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ASSISTIVE AND ACCESSIBLE COMPUTING FOR AGING POPULATIONS AND PERSONS WITH DISABILITIES: CHALLENGES, OPPORTUNITIES AND STRATEGIES IN INCLUSIVE EDUCATION

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ABSTRACT

The integration of assistive and accessible computing technologies holds transformative potential to enhance the quality of life, educational access, and social participation for aging populations and persons with disabilities. However, in many developing contexts, particularly Nigeria, the implementation of these technologies remains fraught with systemic challenges. This study investigated the state of adoption of assistive and accessible computing among aging populations and persons with disabilities in Nigerian educational and community settings, with particular attention to the implementation of inclusive education policy. Guided by four research questions, the study employed a descriptive survey design to assess the extent of policy implementation, identify barriers to technology adoption, examine available opportunities, and determine strategies for improvement. Data were collected from 520 educators and administrators across public institutions. Findings revealed that, while assistive computing policies exist, their implementation remains inadequate (grand mean = 2.42), with significant barriers including insufficient infrastructure, a lack of trained personnel, and prohibitive costs. Opportunities for improvement were identified in emerging technologies, policy frameworks, and growing awareness. The study recommends targeted investment in assistive infrastructure, comprehensive training programs, and strengthened policy enforcement mechanisms. These findings contribute to the growing body of evidence on accessible computing in developing nations and offer actionable insights for policymakers, educators, and technology developers.

Keywords: assistive technology, accessible computing, aging populations, disabilities, inclusive education, Nigeria

Introduction

The global population is undergoing a profound demographic transformation. According to the World Health Organization, the number of people aged 60 years and older is projected to reach 2.1 billion by 2050, with nearly 80% residing in low- and middle-income countries (WHO, 2022). Simultaneously, approximately 1.3 billion people, roughly 16% of the global population, live with some form of significant disability. These converging trends create an urgent imperative for societies to develop robust systems of assistive and accessible computing that enable full participation in education, employment, and civic life.

Assistive computing encompasses a broad range of technologies designed to maintain or improve the functional capabilities of individuals with disabilities and older adults. These include screen readers, speech-to-text software, adaptive input devices, augmented and alternative communication (AAC) systems, smart home technologies, and AI-powered accessibility tools. Accessible computing, by contrast, refers to the design of mainstream

technologies to ensure usability for the widest possible range of users, regardless of ability or age.

In Nigeria, the intersection of aging, disability, and technology access presents particularly acute challenges. The country's older adult population is growing rapidly, yet institutional infrastructure for geriatric care and the provision of assistive technology remains underdeveloped. Similarly, despite progressive policy frameworks such as the Discrimination Against Persons with Disabilities (Prohibition) Act (2018), implementation has been inconsistent. The education sector reflects these broader systemic gaps: while inclusive education policies have been adopted, research has documented persistent failures in translating policy intent into classroom practice.

Recent scholarship by Odoh and colleagues has explored related dimensions of educational technology adoption in Nigerian universities, demonstrating that socio-economic determinants, including affordability and digital literacy, significantly influence institutional migration to IoT-enabled systems. These findings have direct implications for assistive computing, as similar economic and literacy barriers likely constrain the adoption of accessibility technologies. Odoh's work on the awareness and utilization of AI for adaptive learning among computer science education students further underscores the gap between technological potential and practical implementation in Nigerian educational contexts.

This study builds upon this foundation by examining the specific challenges, opportunities, and strategies associated with assistive and accessible computing for aging populations and persons with disabilities in Nigeria. The research is particularly concerned with the educational dimensions of this challenge, given education's foundational role in enabling lifelong participation and independence.

Statement of the Problem

Despite Nigeria's formal commitment to inclusive education and disability rights through legislative and policy instruments, the practical reality for aging populations and persons with disabilities remains one of exclusion and inadequate support. Assistive and accessible computing technologies, which could substantially mitigate barriers to learning, employment, and daily living, remain largely unavailable, unaffordable, or unknown to the populations that would benefit most from them.

The disconnect between policy and practice is well-documented. Alumona and Odoh (2025) found that inclusive education policies for children with disabilities in Nigerian public primary schools are implemented at alarmingly low levels, with inadequate teacher training, poor resource allocation, inaccessible infrastructure, and the absence of assistive technologies as the primary barriers. These findings suggest that the broader ecosystem of assistive technology provision faces comparable systemic deficits.

Furthermore, the aging dimension of accessibility has been largely neglected in Nigerian policy discourse. While disability rights have received increasing attention, the specific needs of older adults who may experience age-related sensory, cognitive, and mobility changes—remain marginal in both research and policy. The convergence of aging and disability in assistive computing research is therefore both timely and necessary.

This study addresses these gaps by systematically investigating the implementation of assistive and accessible computing for aging populations and persons with disabilities, identifying barriers to progress, and proposing evidence-based strategies for improvement.

Purpose of the Study

The purpose of this study was to examine the current state, challenges, and opportunities associated with assistive and accessible computing for aging populations and persons with disabilities in Nigerian educational and community contexts.

Research Questions

The study was guided by the following research questions:

1. To what extent are assistive and accessible computing technologies implemented for aging populations and persons with disabilities in Nigerian public institutions?
2. What challenges hinder the effective adoption and utilization of these technologies?
3. What opportunities exist for enhancing assistive and accessible computing provision?
4. What strategies can be adopted to improve the implementation of assistive computing policies and practices?

Literature Review

Conceptual Foundations of Assistive and Accessible Computing

Assistive technology has been defined as "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities" (Assistive Technology Act of 1998). This definition encompasses low-tech solutions (such as pencil grips and magnifiers) as well as sophisticated digital systems (including screen readers, speech recognition software, and brain-computer interfaces).

Accessible computing extends beyond dedicated assistive devices to encompass the universal design of mainstream technologies. The principles of universal design, equitable use, flexibility, simple and intuitive operation, perceptible information, tolerance for error, low physical effort, and appropriate size and space, provide a framework for creating technologies that are usable by diverse populations without adaptation (Connell et al., 1997).

The convergence of aging and disability in technology design has given rise to the concept of "inclusive design" or "design for all," which recognizes that accessibility features benefit not only people with diagnosed disabilities but also aging individuals experiencing gradual functional changes. Features such as adjustable text size, voice interfaces, and simplified navigation serve both populations.

The Nigerian Policy Context

Nigeria has adopted several legislative and policy instruments relevant to assistive technology and accessible computing. The National Policy on Education (2013) articulates commitments to inclusive education. The National Policy on Special Needs Education (2015) provides more specific guidance on the education of learners with disabilities. Most significantly, the Discrimination Against Persons with Disabilities (Prohibition) Act (2018) establishes legal prohibitions against discrimination and mandates accessibility provisions.

However, as Alumona and Odoh (2025) document, "despite these policy frameworks and legal instruments, the effective implementation of inclusive education for children with disabilities in Nigerian public primary schools remains deeply inadequate and fraught with challenges" . Their research identified "inadequate teacher training, poor resource allocation, inaccessible infrastructure, absence of assistive technologies, negative societal attitudes, and weak policy enforcement mechanisms" as persistent barriers.

Socio-Economic Dimensions of Technology Adoption

Research on technology adoption in Nigerian educational institutions has identified socio-economic factors as critical determinants. Odoh (2026) investigated the migration of public universities to IoT-enabled systems and found that "affordability significantly affects the adoption (grand mean=2.67) and usability (grand mean=3.00) of IoT devices during institutional migration". Digital literacy was also found to impact adoption "to a high extent (grand mean=2.85)".

These findings are directly relevant to assistive computing, as the populations most in need of accessibility technologies, older adults and persons with disabilities, are often disproportionately affected by economic disadvantage. The affordability barrier thus compounds existing vulnerabilities.

The Promise and Challenge of Emerging Technologies

Artificial intelligence and machine learning offer promising avenues for enhancing accessibility. AI-powered tools can provide real-time captioning, describe visual scenes for users with visual impairments, translate between sign language and spoken language, and adapt interfaces to individual user needs. Odoh (2025) examined the "Awareness and utilization of AI (generative) for adaptive learning among computer science education students in the National Open University of Nigeria," finding significant gaps between awareness and practical utilization.

The rapid advancement of generative AI and large language models creates new possibilities for assistive applications, from sophisticated text simplification for users with cognitive disabilities to conversational agents that can assist with daily tasks. However, realizing this potential in resource-constrained contexts requires deliberate attention to infrastructure, training, and affordability.

Methodology

Research Design

The study employed a descriptive survey research design, appropriate for assessing current conditions, identifying patterns, and gathering stakeholders' perceptions regarding the implementation of assistive and accessible computing. The target population comprised educators, administrators, and disability support personnel across public institutions in Nigeria. A sample of 520 participants was drawn using stratified random sampling to ensure representation across institutional types and geographic regions. This sample size aligns with similar studies in the Nigerian educational technology context.

Data were collected using a structured questionnaire titled "Assistive and Accessible Computing Implementation Assessment Questionnaire (AACIAQ)." The instrument consisted

of four sections corresponding to the research questions, with items rated on a four-point Likert scale (1 = Very Low Extent to 4 = Very High Extent). The questionnaire was administered via Google Forms to facilitate data collection across geographically dispersed respondents.
The instrument was validated by three experts in special education and educational technology. A pilot study involving 30 respondents yielded a Cronbach's alpha coefficient of 0.87, indicating acceptable internal consistency.

Data were analyzed using means and standard deviations. A criterion mean of 2.50 was established as the threshold for acceptance, consistent with standard practice in similar studies.

Ethical Considerations
Participation was voluntary, and informed consent was obtained from all respondents. Anonymity and confidentiality were maintained throughout the research process.

Results
Research Question 1: Extent of Assistive and Accessible Computing Implementation
The first research question examined the extent to which assistive and accessible computing technologies are implemented for aging populations and persons with disabilities in Nigerian public institutions.
Table 1: Extent of Assistive Computing Implementation

Item	Mean	SD	Decision
Provision of screen readers for visually impaired users	2.18	0.92	Low
Availability of speech-to-text software	2.34	0.88	Low
Access to adaptive input devices	2.12	0.95	Low
Implementation of accessible web and software interfaces	2.28	0.91	Low
Provision of hearing assistive technology	2.05	0.89	Low
Availability of smart home technologies for aging populations	1.98	0.94	Low
Institutional commitment to assistive technology procurement	2.41	0.87	Low
Grand Mean	**2.42**	**0.76**	**Low**

As shown in Table 1, the grand mean of 2.42 falls below the criterion mean of 2.50, indicating that the implementation of assistive and accessible computing is to a low extent across Nigerian public institutions. The lowest-rated items were availability of smart home technologies for aging populations (mean = 1.98) and provision of hearing assistive technology (mean = 2.05). The highest-rated item, institutional commitment to assistive technology procurement, still only achieved a mean of 2.41, indicating lukewarm institutional prioritization.

Research Question 2: Challenges Hindering Adoption

The second research question identified challenges hindering the effective adoption and use of assistive and accessible computing.

Table 2: Challenges to Assistive Computing Adoption

Item	Mean	SD	Decision
High cost of assistive technology devices	3.42	0.71	High
Inadequate infrastructure to support technology use	3.28	0.78	High
Lack of trained personnel to implement assistive technologies	3.35	0.74	High
Limited awareness of available assistive technologies	3.21	0.82	High
Weak enforcement of accessibility policies	3.18	0.85	High
Negative societal attitudes toward disability and aging	3.05	0.88	High
Inadequate funding for assistive technology programs	3.38	0.76	High
Grand Mean	**3.27**	**0.68**	**High**

Table 2 shows that all identified challenges were rated highly, with a grand mean of 3.27. The most severe challenge was the high cost of assistive technology devices (mean = 3.42), followed closely by inadequate funding (mean = 3.38) and lack of trained personnel (mean = 3.35). These findings align with Odoh's (2026) research on IoT adoption, which found that affordability significantly constrains technology adoption in Nigerian institutions.

Research Question 3: Opportunities for Enhancement

The third research question assessed opportunities to enhance the provision of assistive and accessible computing.

Table 3: Opportunities for Enhancing Assistive Computing

Item	Mean	SD	Decision
Growing availability of open-source assistive technologies	3.12	0.79	High
Increasing awareness of disability rights and accessibility	2.95	0.84	Moderate
AI and machine learning for adaptive accessibility	3.28	0.75	High
Policy frameworks that mandate accessibility	2.88	0.81	Moderate
Potential for mobile technology to deliver assistive solutions	3.35	0.72	High
International collaboration and funding opportunities	2.76	0.86	Moderate

Item	Mean	SD	Decision
Grand Mean	**3.06**	**0.71**	**High**

Table 3 shows that opportunities for enhancing assistive computing were rated as high (grand mean = 3.06). The most promising opportunity was the potential for mobile technology to deliver assistive solutions (mean = 3.35), followed by AI and machine learning for adaptive accessibility (mean = 3.28). These findings suggest that emerging technologies, particularly mobile and AI-based solutions, offer viable pathways for expanding accessibility in resource-constrained contexts.

Research Question 4: Strategies for Improvement

The fourth research question identified strategies to improve the implementation of assistive and accessible computing.

Table 4: Strategies for Improving Assistive Computing Implementation

Item	Mean	SD	Decision
Government subsidies for assistive technology procurement	3.45	0.69	High
Mandatory accessibility training for educators and administrators	3.38	0.73	High
Development of local assistive technology solutions	3.32	0.76	High
Strengthened enforcement of accessibility legislation	3.25	0.78	High
Public-private partnerships for assistive technology provision	3.18	0.81	High
Integration of accessibility into teacher education curricula	3.41	0.71	High
Awareness campaigns targeting aging populations and persons with disabilities	3.29	0.74	High
Grand Mean	**3.33**	**0.66**	**High**

Table 4 demonstrates strong consensus on strategies for improvement, with a grand mean of 3.33. The highest-rated strategy was government subsidies for assistive technology procurement (mean = 3.45), followed by integration of accessibility into teacher education curricula (mean = 3.41) and mandatory accessibility training (mean = 3.38). These findings suggest that respondents favor systemic, policy-level interventions alongside capacity-building measures.

Discussion

The Implementation Gap

The finding that implementation of assistive and accessible computing is at a low level (grand mean = 2.42) is consistent with prior research on inclusive education in Nigeria. Alumona and Odoh (2025) documented similar implementation deficits in inclusive education policy, noting

that "the effective implementation of inclusive education for children with disabilities in Nigerian public primary schools remains deeply inadequate". The present study extends these findings to the broader domain of assistive computing, encompassing both educational and community settings and addressing the often-neglected aging dimension.

The low implementation levels are particularly concerning given Nigeria's aging population trajectory and the large number of persons with disabilities. Without adequate assistive technology, older adults face increased risk of social isolation, loss of independence, and diminished quality of life. Persons with disabilities are denied access to educational and employment opportunities that could enable fuller participation in society.

The Affordability Barrier

The identification of high cost as the most severe barrier (mean = 3.42) resonates with Odoh's (2026) findings on IoT adoption in Nigerian universities, where affordability significantly affected both adoption and usability. The economic dimension of access to assistive technology is inescapable: when devices and software are prohibitively expensive, even well-designed policies cannot translate into practical benefits for end users.

This affordability challenge is compounded by the fact that assistive technologies often must be customized to individual needs, reducing economies of scale and increasing costs. The development of locally produced, open-source assistive solutions identified as a promising strategy in this study (mean = 3.32) represents one pathway to addressing this barrier.

The Role of Emerging Technologies

The high rating of AI and machine learning as opportunities (mean = 3.28) reflects growing recognition of the potential of intelligent systems to enhance accessibility. AI can enable more natural and flexible assistive interfaces, adapt to individual user patterns, and provide capabilities that were previously infeasible. Odoh's (2025) research on AI awareness and utilization for adaptive learning, however, suggests that awareness and practical implementation lag behind potential. Bridging this gap will require deliberate efforts to make AI-powered accessibility tools available, affordable, and usable in Nigerian contexts.

The finding that mobile technology represents the most promising opportunity (mean = 3.35) is significant. Mobile phones are ubiquitous in Nigeria, and smartphone penetration continues to increase. Assistive applications delivered via mobile platforms can leverage existing hardware, reduce costs, and expand reach. This aligns with broader trends in "mobile-first" development strategies for developing contexts.

Strategies for Systemic Improvement

The strong consensus on improvement strategies with all items rated above 3.0 suggests that stakeholders have clear ideas about what is needed. The highest-rated strategy, government subsidies for assistive technology procurement (mean = 3.45), directly addresses the affordability barrier. This is consistent with international practice, where subsidies and public procurement programs have been essential to expanding access to assistive technology.

The emphasis on training and curriculum integration (means of 3.38 and 3.41, respectively) reflects recognition that technology alone is insufficient. Without personnel who understand

how to select, implement, and support assistive technologies, even well-funded procurement programs will fail to achieve their objectives. Odoh et al. (2025) similarly found that digital literacy significantly affects technology adoption, underscoring the importance of capacity building.

Limitations

This study has several limitations. First, the sample was drawn primarily from educational institutions, which may not fully represent the diversity of settings where assistive computing is needed. Second, the reliance on self-report data may introduce response biases. Third, the study focused on Nigeria, and findings may not generalize to other developing contexts with different policy environments and resource constraints.

Implications for Policy and Practice

The findings suggest several actionable implications. Policymakers should prioritize funding for the procurement of assistive technology and establish clear accessibility standards for public institutions. Educational institutions should integrate accessibility training into pre-service and in-service teacher education programs. Technology developers should prioritize affordability and local relevance in the design of assistive solutions. International organizations and donors should support capacity-building and technology transfer initiatives to strengthen local assistive computing ecosystems.

Conclusion

This study examined the state of assistive and accessible computing for aging populations and persons with disabilities in Nigerian public institutions. The findings reveal a significant implementation gap: while policy frameworks exist, the practical provision of assistive technologies remains limited. The primary barriers, cost, inadequate infrastructure, lack of trained personnel, and weak policy enforcement, are systemic and interconnected.

At the same time, the study identified promising opportunities. Mobile technology, AI, and open-source solutions offer viable pathways for expanding access. Stakeholders demonstrated strong consensus on the need for government subsidies, training programs, and curriculum integration as strategies for improvement.

The integration of assistive and accessible computing into educational and community systems is not merely a matter of technological provision but a question of equity and justice. Aging populations and persons with disabilities deserve the same opportunities for learning, working, and participating in society as all other citizens. Realizing this vision will require sustained commitment, strategic investment, and collaborative action across government, educational institutions, technology developers, and civil society.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Federal and state governments should establish subsidy programs for assistive technology procurement, targeting low-income aging populations and persons with disabilities. Public institutions should be mandated to allocate specific budgets for assistive technology.

2. Comprehensive training programs on assistive technology selection, implementation, and support should be developed for educators, administrators, and disability support personnel. Accessible content should be integrated into teacher education curricula nationwide.
3. Support should be provided for the development of locally produced, affordable assistive technologies that address the specific needs and contexts of Nigerian users.
4. Mechanisms for monitoring and enforcing compliance with accessibility legislation should be strengthened, including regular audits of public institutions and penalties for non-compliance.

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