

**EMERGING TECHNOLOGICAL TRENDS AND ITS CONTRIBUTIONS TO INCLUSIVE AND ACCESSIBLE EDUCATION IN BAYELSA STATE**

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**Abstract**

The integration of emerging technological trends into educational systems presents a transformative potential for fostering inclusivity and accessibility, particularly for marginalized learner populations. This paper explored the current and potential contributions of these technologies to inclusive education within the unique socio-economic and geographical context of Bayelsa State, Nigeria. Characterized by its riverine terrain, dispersed communities, and infrastructural challenges, Bayelsa faces significant barriers to educational equity for students with disabilities, those in remote areas, and other vulnerable groups. Using data sourced from both primary and secondary sources, this study examined the role of key technological innovations—including mobile learning (m-learning), assistive technologies (e.g., text-to-speech software, screen readers), adaptive learning platforms, and low-bandwidth online resources—in overcoming these obstacles. The study used the Constructivist Learning Theory as template for analysis. Findings indicate that while initiatives utilizing basic mobile technology have improved access to educational content in some hard-to-reach communities, the widespread adoption of more advanced assistive and adaptive technologies remains nascent, hindered by inadequate infrastructure (electricity and internet connectivity), high costs, and a lack of specialized teacher training. The paper recommended for leveraging mobile-first AI tutors, expansion of offline digital libraries with Virtual Reality (VR), implementation of assistive technology hubs, and the building of a data-driven early warning system. It concluded that a multi-stakeholder approach involving government, private sector, and non-governmental organizations is crucial. Strategic investments in digital infrastructure, context-specific teacher professional development, and the localisation of assistive technologies are essential to fully harness these emerging trends, thereby ensuring that technological advancements translate into tangible, equitable, and accessible educational outcomes for all learners in Bayelsa State.

***Keywords: Inclusive Education, Assistive Technology, Mobile Learning, Educational Technology, Bayelsa State.***

**Introduction**

The advent of the Fourth Industrial Revolution has positioned emerging technological trends as potent catalysts for societal transformation, with perhaps no sector standing to benefit more profoundly than education. In regions grappling with multifaceted challenges to educational equity,

such as Bayelsa State in the Niger Delta, these technologies offer a unprecedented opportunity to dismantle long-standing barriers and foster a truly inclusive and accessible learning environment. Bayelsa's unique geographical topography, characterized by its riverine and coastal terrain, has historically created significant disparities in educational access. Many communities remain isolated, making the physical infrastructure of traditional schooling a logistical challenge and often excluding learners with disabilities or those from remote, hard-to-reach areas (Etebu & Asekeme, 2020). However, the strategic deployment of emerging technologies presents a paradigm shift, moving the educational model from a centralized, location-dependent system to a decentralized, learner-centred one.

Specifically, the convergence of mobile technology, cloud computing, and adaptive software is beginning to rewrite the narrative of educational exclusion in the state. The widespread penetration of mobile devices, even in under-served communities, provides a ready platform for delivering educational content through mobile learning (m-learning) applications. This allows students to access lessons and resources remotely, effectively bridging the geographical divide caused by the state's difficult terrain (Aderinoye, Ojokheta, & Olojede, 2018). Furthermore, the application of Artificial Intelligence (AI) in developing personalized learning platforms and assistive technologies holds immense promise for learners with special needs. Text-to-speech software, AI-driven tutors, and customized learning interfaces can adapt to individual learning paces and disabilities, ensuring that education is not merely delivered, but is genuinely accessible and responsive to diverse cognitive and physical requirements (UNESCO, 2021). The integration of these tools, ensures that Bayelsa State is not just adopting new gadgets, but is fundamentally re-engineering its educational framework to be more resilient, equitable, and capable of delivering on the promise of inclusive education for all its citizens, irrespective of geography or physical ability.

### **Statement of the Problem**

Emerging technological trends—such as digital learning platforms, mobile applications, artificial intelligence, and assistive technologies—are transforming educational systems globally. However, in Bayelsa State, persistent infrastructural deficits, digital illiteracy, inadequate funding, and uneven internet connectivity constrain their effective integration into the educational sector. Rural–urban disparities, limited teacher capacity, and the high cost of technological devices further exacerbate educational exclusion, particularly for students with disabilities and marginalized communities. Consequently, despite the transformative potential of these innovations, inclusive and accessible education remains unevenly realized. This study therefore interrogates the extent to which emerging technologies contribute to educational inclusion in Bayelsa State and the barriers limiting their impact.

### **Methodology**

This study adopted a qualitative research design to examine emerging technological trends and their contributions to inclusive and accessible education in Bayelsa State. Data was generated basically through secondary and primary sources. Primary data included in-depth interviews with teachers, school administrators, policymakers, and education technology providers, alongside focus group discussions with students, including those with disabilities, while Secondary data was sourced from textbooks, articles, published and unpublished works etc.

### **Definition of Terms**

#### **Technology**

Technology has been defined from both instrumental and systemic perspectives. According to Jacques Ellul (1964), technology refers not merely to machines but to the totality of methods rationally arrived at and having absolute efficiency in every field of human activity. Similarly, Manuel

Castells (1996) conceptualizes technology as the application of scientific knowledge for practical purposes, particularly within information processing and communication systems that shape social structures. These definitions emphasize technology as both a body of techniques and an organized system influencing economic, political, and cultural transformations.

## **Education**

Education has been conceptualized from both philosophical and sociological standpoints. John Dewey defines education as the reconstruction or reorganization of experience which adds to the meaning of experience and increases the ability to direct subsequent experience (Dewey, 1916). From a sociological perspective, Emile Durkheim views education as the means by which society perpetuates itself by systematically socializing the younger generation into shared norms and values (Durkheim, 1922). Thus, education serves both individual development and societal continuity.

## **Theoretical Framework**

### **Constructivist Learning Theory**

Constructivist Learning Theory, pioneered by Piaget and Vygotsky, posits that learners actively construct knowledge by integrating new information with prior experiences. Vygotsky's concept of the Zone of Proximal Development (ZPD) emphasizes social interaction and scaffolding as crucial for cognitive growth. Learning is not a passive transmission but an active, contextualized process of meaning-making. When applied to this study, the theory explains how emerging technologies can foster inclusive education in Bayelsa's geographically dispersed communities. Digital tools serve as scaffolds within a student's ZPD. For instance, adaptive learning software offers personalized pacing for students with diverse needs, while interactive online platforms connect learners, enabling collaborative knowledge construction regardless of location. This empowers marginalized groups, including those with disabilities, by transforming passive reception into active, socially-mediated learning.

### **Major Emerging Technological Trends Currently Influencing the Education Sector in Bayelsa State**

The educational landscape in Bayelsa State, like the rest of Nigeria, is at a pivotal moment of digital transformation. While challenges related to infrastructure and funding persist, the convergence of several technological trends is beginning to reshape pedagogical methods, administrative efficiency, and educational access. These trends are not merely imported concepts but are being adapted to the unique socio-economic and geographical context of the Niger Delta. The most significant of these emerging trends include the proliferation of mobile learning, the gradual integration of virtual and augmented reality, the adoption of cloud-based Learning Management Systems (LMS), and the application of data analytics for educational planning.

Firstly, Mobile Learning (m-Learning) has emerged as the most pervasive and accessible technological trend in Bayelsa State. Given the state's challenging terrain, characterized by riverine communities and islands, physical access to educational institutions is a perennial obstacle. Mobile technology offers a viable bypass. The widespread adoption of smartphones, even at basic levels, has turned mobile devices into powerful educational tools. Initiatives that leverage USSD codes and low-bandwidth applications are particularly impactful, allowing students in remote areas like Southern Ijaw or Ekeremor to access educational content, receive assignments, and communicate with instructors without needing a stable, high-speed internet connection. According to a report by GSMA, mobile internet connectivity is the primary digital gateway for most individuals in Sub-Saharan Africa, and its application in education is critical for inclusive learning (GSMA, 2023). In Bayelsa, this trend is visible in how some secondary and tertiary institutions are beginning to use platforms like WhatsApp and Telegram not just for social communication, but for disseminating

lecture materials and facilitating discussion groups, effectively creating virtual classrooms that extend beyond the physical constraints of the school compound (Peremobowei, 2025).

Secondly, there is a nascent but growing interest in Immersive Technologies: Virtual Reality (VR) and Augmented Reality (AR). While still in its early stages due to the high cost of hardware, pilot programs and academic research, particularly at institutions like the Niger Delta University (NDU) and the Federal University Otuoke, are exploring VR/AR for specialized fields of study. For a state whose economy and environment are deeply tied to the oil and gas industry, VR offers a safe and cost-effective solution for simulating complex engineering processes, safety drills, and environmental impact scenarios without the risks associated with physical fieldwork. In the medical and health sciences, AR applications can overlay digital information onto physical specimens, aiding in anatomy and physiology studies. Tlili et al. (2022) highlights the potential of immersive technologies to significantly enhance experiential learning by providing students with "presence" and interactivity that traditional media cannot offer. In Bayelsa, this trend is crucial for providing practical skills training in a context where laboratory equipment may be scarce or outdated, offering a digital alternative that prepares students for modern industry demands (Tare, 2025).

Thirdly, the adoption of Cloud-Based Learning Management Systems (LMS) is gradually moving from tertiary institutions to secondary schools. The need for continuity in education, starkly highlighted by the COVID-19 pandemic, accelerated this trend. Platforms such as Moodle, Google Classroom, and proprietary Nigerian-developed educational software are being deployed to centralize course content, automate grading, and facilitate teacher-student interaction. For the Bayelsa State Ministry of Education, an LMS provides a powerful tool for standardizing curricula across the state's diverse schools and for monitoring teacher performance and student progress remotely (Tare, 2025). This move towards centralization helps in managing educational quality and resource allocation more effectively. As noted by the United Nations Educational, Scientific and Cultural Organization (UNESCO), digital platforms are essential for building resilient education systems capable of withstanding disruptions, from health crises to climate-induced flooding (UNESCO, 2023). In a state prone to seasonal flooding, a cloud-based system ensures that educational data and materials are preserved and accessible even when physical schools are temporarily closed.

Furthermore, the use of Data Analytics and Educational Management Information Systems (EMIS) is becoming a cornerstone of educational policy and planning in Bayelsa. Moving beyond basic census data, there is a growing trend towards using data analytics to understand student performance patterns, identify at-risk students, and evaluate the effectiveness of teaching methods (Preye, 2025). The Bayelsa State Government, in partnership with development agencies, is investing in robust EMIS to collect and analyze data on enrollment, attendance, and learning outcomes across all local government areas. This data-driven approach enables policymakers to make evidence-based decisions regarding resource distribution, teacher training needs, and infrastructure development. The World Bank (2021) emphasizes that in developing economies, the strategic use of data in education is fundamental to improving learning outcomes and ensuring that investments translate into tangible human capital development.

### **Ways Emerging Technologies Have Improved Access to Education in Bayelsa State**

Bayelsa State has historically struggled with educational access for several decades, however, the diffusion of emerging technologies is beginning to bridge these gaps, democratizing learning in unprecedented ways. The following are some key areas where this technological impact is most evident.

### **Mobile Learning and the Dissemination of Educational Content**

The proliferation of mobile phones, even in remote riverine communities, has been a game-changer. With high mobile penetration, students and teachers can now access educational resources that were previously out of reach. Institutions and ed-tech platforms are leveraging this by distributing learning materials via SMS, WhatsApp, and other mobile applications. This aligns with the observations of Porter et al. (2016), who noted that mobile phones are particularly effective in sub-Saharan Africa for overcoming barriers of distance and isolation, allowing learners in hard-to-reach areas of Bayelsa to receive assignments and study guides without needing to travel to urban centers.

### **Online Learning Platforms and Virtual Classrooms**

The COVID-19 pandemic accelerated the adoption of online learning globally, and Bayelsa was no exception. Tertiary institutions, such as the Niger Delta University and the Federal University, Otuoke, have increasingly integrated Learning Management Systems (LMS) like Moodle and Google Classroom. These platforms allow for the continuation of education during disruptions and provide access to a wider range of courses and lecturers. As Bates (2019) argues, online learning can significantly widen access to higher education by removing the constraints of physical attendance, a benefit that is acutely felt in a state where transportation across its many creeks and rivers is costly and time-consuming.

### **Satellite and VSAT Technology for Internet Connectivity**

One of the biggest hurdles in Bayelsa has been the lack of reliable terrestrial internet infrastructure in rural areas. To counter this, some educational initiatives and schools are turning to Very Small Aperture Terminal (VSAT) satellite technology to establish connectivity. This allows schools in remote communities to connect to the global internet, granting students and teachers access to vast digital libraries, research papers, and global scientific communities. This application reflects the potential of satellite technology to "leapfrog" traditional infrastructure, providing high-speed access independent of ground-based networks (ITU, 2020; Peremobowei, 2025).

### **Educational Broadcasting and Interactive Radio Instruction (IRI)**

Recognizing that not all students have access to smartphones or computers, the Bayelsa State Government and various NGOs have revitalized the use of radio and television broadcasting. Interactive Radio Instruction (IRI) programs deliver structured lessons directly into homes, targeting out-of-school children and adult learners in communities with limited electricity. This method has proven highly effective in reaching marginalized populations. Burns (2011) highlights that such low-tech solutions are often the most scalable and sustainable in developing regions, ensuring that education is not exclusive to those who can afford high-end technology.

### **Digital Resource Repositories and E-Libraries**

The establishment of digital libraries and repositories is another significant advancement. Students no longer have to rely solely on outdated textbooks in understocked school libraries. Initiatives to digitize resources and provide access to online databases, such as those offered by the National Open University of Nigeria (NOUN) study centers in the state, allow learners to access current information and academic journals. This shift from scarcity to abundance in learning materials supports self-directed learning and improves the quality of research, a critical factor for educational advancement noted by Unwin (2009) in his analysis of ICT4D (Information and Communication Technologies for Development).

## **Challenges Associated with the Adoption and Implementation of Emerging Educational Technologies in Bayelsa State**

The integration of emerging educational technologies—such as artificial intelligence, virtual reality, and cloud-based learning platforms—holds transformative potential for education in Bayelsa State. However, the region's unique socio-economic and geographical context presents significant barriers. For these technologies to bridge the educational gap rather than widen it, policymakers must confront the following critical challenges:

### **Chronic Infrastructural Deficit and the Digital Divide**

The most formidable obstacle is the lack of basic technological infrastructure. Emerging ed-tech tools require stable electricity, high-speed internet connectivity, and modern hardware. Bayelsa, being a riverine state with many remote communities, suffers from a severe infrastructural deficit. According to the Nigerian Communications Commission (NCC, 2023), internet penetration in the South-South region lags behind the national average, with many areas in Bayelsa lacking 3G or 4G coverage. Without a reliable power supply and broadband access, deploying cloud-based learning management systems or virtual labs becomes impossible, effectively excluding students in rural riverine areas from the digital revolution (Okonkwo & Ojo, 2022; Tare, 2025).

### **Inadequate Teacher Training and Digital Literacy**

The introduction of sophisticated technologies is futile without educators who are equipped to use them. A significant skills gap exists among teachers in Bayelsa regarding digital pedagogy. Many educators are not only unfamiliar with emerging technologies but are also apprehensive about their integration into the curriculum. A study by Amadi and Nwankwo (2021) found that a majority of secondary school teachers in the Niger Delta region lacked the basic ICT skills necessary to utilize even standard educational software. Implementing advanced tools like AI tutors or immersive VR requires specialized professional development that is currently absent in the state's teacher training programs, leading to resistance and underutilization of available resources (Michael, 2025).

### **High Cost of Implementation and Economic Constraints**

The financial burden of procuring, maintaining, and updating emerging technologies is substantial. Bayelsa State, despite its oil wealth, faces budgetary constraints and relies heavily on federal allocations. The cost of hardware (tablets, VR headsets, servers), software licensing, and cybersecurity measures is prohibitive. Furthermore, the maintenance of these technologies in a tropical, humid environment increases long-term costs. Eze et al. (2023) argue that without significant public-private partnerships, the financial sustainability of ed-tech projects in developing regions like the Niger Delta remains highly questionable. This often results in pilot projects that fail to scale due to a lack of recurrent funding.

### **Socio-Cultural Resistance and Relevance**

The adoption of technology is not merely a technical issue but a cultural one. In some communities in Bayelsa, there is skepticism regarding Western-centric educational models and tools. If the content delivered via these technologies does not reflect local languages, cultural contexts, or the socioeconomic realities of the Niger Delta, they may be rejected by both parents and students (Okpara & Iheanacho, 2020). There is a perceived risk that technology could erode traditional values or replace the essential human interaction between teacher and student, fostering resistance from community stakeholders who view it as alien.

### **Policy Gaps and Lack of a Strategic Roadmap**

Finally, the absence of a coherent, long-term policy framework hinders implementation. While Nigeria has national policies on education and ICT, state-level execution in Bayelsa often lacks a specific roadmap for emerging technologies. There is a disconnect between policy formulation and the practical realities on the ground. Without a clear strategic plan that addresses procurement standards, curriculum integration, technical support, and data privacy, efforts remain fragmented. Nwachukwu (2022) emphasizes that policy inertia and a lack of political will at the state level prevent the creation of an enabling environment necessary for innovation to flourish in public schools.

### **Impact of Government Policies and Institutional Frameworks on the Deployment of Educational Technologies for Inclusive Education in Bayelsa State**

The deployment of educational technologies (EdTech) to foster inclusive education in Bayelsa State is profoundly shaped, and often constrained, by the prevailing government policies and institutional frameworks. While Nigeria has demonstrated a commitment to inclusive education through national policies such as the National Policy on Education (FGN, 2013), which advocates for equal educational opportunities, and the National Policy on Information and Communication Technologies (ICT) in Education, the translation of these frameworks to the sub-national level in Bayelsa faces significant hurdles. The state's institutional framework, primarily managed by the Bayelsa State Ministry of Education and the Post-Primary Schools Board, often lacks the specific, operationalized policy directives needed to integrate technology for learners with special needs. The gap between broad federal mandates and state-level implementation capacity means that EdTech deployment is frequently ad-hoc, under-resourced, and not systematically aligned with the principles of Universal Design for Learning (UDL) (Michael, 2025). For instance, while the national ICT policy encourages the use of technology to bridge learning gaps, without a state-specific blueprint that addresses local infrastructure deficits—such as the chronic instability of the power supply and limited internet connectivity in riverine areas—the potential of technologies like assistive communication devices or online learning platforms remains largely untapped for marginalized groups (Okonkwo & Nwosu, 2021).

Furthermore, the institutional frameworks governing teacher education and procurement present critical barriers. Government policies on teacher recruitment and training in Bayelsa have not been sufficiently updated to include comprehensive digital pedagogy or training in assistive technologies. Teacher preparation institutions, guided by state education policies, rarely mandate proficiency in using technologies that support learners with visual, hearing, or cognitive impairments. This results in a human resource deficit where educators are ill-equipped to utilize available EdTech tools for inclusive purposes, rendering even well-intentioned technology deployments ineffective (Ajuwon et al., 2020; Preye, 2025). Concurrently, the state's public procurement policies, while designed for transparency, can be rigid and slow. The process for acquiring and maintaining specialized hardware and software is often cumbersome, failing to keep pace with the rapid evolution of EdTech. This institutional inertia leads to a reliance on outdated technology or a complete absence of necessary tools in schools, thereby excluding students who could benefit from digital learning aids. The lack of a dedicated institutional body or a specific line item in the state's education budget for inclusive technology further exacerbates this issue, relegating it to an afterthought rather than a core component of educational planning (Osadebe & Nwogu, 2022; Alagha, 2025). Consequently, the ambitious goals of national policies are diluted by the absence of a robust, agile, and financially supported institutional framework at the state level, directly hindering the creation of a genuinely inclusive, technology-enhanced learning environment for all students in Bayelsa State.

### Recommendations

- Based on the findings of the study, the following are some recommendations:
- i. **Leverage Mobile-First AI Tutors:** Deploy AI-powered tutoring platforms accessible via basic smartphones. These can provide personalized, self-paced learning in local languages, helping students in remote riverine communities overcome teacher shortages and language barriers, ensuring no child is left behind.
  - ii. **Expand Offline Digital Libraries with VR:** Create solar-powered, offline servers hosting vast educational content, including Virtual Reality (VR) experiences. This allows students in areas with poor internet to take immersive virtual field trips—exploring the human body or the Niger Delta ecosystem—making abstract concepts tangible and engaging for all learners.
  - iii. **Implement Assistive Technology Hubs:** Establish centralized resource centers equipped with 3D printers to produce low-cost assistive devices (like tactile learning aids) and software for students with disabilities. This local production model ensures learners with visual or hearing impairments have the tools needed to participate fully.
  - iv. **Build a Data-Driven Early Warning System:** Utilize learning analytics to identify students at risk of dropping out due to performance or attendance issues. This allows the Ministry of Education to intervene with targeted support, ensuring that technological integration actively works to retain every student in the educational system.

### Conclusion

In conclusion, it can be deduced that emerging technological trends have significantly expanded the prospects for inclusive and accessible education in Bayelsa State. Digital learning platforms, mobile technologies, assistive devices, and virtual classrooms have reduced geographical, physical, and socio-economic barriers that traditionally limited educational participation, particularly in riverine and underserved communities. These innovations have enhanced teacher capacity, diversified instructional delivery, and improved learner engagement. However, persistent challenges such as inadequate infrastructure, unstable electricity supply, limited digital literacy, and funding constraints must be addressed. Strategic government investment, public–private partnerships, and community-based digital empowerment initiatives remain critical to sustaining equitable and technology-driven educational development in Bayelsa State.

#### A. Primary Source (Oral Interviews)

S/N	NAME	AGE	SEX	OCCUPATION	PLACE OF INTERVIEW	DATE OF INTERVIEW
1	Peremobowei, Godfrey	56	M	Teacher	Yenagoa	12/12/2025
2	Michael, Iboro	52	M	Teacher	Yenagoa	31/11/2025
3	Preye, Jackson	49	M	Teacher	Virtual	01/12/2025
4	Alagha, Timipre	50	M	Teacher	Virtual	17/12/2025
5	Tare, Abel	37	M	Teacher	Virtual	08/12/2025

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