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Research Article

Harnessing ICT as a Catalyst for Achieving Sustainable Development Goals in Nigeria

Kayode Sunday John Dada*

University Library, Federal University of Education, Zaria, Kaduna State, NIGERIA.

ABSTRACT
Information and Communication Technologies (ICTs) is the foundation and pillar of today's digital economy with enormous potential to achieve SDGs in sectors and improve individuals lives in many fundamental ways. Sustainable Development Goals (SDGs) are seen as global initiative aimed at making nations and countries a better place to live, end poverty in all forms. Information and Communication Technologies (ICTs) have proven to accelerate attainment of all 17 Sustainable Development Goals (SDGs). With sound relevant, updated and adequate information, identifying indicators, and analysis for achieving sustainable food security, democracy, health, education, gender equality in all sectors. The paper concludes ICT improves student learning efficiency, Reduce the burden on Educators, Teachers and Lecturers, increases student motivation to learning, and recommends that there is need for strong advocacy on the use and implementation of adaptive governance to addresses institutional, cross-scale challenges, promotion of public awareness and engagement, collaboration with Ministry of Communication, Digital Economy and Educational institutions for the achievement and implementation of SDGs Goals for development of innovation and development across spectrum of development areas in the country.

Keywords: Achievement, Catalyst, ICT, Nigeria, Sustainable Development Goals.

Correspondence:
Kayode Sunday John Dada
University Library, Federal University of Education, Zaria, Kaduna State, NIGERIA.
Email: kayodescholar@gmail.com

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INTRODUCTION

Information and Communication Technologies (ICTs) is a critical foundation for enhanced social and economic development in any nation. The use and applications for ICT innovations to produce new forms of information and communication technologies is significant as sectors relying on its adoption and deployment for manufacturing and development (Hanić *et al*., 2021). The United Nations frameworks on SDGs which include indicators like environmental, social, and economic issues, has led to sustainable production and consumption, reduction of climate change and poverty, preservation of marine conservation, enhanced food security, promotion of gender equality, and economic growth in all sectors (Agarwal, 2018; Marsuki, 2009; Muhmad, Muhamad and Sulong, 2021; Jones *et al*., 2017).

Over the past several years, ICT have brought in innovations that industries, organization used for the benefit of advancing technology and achieving sustainable development goals (Hanić, and Sućeska, 2023; Wu, 2021). These attributes have a significant benefit for individuals, educators, researchers, manufacturers in the society. Since 2020, The Nigerian Government in collaboration with the Ministry of Education at all levels in Nigeria embraced and deployed the use of ICT, abolishing face-to-face classes due to the outbreak of corona virus making the educator sector, to seek other platforms to conduct teaching and learning from elementary, junior high, and high schools as well as banking industry deployment of mobile applications for financial transactions to reduce the spread of the virus (Jones *et al*., 2017). These laid the foundation for the Federal Government of Nigerian for the development National Digital Economy Policy and Strategy, National Broadband Plan, and inclusion of digital economy at spheres of the sector to improve the education (Pantami, 2020; Agarwal, 2018).

ICTs enable worldwide communication and networking for individuals in all works of life without leaving their comfort zone and passing information across the globe within a twinkle of eyes, speeding its deployment to reduce the costs of production and service delivery, enhanced auto supervised transportation. The use of ICT education is paramount for the development of digital literacy and informed citizenry for positive contribution to the society (Ameyed, 2018). but this is limited in disadvantaged regions, where lack of access and use of ICT could be limited leading to digital illiterate individuals who lack the skills for contributing towards achieving Sustainable Development Goals (Disability Development, 2019; Agarwal, 2018).

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Another potential usage of ICTs in the educational sector, its use for web conferencing, with learners and educators across the globe to learn due to proximity and geographical boundaries and keep abreast of current technological changes from developed countries promoting inclusive education (Jones, Wynn, Hillier and Comfort, 2017). Another significant use of ICTs in sustainable development is the eCommerce platform that providers individuals and businesses across the globe to connect for trading and transaction promoting economic growth and national development.

ICT is a crucial component for schools and educational institutions, for carrying out teaching and learning with ease, for research work and projects, timely assessment of examination results, digital supervision of students and ICT deployment for teaching promotion a sound educated digital literate individuals who can partake in the achievement of sustainable development goals (Mukalele, 2018; Sachs, 2015; Tjoa and Tjoa, 2016). it is worth noting that institution, libraries and organization who formely rely on traditional printed information resources could perform better, make informed decision, sound policy formulation and efficiently with the integration of ICT technology to accelerate action on the achievement of SDGs (Sachs, 2015). This prompted the Federal Government of Nigeria to establish a Ministy of Communications and Digital Economy, headed by Prof. Isa Pantami, to ensure all sectors in the country explored e-government and the potentials of ICTs for achieving a sustainable economy.

The Minister of Communications and Digital Economy, Prof. Isa Pantami, (2020) reported that the ICT sector has contributed immensely with about 14.07% to the Gross Domestic Product (GDP) in his report, the Nigerian National Bureau of Statistics (2020) supported this claims that the country's GDP grew exponentially by 1.87% on year-on-year revealing that the ICT sector have contributed successively in the Nigerian Sector (Pantami, 2020).

Concept of Information Communication Technology

Information and Communication Technology (ICT) in education refers to the application and deployment of information and communication technology tools, equipment and infrastructures in educational settings for teaching and learning (Leanringbox, 2022). According to Oghogho and Ezomo (2013) Information and Communication Technology is seen as "a broad-based technology including its methods, management and application for the development, creation, storage, manipulation and use of communication tools for information dissemination and access (Oghogho and Ezomo, 2013). Based on the above definitions, these technologies offer access to information through communication through physical hardware, components, tools, and the other cyber infrastructure that aid sending and receiving of information (Disability Development, 2019).

Sustainable Development Goals

Sustainable development brought together countries, stakeholders in 1987 for the discussion and development of Brundtland report. This attention in 2015, mandated the United Nations (UN) to assemble countries' stakeholders for General Assembly for the formulation of 17 Sustainable Development Goals (SDGs) which must be achievable in countries by 2030. The development of a new set of Sustainable Development Goals (SDGs) by the UN was preceded by the Millennium Development Goals (MDGs), which measured eight (8) goals by the year 2015. Wu (2021) reported that most of the MDG targets were achieved and the SDGs were to succeed in improving and achievement by 20230 among member nations. Sustainable Development Goals (SDGs) refers to a set of globally sustainable targets developed for member nations improvement for the economy, society, and environment. Thes goals launched in 2015 during the UN General Assembly urged member nations to embrace these targets in all sectors including business, energy, education, power of their nations towards a sustainable developed nation (Wu, 2021).

Ajiye (2014) and (Udjo and Lalthapersad-Pillay, 2015), reported that though most of the MDGs goals were achieved in developed nations, but were not effective in developing countries like Nigeria due to many factors like corruption, lack of supervisory agencies for SDGs implementation (Ajiye, 2014; Udjo and Lalthapersad-Pillay, 2015). Although, the Seventeen (17) Sustainable Development Goals target to end poverty, hunger and inequality, take action on climate change and the environment, improve access to health and education, must build strong institutions, partnerships and collaboration for its implementation and achievement (Ukubeyinje and Ejitagha, 2019). The ICT sectors play an important roles in its implementation and achievement due to its advancement for meeting targets including universal coverage for basic services in the areas of health, education, finance and energy (Kostoska and Kocarev, 2019; Crawford., 2017; International Telecommunication Union, 2017).

The SDG specific goals are to:

SDG1: No Poverty.

SDG2: Zero Hunger.

SDG 3: Good Health and Well-being.

SDG 4: Quality Education.

SDG 5: Gender Equality.

SDG 6: Clean Water and Sanitation.

SDG 7: Affordable and Clean Energy.

SDG 8: Decent Work and Economic Growth.

SDG 9: Industry, Innovation and Infrastructure.

SDG 10: Reduce inequality.

SDG 11: Sustainable Cities and Communities.

SDG 12: Responsible Consumption and Consumption.

SDG 13: Climate Action.

SDG 14: Life below Water.

SDG 15: Life on Land.

SDG 16: Peace, Justice and Strong Institutions.

SDG 17: Partnership for the Goals.

Adopted from Kostoska, O. and Kocarev, L. (2019) A Novel ICT Framework for Sustainable Development Goals

The targets for 2030 for Goal 1, aims at end poverty in all its forms everywhere, including eradicating extreme poverty as, measured by statistics, that individual must be able to afford a square meal and not living below $1.25 per day. This take cognizance that men, women economic disadvantage and the poor have equal rights to economic resources, access to basic services, ownership and control over land, property and reduce their exposure to climate change and its related extreme events (Kostoska and Kocarev, 2019) For SDG Goals 6: Clean Water and Sanitation, that individuals irrespective of age, gender, ethnic backgrounds must have equitable access to safe and affordable drinking water, could be saddle with the responsibilities for protecting and restoring water related ecosystem to reduce pollution, eliminating dumping and minimising the release of hazardous chemicals (Hilty and Aebischer, 2015).

SDG 9: Industry, Innovation and Infrastructure, that every individual must be able to have access to sound resilient infrastructure to foster innovation individuals must be able to access, use affordable ICT infrastructure and emerging technologies irrespective of economic background for a knowledge society for the participation in the digital economy (International Telecommunication Union, 2017). Some contributions of ICT through foundation like MCarthur Foundation, Gates Foundation, MTN Foundation, Tony Elumelu Foundation and Whitaker Peace and Development Initiative (WPDI) support provision of ICT infrastructure and connectivity have assisted disadvantaged and vulnerable communities for open access to academic research, enhanced transparency, use of digital platforms for learning (Crawford, 2017; SDG Advocates, 2017).

SDG 10: Reduce inequality: the target mandated that every individual must have equitable access to information and knowledge, with the use of ICT tools will help reduce inequality among disadvantaged communities within and among countries will promote social and economic progress even with person with special needs (Crawford, 2017).

SDG 11: Make cities inclusive, safe, resilient and sustainable: with the use of ICT in cities and its infrastructure application for management of building into smart buildings will assist in smart water management, intelligent transport systems, and better efficiencies in energy and resource waste management. Organizations like International Telecommunication Union ITU and the United Nations Economic Commission for Europe (UNECE) facilitate the transition to smart sustainable cities by launched "United for Smart Sustainable Cities" (U4SSC) in 2016 promoted the effective and holistic city management of buildings across the globe (Crawford, 2017; International Telecommunication Union, 2017).

SDG 12: Sustainable consumption and production patterns: with the use of ICT applications for development manufacturing, maintenance in sectors will lead to increased dematerialization, sound products virtualization and smart technologies for smart production reducing excessive use of materials for production and reduction of emission triggering climate change (Crawford, 2017).

SDG 13: Urgent action to combat climate change and its impacts: with the use of smart ICT applications for management, optimization of resources of energy, transport and buildings, manufacturing, smart services and agriculture will help alleviate climate change due to availability of data and real time weather information updates for stakeholders to address climate change in case of emergencies such as land slids, hurricane, flood etc. (Crawford, 2017).

SDG 14: Conserve and sustainably use oceans, seas and marine resources: with the use of ICT application will help management marine ecosystem and blue economy for sustainable marine conservation, through satellite surveillance and monitoring. By creation of blue economy in Nigeria through use of radio-frequency spectrum satellite orbits will provide marine engineers, marine scientists detailed information for prompt analysis observations and management of oceans, marine life and terrestrial ecosystems to help plan mitigation strategies for regions, states and countries prone to environmental hazards (Crawford, 2017; International Telecommunication Union, 2017).

SDG 15: SDG 15: Life on Land: individuals, scientists and other stakeholders use of ICT applications/tools through collected data for analysis, monitoring and reporting possible for the conservation and sustainable use of land, as well as preventing biodiversity loss could help protect, restore, promote sustainable use of terrestrial ecosystems, and land (Crawford, 2017).

SDG 16: Peace, justice and strong institutions: With the of ICT for conflict resolution and crisis management will build peace during elections for electoral monitoring. And sensitization on the need for citizens to participate in electoral process for election of officers who valued its citizens and places its members a significant contributor for nation development, Organizations like International Telecommunication Union through its electronic citizen empowerment programs on sensitization for monitoring

and social inclusion of voter participation promoted transparency and, empowered citizens for economic growth (Crawford, 2017; International Telecommunication Union, 2017).

SDG 17: Strengthen the means of implementation and global partnerships for development: with the use of ICT tools/ technology for collaboration, multi-stakeholder partnerships among different organizations, industries key players, across member states will strengthen the implementation SDGs and enhanced sound 1data monitoring and accountability (Crawford, 2017).

ICT Inclusion in Nigeria Sectors

ICT in Finance

According to Helleiner (2011), Weber (2014), financial institutions' awareness about sustainability has increased. In fact, these institutions have embraced the sustainability concept over the last decade, particularly in insurance, investment, banking industries leading to investment and efficient financial practices in all levels of financial sector (Risi, 2020). This awareness has greatly influenced the current economic situation, besides contributing to society and sustainable development. ICTs enhanced financial transactions through the use of mobile money applications for seamless financial transaction (Ameyed, 2018)

ICT for Sustainable Education

Kent and Facer (2004) pointed out that ICT which includes the use of internet, computers, and other electronic delivery modes for teaching and learning provides children with needed basic digital literacy skills to .actively participate in classroom activities they postulated that ICT remains a powerful tool for 21st century digital literacy development and must be deployed across nations for teaching, learning, and assessments in the education sector promoting sustainable education in the country.

ICT improves student learning efficiency: For instance, in the past, Nigerian students would write notes taught in the class from the board and then revisit these notes to consolidate their memory of the lesson in preparation for assessment. With the use of ICT, tech savvy students no longer need to write long notes copied from board but have access those resources on their tablets and other devices leading to updated information to aid their learning experience (Iyejare, 2023). Digitization provides a platform for educators, students, and information users to move from the traditional way of teaching into an era of digital learning through the adoption of an interconnected ICT environment (Wu, 2021).

Reduce the burden on Educators, Teachers and Lecturers: with the deployment of ICT in the education will reduces teaching stress of writing on boards, and managed time allocated using smart devices likes tablet with educational materials installed This burden on educators is seen as a problem in the field of education, and these challenges is reduce to the bearest minimum and adequate teaching and learning will take place in Nigerian Educational System (Pantami, 2020).

Increased Student learning motivation: According to Brush, Glazewski and Hew (2008), ICT for education sustainability has helped impact knowledge on learners, students and educators across the world access unlimited educational material which is used by students' to increase learning motivation and interest (Mukalele, 2018; Wu, 2021).

ICT In Agriculture

The use of ICT in agriculture includes the use of smart farming technologies to produce crops, smart systems to analyze weather, soild information to control irrigation, application of fertilizers and pesticides, water conservation to reduce environmental damage cause by erosion of water and pesticides runoff. The information provided through the use of ICT farmers can build effective business plans to improve yields, profitability, reduce transactions cost and facilitate farmer linkages to markets in a sustainable way (SDG ICT Playbook, 2015).

ICT in Energy

The use of ICT in the energy sector has promoted development of sustainable energy power grids for recording energy consumption levels, and deployment of conservative measures for a sustainability-wise, smart cities with energy efficient with little or no dependence on other sources of fuel causing environmental hazards (International Telecommunication Union, 2017).

ICT in Transport

The use of ICT in transportation has aided accessibility, reduce motor accidents, smart road networks. For instance, the Internet of Things (IoTs), has been used in countries luke China, Japan, and European Countries to alert users arrivals, departure of buses, train, change of schedules, through mobile applications notifications on smartphones and to keep metros and buses running smoothly and in a timely manner. ICTs have been deployed through the use of self-driving cars (Googe Cars) that are usable by anyone and everyone to reduce road accidents, stress on driving, recycling plants for water sanitation services for proper utilization wastewater for farming purposes (Disability Development, 2019). ICTs have been used in emergent situations to notify people of hazards and evacuation routes for safety, protection of lives and properties (International Telecommunication Union, 2017).

Challenges of ICT Inclusion for Sustainable Development

Before the implementation of ICT for achieving Sustainable Development, it is imperatively important to have a clear understanding of its challenges:

a) Costs: ICT implementation and usage necessitate large infrastructure, hardware, software, and maintenance expenses. It is inevitable that certain costs will be incurred to implement ICT Tools through acquisition of ICT infrastructure, internet, hardware, equipment's, services and maintenance. This is perhaps the biggest challenge in its inclusion in developing countries like Nigeria. Most industries, organizations, educational centers, companies are faced with limited financial resources for its acquisition of equipment ICT tools including, laptions, tablet devices, Internet infrastructures, smart boards, etc., and on the software side (Learningbox,2022).

b) Instability of Network and Electricity: ICT, by its very nature, is greatly enhanced in an online environment for full functionality. In Developing country like Nigeria which is still lagging behind in use of alternative energy power sources and green energy like solar power, biogas, and bio resources for production of electricity to power the ICT infrastructures and its resources. However, there is also issues with network troubles as a result use of lower internet facilities (Learningbox, 2022).

c) Lack of adequate Use of ICT Infrastructure and Equipments: Individuals in all sectors of the economy from education, finance, and manufacturing require extensive training and assistance in order to use ICT tools in their organization effectively. Regrettably, many lack the abilities and understanding needed to make the best use of ICT technology. This knowledge gap may restrict the potential benefits of ICT integration into the services, that's why most organization in administrative task is herculean as most clerks and administrative officers to conduct their responsibilities using conventional filling system for their staff (Vien, Ai and Sung, 2019).

d) Resistant to Change, Fear of Replacement and unfavourable organizational culture, Poor attitude and beliefs-Often in developing nations, the organizations and management fail to perceive the importance and seriousness of the role of ICT in service delivery. Most employees' attitudes and beliefs are outdated and orthodox and belief its usage will take them out of their jobs and fail to embrace its applicability in discharging their duties to improve efficient and that ICT is meant primarily for the youngsters (Abbas *et al*., 2023).

e) Inadequate administrative support: Fu (2013) pointed out most administrators in the developing countries on education system focus more on the quantity of the education without monitoring content being provided rather than on the ICT usage (Fu, 2013).

Way forward for ICT Inclusion for Sustainable Development in Nigeria

To achieve the SDGs, ICT needs to be combined with innovative policies, services, and solutions. It can be a powerful means of implementation in many significant ways:

a) Training of Employees ICT Usage: To meet the increasing demand for a workforce with up-to-date skills and competencies aligned with globally competitive industries and continue driving economic growth into the next century, staff needs to be taught on training programmes and,

b) Workshops on various applications of ICT in their services as it will promote efficiency in service delivery towards attainment of SDGs Goals.

c) Formulation and implement of ICT Policies: Fu (2013) there is need for the establishment of well-managed ICT driven education system which must be readily accessible for all to ensure efficient division of tasks for learners and their instructors. This will outline roles mandated to achieve the curriculum structured towards achieving Sustainable Development Goals (Remenyi, 2017).

d) Use of Alternative Sustainable Power: ICT infrastructure and services requires adequate and steady power supply which is presently far from available in Nigeria. If the power availability problem is solved through sustainable energy of SDGs, and use of other sources of energy including solar energy, bio resources for energy production, the country would succeeded in reducing the overall cost of providing ICT services and avert the use of generators that pollutes the natural ecosystem through release of carbon into the atmospheres and land degradation due to oil spillage from these machinery affecting land and water towards achieving sustainable development goals (Crawford., 2017).

e) Reduction in the deployment costs of ICT Infrastructure: According to Ericsson Mobility Report (2021) mobile broadband (3G or above) covered 90% of the world´s population, leaping from almost one billion subscribers in 2010 to 7.7 billion subscriptions by 2021. By the end of 2015, the total number of mobile subscriptions had reached 100 percent penetration at around 7.3 billion the same number of mobile subscriptions as people in the world. It also reported that about 4 billion people from developing countries were still not using the Internet (Otindo, 2023). However, this staggering ability to scale fast will help overcome the challenges of 'connecting the unconnected' and reaching the 'last mile' to deliver unprecedented social and economic inclusion. ICT, especially mobile broadband, is an essential

infrastructure platform for the SDGs achievement in many sectors for improve existing technologies with innovation, connectivity, productivity and efficiency across areas. The top six sectors that will be significantly impacted by ICT are Energy, Manufacturing, Buildings, Agriculture, Mobility and Health. There is an increasing need to make technology accessible around the world through subsidy provision in the acquisition of ICT infrastructure for affordability as technology brings increased productivity and global understanding.

CONCLUSION

The use of information and communications technology and tools is crucial for achieving SDGs target by 2030. this achievement will accelerate human progress, bridge the digital divide, institutional gaps by integrating informal trade into formal frameworks and equipped digital literate individuals and knowledge societies. It fosters innovation, drive the economic growth of nation in general. While ICTs have incredible potential in their application to the sustainable development, there is need for member nations to bridge the digital divide between countries, individuals, sectors with innovative policies, services and solutions to deliver transformation at unprecedented speed and scale during implementation in order to achieve sustainable development.

RECOMMENDATION

There is need for collaboration of Ministry of Communication and Digital Economy and Educational Research institutions with Tech Hubs in ensuring global ICT infrastructure governance and policies are implemented to create an enabling environment for the development of ICT Sector.

There is need for collaboration of Public-Private Partnerships (PPPs) with Tertiary and research institutions on resources mobilization, financial resources and technical and management expertise to ensure the sustainability and scalability of ICT Usage in all sectors of the economy Nigerian Governments should drive and facilitate partnerships that include attracting private sector investments on a sustained basis, and tap upon the expertise and resources to promote equal access to quality, ICT driven society.

There is need for enhanced public awareness and engagement in developing cities like Nigeria to use smart ICTs in an inclusive manner in all sectors for intentional planning and development. A wide variety of stakeholders need to be involved at all stages of the planning process and there needs to be feedback mechanisms so that these technologies can be updated to meet the ever-changing needs.

There is need for strong advocacy on the use and implementation of adaptive governance to address institutional, cross-scale challenges, structures and incentives through consideration of iterative decision-making mechanisms, feedbacks between monitoring and decisions learning, characterization of system uncertainty with multi-model inference, and by implementing legal and institutional oversight built-in mechanisms for adaptation.

There is need for close collaboration between United Nations, Stakeholders, policy makers and the Federal Government of Nigeria in all sectors, governments, business communities and civil society organizations for a greater coordinated action and the use of Information and Communications Technology (ICT) to support that action in all industries, sectors for achievement of SDGs goals.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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