ADVOCACY FOR TECHNOLOGICAL ENHANCEMENT FOR EDUCATIONAL EQUITY IN NIGERIA UNDERSERVED COMMUNITIES

By

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Abstract

Underserved communities are confronted with educational challenges due to economic, geographic, and infrastructural barriers such as inadequate access to teachers, resources, and digital technology. Provision of appropriate technologies could provide solutions to these challenges. This paper explored the role of technological adaptation and usage in addressing educational inequities among these underserved communities. It also highlights the importance of local engagement in designing and implementing educational technologies, emphasizing the importance of community involvement for technological acceptance. Infrastructure investments, such as in energy and internet access, are crucial for sustaining these initiatives. Overall, educational technology, when tailored to local needs and supported by essential infrastructure, has the potential to empower underserved communities, fostering equity and socio-economic growth.

Keywords: Under-served communities; Educational technology solutions

Introduction

An underserved community is basically described as a group of people who lack adequate access to essential services and resources like education, healthcare, and technology which are available to other people in other locations. Underserved communities are confronted with systemic barriers related to socioeconomic status, geographic location, or other marginalizing factors, resulting in significant disparities in opportunities and outcomes (Davis, Berke, Diamond, Griffard, Haynes, Johnson, Warraich, Crisostomo-Morales, Benissan, Gillespy, & Butterfield, 2021). In education, underserved communities lack access to standard schools, up-to-date learning materials, and technological resources that are important for reducing achievement gaps and ensuring equity. To combat these challenges, there is a need to explore the potential of technology enhancement among these populations. Incorporating technology

into educational frameworks can lead to positive learning outcomes and therefore promote equity by accommodating diverse learning styles and creating conducive and interactive environments (Eden, Chisom & Adeniyi, 2024). Enhancing technology for educational purposes in rural environments has been used and found to be helpful among out-of-school children as they promote adaptable and sustainable learning support (Badar, Mason, & Khan, 2018). It is hence necessary to address the digital divide through the use of technology adaptation and enhancement in order to prepare students from underserved communities for academic as well as professional successes in an increasingly technology-driven society (Banerjee, 2020).

Challenges Faced By Underserved Communities

Underserved communities are faced with a multitude of challenges ranging from geographical, health, economic, to educational challenges. The underserved communities lack basic infrastructure that will make them have a good quality of life, such as modern housing, a good road and transportation system, a communication system, a decent portable water supply, healthcare delivery services, and qualitative educational resources. They also experience various forms of economic disadvantage, and hardships (Saungweme, 2017).These challenges are sometimes interwoven. For instance, their limited access to healthcare facilities may be due to difficult terrains like mountainous, riverine, or swampy areas, or due to a lack of good roads and effective and efficient transportation systems to convey the people to the hospitals or clinic. Often time, there are disparities in the distribution of the facilities due to economic disadvantages or problems of cultural barriers (Xu, Yue, Wei, Yang, Chen & Pan, 2022).

Underserved populations are faced with educational challenges due to their peculiarities in terms of distance, location, cultural barriers, and lack of development. Children from disadvantaged backgrounds usually lack access to quality educational opportunities, have fewer opportunities to succeed in school, lack engagement in learning, and find traditional classroom instruction to be boring and unengaging (Vadivel, Alam, Nikpoo, & Ajanil, 2013). Their lack of access to qualitative education is due to poor resources and the absence of free and compulsory education for pupils in basic classes, despite Nigerian government policies on free and compulsory education. Students in underserved communities still need to pay for so many things in order to access education, such as desks, chairs, textbooks, exercise books, stationery, chalk, and even school uniforms. This, invariably, has led to an increase in the number of out-of-school children (Ukpong, 2020).

Another identified barrier to acquiring quality education by underserved communities is a lack of committed, well-trained, and motivated teachers in public schools. Qualified and adequately trained teachers may not have enough incentives to work in the underserved areas; this category of teachers migrates to more advantaged areas where they will get better opportunities (Bolaji, 2014). Hence, the underserved communities are at the mercy of unqualified and ill-trained teachers, who cannot teach well or use technology effectively in the classroom. Children with special needs face additional challenges like the problem of stigmatization, having to deal with negative prejudice and attitude from the community, inability to be integrated into the mainstream school system, and lack of equal access to healthcare and basic resources (Adebisi, Jerry, Rasaki, & Igwe, 2014).

Rural schools and the underserved communities are also disadvantaged in the areas of technology as part of the educational system. They experience the digital divide due to a lack of

accessibility to the technologies that are required to participate in digital learning. The exorbitant cost of gadgets and devices can be a barrier for schools and families in low-income areas, as they may not have the financial resources to procure such technology (Chama, 2023).Thus, the digital divide continues to widen, and low-income communities continue to be impoverished and lacked. There are usually no ICT strategies and policies to guide the usability and operation ability of ICT in schools. There are problems of electricity, internet facilities as well as other infrastructure needed to use the online method in accessing quality education (Olanrewaju, Adebayo, Omotosho & Olajide, 2021).

The existence of a digital divide between developed and underdeveloped regions gives rise to some disadvantages in the less developed region, like reduced educational opportunity, slow economic development, inadequate healthcare accessibility, and poor political engagement. Rural people lack access to internet facilities, which deprives them of getting online educational resources and material. Lack of internet connectivity also leads to difficulty in attracting investment in this digital age. It also creates problems in accessing quality healthcare information and treatment.

The Role of Technology in Addressing the Challenges of Underserved Communities.

Understanding the complex interplay between geographical and demographical factors on one hand and the specific needs of each community on the other is essential for designing effective development strategies for them (Ambroso, Dunn, & Fox, 2021). Investments in infrastructure, sustainable resource management, and culturally sensitive education can empower these communities to overcome their limitations and build a brighter future. In providing solutions to the educational challenges being faced by the underserved communities in Africa, the appropriate use of educational technology should be considered. Technological enhancement such as ICT will not only improve access to education but also to improved health care and agricultural sectors, hence leading to an increase in the socioeconomic rating of the community (Pate & Pate, 2020). Also, through the use of appropriate technology, communities will be opened to new opportunities, increase their knowledge, facilitate the community economy, and improve digital literacy (Migiro & Kwate, 2007; Ko, Routray & Ahmad, 2019).

The Effectiveness of Various Educational Technology Interventions in Addressing Educational Challenges in Underserved Areas

In providing solutions to the educational challenges being faced by the underserved communities in Africa, the appropriate use of educational technology should be considered. For instance, underserved communities with limited or no internet facilities can make use of offline-accessible educational apps and e-readers (Wiebe, Crisostomo, Feliciano, & Anderson, 2022). These apps and devices contain curriculum contents, language learning, and vocational training that can be used in teaching and learning without the need for internet access. Educational programmes on radio and television stations can also be designed to be broadcast in languages understood by people and contain contexts to provide basic literacy and life skills education to a wider audience. Aside from being used for education purposes, they can also serve as media to propagate vital information on health, disaster preparedness, and community development.

More so, the provision of digital libraries with steady sources of energy, like solar power systems, can offer educational resources, research materials, and entertainment in places without physical libraries. It is essential to train and support underserved communities with the

requisite skills on how to use these technologies effectively (Ahuja, 2023). Community-based digital centers can play a major role in this situation. Encouraging local ownership and participation is important. The community should be involved in the design, implementation, and maintenance of any technology solutions being proposed for them. This is to ensure that their specific needs and cultural context are met. It will also encourage local ownership, which will boost community participation and support for the program (Benneworth, 2018).

Aside from taking care of technology and infrastructure, special attention should also be given to empowering teachers and educators working in these communities if reasonable improvement is expected. Teacher training and professional development such as digital literacy programmes and online resources can equip teachers with skills to effectively use technology in their classrooms (Haleem, Javaid, Qadri, & Suman, 2022). Online communities and forums can connect educators across geographically dispersed areas for knowledge exchange and peer support. And also, the use of educational management tools can streamline administrative tasks, manage student data, and provide valuable insights for improving learning outcomes.

The transformative potential of educational technology in empowering underserved communities is undeniable. The current focus is shifting from mere access to technology to harnessing its potential for deeper impact, equity, and sustainability. More recently, artificial intelligence (AI) has been used for personalized learning, thereby tailoring content, pace, and difficulty to each student's needs. It encourages students to experience deeper engagement, mastery of concepts, and a more equitable learning experience (Pratama, Sampelolo, & Lura, 2023). Virtual Reality (VR) and Augmented Reality (AR) are also found to be useful for immersive learning environments, which allow students to virtually explore historical events, conduct scientific experiments, or visit different cultures while in their locality. Students gain deeper understanding, develop critical thinking skills, and foster a love for learning through engaging experiences (Dumont & Ready, 2023).

Another helpful technology is Blockchain, which is for secure and transparent learning records. It helps in verifying records of student achievements, credentials, and academic journeys. Students gain ownership of their learning data, access scholarship opportunities, and seamless transition between educational institutions (Balobaid, Alagrash, Fadel, & Hasoon, 2023). It is a known fact that top-down educational technology solutions often fail to address the specific needs and cultural contexts of underserved communities because the end users are not carried along in the design and implementation of such programmes. Therefore, community-driven educational technology design and implementation that actively involve community members in identifying needs, selecting technologies, and shaping implementation strategies are culturally relevant, sustainable, and effective educational technology solutions that empower communities and foster ownership (Anthony Jr., 2023). Similarly, limited access to expensive technology and reliable but costly internet connectivity can hinder educational technology adoption. Therefore, considering local resources and exploring low-cost solutions such as offline learning content and solar-powered solutions ensure wider accessibility and sustainability. It enables educational technology to reach more learners, even in remote areas with limited resources, thereby promoting inclusivity and bridging the digital divide (Pesanayi & Lupele, 2018).

Examples of Educational Technology Used in Uplifting Underserved Communities

Technology, when implemented thoughtfully and inclusively, can be a powerful tool for mitigating the challenges faced by underserved communities in accessing quality education

(XuSerrano, Dea-Ayuela, Gonzalez-Burgos, Serrano-Gil & Lalatsa, 2019). Here are some inspiring case studies that showcase the positive impact of educational technology. When limited access to education in remote villages was observed in India, the "Hole-in-the-Wall" programme was introduced. This involved placing solar-powered computer kiosks in rural areas where children engaged in self-directed learning. This led to many of these children becoming computer literate (Dangwal, Sharma, & Hazarika, 2014). The Afghan Girls' Programming Project was a programme introduced in Afghanistan to address the problem of limited educational opportunities for girls as a result of cultural practices. The Afghan Girls' Programming Project provided coding and technology training to girls in rural areas, allowing them to gain essential digital skills, build confidence, and gain access to career opportunities in the technological sector (Ahmed, Tasmin & Ibrahim, 2022).

Also of significant reference is the 'Room to Read' programme, which was put in place to solve the problem of limited educational resources in Nepal, brought about by the destruction of several schools in the aftermath of the Nepal earthquake. The 'Room to Read' program was the establishment of digital libraries in schools, thereby providing access to e-books, audiobooks, and educational games. The programme was a success because it helped students regain access to learning materials, improve their reading culture, and continue their education despite the challenging circumstances (Khan, Jackson, Clark, Bergenfield, Puri & Yount, 2018).

Challenges to Technological Integration in Underserved Communities

The cost of acquiring the new technologies is one of the major hindrances to technological enhancement for underserved communities, as these may be out of reach for many rural dwellers. Another challenge is a lack of trust in new technology, leading to non-acceptance of such tools to improve their condition. Lack of regular power supply to the underserved communities can also constitute a big challenge to the use of technology as well as a lack of skilled personnel and human resources (Anoemuah, 2019; Uzoagu and Oriji, 2022). There may also be problems of internet and connectivity when the new technology is ICT in nature. These are complicated by a lack of financial resources for data and internet charges (Gupta and Gautan 2017).

Socioeconomic disparity also contributes to the gap in access to technology such as internet facilities and other ICT gadgets, which are important for the modern educational system. To have equitable education, these socioeconomic factors need to be addressed. It is of general knowledge that underserved communities lack sufficient social infrastructure, which contributes to the widening of the gap between them and developed communities.

Addressing the Challenges of Technology Integration in Underserved Communities

Community-led infrastructure development will significantly result in social cohesion and the development of disadvantaged societies. The citizen participation and involvement in the provision of this needed infrastructure can lead to the much-needed development (Manthey, 2024). Such infrastructure includes schools, hospitals, housing, and other areas that are necessary for the social wellbeing of the population. Provision of these infrastructures leads to economic growth, improved quality of life, and social cohesion.

Specific infrastructure development that will enhance underserved community development includes the provision of a good transportation system that will connect difficult terrains to the urban centers, thereby enhancing easy connectivity and mobility between different regions.

Provision of clean and safe water will ensure good health, thereby preventing diseases associated with dirty water and poor sanitation. Another area of infrastructure is providing affordable and decent houses for citizens. This will ensure security of life and properties for underserved communities (Manthey, 2024). Investing in infrastructure will ensure economic growth by creating job opportunities and increasing productivity in construction companies and related industries. It will also lead to a better quality of life for the people by making it easy to access basic necessities of life like a good house, clean and safe water, and good healthcare facilities. Provision of necessary infrastructure is also important because it opens ways for investment by well-to-do individuals and leads to innovations and technological advancements like renewable energy like solar energy.

However, investing in infrastructure has its own challenges, which may be lack of funding, political instability, lack of political willpower, obsolete technological problems, and lack of skilled human capital (Palei, 2015) (Chin, Ong, Wai & Kon, 2021; Srinivasu and Rao, 2013). There must be visible and concerted efforts to improve infrastructure in underserved communities. These include the provision of a sustainable, reliable, and steady supply of electricity, internet connectivity, and access to affordable digital devices, as these are important for technology adoption. When technological solutions are tailored to local needs, it will bring about the empowerment of underserved communities and speed up their development. It must be said that any form of technological solution being proffered must be cost-effective, maintainable, sustainable, and locally available as much as possible (Cabacungan, Saddi, Rocamora, Cao, Granada & Santiago, 2023).

Conclusion

This article highlights the multifaceted challenges the underserved communities face and underscores the role of technological solutions in bridging gaps in educational access and outcomes between them and developed communities. It also provides a framework for community-driven, sustainable, and context-sensitive approaches to integrating technology in disadvantaged settings, paving the way for future research and practical interventions. It emphasizes the importance of blending infrastructure development, community participation, and emerging technologies to promote equity and create an inclusive and transformative educational landscape.

Recommendations

The government at all levels should prioritize investments in infrastructure such as reliable electricity, affordable internet access, and low-cost digital devices to facilitate technology integration in underserved communities. Engaging local communities in the design, implementation, and maintenance of technological solutions is crucial to ensuring cultural relevance, community acceptance, and long-term sustainability.

Teacher training and professional development programmes should focus on enhancing digital literacy for educators in underserved regions to improve the effective use of educational technology in classrooms. Additionally, strong political will and supportive policies are essential to promote technology adoption tailored to the unique needs of these communities, bridging the digital divide.

Addressing the underlying socioeconomic disparities is equally important. This can be achieved through scholarships, subsidies for educational resources, and targeted initiatives aimed at reducing inequities in access to technology and education for students in underserved areas.

References

Adebisi, R. O., Jerry, J. E., Rasaki, S. A., &Igwe, E. N. (2014). Barriers to special needs education in Nigeria. *International Journal of Education and Research*, 2(11), 451-462.

Ahmed, N., Tasmin, M., & Ibrahim, S. M. N. (2022). Technology for empowerment: Context of urban Afghan women. *Technology in Society, 70, 102058.*

Ahuja, V. (2023). Equity and Access in Digital Education: Bridging the Divide. In *Contemporary Challenges in Education: Digitalization, Methodology, and Management (pp. 45-59). IGI Global.*

Ambroso, E., Dunn, L., & Fox, P. (2021). Research in Brief: Engaging and Empowering Diverse and Underserved Families in Schools. *Regional Educational Laboratory West*.

Anoemuah, R. A. (2019). Innovative ICT solutions and entrepreneurship development in rural area such as Michael and Cecilia Ibru University (MCIU) Community, Agbarha-Otor, Delta State, Nigeria. *International Journal of Research and Innovation in Applied Science (IJRIAS)*, 52-55.

Anthony Jr, B. (2023). The Role of Community Engagement in Urban Innovation Towards the Co-Creation of Smart Sustainable Cities. *Journal of the Knowledge Economy*, *1-33*

Badar, F., Mason, J., & Khan, K. (2018). Re-thinking out-of-school learning in rural Pakistan. In *26th International Conference on Computers in Education, ICCE 2018* (pp. 440-445). Asia-Pacific Society for Computers in Education.

Balobaid, A. S., Alagrash, Y. H., Fadel, A. H., &Hasoon, J. N. (2023). Modeling of blockchain with encryption based secure education record management system. *Egyptian Informatics Journal, 24(4), 100411*

Banerjee, M. (2020). An Exploratory Study of Online Equity: Differential Levels of Technological Access and Technological Efficacy among Underserved and Underrepresented Student Populations in Higher Education. *Interdisciplinary Journal of e-Skills and Lifelong Learning*, *16*, 93-122.

Benneworth, P. (2018). Definitions, approaches and challenges to community engagement. *Mapping and Critical Synthesis of Current State-of-the-Art on, 39, 16.*

Bolaji, S. D. (2014). Intent to action: Overcoming barriers to universal basic education policy

implementation in Nigeria.

Bon, A., Saa-Dittoh, F., &Akkermans, H. (2024). Bridging the digital divide. *Hannes Werthner· Carlo Ghezzi· Jeff Kramer· Julian Nida-Rümelin· Bashar Nuseibeh· Erich Prem·*, 283.

Cabacungan, P. M., Saddi, K. C. M., Rocamora, M. T. J. G., Cao, R. P., Granada, S. P., Santiago, P. R. A., et al. (2023). Sustainable Technologies for Environment-Friendly and Ecological Resilience. In *International Congress on Information and Communication Technology (pp. 745-762). Singapore: Springer Nature Singapore.*

Chama, A. (2023). Digital literacy skills of teachers: A study on ICT use and purposes.

Chin, M. Y., Ong, S. L., Wai, C. K., &Kon, Y. Q. (2021). The role of infrastructure on economic growth in belt and road participating countries. *Journal of Chinese Economic and Foreign Trade Studies*, *14*(2), 169-186.

Dangwal, R., Sharma, K., & Hazarika, S. (2014). Hole-in-the-Wall learning stations and academic performance among rural children in India. *Journal for Multicultural Education, 8(1), 31-53.*

Davis CR, Berke P, Diamond Ebanks Holloman M, Griffard MR, Haynes S, Johnson E, Warraich Z, Crisostomo-Morales L, Benissan DG, Gillespy C, Butterfield W. Support strategies for socially marginalized neighborhoods likely impacted by natural hazards. Coastal Resilience Center, The University of North Carolina at Chapel Hill, Chapel Hill, NC. 2021 Jul.

Dumont, H., & Ready, D. D. (2023). On the promise of personalized learning for educational equity. *Npj science of learning, 8(1), 26.*

Eden, C. A., Chisom, O. N., &Adeniyi, I. S. (2024). Harnessing technology integration in education: Strategies for enhancing learning outcomes and equity. *World Journal of Advanced Engineering Technology and Sciences*, *11*(2), 001-008.

Gupta, A., &Gautam, S. (2017). ICT for rural development: Opportunities and challenges. *Int. J. Inf. Comput. Technol*, *7*(1), 13-23.

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers, 3, 275-285.*

Khan, Z., Jackson, E., Clark, C. J., Bergenfield, I., Puri, M., &Yount, K. M. (2018). Supporting girls' education: an evaluation of 'Room to Read'in Nepal Emerging baseline findings Executive Summary. *London: GAGE/ODI*.

Ko, G., Routray, J. K., & Ahmad, M. M. (2019). ICT infrastructure for rural community

sustainability. *Community Development*, *50*(1), 51-72.

Manthey, N. A. (2024). The role of community-led social infrastructure in disadvantaged areas. *Cities*, *147*, 104831.

Migiro, S. O., &Kwake, A. (2007). Information needs and communication technology adoption in Africa: a comparative study of rural women in Kenya and South Africa. *Journal of Social Development in Africa*, *22*(1), 109-141.

Monday, O. M., &Mallo, G. D. (2021). Higher Education in Nigeria: Challenges and Suggestions.

Olanrewaju, G. S., Adebayo, S. B., Omotosho, A. Y., &Olajide, C. F. (2021). Left behind? The effects of digital gaps on e-learning in rural secondary schools and remote communities across Nigeria during the COVID19 pandemic. *International Journal of Educational Research Open*, *2*, 100092.

Palei, T. (2015). Assessing the impact of infrastructure on economic growth and global competitiveness. *Procedia Economics and Finance*, *23*, 168-175.

Patel, R., & Patel, S. (2020). Role and Applications of ICT in Rural Development and Management.

Pesanayi, V. T., &Lupele, C. (2018). Accelerating sustainable solutions at the local level. *Issues and trends in Education for Sustainable Development*, *177.*

Pratama, M. P., Sampelolo, R., &Lura, H. (2023). Revolutionizing education: harnessing the power of artificial intelligence for personalized learning. *Klasikal: Journal of Education, Language Teaching and Science, 5(2), 350-357*.

Saungweme, S. F. J. (2017). The right to development for indigenous peoples in Africa: still a long walk to freedom. *Africa Insight*, *47(3),112-134.*

Srinivasu, B., & Rao, P. S. (2013). Infrastructure development and economic growth: Prospects and perspective. *Journal of business management and Social sciences research*, *2*(1), 81-91.

Ukpong N. N (2020). Effective Management of Free and Compulsory Education for Youths Freedom from Illiteracy in Akwa Ibom State, Nigeria. Journal of Continuing Education and Development Studies 3. 17-23.

Uzoagu, I. F., &Oriji, A. (2022). Developing Rural Communities in Nigeria Through Information and Communication Technologies and the Potential Barriers. *British Journal of Education*, *10*(6), 1-16.

Vadivel, B., Alam, S., Nikpoo, I., &Ajanil, B. (2023). The Impact of Low Socioeconomic Background on a Child's Educational Achievements. *Education Research International*, *2023*.

Wiebe, A., Crisostomo, L., Feliciano, R., & Anderson, T. (2022). Comparative Advantages of Offline Digital Technology for Remote Indigenous Classrooms in Guatemala (2019-2020). *Journal of Learning for Development*, *9(1), 55-72.*

Xu, R., Yue, W., Wei, F., Yang, G., Chen, Y., & Pan, K. (2022). Inequality of public facilities between urban and rural areas and its driving factors in ten cities of China. *Scientific Reports*, *12*(1), 13244.

XuSerrano, D. R., Dea-Ayuela, M. A., Gonzalez-Burgos, E., Serrano-Gil, A., &Lalatsa, A. (2019). Technology-enhanced learning in higher education: How to enhance student engagement through blended learning. *European Journal of Education*, *54(2), 273-286.*