CHAPTER SEVEN

COVID-19: An Epiphany to Vitalize ICT in Science and Technology Education in Nigeria

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Abstract
The use of Information and Communication Technology (ICT) in Science and Technology Education is an issue that cannot be disdained in Nigeria in order to put the country's education on a solid pedestal. In view of the obtrusion to teaching and learning of Science and Technology Education due to Coronavirus (COVID-19) pandemic, this paper focuses on exploration of the use of ICT as an alternative strand to ameliorate unexpected cessation of teaching and learning processes. Hence, this paper also highlights the historical antecedent of Coronavirus (COVID-19), the concept of ICT and its relevance to science and technology education, status of ICT integration in Science and Technology Education in Nigeria, challenges of integrating ICT in science and technology education in Nigeria and COVID-19 pandemic as an insight to ICT integration in science and technology education in Nigeria. In order to meet up with the global trend in the use of ICT in science and technology education, it is recommended among others that e-learning should be strengthened by the teachers and government for transmission of knowledge in this digital revolution, particularly during the periods of school closure to keep the doors of learning open for all always.

Keywords: COVID-19, Pandemic, Information and Communication Technology, Science and Technology Education

Introduction

COVID-19 PANDEMIC: THE PENDULUM FOR RECONSTRUCTION OF INSTRUCTIONAL SYSTEM IN NIGERIA

Nations of the world are increasingly pressured to prepare youths to become active, capable and resourceful in this technological driven society. The knowledge of science and its applications (technology) are fundamental in this regard. Science and technology essentially transformed peoples' ways of life, their mode of communication and transaction and with stern effects on the national and economic advancement. Hence, no doubt that science and technology has contributed immensely to the development of Nigeria and indeed the whole world. This is evidenced in the 21st century emerging technological evolutions in areas such as microprocessors, telecommunications, bio-technology, nano-technology, and artificial intelligence. Similarly, the breakthroughs in health, agriculture, transportation and education sectors due to these emerging scientific and technological evolutions cannot be over-emphasized. Hence, science and technology, and its integration in national and economic growth should be accorded the maximal priority especially in Nigeria. Considering that science and technology are part of national strategy for development, obviously, its literacy would be a requirement to live in the present-day reality. Therefore, science and technology education become imperative.

The surge in population, knowledge explosion, and the growing pervasiveness of information and communication technology in education globally, necessitated the need to expand, promote and improve the quality of teaching and learning of science and technology through integration of information and communication technologies (ICTs) of all kinds. ICT integration in science and technology education may take different forms and often combination of the following, which include: online learning, blended learning, instructor-led group, self-study, self-study with subject matter expert, web-based, computer-based (CD-ROM), video/audio tape, synchronous and asynchronous (Essays, 2018). ICT integration in education is not all about technology nor utilization of modern digital devices alone, the emphasis is on teacher's innovativeness in meaningful lesson delivery. The rationale for integration of ICT into science and technology education among others, were to use ICT to: provide students with the required skills for future social and vocational functioning; enhance students' learning, achievement and retention; facilitate and foster educational change; equalize access to education unbound of time and location; prompt students to engage in learning activities; monitor students; and manage educational organizational processes and components (Donnelly, McGarr, & Reilly, 2011). Thus, these justifications are geared towards improving the quality of teaching and learning, and to equip learners with the 21st century skills (eLimu, 2015).

COVID-19 PANDEMIC: THE PENDULUM FOR RECONSTRUCTION OF INSTRUCTIONAL SYSTEM IN NIGERIA

ICT has the potential to prepare students for life in the 21st century and the current globalization (Ghavifekr & Rosdy, 2015). As such, schools and other stakeholders in education are presumed to prepare students to cope in this digital era through ICT integration in teaching and learning processes. In Nigeria however, ICT integration into science and technology education has suffered immense impediment due to low prestige accorded to education in general. Similarly, the pedagogical pattern used in Nigerian classrooms doesn't prepare students for information and globalization, that is, students are not equipped to live effectively in the modern age of science and technology (Abdullahi, 2013). The ultimate consequence of this milestone is the total disruption of academic activities across all levels of education system in Nigeria especially at this time of global crisis of Coronavirus Disease 2019 pandemic. Today, the world faces a global crisis that threatens our existence. With the need to contain the virus, many countries implemented measures to reduce social gatherings where schools are not left out. Nigerian students are disengaged, remain idle and unproductive. However, online schooling continues in most European and Central Asian countries. Students are being educated remotely using older and proven technologies such as radio, television and modern ICT gadgets (Patrinos & Shmis, 2020). Hence, this paper examined the need to vitalize ICT in science and technology education in Nigeria.

Historical Antecedent of the Novel Coronavirus Disease (COVID-19)

Viruses are small unit of microorganisms which are not visible to the naked eye but can only be visualized with the aid of microscopes. Most microbes - bacteria, fungi, protozoa, and algae thrive only in plant and animal cells except for viruses which could exist in the living and non-living states. Viruses are acellular microorganisms containing only one type of nucleic acid that is, the Deoxyribonucleic Acid (DNA) or Ribonucleic Acid (RNA). They are mainly obligate and intracellular parasites capable of reproducing in living susceptible cells and depend solely on their cellular host for the synthesis of protein and production of energy (Ali & Sultana, 2013). Several diseases and infections such as chickenpox, flu (influenza), herpes, Acquired Immunodeficiency Syndrome, mononucleosis, mumps, measles, hepatitis, meningitis, and pneumonia have been associated with viruses (Healthgrades, 2018). The coronavirus is a large family of viruses that causes respiratory problems or infections in human and other animals. The first form of human coronavirus disease was identified in mid-1960. There are six common forms of human coronaviruses; 229E (alpha coronavirus), NL63 (alpha coronavirus), OC43 (beta coronavirus), HKU1 (beta coronavirus), Middle East Respiratory Syndrome

(MERS-CoV), and Severe Acute Respiratory Syndrome (SARS-CoV) which was first identified in 2002 in Guangdong province of southern China (World Health Organization, 2020). The latest form of human coronavirus is the Novel Coronavirus Disease 2019 (COVID-19) named SARS-CoV-2 by the International Committee on Taxonomy of Viruses (Gorbalenya, et al., 2020).

COVID-19 outbreak was first reported in December 2019 in Wuhan, Hubei Province, China and has sporadically spread to all the continents of the world due to its mode of transmission and the lack of antiviral vaccines (Centre for Disease Control and Prevention, 2020). Generally, COVID-19 has resulted in high rate of morbidity and mortality in different countries of the world. The viral infection is spread from human to human through contact with contaminated surfaces or droplets of an infected person and the high spate of infections around the world made the World Health Organization tag the Novel Coronavirus Disease 2019, a pandemic and Public Health Emergency of International Concern. Meanwhile, the infection rate of COVID-19 pandemic has been forecasted at 40-70% of the world population (Petropoulos & Makridakis, 2020). In Nigeria, the first confirmed case of the COVID-19 infection was reported on 27th February, 2020 in Lagos and since then, other index cases and deaths have been recorded in the country (Anjorin, 2020). In a view to contain the spread of the highly contagious virus, the Federal government of Nigeria declared that all gatherings should be suspended, hence, educational institutions were not spared as all state governments, examination bodies and private institutions suspended all academic activities. Thus, learners at all levels of education (pre basic, lower basic, upper basic, secondary and tertiary) are having a free day of academic activities occasioned by the dreaded monster, the 2019 Novel Coronavirus Disease.

Concept of ICT and its Relevance to Science and Technology Education

Information and Communication Technology (ICT) is a veritable tool to facilitate teaching and learning pedagogical activities in science and technology education. ICT can be referred to as any electronic device that is used as a way of encapsulating, processing, cumulating and dispersing information. Bello and Bello (2018) opined that ICT is a combination of Information Technology (IT) and Communication Technology (CT), and the former (IT) has to do with the processing and packaging of information while the latter (CT) involves the interaction of the users with information and data base through networking. Most developed countries have experienced significant developments

traceable to ICTs. In view of this, the issue of ICT policy became an official statement in Nigeria in March 2001 through formulation of a National Information Technology Policy (NITP) by the Federal Executive council. This also led to establishment of implementing agency called the National Information Technology Development Agency (NITDA). The agency was charged with the duty of implementing Nigeria's IT policy (Oso, 2018). The Federal Government of Nigeria also commissioned a Mobile Internet Unit (MIU) to effectively equip secondary schools with ICT tools and the unit was operated by NITDA.

In realization that technology can revolutionize the 21st century classroom, Federal Government of Nigeria in its National Policy on Education categorically stated that classroom activities should be IT supported (Federal Republic of Nigeria, 2013). Science and technology teachers can employ a number of ICT tools for effective instructional delivery since teaching has gone beyond conventional method of talk and chalk. Eze (2016) ascertained that ICT has been found to enhance the quality and quantity of instructional delivery, meet learning needs of learners, promote equal educational opportunities, increase students' self-efficacy and independence and promote teachers' professional development in science and technology education because of its dynamic and interactive nature. Abdulraheem-Olaniyi (2016) also buttressed that integration of ICT in teaching and learning of science and technology kindles students' interest by promoting a positive attitude towards learning as an essential part of a lifelong interest in learning. The author further submitted that the use of ICT enhances recall of previous learning, provides new stimuli, and activates the learners' response as well as providing systematic and balanced feedback. The advocacy for a shift from teacher-centered learning approaches to student-centered approaches can be achieved if backed up with integration of the innovative and technological advance offered by digital learning. Ikemelu (2015) canvassed that application of ICT in teaching of science and technology subjects is one of the indispensable tools for achieving an effective classroom curriculum delivery in education system because it enhances conceptual understanding and promotes higher order thinking skills. Application of ICT in teaching and learning creates excitement and stimulates critical thinking for conceptual understanding of scientific concepts.

Thus, effective use of ICT tools in science and technology education becomes imperative. ICT tools and gadgets encompass different types of technologies such as phones, computer, satellite, telex, fax, radio, television, software, hardware, projector, video, bulletin, board, microwave, internet and electronic mail, to mention a few (Bello & Bello,

2018; Ikemelu, 2015). Some aspects of ICT tools applicable for holistic transmission of knowledge in science and technology education addressed in this section include; Computer, internet, e-mail, and software.

Computer and the Teaching of Science and Technology at COVID-19

The advent of computer has provided opportunity to create conducive learning environment in science and technology education by increasing appreciably the number of possible classrooms learning activities and strategies used in transmitting knowledge to learners. The transition from conventional method of teaching to e-Learning and e-Teaching with ICT equipment such as computer cannot be overemphasized. Ateequ (2015) opined that Computer-Assisted Learning (CAL) which is any interaction between a student and a computer system to assist the learners to learn includes drills, tutorials and simulation that can assist in complex learning situations. The author further averred that Computer-Assisted Inquiry (CAI) which is the use of ICT as an aid for collecting information and data can equally be used in science and technology inquiries for acquisition of data and processing in laboratory. The greatest advantages of computer are speed, cost-effectiveness and excellent usage of available resources and some other useful basic accessories include CD ROM, Diskettes, flash drive and so on (Bello & Bello, 2018).

During COVID-19 pandemic, computer as a technology tool along with internet facility could be used by teachers for virtual class to teach learners from home with all necessary tools at their disposal. This could be achieved through the use of zoom which is effective tele-conferencing software. Computer offers opportunity to cover a great deal of content during COVID-19 pandemic as it helps in forming note and creating presentation slides by making use of Microsoft word and power point.

Internet and the Teaching of Science and Technology at COVID-19

Internet is a valuable educational tool that provides enormous and quick academic and scientific information to a large audience. It is a communication network that involves a number of computers that give room for user-to user communication. Omobola (2013) stressed that the availability of high internet in 21st century has transformed learning beyond the confines of classrooms because a student can employ the use of interactive multimedia technology to participate in regular classes anywhere and anytime. The author further stated that internet makes distance learning and E-learning possible as students are enriched by all forms of electronically supported learning and teaching to improve

effectiveness of instruction and learning outcomes. Learning materials in science and technology subjects can easily be accessed by the students and teachers through internet and the World Wide Web (WWW) thus, gives room for learners to be adequately enriched with learning contents and even experimental procedures. Live interaction takes place between students and students, students and teachers, teachers and teachers of science and technology through internet to discuss difficulty topics and to cross-fertilize ideas. Internet has dramatically paved way for continuous teaching learning despite the shutting down of schools across the world as a result of COVID-19 pandemic. With the use of internet, students could make use of e-library as alternative to physical library. Evaluation could be possible by giving assignments, continuous assessment test, project and even examination due to internet facility. The effect of the pandemic made the Federal government of Nigeria to partner with telecommunication service providers and other private bodies which lead to the creation of www.schoolgate.ng, www.mobileclassroom.com.ng, www.khanacademy.com, among others.

Electronic Mail (e-mail) and the Teaching of Science and Technology at COVID-19

This is a personal message that is sent electronically from one person to another. The importance of electronic mail in enhancing E-learning either synchronously or asynchronously in science and technology education cannot be overemphasized. Inyang and Effiong (2016) stated that electronic mail is a tool for delivering learning materials and feed back to students within a matter of seconds and therefore motivates learners and encourages authentic information. The author added that the adoption of e-mail has led educational institutions to open e-libraries where students can have access to various learning materials. Electronic Mail could be a veritable teaching and learning tool during COVID-19 pandemic. Learning materials could be sent to students' e-mail addresses for them to learn asynchronously at their convenient time. Students as well could respond to evaluation materials via their teacher's email.

Software and the Teaching of Science and Technology at COVID-19

Software, software package, computer program and application are synonymous and therefore they are treated to mean the same. There are many online and offline educational softwares for more interactive educational experiences for both students and teachers. Examples of educational software are educational games, tutorial software, drill and practice software, graphic software, simulations, mathematics solving software, Microsoft software (such as Power point and OneNote), media player to mention a few. Spencer

(2016) contended that Microsoft Power point facilitates a class discussion in a fashionable and precise manner as it gives room for incorporation of animations, audio and video materials. The author further submitted that presentation slides can be sent to students via email for continuous learning in their different locations. The use of software makes teaching and learning of science technology to be active and interactive where students are no longer passive receiver of knowledge but rather active beings as a result of the use of multimedia content such as pictures, graphics and sound.

The importance of software for e-learning during COVID-19 pandemic cannot be overemphasized. It helps in carrying out learning process by sharing educational information through applications or software. For instance, Courseware software could be used in delivering lessons through platforms like zoom and other video conferencing applications. Platforms like uLesson, Edmodo, edufirst, and eLimu cloud also make virtual learning possible in the face of lockdown as a result of COVID-19 pandemic. Assessment software could be designed to deliver tests or quizzes, record answers and score the result. Software could help to monitor the operation of learning process when students and teachers cannot be in the same room as a result of COVID-19 pandemic.

Challenges of Integrating ICT in Science and Technology Education in Nigeria

The integration of ICT in science and technology education in Nigeria is confronted with myriads of challenges. It is worthy to note that ICT constitute an integral part of the science and technology curricula at all levels of education (primary, secondary and tertiary) in Nigeria. Nonetheless, research studies (Onwuagboke, Singh, & Fook, 2015; Junaidu, 2019) have reported the non-availability and poor integration of ICTs in the delivery of science and technology education due to several factors which are discussed as follows:

Teacher Related Factors

Teachers play a significant role in the process of curriculum planning and development because they are saddled with the responsibility of implementing the curriculum contents. According to McFarlane and Sakellariou (2002) the place of ICTs in the attainment of classroom teaching and learning objectives of science and technology related subjects cannot be over-emphasized. However, teacher related factors such as the lack of ICT pedagogical skills, resistance to change from traditional pedagogical methods, technophobia, lack of confidence in the utilization of ICTs, generational gap between

teachers and students, and lack of motivation for teachers, tends to impede the full integration of ICT into science and technology education in Nigerian schools. The challenge that had surfaced in most literature is the lack of ICT pedagogical skills by in-service science and technology teachers (Bello, et al, 2016; Ibara, 2019; Onwuagboke, Singh, & Fook, 2015).

Learners Related Factors

The main aim of teaching and learning is to ensure a permanent change in learners' behaviour through the use of appropriate tools and strategies that best suit learners mental and chronological ages. ICTs, due to its dynamic and multifaceted nature has been identified as relevant tools for the learning of science and technology related courses in all Nigerian educational institutions (Gidadawa & Dogondaji, 2014). Conversely, learners related factors such as the lack of ICT knowledge (Damkor, Irinyang, & Haruna, 2015), fear of using ICT tools due to lack of confidence (Oyeboade & Gbotosho, 2017), learners' over-population (Ukaegbu & Nwagbo, 2016), and inadequate access to ICT tools (Ogundile, Bishop, Okagbue, Ogunniyi, & Olanrewaju, 2019) are among the many challenges that affects the integration of ICTs into science and technology education in Nigeria.

Government Related Factors

Government related challenges militating against the integration of ICT in science and technology education in Nigeria has been documented in literature to include; poor implementation of ICT policies and projects (Damkor, Irinyang, & Haruna, 2015), limited budgetary allocation (Adomi & Emperor, 2010), epileptic or irregular power supply (Gadzama, Katuka, Dalhatu, Abali, & Ngubdo, 2016; Olofin & Aniede, 2015), and inadequate supervision and maintenance of the available ICTs (Onwuagboke, Singh, & Fook, 2015).

Infrastructural Related Factor

Infrastructural related factors that poses as challenge to the implementation of ICT in science and technology education in Nigeria include: non availability of ICT tools and equipment, lack of appropriate ICT storage equipment and buildings. Nwiyi (2016) specifically identified the non-availability of ICT tools as the major infrastructural challenge militating against the full integration of ICTs into science and technology education in Nigeria.

Finance Related Factor

Funding issues has been identified in literature as one of the major problems facing the development of education in Nigeria most especially the integration of ICT into the field of science and technology (Idowu & Esere, 2013). Other financial related factors affecting the integration of ICT into science and technology education in Nigeria has to do with the high cost of ICT components and bandwidth subscriptions together with the cost of maintain the available ICT tools (Olofin & Aniede, 2015).

Technological Related Factor

Technology related factors militating against the integration of ICTs into science and technology education in Nigeria include; inadequate ICT technical experts to manage the available ICT tools (Aworanti, 2016), inadequate educational software (Idowu & Esere, 2013) and poor internet connectivity partly due to the location of many educational institutions which are sited in areas outside the reach of internet connectivity.

Status of ICT Integration in Science and Technology Education in Nigeria

The Federal Government of Nigeria came up with revised edition of National Policy on Education incorporating integration of ICT in education as fragment of the policy. To ensure effective integration of technology in education, the policy makes computer science as a core compulsory subject for all students in primary and junior secondary schools to strengthen ICT literacy skills. Agbetuyi and Oluwatayo (2012) corroborated that special interventions have been made to secondary and higher institutions by government, NGOs, banks and many private sector groups. For instance, the MTN embarked on virtual library in some Nigerian universities and NUC also set up network cables to strengthen research opportunities. Despite these efforts, level of integration of technology is still shallow in Nigerian educational system. Garba (2014) concluded in his study that not much of a success has been recorded as regards ICT integration in education because no significant shift has been witnessed from the use of traditional pedagogical practices to the 21st century approach. The author buttressed his conclusion that the pedagogical practices and curriculum design of teacher education in Nigeria is yet to be geared towards production of ICT literate teachers to integrate ICT in their professional practices. In view of the state of ICT in Nigerian education, it accords for the reason why some states such as Kwara, Lagos, Oyo, Ekiti among others resorted to radio and television which are oldest technologies in the transmission of knowledge of science

subjects and other subjects to students during COVID -19 pandemic for continuous education as a result of compulsory lockdown in these states. Radio as a tool of technology is not an appropriate means of handling practical lessons in science subjects. Hence, there is need for advancement in integration of ICT tools that involve two-way interaction rather than tools with one-way interaction process in science and technology education in Nigeria.

COVID-19 Pandemic as an Insight to ICT Integration in Science and Technology Integration in Nigeria

Education holds the potential to contribute to the protection of children and youths, and helps them cope or maintain some normalcy during crisis such as the current COVID-19 pandemic. Education interventions during crisis is known to support prevention; recovery of public health; and also mitigate its impact on learning. While school closures could present a logical solution to enforcing social distancing, prolonged closures may however, have a negative impact on students (Azzi-huck & Shmis, 2020). Hence, the need for schooling to continue regardless of the closure becomes imperative. Also, considering that many areas of life such as education and work are adversely affected and with no clear signs as to when the virus will cease, educational institutions may continue to stop functioning and hence, having a huge impact on the global education. At this critical moment, teaching and learning do not have to grind to halt. Perhaps, can continue through innovative approaches such as the use of radio, television, smartphone and internet (Fleet, 2020). Hence, these lockdowns, especially in Nigeria, could be used as a best test for education technology interventions (Azzi-huck & Shmis, 2020).

Around the world today, online learning seems to be growing exponentially. Schools are using existing platforms such as Microsoft, google and conferencing applications to deliver lessons for their students. In the United Kingdom, virtual gym class proved to be popular; “my classroom at home” is being used in France; live television broadcast is being used in China; learning via interactive Apps in Hong Kong; in Japan, digital platforms were created and so on. This seems inspiring as the teaching and learning goes beyond replacing physical schools with digital analogues and that, bricks-and-mortar schools will be replaced by e-learning anytime soon (Broom, 2020). This implies that education may never be the same again, thanks to the COVID-19 pandemic. On this note, COVID-19 has become a catalyst for educational institutions across the globe to search for innovative solutions in relatively short period of time. Hence, Nigerian education

system is confronted with greater challenges and obviously, new policies are needed to clarify the importance, role, and the need to fully implement ICT integration into teaching and learning across all levels of education and fields of study.

Conclusion

COVID-19 pandemic is currently ravaging the world and has halted lots of human activities in many countries. In Nigeria, the pandemic has greatly affected the education sector causing the suspension of all academic activities, as stay at home order was enacted. In fact, some states where put under total lockdown. The current situation therefore, is an impetus on the need to vitalize Information and Communication Technology in the nation's education system most especially the field of science and technology education because ICT tends to eliminate the barrier of human-to-human contact. Hence, it can be deployed to reach all learners at the same time, so as to ensure the continuity of teaching and learning as long as COVID-19 pandemic lasts.

Suggestions

Although, ICT integration into teaching and learning in Nigeria is evidenced in the policy statement. Its implementation is however, superficial, as the nation is yet to witness any significant shift from traditional pedagogy to that of the 21st century approach. As a matter of urgency, the need to bridge the gap between science and technology education of the western world and that of Nigeria becomes crucial. Hence, the following recommendations among others were made:

i. a strategic plan to equip all schools with good infrastructural facilities for successful ICT integration should be developed and monitored for full implementation;
ii. science and technology curriculums at all levels should be reviewed to allow ICT integration as a pedagogy;
iii. in-service training should be organized for teachers and lecturers to upgrade their technological pedagogical content knowledge (TPACK);
iv. science and technology educational software should be supported for design and development;
v. teachers and lecturers should be enjoined to create virtual classrooms and relevant courseware should be uploaded; and
vi. e-learning platforms for both synchronous and asynchronous learning should be introduced.

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