeholder communication, task coordination, and reporting have been eased by digital tools, particularly in developing contexts like Nigeria where paperwork and delays are common barriers to effective governance (Timotheou et al., 2023). Digital record-keeping systems have been especially transformative, replacing paper-based files with electronic databases, cloud storage, and computerised management tools that enable secure, searchable, and accessible storage of student

records, staff files, attendance logs, examination results, and financial data. In Rivers State public senior secondary schools, recent studies highlight that computers and cloud storage significantly enhance record management by allowing rapid input, retrieval, and updating of information, thereby reducing errors and improving transparency and accountability.

Impact on Teaching and Instruction

Technology integration, guided by effective digital leadership, has significantly reshaped teaching in Rivers State public secondary schools. A major transformation is the shift toward learner-centred pedagogy, where digital tools allow students to engage in inquiry, self-paced learning, and problem-solving, moving teachers from information providers to facilitators of learning experiences (Fullan, 2013; Nwobodo & Udoka, 2025). Digital leadership has also encouraged blended learning models that combine face-to-face instruction with online environments, enhancing instructional continuity and personalisation, a trend accelerated by the COVID-19 pandemic (World Bank, 2020). Interactive tools such as simulations, educational software, and multimedia presentations improve comprehension by presenting abstract concepts visually, while collaborative digital platforms enable group assignments and peer feedback beyond classroom boundaries, fostering teamwork and 21st-century skills like creativity and problem-solving (UNESCO, 2021; Teo, 2011). Assessment practices have been transformed through online quizzes, automated grading, and data analytics that provide immediate feedback, supporting formative assessment and real-time instructional adjustment. Virtual classrooms enable synchronous and asynchronous learning, promoting flexibility and continuity, while access to global educational resources such as open materials and online libraries reduces information limitations and promotes equity (World Bank, 2020; UNESCO, 2021). Overall, technology integration under effective leadership has redefined teaching, but sustainability depends on continuous teacher training, infrastructural development, and supportive policies.

Impact on Student Engagement and Learning Outcomes

Technology integration significantly affects student engagement and academic achievement, shifting classrooms from passive reception to active interactive experiences. In Nigerian public schools, tools like interactive simulations, multimedia resources, educational apps, and collaborative platforms can motivate students and enhance participation, though outcomes depend on implementation quality, infrastructure, and teacher readiness (Timotheou et al., 2023; Kuznetsov, 2025). Motivation and participation are among the most consistently reported benefits. Interactive digital tools capture attention more effectively than conventional lectures, leading to heightened curiosity and active involvement. Studies in Nigerian secondary schools show significant positive correlations between these tools and increased engagement, especially in STEM subjects where visual aids make abstract concepts tangible (Kuznetsov, 2025; Bolanle, 2025). Even low-bandwidth or offline tools like downloaded Khan Academy videos have been linked to improved participation in Rivers State, aligning with transformational leadership's emphasis on inspirational motivation (Okon, 2025). Digital literacy development equips students with skills to navigate, evaluate, and create digital content, which significantly predicts academic engagement, though urban students show stronger outcomes than rural peers due to better access (Okon, 2025). This fosters self-efficacy and confidence, as per TAM's perceived usefulness and ease of use (Davis, 1989; Zakir et al., 2025). Academic performance improves when technology is meaningfully integrated through differentiated instruction and immediate feedback, with

Nigerian studies showing students in technology-enhanced environments outperforming peers in traditional settings (Kuznetsov, 2025; Omiyale, 2025). In Rivers State, positive but modest correlations emerge when tools are used effectively, supporting systems theory's view of interdependent subsystems aligning for holistic improvement (Peled, 2021; Nwobodo & Udoka, 2025). Inclusion and access equity represent both a promise and a challenge. Digital tools can bridge gaps through personalised learning paths and support students with special needs, but the digital divide is evident in Rivers State's urban-rural disparities, unreliable power, and limited devices risks exacerbating inequities without offline solutions and teacher training (Okon, 2025; Rodriguez-Segura, 2022). Successful cases rely on digital leadership to advocate for inclusive policies, ensuring technology serves as a bridge rather than a barrier. Overall, technology can transform student experiences in Rivers State provided barriers like infrastructure and training are addressed, aligning with the study's theoretical lenses: transformational leaders inspire engagement, TAM explains acceptance through perceived benefits, and systems theory emphasizes holistic alignment for sustainable outcomes.

BARRIERS TO EFFECTIVE TECHNOLOGY INTEGRATION IN RIVERS STATE PUBLIC SECONDARY SCHOOLS

Effective integration of technology in teaching, learning, and administration in Rivers State public secondary schools remains limited, despite national policies promoting ICT adoption. These barriers can be categorized into structural factors related to physical and systemic resources, and human/organizational factors tied to people, attitudes, and institutional dynamics.

Structural barriers primarily stem from inadequate infrastructure and resource limitations that hinder reliable access and sustained use of digital tools. Inadequate ICT infrastructure, including a shortage of functional computers, projectors, tablets, and dedicated computer laboratories, is consistently reported as a major impediment, with many schools lacking even basic devices for classroom or administrative purposes (Nwobodo & Udoka, 2025; Aziaka & Nwogu, 2023; Tagbo, 2024). Unstable electricity supply exacerbates this issue, as frequent power outages in the Niger Delta region render available equipment unusable for extended periods, forcing reliance on offline or intermittent solutions (Nwobodo & Udoka, 2025; Ewhrudjakpo et al., 2024; Okon, 2025). Poor internet connectivity further restricts access to online resources, collaborative platforms, and real-time updates, with many schools experiencing slow, unreliable, or absent broadband services, particularly in rural and semi-urban areas (Nwobodo & Udoka, 2025; Aziaka & Nwogu, 2023). Funding constraints compound these problems, as limited budgetary allocations from government and insufficient private-sector support restrict procurement, maintenance, and upgrades of ICT facilities, leading to outdated or non-functional systems (Aziaka & Nwogu, 2023; Agoha, 2025).

Human and organizational barriers arise from attitudinal, skill-based, and leadership-related challenges that affect acceptance and implementation. Resistance to change among teachers, often rooted in preference for traditional methods or discomfort with disruption to established routines, limits proactive adoption (Okeke, 2023; Nwobodo & Udoka, 2025). Limited digital competence, including insufficient training and low proficiency in using educational software, simulations, or online platforms, prevents effective pedagogical integration, even when basic hardware is present (Nwobodo & Udoka, 2025; Aziaka & Nwogu, 2023). Fear of technology, manifested as anxiety over errors, job displacement, or complexity, further discourages experimentation and sustained use (Bingimlas, 2009; Okon, 2025). Leadership gaps, such as inadequate mentoring, lack of visionary direction from principals, or

failure to prioritize ICT through policy enforcement and resource advocacy, undermine institutional momentum and teacher support (Okeke, 2023).

These interconnected barriers explain the generally low levels of technology integration observed in Rivers State public schools, where usage often remains below acceptable thresholds despite moderate teacher proficiency in personal ICT skills (Nwobodo & Udoka, 2025). Addressing them requires targeted interventions, such as solar-powered infrastructure, ongoing professional development, and stronger leadership alignment with national ICT policies.

Sustainability and Future Directions

Sustainability of technology integration in Rivers State public secondary schools depends on shifting from short-term pilots to long-term, resilient systems that can withstand infrastructural, financial, and human challenges while aligning with Nigeria's National Policy on ICT in Education and broader sustainable development goals (Federal Ministry of Education, 2019; Nwobodo & Udoka, 2025). Current evidence shows low to moderate integration levels, with persistent issues like erratic power, poor connectivity, and limited funding threatening longevity. However, sustainable progress is achievable through eco-friendly adaptations, policy enforcement, and community involvement (Nwobodo & Udoka, 2025).

Key elements for sustainability include renewable energy solutions to address electricity instability, such as solar-powered systems for device charging, labs, and offline servers, which have shown promise in off-grid Nigerian contexts by enabling consistent access to pre-loaded educational content (Agoha, 2025). Offline and low-bandwidth tools, including downloaded apps, USB-based Khan Academy resources, and localised e-learning platforms, reduce dependency on unreliable internet, promote equitable access in rural and semi-urban Rivers State schools, and minimise operational costs (Rodriguez-Segura, 2022; Kingscare School, 2024). Long-term viability also requires ongoing teacher professional development integrated into school routines with incentives to build digital competence and reduce resistance, ensuring that human capital sustains technological gains (Okeke, 2023). Public-private partnerships, for example with oil companies in the Niger Delta, telecoms, and NGOs, offer scalable funding for infrastructure maintenance, device provision, and monitoring, fostering shared ownership and accountability (Agoha, 2025; Bello & Ajao, 2024).

Looking to future directions, technology integration in Rivers State and Nigeria is poised for acceleration through emerging EdTech trends and sustainable practices. Low-tech AI solutions that operate offline or with minimal data, sometimes called low-tech AI unicorns for underserved areas, are emerging as tools to transform personalised instruction without heavy infrastructure demands (EdTech Hub, 2025 predictions). Broader continental visions, such as the Africa EdTech 2030 Vision and Plan, emphasise phased scaling: foundation-building from 2025 to 2026 through policy pilots and infrastructure, system integration from 2027 to 2028 with teacher training and platforms, and consolidation from 2029 to 2030 for sustainability and innovation export (AUDA-NEPAD). In Nigeria, this aligns with a growing EdTech market projected for multibillion-dollar growth by the 2030s, driven by AI personalisation, hybrid models, and policy reforms for digital classrooms (HolonIQ, 2026 Outlook; various 2025–2026 forecasts). For Rivers State specifically, future efforts should prioritise curriculum restructuring through digitalisation to produce digitally competent graduates, solar-hybrid models for resilience and data-driven monitoring to track equity and impact (Nwobodo & Udoka, 2025).

Ultimately, sustainable integration requires holistic alignment: transformational leadership to champion change, systemic investments as per TAM and Systems Theory

principles, and inclusive strategies to bridge divides. With deliberate action, Rivers State public schools can evolve into digitally empowered institutions that contribute to Nigeria's knowledge economy and sustainable development.

CONCLUSION

Digital leadership practices in public secondary schools in Rivers State represent a transformative shift from conventional school administration toward technology-enabled educational management. Through strategic vision, administrative digitalization, teacher capacity development, instructional innovation, and data-driven governance, school leaders play a critical role in reimagining teaching and learning processes. Ultimately, effective technology integration holds transformative promise for Rivers State public secondary schools: fostering student-centered learning, building 21st-century skills, improving administrative responsiveness, and advancing equity toward Nigeria's sustainable development and knowledge economy goals.

However, the effectiveness of these practices depends largely on sustained government investment, leadership training, infrastructural development, and continuous professional support for educators. Strengthening digital leadership capacity therefore remains essential for achieving sustainable educational transformation in Rivers State's public secondary school system.

Recommendations

Based on the findings and aligned with national priorities, the following actionable recommendations are proposed for stakeholders to promote sustainable and effective technology integration in Rivers State public secondary schools:

- Government and Policy makers should intensify implementation of the National Policy on ICT in Education by allocating dedicated budgets for infrastructure upgrades, ensuring reliable power through solar-hybrid systems, and expanding subsidized broadband or community Wi-Fi in public schools. The establishment of state-level monitoring mechanisms to track integration progress and equity is also apt.
- Principals should adopt transformational leadership practices, serving as role models, providing intellectual stimulation, and offering individualized support, to foster a culture of innovation and reduce resistance. School leaders and administrators should see to the implementation of school-based ICT policies, including routine maintenance schedules and incentives for teachers who integrate technology effectively.
- There should be regular, hands-on training programs for teachers' professional development, workshops, peer mentoring, online/offline modules, to build digital competence, pedagogical skills (e.g., TPACK application), and confidence, addressing fear and limited literacy. There should be a partnership with universities and NGOs for certification and continuous professional development.
- For infrastructure and resource enhancement, low-cost, sustainable solutions should be prioritized - solar-powered labs/devices, offline educational content (e.g., pre-loaded apps/videos), and shared resources via PPPs with locals, telecoms, and NGOs to overcome power and connectivity barriers.
- Government should target rural and underserved schools first in rollout plans to bridge urban-rural divides, ensuring gender-sensitive and inclusive access (e.g., adaptive tools

for diverse learners). They should conduct awareness campaigns to highlight benefits and promote digital citizenship among students and parents.

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