



INCLUSIVE TEACHING-LEARNING IN POST-PANDEMIC NIGERIA: A MANAGEMENT-ORIENTED FRAMEWORK FOR MULTIMODAL DIGITAL TRANSFORMATION

Dr. Iyanuoluwa Samuel Adalakun

adelakuniyanuoluwasamuel@gmail.com <https://orcid.org/0000-0002-3361-4354>

Victoria Modupe Bankole,
victoria.bankole@fuoye.edu.ng

Bukola Roseline Aruleba,
bukola.aruleba@fuoye.edu.ng

&

Adefunke Deborah Adegbesan
adefunke.adegbesan@fuoye.edu.ng

Department of Educational Management and Business Studies, Faculty of Education,
Federal University Oye-Ekiti, Nigeria

ABSTRACT

The COVID-19 pandemic exposed persistent inequalities in Nigeria's capacity to sustain inclusive teaching and learning during educational disruption. Although face-to-face schooling has resumed, barriers associated with poverty, geographical location, disability, infrastructure, digital access, teacher capacity and insecurity continue to shape educational participation. This conceptual review synthesises Nigerian empirical evidence, policy documents and recent digital-learning initiatives to examine how digital transformation can strengthen inclusive and resilient teaching-learning in the post-pandemic era. The analysis indicates that technology can extend access, support learning continuity, enhance teacher capacity and accommodate learner diversity; however, digital provision alone does not ensure inclusion. Equitable outcomes depend on affordable connectivity, reliable infrastructure, accessible content, sustained teacher digital-pedagogical competence, multimodal delivery and institutional preparedness. Experiences such as EdoBEST@Home and the Nigeria Learning Passport demonstrate the potential of mobile, online and offline approaches to complement conventional schooling and reach underserved learners. The paper therefore argues for a shift from technology-centred digitalisation to equity-oriented digital transformation, in which technology complements rather than replaces face-to-face education. A management-oriented framework built around access, accessibility, pedagogical capacity, resilience and accountability is proposed to guide policy and institutional practice towards more inclusive, flexible and sustainable educational provision in post-pandemic Nigeria.



Keywords: Digital Learning; Inclusive Teaching-Learning; Educational Resilience; Digital Inequality; Multimodal Learning; Educational Management; Nigeria

Introduction

The COVID-19 pandemic exposed a structural weakness in Nigerian education: the capacity to sustain learning depends heavily on learners' unequal access to educational resources. School closures in 2020 prompted the rapid adoption of digital platforms, mobile communication, radio, television and other distance-learning modes (Adu, 2022; Ajadi et al, 2025; Adelakun, 2020^a). However, alternative delivery did not guarantee equitable participation. A national study found significant differences in remote-learning access by socioeconomic status and school type, while parental education influenced the capacity to support learning at home (Adeniran et al., 2021). Similar digital gaps constrained participation in rural and remote communities (Agbo et al., 2021). Consequently, Nigeria's COVID-19 response linked remote learning with recovery, resilience and inclusive quality education, reinforcing educational continuity as a system responsibility rather than an emergency measure (Federal Ministry of Education, 2020).

The significance of these lessons extends beyond COVID-19; the return to conventional schooling has not eliminated inequalities associated with poverty, disability, geographical location, displacement, insecurity, infrastructure and teacher capacity. UNICEF Nigeria (2023) reported that only about one in four Nigerian children aged 7-14 could read with comprehension or solve simple arithmetic problems, highlighting that educational inclusion must address meaningful learning, not attendance alone. More recent policy priorities therefore emphasise foundational learning, teacher development, digital transformation, resilience and inclusive provision (Federal Ministry of Education, 2024; UNESCO, 2024^a). Digital inequality also persists: UNICEF Nigeria (2024b) reported household internet access of approximately 24% nationally and 15% in rural areas, while limited electricity and digital literacy continue to constrain participation.

Evidence from six Nigerian states similarly identified poor connectivity, electricity shortages, poverty and inadequate ICT infrastructure as barriers to rural e-learning participation (Olanrewaju et al., 2021). The World Bank further identifies continuing gaps in digital skills and school-level digital infrastructure (De Simone & Manolio, 2025). These conditions demonstrate that technology can reproduce educational inequalities when access and pedagogical support remain uneven. The post-pandemic question is therefore not whether Nigerian education should use digital technologies, but how digital transformation can support equitable participation and meaningful learning. Nigeria's Learning Passport illustrates this transition, combining online and



offline curriculum-aligned resources and expanding from an emergency response into longer-term learning infrastructure (UNICEF Nigeria, 2024c).

Existing literature documents Nigeria's digital divide and COVID-19 learning disruptions, but less attention has been given to how these lessons can be integrated into a management-oriented framework that connects equitable access, accessibility, teacher capacity, institutional resilience and accountability in the post-pandemic education system. This paper argues for a multimodal post-pandemic learning system in which face-to-face, mobile, online, offline and broadcast approaches complement one another according to learner needs and contextual conditions. It examines the barriers to inclusive digital learning, the opportunities offered by multimodality, and the management and policy conditions required to strengthen educational resilience in Nigeria.

Conceptualising Inclusive Teaching-Learning in the Post-Pandemic Era

Inclusive teaching-learning concerns more than the physical placement of learners with disabilities in mainstream classrooms. (Hussaini & Aminu, 2025; Lawal, 2026). It involves reducing barriers to access, participation, engagement and learning outcomes. In Nigeria, these barriers may arise from disability, poverty, geographical isolation, language, displacement, insecurity, limited connectivity and inadequate learning support. The distinction between equality and equity is central. Providing every learner with the same digital material does not necessarily produce equitable participation. A learner with reliable broadband and a personal computer has substantially different learning conditions from one who depends on a shared smartphone, intermittent electricity or offline materials. Inclusive digital education therefore requires multiple routes to common learning objectives, rather than identical technological provision. This principle is particularly important for disability inclusion. Digital resources should incorporate captions, transcripts, alternative text, screen-reader compatibility, accessible document formats and flexible assessment arrangements. UNESCO's recent guidance identifies accessible ICT infrastructure, teacher competence and learner-centred technology use as important conditions for inclusive digital education (UNESCO Institute for Information Technologies in Education [UNESCO IITE, 2025). Inclusion also requires recognition of intersecting disadvantages (Manxusa & Botha, 2025). Disability may coincide with poverty; rural residence may coincide with weak connectivity; and insecurity may result in displacement and interrupted schooling. Digital participation should therefore be considered alongside physical participation. A learner may be enrolled in school but remain excluded from digitally mediated homework, assessment or supplementary learning because of device, data, electricity or accessibility constraints.

Disability inclusion is central; digital learning resources must feature captions, transcripts, audio descriptions, screen-reader compatibility, readable layouts, and flexible assessments. UNICEF (2023) emphasises the importance of barrier-free services, assistive technologies and meaningful participation for children with disabilities, including in humanitarian and emergency contexts. In Nigeria, such accessibility is particularly important because insecurity, displacement and other disruptions can compound existing disability-related barriers. The appropriate post-pandemic objective is consequently not maximum technology adoption but equitable educational participation supported by appropriate technology.



From Emergency Remote Teaching to Educational Resilience

Emergency remote teaching and planned digital education should not be treated as equivalent. Emergency remote teaching was implemented rapidly under exceptional



conditions, often with limited preparation and inadequate pedagogical support. Evidence from Nigerian teachers demonstrates the problem. A mixed-methods study involving 1,901 respondents found that many teachers lacked the pedagogical competencies and resources required to deliver remote teaching effectively during school closures (Adebayo et al., 2023). The post-pandemic task is therefore to institutionalise the useful elements of emergency response without institutionalising its weaknesses. Educational resilience should mean the capacity to maintain essential learning, adapt delivery when circumstances change, identify learners who become disconnected, recover learning losses and improve preparedness for future disruptions.

The EdoBEST@Home experience illustrates this transition. Edo State used mobile phones as a major delivery channel and combined curriculum-aligned content with virtual classrooms, teacher coaching, formative assessment and parent communication. The World Bank (2024) reports that 56% of primary and junior secondary students with access to the programme were able to learn away from school. The significance of EdoBEST@Home lies less in its technological sophistication than in its adaptation to the technologies available to learners. This supports a central proposition of the paper: resilience requires flexibility rather than technological uniformity. Nigeria's education system should maintain alternative delivery mechanisms that can be activated during pandemics, insecurity, displacement, flooding and other disruptions.

Persistent Barriers to Inclusive Digital Learning in Post-Pandemic Nigeria

The transition from emergency remote teaching to sustainable digital and blended learning has not removed the structural inequalities exposed during COVID-19. In Nigeria, inclusive digital learning remains constrained by affordability, infrastructure, teacher capacity, accessibility, language, socioeconomic inequality and insecurity. These barriers interact, making digital exclusion an educational-system problem rather than a technology problem alone.

1. Digital Inequalities

Access to devices and affordable connectivity remains fundamental to participation. During the pandemic, learners from higher-income households and private schools were better positioned to participate in remote learning, while socioeconomic status and parental education influenced access and home-learning support (Adeniran et al., 2021). Olanrewaju et al. (2021) similarly identified poverty, electricity, connectivity and socioeconomic conditions as major determinants of digital participation in rural Nigerian communities. These inequalities persist beyond the pandemic. UNICEF Nigeria (2024^a) reported substantial disparities in household internet access, particularly between urban and rural communities. The World Bank also identifies uneven digital infrastructure and skills as continuing constraints on Nigeria's digital readiness (World Bank, 2024; De Simone & Manolio, 2025). Thus, providing a platform



without addressing the cost of devices, data and electricity can shift educational costs to households least able to absorb them. Inclusive digital transformation requires affordable connectivity, device support and low-bandwidth or offline alternatives.

2. Epileptic Infrastructure, Electricity and Connectivity

Reliable electricity, network coverage, bandwidth and institutional infrastructure are necessary for sustained digital participation. Rural and remote communities remain particularly disadvantaged, while unreliable connectivity can interrupt lessons, restrict access to materials and limit feedback and assessment (Olanrewaju et al., 2021). Agbo et al. (2021) identified digital gaps affecting participation in rural and remote settings, demonstrating that geographical location remains closely associated with digital opportunity. The implication is that digital inclusion should be measured by continuity and usability, not simply by the presence of devices or platforms. Nigeria's Learning Passport illustrates the value of this approach: its online, mobile and offline architecture allows learning to continue where internet access is intermittent or unavailable (UNICEF Nigeria, 2024^b). Multimodal provision should therefore combine online platforms with downloadable content, offline resources and other context-appropriate channels.

3. Teacher Digital-Pedagogical Unreadiness and Incompetencies

Digital infrastructure has limited educational value when teachers lack the capacity to use it pedagogically. Nigerian evidence shows that many teachers lacked the competencies and resources required for effective remote teaching during school closures (Adebayo et al., 2023). Digital competence should extend beyond operating devices to lesson design, learner engagement, formative assessment, accessible content, digital safety and selection of appropriate delivery modes. Recent evidence is more encouraging. A study of Nigerian educators found that structured UNESCO MGIEP digital teacher training improved several dimensions of digital-pedagogical competence (Olugbade et al., 2025). Evidence from Nigeria shows that many teachers lacked the pedagogical competencies and resources required for effective remote instruction during the pandemic (Okagbue et al., 2023; Adebayo et al., 2023). Furthermore, evidence from Adebayo et al. (2023) on school closures showed substantial gaps in teacher resources and pedagogical preparedness. Teacher development should therefore be continuous, practice-based and integrated into digital-learning implementation rather than delivered as one-off ICT training.

4. Disability and Inaccessibility to Assistive Technologies

Digital learning can widen participation for learners with disabilities, but inaccessible content can create additional barriers. Videos without captions, documents incompatible with screen readers and inflexible assessment arrangements can exclude learners who require accessible formats or assistive technologies. Accessibility should consequently be incorporated into content design, procurement and evaluation. UNICEF (2023) emphasises the importance of barrier-free services, assistive technology and meaningful



participation for children with disabilities, including during emergencies. Captions, transcripts, alternative text, keyboard navigation, screen-reader compatibility and appropriate assistive technologies should be provided according to learner needs. This aligns with current international guidance emphasising accessible digital environments and assistive technologies as conditions for inclusive technology-supported education (UNESCO IITE, 2025).

5. Language and cultural Imbalances

Language remains an important dimension of digital inclusion. Research on ICT-enabled Almajiri education found that Hausa was commonly used by learners and teachers despite English being the formal language of instruction, and recommended indigenous-language courseware and multimedia approaches (Fahm et al., 2022). Digital content should therefore reflect Nigeria's linguistic and cultural diversity, particularly for early-grade, rural, displaced and marginalised learners. The Nigeria Learning Passport provides a practical example by offering curriculum-aligned resources in English, Hausa, Igbo and Yoruba (UNICEF Nigeria, 2024^b).

6. Socioeconomic, Geographical and Intersecting Inequalities

Digital exclusion often results from overlapping disadvantages. A rural learner may simultaneously experience poverty, weak connectivity, unreliable electricity and limited access to qualified teachers; a displaced learner may lose both schooling and learning resources; and a learner with a disability may face accessibility and financial barriers. (Ahmad et al., 2025; Nwaokomah et al., 2025; Olanrewaju et al., 2021). Consequently, uniform interventions are unlikely to produce equitable outcomes. Resource allocation should reflect differentiated need, while monitoring should examine who participates, how consistently they participate and whether participation produces learning. Digital programmes should therefore prioritise underserved communities rather than assume that equal provision produces equal opportunity.

7. Insecurity, Displacement and Educational Disruption

Insecurity can interrupt schooling through displacement, restricted movement, attacks on schools and disruption of teaching. UNESCO (2024^b) identifies insecurity as an ongoing constraint on access to schooling in parts of northern Nigeria, with learners with special needs facing additional difficulties where appropriate support infrastructure is unavailable. Insecurity creates a distinct form of exclusion because the barrier is not simply technological; it may involve the physical safety of learners, teachers and school facilities (Adelakun & Olorunsola, 2024). It therefore represents an educational barrier that extends beyond technology. Digital learning can support continuity when physical access becomes impossible, but it cannot substitute for safety, electricity, devices, psychosocial support or stable learning environments. The appropriate response is consequently an integrated continuity strategy. Schools and education authorities should identify alternative delivery channels, maintain communication with learners and families, provide accessible resources and establish mechanisms for monitoring



participation during disruption. Digital platforms should form one component of this preparedness system, not a stand-alone solution.

8. From Isolated Barriers to a Systemic Inclusion Challenge

The barriers discussed above are mutually reinforcing: affordability influences device and data access; infrastructure determines connectivity; teacher capacity affects instructional quality; accessibility determines whether learners with disabilities can participate; language influences usability; and insecurity can disrupt the entire learning process. The post-pandemic issue is therefore not whether Nigerian schools have adopted digital technologies, but whether digital transformation produces equitable access, meaningful participation and sustained learning. The appropriate response is a context-responsive learning ecosystem that combines technology with affordable access, accessible content, teacher capacity and institutional resilience. This provides the basis for moving from emergency remote teaching towards a more inclusive and sustainable Nigerian education system.

Opportunities for Inclusive Digital Learning in Post-Pandemic Nigeria

The persistence of digital and structural inequalities does not negate technology's potential to strengthen educational inclusion; rather, it defines the conditions for its effective use. In post-pandemic Nigeria, digital learning is most valuable when it complements face-to-face education by expanding access, supporting teachers, accommodating learner diversity and sustaining learning during disruption. The focus should therefore be on how technology can reduce exclusion while improving learning quality, rather than on technology adoption itself.

1. Extending Access through Multimodal Learning

Digital technologies can extend learning beyond the classroom when combined with low-technology and offline approaches. Nigeria's uneven connectivity makes a single delivery model unsuitable for urban, rural, remote and crisis-affected communities. The EdoBEST@Home programme illustrates this approach by combining mobile phones, WhatsApp, interactive text messages and web-based resources with teacher support, homework feedback and parental communication (World Bank, 2024). Its significance lies in using technologies available to learners rather than assuming uniform access. Post-pandemic digital learning should therefore be multimodal by design. Online platforms can serve learners with reliable connectivity, while mobile communication, downloadable and printed materials, radio, television and offline repositories can provide alternatives where connectivity is limited. The objective is equitable access to common learning objectives, not identical technology for every learner.



2. Supporting Continuity during Educational Disruption

Digital learning can strengthen continuity when physical schooling is interrupted by pandemics, insecurity, displacement and other emergencies. UNESCO identifies insecurity as a continuing constraint on school access in parts of Nigeria and emphasises preparedness that protects marginalised learners (UNESCO, 2025^c). Schools and education authorities should therefore establish continuity systems before disruption occurs, including digital repositories, communication channels, alternative instructional materials, learner-tracking mechanisms and recovery procedures. Effective continuity requires more than maintaining teacher contact; learners also need curriculum-aligned content, instructional guidance, assessment, feedback and appropriate support. The World Bank (2024) identifies remote-learning curricula, teacher preparation, appropriate technology and learner engagement as key elements of effective crisis response.

3. Reaching Learners in Underserved Communities

Digital learning can extend educational resources to communities underserved by conventional provision. The Nigeria Learning Passport demonstrates this potential. Launched during COVID-19, it reached one million subscribers by June 2024 and provided more than 15,000 curriculum-aligned resources for learners, teachers and parents. It subsequently expanded to 21 states and approximately 1.8 million users, illustrating how an emergency intervention can evolve into longer-term digital infrastructure (UNICEF Nigeria, 2024^a). Its offline functionality is particularly relevant to communities with limited connectivity. UNICEF reported the extension of Offline Learning Passport facilities to 60,000 learners in marginalised communities through local offline hubs. This demonstrates that inclusive digital education does not require continuous broadband access; offline digital provision can itself be an inclusion strategy (UNICEF Nigeria, 2024^a).

4. Enhancing Teacher Capacity and Instructional Quality

Technology can strengthen inclusion by expanding teachers' access to instructional resources, professional learning and collaborative support. UNICEF's Learning Lab initiative in Borno, Kaduna and Lagos combined instructional leadership, mentoring, collaborative learning and inquiry cycles, supported by digital tools for data collection and monitoring (UNICEF Nigeria, 2024^b). Teacher development should therefore move beyond one-off ICT training towards sustained digital-pedagogical development encompassing learner engagement, differentiation, assessment and inclusive instructional design. Recent Nigerian evidence indicates that UNESCO's digital teacher-training intervention improved several dimensions of digital-pedagogical competence (Olugbade et al., 2025; UNESCO, 2025^b). Technology is consequently more likely to improve inclusion when teachers can use it pedagogically rather than merely operationally.



5. Personalising Learning and Supporting Learner Diversity

Digital platforms can provide flexible learning by allowing learners to revisit materials, work at different paces and access supplementary resources. This can benefit learners whose participation in conventional schooling is constrained by disability, displacement, geographical isolation or other circumstances. The Nigeria Learning Passport incorporates personalised learning features and supports foundational literacy and numeracy, including in non-formal education settings (UNICEF Nigeria, 2024^c). Digital personalisation should, however, complement rather than replace teachers. Teachers remain responsible for diagnosing learning needs, providing feedback and exercising pedagogical judgement.

6. Strengthening Disability-Inclusive Learning

Digital technologies can reduce barriers for learners with disabilities when accessibility is incorporated into content and platform design. Captions, transcripts, alternative text, screen-reader compatibility and adaptable presentation formats can improve participation. UNICEF Nigeria (2024^a) highlights the need for accessible learning materials, teacher preparation and greater access to assistive technologies, while UNESCO's guidance emphasises accessible ICT infrastructure and inclusive technology-supported pedagogy (UNESCO, 2025^c). The priority should therefore be accessibility by design, rather than retrofitting digital resources after deployment. This makes disability inclusion a core requirement of digital transformation.

7. Supporting Inclusion in Conflict-Affected Communities

Flexible digital approaches are particularly relevant where insecurity repeatedly disrupts conventional schooling. UNESCO-supported digital transformation hubs in Borno and Yobe have combined computers, solar power, internet connectivity and digital-skills training for women, hard-to-reach youth and persons with disabilities. The programme reported more than 10,000 participants completing digital-skills programmes, with women comprising 60% and persons with disabilities 15% of participants (UNESCO, 2025^c). The significance of this model is its integrated approach: infrastructure, energy, connectivity, skills and community support are addressed together. This is more appropriate for fragile settings than interventions that assume household-level digital access.

8. From Technology Adoption to Inclusive Digital Transformation

The educational value of technology depends on how, for whom and under what conditions it is deployed (Ogwu et al., 2023; Mbaying et al., 2025). Mobile learning can extend access where computers are unavailable; offline platforms can serve communities without reliable internet; teacher-support systems can strengthen instructional capacity; accessible technologies can reduce disability-related barriers; and community digital hubs can support learning in fragile settings. The post-pandemic priority should therefore be to move from technology adoption to inclusive digital transformation. Nigeria's 2024-2027 education partnership framework places accessible



and equitable foundational learning alongside teacher development, non-formal education and stronger education-management systems. UNESCO's current work in Nigeria similarly links digital transformation and connectivity with efforts to address digital divides and strengthen educational resilience (UNESCO, 2025^a).

Accordingly, digital learning should be embedded within an educational architecture connecting infrastructure, teacher competence, accessible content, learner support, institutional preparedness and evidence-based monitoring. Success should be judged not by the number of platforms or users, but by whether previously excluded learners can access, participate in and benefit from quality education.

A Management-Oriented Framework for Inclusive Digital Transformation

The study suggests that inclusive digital transformation in post-pandemic Nigeria requires more than expanding technology infrastructure. It requires coordinated management of access, accessibility, pedagogical capacity, resilience and accountability. These five pillars are mutually reinforcing and provide a practical framework for determining whether digitalisation is contributing to equitable learning rather than reproducing existing educational inequalities.

1. Access

Access constitutes the foundation of participation. Educational authorities and institutions should ensure that learners can reach learning opportunities through an appropriate combination of affordable connectivity, suitable devices, reliable electricity and online or offline resources. This is particularly important in rural and low-income communities, where connectivity and household access remain substantially below national levels (UNICEF Nigeria, 2024^a). The Nigeria Learning Passport's integration of online and offline delivery demonstrates the practical value of designing access around contextual constraints rather than assuming universal broadband availability (UNICEF Nigeria, 2024^c).

2. Accessibility

Accessibility extends access by addressing the specific requirements of learners with disabilities and other groups facing participation barriers. Digital platforms should incorporate accessible formats, captions, transcripts, screen-reader compatibility, alternative text and flexible assessment arrangements where appropriate. Accessibility should be embedded at the design and procurement stages rather than added after implementation. UNESCO IITE (2025) similarly emphasises accessible digital environments and appropriate assistive technologies as conditions for inclusive technology-supported education.

3. Pedagogical capacity

Pedagogical capacity determines whether available technologies translate into meaningful learning. Teachers require sustained professional development in digital pedagogy, differentiated instruction, formative assessment, learner engagement and



accessible instructional design. Evidence from Nigeria indicates that targeted digital teacher training can improve teachers' digital-pedagogical competencies, reinforcing the need to integrate professional development into digital-learning initiatives rather than treating it as a supplementary activity (Olugbade et al., 2025).

4. Resilience

Resilience concerns the capacity of institutions to maintain essential learning when normal delivery is disrupted. Schools and education authorities should establish continuity plans that specify alternative delivery channels, communication arrangements, learner-support mechanisms and learning-recovery procedures. The experience of EdoBEST@Home demonstrates how mobile technologies, teacher support and home-based learning can sustain educational engagement during disruption (World Bank, 2024).

5. Accountability

Accountability provides the mechanism for determining whether these investments produce equitable outcomes. Evaluation should move beyond the number of devices distributed, platforms established or users registered and examine access, participation, engagement, learning and equity. Where ethically and practically feasible, monitoring should disaggregate evidence by location, disability, socioeconomic vulnerability and other relevant characteristics.

Collectively, the five pillars should therefore be understood as an interdependent system rather than a linear checklist: structural conditions shape access; access enables participation; accessibility and pedagogical capacity determine the quality of participation; resilience sustains learning during disruption; and accountability provides evidence for continuous improvement. The framework can consequently be expressed as:

Structural conditions → Equitable access → Accessible and inclusive pedagogy → Meaningful participation → Learning outcomes → Educational resilience → Continuous improvement

This framework positions educational managers as system integrators, responsible for aligning technology, people, infrastructure and policy around equitable learning outcomes rather than technology adoption alone.

Implications For Policy and Educational Management

The principal implication is that digital transformation should be managed as an educational equity and learning-quality issue, rather than as a technology procurement exercise. Federal and state ministries should adopt needs-based resource allocation, prioritising schools and learners facing connectivity, poverty, disability and geographical barriers. School leaders should embed digital continuity within institutional planning, establish procedures for maintaining instruction during pandemics, insecurity and displacement, and use participation data to identify



persistently disconnected learners. Resilience and inclusion should consequently be treated as permanent education-system capacities rather than temporary responses to COVID-19.

Multimodal delivery should be institutionalised by combining face-to-face, mobile, online, offline, radio, television and printed approaches according to learner and community conditions. Low-bandwidth and offline options should receive particular attention in rural, remote and connectivity-constrained communities where continuous internet access cannot be assumed. Nigeria's Learning Passport demonstrates the feasibility of combining online and offline resources to extend learning opportunities to underserved learners (UNICEF Nigeria, 2024^c). Such provision should be supported by multilingual and locally relevant digital content, particularly for early-grade and marginalised learners, to improve accessibility and contextual relevance.

Accessibility should be embedded in the design, procurement and evaluation of publicly funded digital platforms and learning resources. Platforms should incorporate captions, transcripts, alternative text, screen-reader compatibility and other appropriate accessibility features, alongside technical and pedagogical support for learners with disabilities (UNICEF Nigeria, 2024^a; UNESCO, 2025^b). Accessibility should therefore be treated as a design requirement rather than an additional feature introduced after implementation. Similarly, digital investments should prioritise identified educational needs rather than uniform provision, ensuring that resources reach learners and schools experiencing the greatest barriers.

Teacher development should form an integral component of digital-learning investment. Professional development should move beyond basic ICT operation to encompass digital and inclusive pedagogy, lesson design, differentiated instruction, formative and digital assessment, accessible content development, learner engagement, digital safety and the responsible use of emerging technologies. Evidence from Nigeria's recent digital teacher-training intervention supports this approach (Olugbade et al., 2025). Teachers should therefore be equipped to select and apply technologies according to specific learning objectives and learner circumstances, rather than technology availability alone.

Technology providers and development partners should align interventions with national curricula, accessibility standards and measurable learning outcomes. The Nigeria Learning Passport illustrates the potential of government–development partner–private sector collaboration; however, sustained impact requires institutional ownership, coordination and predictable financing. Investment should consequently extend beyond initial procurement to connectivity, maintenance, content development, teacher



development and accessibility. Families and communities should also receive clear guidance and accessible channels for supporting learning beyond school. Community access points and offline facilities can reduce dependence on household connectivity, particularly in underserved areas (Adelakun, 2020^b; Adesua et al., 2021).

Finally, digital transformation should be evaluated through an access → participation → engagement → learning → equity pathway rather than platform registration, user numbers or device distribution alone. Where ethically and practically feasible, monitoring should disaggregate outcomes by location, disability and socioeconomic vulnerability to identify who participates, who remains excluded and whether participation translates into learning. This evidence should inform continuous improvement and resource allocation. The overarching policy priority is therefore a flexible, accessible and context-responsive learning system in which digital technologies complement classroom teaching, strengthen educational continuity and reduce rather than reproduce existing inequalities.

Limitations and Directions for Future Research

The following were identified from the study as limitations:

- First, it relies on published and accessible literature and therefore may not capture relevant unpublished studies, institutional evidence or emerging initiatives that are not publicly available.
- Second, the temporal focus on 2020–2026 was appropriate for examining the pandemic and post-pandemic transition but may exclude earlier evidence that could provide useful historical or contextual insights.
- Third, the review may be affected by English-language and database-selection bias, potentially limiting representation of relevant evidence published in other languages or indexed elsewhere.
- Fourth, the study does not generate primary evidence from learners, teachers, school leaders or education managers; consequently, the reported experiences and implementation challenges are derived from existing sources.
- Fifth, although the reviewed initiatives demonstrate promising applications of digital and multimodal learning, causal evidence linking specific interventions to sustained improvements in learning and equity remains limited.

However, future research should therefore generate primary, longitudinal and comparative evidence across Nigerian states and learner groups. Mixed-methods studies could examine how access, accessibility, pedagogical capacity, resilience and accountability interact in different educational contexts. Longitudinal evaluations should assess whether digital and multimodal interventions produce sustained improvements in participation, learning outcomes and equity beyond initial adoption.



Comparative studies could further examine implementation across urban, rural, conflict-affected and underserved communities. Such evidence would strengthen empirical validation of the proposed framework and support more precise, context-responsive policy and management decisions.

Conclusion

The post-pandemic challenge for Nigeria is not to preserve emergency remote teaching but to institutionalise the useful lessons it revealed. COVID-19 demonstrated both the potential of technology to sustain learning and the extent to which unequal access, infrastructure, teacher preparedness and accessibility can reproduce exclusion. These challenges remain relevant despite the return to conventional schooling. It was established that digital learning can strengthen inclusion when it is multimodal, accessible, pedagogically purposeful and responsive to local conditions. Experiences such as EdoBEST@Home and the Nigeria Learning Passport show that mobile and offline approaches can complement conventional schooling and extend learning beyond the classroom.

The study therefore advances a shift from technology-centred digitalisation to equity-oriented digital transformation, anchored in access, accessibility, pedagogical capacity, resilience and accountability. Access, accessibility, pedagogical capacity, resilience and accountability must operate together if digital learning is to contribute to meaningful educational participation. For educational managers, the critical question is not how much technology has been introduced, but whether learners who face the greatest barriers can access, participate in and benefit from quality learning. Nigeria's post-pandemic education strategy should consequently retain physical schooling as the core institutional setting while using digital, mobile, offline and broadcast modalities to make learning more flexible and resilient. Such a context-responsive approach can strengthen educational resilience, reduce exclusion and provide more sustainable pathways for bridging learning gaps in the post-pandemic era.

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