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CHALLENGES TO THE USE OF ONLINE EMERGING COMPUTER TECHNOLOGIES (OECTs) FOR EFFECTIVE TEACHING AND LEARNING IN SCHOOLS DURING COVID-19 PANDEMIC

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ABSTRACT
The consistency in use of Online Emerging Computer Technologies (OECTs) has great advantages and significance in the teaching and learning processes in the Nigerian schools especially during the COVID-19 pandemic. The use of OECTs assisted many schools to continue their academic activities during the COVID-19 pandemic. But there are challenges inhibiting the use of OECTs especially during the COVID-19 pandemic which needs adequate attention in order to be resolved. This paper therefore, discussed the challenges to the use of OECTs for promoting effective teaching and learning in schools during the COVID-19 pandemic. Few concepts were described and examples of these OECTs useful for effective teaching and learning in schools were equally identified in the paper. Further discussed in the paper were the benefits of using OECTs in teaching and learning during COVID-19 pandemic; and challenges to the use of OECTs for effective teaching and learning during COVID-19 pandemic. Finally, ways to improve the use of Online Emerging Computer Technologies (OECTs) for effective teaching and learning during the COVID-19 pandemic were discussed in the study.

Keywords: Challenges, Use, Online, Emerging, Computer Technologies, Effective, Teaching, Learning, Schools, COVID-19, Pandemic

Introduction

The use of various technologies which include both hardware and software technologies coupled with the online emerging computer technologies (OECTs) are beginning to make significant and positive impacts in teaching and learning in schools for the realization of educational goals during the COVID-19 pandemic. Computer technologies that directly correlate with information technology encompasses a list of different software programmes and hardware devices used to support teaching and learning. The first major development in computer technology was in 1946, with a vacuum tube-based computer model that was produced to aid in military efforts. Since the invention of computers and the internet, technologies including the operating systems, online platforms, mobile computing, hardware and software technologies have rapidly advanced in teaching and learning in schools. According to Johnson, Jacovina, Russell and Soto (2016), technology is perhaps the strongest factor shaping education today and many schools are showing support using various computer technologies to improve literacy or learning for students. The Federal Republic of Nigerian (FRN, 2014) under sections 1 and 2 of the National Policy on Education

(NPE) gave approval of the use of computer technology in education pointing out that teaching and learning shall be made practical, activity-based, experiential and Information Technology (IT) supported (pg.3).

For effective functioning in a knowledge driven world, Government shall provide adequate infrastructure and develop capacity for effective utilization of IT to enhance the delivery of education in Nigeria (pg.15). Given the Federal Government's approval and directives on the use of technologies in education, the use of online emerging technologies was emphasized during the COVID-19 pandemic. Educational institutions in Nigeria, those in the United States (U.S.), African countries and other European countries were advised and directed to use the Online Emerging Computer Technologies (OECTs) in order to restrict the face-to-face classroom contact and to further provide teaching and learning for students at home. Richards (2020) attested that when the Covid-19 pandemic took hold in the U.S. in early 2020, it profoundly disrupted nearly every facet of daily life, including the education sector. As educators made the hasty transition to online teaching, they made do with the online emerging computer tools and tactics they were given. Therefore, technological innovation and advancements have brought about massive changes in the society including the education sector but the use of online emerging computer technologies in teaching and learning is still limited. The inadequate use of online emerging technologies can be attributed to some challenges, which include financial constraints, poor ICT policy implementation challenges, infrastructural challenges, high cost challenges, poor access to Internet network and connectivity problem, capacity building challenges, among others. For effectiveness in the use of OECTs in teaching and learning in schools during the COVID-19 pandemic, all these challenges must be curtailed and resolved. Besides, teaching and learning as defined by the IGI Global Partnership (2022) is a method in which the knowledge of teachers is transferred to their students. It involves a two-way interaction between teachers and students where teachers try to transmit knowledge and contents to students according to their age, capabilities, skills and living conditions. This paper therefore discussed issues relating to challenges to the use of online emerging computer technologies (OECTS) for effective teaching and learning in schools during covid-19 pandemic in Nigeria.

The Outbreak of COVID-19 Pandemic in Nigeria

The COVID-19 as observed by Vergnaud (2020) is an acronym which stands for the Coronavirus Disease of 2019, which started in Wuhan China and has crossed many societies, regions and countries making it a pandemic. A **pandemic** on the other hand, as described by Robinson (2020), is a disease outbreak that spreads across countries or continents. It affects more people and takes more lives than an epidemic. A pandemic is therefore, the worldwide spread of a new disease. *Pandemic* can be used for a disease that has spread across an entire country or other large landmass. The word is generally reserved for diseases that have spread across continents or the entire world (Health Direct, 2020). The World Health Organization (WHO) declared COVID-19 to be a pandemic when it became clear that the illness was severe and that it was spreading quickly over a wide area. The official name for the virus is "the COVID-19 virus", an epidemic which broke out causing pandemic throughout the world (Vergnaud, 2020). However, the outbreak of the COVID-19 pandemic in Nigeria started in the year 2020. According to Oyeranti and Sokeye (2020), the first case of COVID-19 was confirmed in Infectious Disease Centre, Yaba, Lagos State, Nigeria on the 27th February, 2020, with an Italian citizen who arrived at the Murtala Muhammed International Airport, Lagos, on-board with a Turkish airline from Milan, Italy at 10:00 p.m. on 24th February, 2020. The Italian citizen visited his company's site in Ogun State the following day where he presented himself at his company's staff clinic. The physician-on-duty had a strong suspicion of the presence of the virus. This led him to refer the Italian citizen to Infectious Disease Hospital (IDH) and the COVID-19 status was confirmed (Nigeria Centre for Disease Control, 2020). Within a period of two weeks, a cluster of cases was detected in Lagos, Ogun and Abuja, this was noted to be the emergence of the nationwide spread of the virus. Other confirmed cases of COVID-19 were detected in other parts of the country in Kano State, Delta State, among others. As a result of the pandemic, series of lockdowns

and restriction of movements including international and interstate travels were initiated. The pandemic also led to school closure, a halt in face-to-face academic activities and initiated students studying from their homes. Onyeji (2020) noted that the nationwide spread of the virus led to the Federal Government of Nigeria effecting certain measures to contain the virus. Educational and religious institutions were the first bodies restricted before containment measures extended to non-essential services. To contain the spread of COVID-19 in schools, likewise for academic activities to continue, educational institutions were directed to use Online Emerging Computer Technologies for administering their programmes and managing teaching and learning activities. This gave a massive recognition to the use online education and emerging computer technologies.

What then is Online Emerging Computer Technologies (OECTs)?

Online Emerging Computer Technologies (OECTs) is a word formed from four separate words which are separated but are used together to create a new idea with a specific meaning. Online according to Technopedia (2021), refers to when an electronic device connected to other devices, such as another computer, a network or a device such as a printer. It equally means when something is done on or via computer network. In general, when a machine is "online," it is turned on and connected to other devices. For example, when a network printer is online, computers connected to that network can print from it. Other devices, such as scanners, video cameras, audio interfaces, and others are said to be online when they are running and connected to a computer system (TechTerms.com, 2021). A computer on the other hand, is an electronic device that manipulates information, or data. It has the ability to store, retrieve, and process data. A computer can equally be used to type documents, send email, play games, and browse the Web. One can also use it to edit or create spreadsheets, presentations, and even videos. Examples of computers includes hardware such as laptops, desktops, tablets, server, projectors, smartphones, wearables, television set, among others. Computers also include software technologies used to support teaching and learning (Evans, 2011; Goodwill Community Foundation Global, 2021). Technology as defined by Wood and Cena (2021) is the use of scientific knowledge for practical purposes or applications, whether in industry or in our everyday lives. The Encyclopaedia Britannica online (2021) described technology as machinery and equipment developed from the application of scientific knowledge. From all the foregoing explanations, emerging computer technologies as described by Winston and Strawn (2021) refers to technologies that are currently developing, or that are expected to be available within the next five to ten years, and is usually reserved for technologies that are creating, or are expected to create. Emerging computer technology is a term generally used to describe a new technology, but it may also refer to the continuing development of an existing technology. Veletsianos (2010) opined that a technology is still emerging if it is not yet a "must-have." For example, a few years ago email was an optional technology. In fact, it was limited in its effectiveness as a communication tool when only some people in an organization had regular access to it. Today, it is a must-have, must-use technology for most people in most organizations. In this sense a technology can be a standard expectation in the commercial or business world, while still being considered as "emerging" in the education sector. Online Emerging Computer Technologies (OECTs) as perceived by Bates (2016) are a set of technologies which are conducted partly or wholly over the Internet. They can equally be used to promote and administer students learning in school. The IGI Global Partnership (2021) provided several definitions of (OECTs) and they include that group of new technologies that allow users to access information and communication over the World Wide Web (Web browsers, ftp, e-mail, associated hardware, Internet service providers, and so forth). They can also be defined as a group of new web-based technologies that facilitate communication. A communication-based information technology, including network protocols and communication mechanisms that enable data transmission within and between geographically dispersed organizations (IGI Global Partnership, 2021). They are online emerging computer technologies because they are new and serve or are used

through or via the Internet. They are equally a set of technologies that are being generated and tested as a result of the successive innovations. Most of these emerging computer technologies include artificial intelligence, cloud computing, social networking technologies, advanced robotics, among others (Law Insider, 2021). Examples of these OECTs have been disclosed in the next section.

Examples of these OECTs Useful for Effective Teaching and Learning in Schools during COVID-19 Pandemic

Scholars and authorities such as Goodman (2021) and Natarajan (2006) have indicated various Online Emerging Computer Technologies (OECTs) that can be used in promoting effective teaching and learning in schools and they vary in different forms. These OECTs include the following:

1. Internet: The Internet is a technology that enables teachers retrieve information online. Through the Internet both teachers and students search and retrieve information that will be used to improve teaching and learning.

2. E-mail: Administration of the electronic mail, that is email, enables students to stay in touch with their peers and with their teachers. Teachers can read students projects and assignments through emails. The reply may be of text with multimedia explanatory materials including audio and video.

3. Web-based Instruction (WBI): WBI is defined broadly as any form of innovative approach for delivering instruction to a remote audience in which the Web is included as a tool. Presently, several Websites have been developed to provide learners with access to instructional resources from a distance. Goodman (2021) opined that the internet is a function of multiple pieces of digital technology, and websites are one of the most common ways that people access it. Websites provides all sorts of information and have equally become increasingly interactive. Natarajan (2006) identified several ways of using the Web which includes the following:
a. The Web can be used as a source of information
b. It serves as an electronic book which assist students to read materials, access multimedia programmes and carry out other activities. Thus, the Web acts as the communication medium for the necessary interaction. A model such as these aims to mirror a face-to-face learning environment, within which the students will be able to establish some form of human relationship with the teacher. The aim of Web-based education enables a large proportion of the student population to learn relatively easily and successfully.

4. CMC systems: Computer Mediated Conference (CMC) allow groups to interact over time as well as over geographical location. This is a different type of interaction supported by videoconference systems, which allow people to be geographically dispersed, but require them to be present at the same time. Other examples of asynchronous computer conferencing systems are Lotus Notes/Domino, First Class, Top Class and Web Board.

5. Computer-assisted learning (CD-ROM): The development of computer-based technology contributes to effective science education, which has grown exponentially. The multimedia software available on CD-ROM plays a powerful role with applications in laboratories and lectures, tutorials and project work.

6. Virtual laboratories: They present a range of equipment on-screen and offer a very high degree of interactivity. During virtual laboratories students actively perform experiments themselves with simulated responses.
7. Teleconferencing: This is a new mixed model approach for distance education (DE) combining satellite teleconferencing with hands-on activity session. It was developed to adjust for many of the disadvantages associated with DE and traditional in-person training. The mixed model used live teleconference speakers, video clips, interactive call-in sessions and local sessions.

8. Quiz: The most encouraging one could be, conducting quiz for the students at various rounds, which inculcates into the students a team spirit, leadership, better organizing abilities and interest and better comprehension of the subject. The quizzes help in improving memory

power, vocabulary and active learning through integrative reasoning, which helps to improve intellectual power.

9. Social Media Technologies: This is one of the commonest online emerging technologies that can be used in promoting effective teaching and learning. It comes in different forms and packages. The social media allow users to create and share information, ideas and content via online virtual communities and networks (Bik & Goldstein, 2013; Cann, 2015). Richards (2020) draws attention on social media platforms such as Google classroom, Google Meet, hangouts and Zoom which offer a comprehensive playbook for educators that literally walk them through specific strategies and tactics that bring these and other technologies, into the online classroom. The goal is to use these platforms and other tools to make online learning interactive, immersive, and fun for both students and teachers. Goodman (2021) observed that the social media sites, such as Facebook, Twitter, YouTube, Wikis and Instagram, among others have seen an explosion in popularity in recent years. They bring together multiple pieces of digital technology to enable users to interact via text, photos, video, as well as form social groups. Social media applications rely almost entirely on user-generated content.

Apart from the social media technologies, Goodman (2021) further identified other online emerging technologies to include among others; robotics, Blogs, Video Streaming, and eBooks. In explaining further, Goodman (2021) noted that as digital robotic technology is becoming more sophisticated and widely used. Robotic machines can already be commonly found in the manufacturing industry. They are also used for tasks that are dangerous to humans, such as detecting and defusing bombs. Scientists are also working on nanorobots, tiny robots that can be injected into the human body to carry out medical investigations and procedures. Digital technology has enabled the creation of blogs, which are now commonly found across the web. Video streaming can be used for numerous purposes to support teaching and learning. An individual can watch movies or shows online. One can also chat with people online and see them live using applications such as Skype. One can watch or stream live events using live streaming. Sites such as YouTube provide numerous viewing options for information or entertainment. Steaming technology can increasingly be accessed through a variety of devices, including computers, televisions, and smartphones. eBooks enables users to access a multitude of reading materials from a single, portable device, so there is no longer the same need to carry around a lot of bulky, heavy books. It is easy to alter the font size and style to suit reader preferences (Goodman, 2021).

10. Cloud Computing: This is equally one of the online emerging technologies. For online learning, the "cloud" offers a shared pool of configurable computing resources (eg, networks, servers, storage, applications, and services) that can offer a range of benefits. Joint Information Systems Committee (JISC, 2021) highlighted the potential benefits of the cloud computing for educational institutions. It can support them to:

a. Make new services available and adopt them quickly to allow institutions to respond to user needs in an agile way.
b. Provide flexible, on-demand services any time, any place, any device. Reduce cost, and benefit from shared services.
c. Reduce energy consumption.

From all the foregoing discussions, Walsh (2009) added that there are so many different computer tools and emerging technologies available online on the internet today, with different names and concepts; they include:

1. **Video and Podcasting which is** one of the most widely used internet technologies in instructional settings via video streaming. Between YouTube, TeacherTube, EduTube and many other video hosting sites, there are abundance of lectures, videos and support materials available in the form of web based video. Podcasting has also been used to provide similar offerings of audio materials through popular sites like iTunes.

2. **Presentation Tools:** This category is vast and rich. There are hundreds (perhaps thousands) of tools on the Internet that can be used to create and share presentations, from simple PowerPoint slide players like Slideshare to multimedia timeline tools

like Vuvox and One True Media. These tools can be used to support classroom teaching or distance learning, or for student reports and presentations.

3. **Collaboration and Brainstorming Tools:** This is another wide ranging category of technology, including thought-organizing tools like the mind map and bubbl.us, and collaborative tools like web based interactive whiteboards and Google Documents. Additionally, other tools in this list, include wikis and virtual worlds, which also serve as collaboration tools.
4. **Blogs and Blogging:** Bloggers and many other regular Internet users are well aware of blogs and blogging. Educators should be aware of sites like Blogger and WordPress, where users can quickly and easily create their own blogs for free.

5. **Wikis:** The use of Wikis in educational settings is growing every day. Sites like Wet paint and others allow users to create free wiki web sites and are a great way to get started with using wikis for educational applications.

6. **Social Networking:** This include use of sites like LinkedIn, Facebook and Myspace which can be used to support teaching and learning in school.

7. **Twitter**: Twitter was founded by Evan Williams and Biz stone in 2009. It is an online Micro blogging service for distributing short messages among group of recipients via personal computer or mobile phone. Teachers can use twitter to facilitate online discussions about course materials likewise students can ask teachers questions about difficult learning task (Nwokike, Ezeabii & Oluka, 2021). Twitter can be great as a discussion board or message board for a class. Teachers can create a single Twitter handle per class and reuse it every year, or they can create a new handle each school year. The 280-character limit makes students think critically on communicating concisely and effectively. Teachers can use Twitter to post reminders for assignment due dates or share inspirational quotes and helpful links to practice quizzes or resources. Teachers can also use Twitter to create discussions and chats on a specific topic or subject matter.

8. **Skype**: Skype is a social media and an online tool for teaching and learning. Skype provides a lot of educational classroom such that the students can connect with other students, increase their knowledge and internet with other people's culture. This social media platform can be used to present speeches by guest speakers in the classroom (Nwokike, Ezeabii & Oluka, 2021).

9. **Virtual Worlds**: A virtual world is a computer-based online community environment that is designed and shared by individuals so that they can interact in a custom-built, simulated world. Users interact with each other in this simulated world using text-based, two-dimensional or three-dimensional graphical models called avatars. Today's virtual worlds are purpose-built for entertainment, social, educational, training and other purposes. All virtual worlds possess the qualities of persistence and interactivity. This enables the users to explore the inherent benefits of socialization and allows them to study human nature and users' abilities. Examples of this virtual world are the entertainment-based and social interaction-based virtual worlds (Technopedia Inc, 2021).

10. **RSS Feeds –** RSS allows users to create their own "push" data streams (that is, define data flows you want coming to you automatically, rather than having to go and "pull" the information with a Google search or other browsing effort). RSS feeds enable user to take advantage of streams of published content that will be sitting in the In-Box, or in an RSS reader, when the user wants them. There are RSS feeds available for many topics and many web sites.

All the above online emerging computer technologies have their benefits in teaching and learning during the

COVID-19 pandemic which has been illustrated in the next section.

Benefits of Using OECTs in Teaching and Learning during COVID-19 Pandemic Era

The benefits derived from using OECTs are enormous and Natarajan (2006) opined that OECTs promote teaching and learning in several ways. They enable education anywhere, anytime and to anyone. They facilitate self-paced learning at one's own their convenience. They are cost saving in the sense that a lot of amount can be saved in travel and downtime for regular classes. They are learner focused technology that can personalize content and anticipate learner's future information learning needs. They produce better learning outcomes and promote knowledge retention when compared to traditional methods of teaching. Most institutions use these emerging online computer technologies to make their courses more engaging and to improve access to learning for students. As new technologies have become more reliable, viable and sometimes more affordable, they have brought exciting opportunities to reconsider how we teach, engage with or involve learners in different ways. Online technologies offer institutions a way to take advantage of these opportunities, either for large scale distance learning courses or as an element of existing face-to-face courses (Joint Information Systems Committee - JISC, 2021). For Walson and Okanu-Igwela (2019), the use of online technologies helps to empower learners, makes teaching and learning of curriculum content more creative and innovative, offers flexibility to instructional delivery, helps produce a workforce and fulfilled citizens with knowledge and skills that would enhance knowledge transfer and contribute to revolutionize the educational system, promotes self-study, and the use of emerging online technologies for instructional delivery will help learners to create a situation or atmosphere in which curiosity is aroused, imaginations stimulated, interest generated, viewpoints enlarged and attitudes changed for attaining the basis of education.

The benefits of using OECTs in teaching and learning as further observed by the Joint Information Systems Committee (JISC, 2021) includes the under listed:

a. **Enhancing student interaction and learning**: Educational institutions have been using web-based technologies and social networking technology such as email for years. Increasingly, they provide students with administrative information, such as timetables, reminders and requests for information.

b. **Social networks**: Many educators have already adopted social networking technologies to support learning and teaching through the use of wikis, blogs and specific services such as Twitter, Facebook, and Google+, and through content sharing sites such as Flickr and Pinterest. These technologies and services can support face-to-face learning as well as online learning, but their adoption is likely to enhance online learning. In particular, these tools support a 'connectivist' approach to teaching and learning, where social networking and connecting form an integral part of student interactions. Social networking tools allows for more e-learning opportunities. As remote jobs and online classes are becoming more popular, training students to work from a distance is an important lesson, and social networking tools can help with that.

c. **Collaborative tools**: They serve as collaborative tools which strengthens collaboration during instructional delivery. These technologies can be used to extend the relationships that students may normally have. They aid academic inputs from students, external professionals and experts outside the institution.

d. **Recording activity and evidence gathering**: An advantage of social networking technologies is that many of them record activities that can be mapped and tracked to help teachers and educators gather evidence to support their teaching. The same tools can help academic and other professional staff build their own professional identities and profiles and share learning practice, research and content online. Specialist services such as LinkedIn, and academia.edu are also useful. Online social networking tools and services

support communication, collaboration and sharing in ways that have transformed how people interact with family, friends, co-workers, commercial and government organizations. It is now ubiquitous and has already had a significant impact on learning and teaching. Connected mobile devices have given people access to, and even some control over these networks, as new ways of sharing information and content have democratized ownership of information and knowledge. Despite all of this, there are still people who are unable to take advantage of these technologies as a result of lack of empowerment, poverty, access or inclination.

e. **Presenting live content**: Webinar software offers ways to present content in a live context, and incorporate video, chat, interactive whiteboards and webtours. An individual can record these and give them to non-attendees. Webinars can feel quite intimate and work well for small numbers of people, but can also be open to larger groups.

f. **Alternative presentation tools**: Some presentation technologies encourage the traditional approach of the 'expert' teacher providing the content and being in control of when and how things are presented. These kinds of tools, such as Microsoft PowerPoint and Apple Keynote, do not aim to be collaborative but can be used by students to work collaboratively. Prezi or emaze are examples of a more dynamic presentation tool. Presentations in different formats can be shared through social networking services like SlideShare and blogs, and users can upload video and audio to YouTube and Vimeo. Some open source products like Xerte toolkits can combine a range of benefits allowing users to create presentational slides alongside quizzes, videos or embedded collaboration tools like Padlet, Google documents or other online services.

g. **Managed approach to student data**: Institutions are having to take a more managed approach to measurement, collection, analysis and reporting of student data, and need to consider ethical as well as technical issues. Data sources tend to be large institutional administration systems such as student information systems, VLEs, attendance records, library systems or IT systems, with data gleaned from log-ins or student surveys.

h. **Open access**: Using external web-based technologies and services means that teachers, students and external peers or mentors can create, share and assess online content without the need for institutional authentication. This kind of approach can support open access to learning activities and content, which defies traditional boundaries around when classes take place and who can contribute. Notwithstanding all these benefits of OECTs, moreover, there seems to be some challenges preventing this course from effectively taking place in educational administration. Hence, the challenges to the use of (OECTs) in teaching and learning has been discussed in the next section.

Challenges to the Use of Online Emerging Computer Technologies (OECTs) for Effective Teaching and Learning in Schools During COVID-19 Pandemic

The challenges to the use of OECT for effective educational administration in Nigerian schools during the COVID-19 pandemic are enormous. This challenges as observed by scholars and authorities such as Aina, Okunnu and Dapo-Asaju (2014), Jegede, Ebio and Iroegbu (2019), the United Kingdom (U.K.) Joint Information Systems Committee (JISC, 2021), Oghenetega, Umeji and Obue (2014), Walson and Okanu-Igwela (2019) include financial constraints, infrastructural challenges, poor access to Internet network and connectivity problem, capacity building challenges, among many others. These challenges have been further discussed below.

i. **Financial Constraints**: Providing adequate finance for effective administration of technologies in school is a big challenge. The underfunding of the education sector affects the implementation of ICT policy for effective teaching and learning in schools. Walson and Okanu-Igwela (2019) and Oghenetega, Umeji

and Obue (2014) gave a remark that one of the notable challenges to the integration of ICT-enabled programmes in educational institutions for instructional delivery is underfunding. The integration of ICT-based education programmes in educational institutions require large capital investments and developing countries like Nigeria has fallen short in the integration of ICT in educational institutions due to inadequate budgetary provisions less than the 26% UNESCO recommendation for the education sector.

ii. **Infrastructural Challenges**: The effective incorporation of OECTs in teaching and learning during the COVID-19 pandemic requires the deployment of infrastructure. Many schools lack the requisite infrastructure and facilities that promote the use of OECTs. Even most of the facilities that are available are outdated and needs upgrading or total replacement. Walson and Okanu-Igwela (2019) opined that a country's educational technology infrastructure depends on the national telecommunications and information infrastructure. To this end, before any ICT-enabled programme is launched; policy-makers and planners must carefully consider buildings to house available ICT facilities, availability of electricity, and ambiguity to types of ICT. In areas where there are old school buildings, extensive retrofitting to ensure proper electrical wiring, heating/cooling and ventilation, safety and security will be needed. The availability of electricity supply is also essential as most of technological facilities use electricity to function. Nigeria still experiences erratic power failure and most educational institutions rely on power for use of OECTs. Critical consideration of the ambiguities of different types of ICT in the country and in the educational system is important. For instance, a basic requirement for computer based or online learning is access to computers in school, communities, and households, as well as affordable internet service. According to Gikas and Grant (2013), the implementation of online learning requires mobile devices such as smartphones, tablets, and laptops that can be used to access information anywhere and anytime; rather many of these devices are lacking in schools (Oghenetega, Umeji & Obue, 2014).

iii. **High Cost Challenges**: The high cost of most of these technologies has made it difficult for schools to procure them. Walson and Okanu-Igwela (2019) attested that the cost of using technologies and related media technologies in instructional delivery is relatively expensive compared to the traditional face-to-face classroom teaching and learning. In the use of educational technologies and other ICT facilities in the teaching and learning process, both fixed and variable cost must be considered. Fixed cost does not vary over a period of time. It involves the initial cost like: construction or retrofitting of physical facilities, purchase of equipment, initial material production, hardware and networking, software, and upgrade and replacement. The variable or current cost varies with time. This includes cost of professional development of personnel to be compliant with the models for instructional delivery, connectivity, including internet access maintenance and support, as well as utilities and supplies. All these cost when pulled together affects using technologies in education. Jegede, Ebio and Iroegbu (2019) and Oghenetega, Umeji and Obue (2014) reported in their study that the cost of obtaining a computer, weak infrastructure, lack of skills, lack of relevant software, and limited access to the internet are the factors impeding the successful use of online technologies in Nigerian education.

iv. **Poor Access to Internet Network and Connectivity Problem**: Jegede, Ebio and Iroegbu (2019) opined that poor network service or poor internet service is another problem preventing effective administration of ICT facilities in Nigerian schools for delivering teaching and learning. Jegede, Ebio and Iroegbu (2019) observed that limitation to internet access act as constraints to the use of online technologies. This is not untrue about the nation, educational institutions in Nigeria suffer poor or no internet access and connectivity problem while majority of the country's secondary schools have no access to internet at all. Lack of skills is also an obvious factor that needs

attention in the proper implementation of computer education in the nation.

v. **Capacity Building Challenges**: For successful integration of ICT-enabled programmes in the educational system in Nigeria, Walson and Okanu-Igwela (2019) noted that various competencies are required for effective use of technologies in teaching and learning and these competencies relates to: teachers' technical skills, technical support specialist, and for content developers. The competencies required of teachers are to develop skills with particular applications; integration into existing curricula; curriculum changes related to the use of IT (including changes in instructional design); changes in teacher role; and underpinning educational theories. Walson and Okanu-Igwela (2019) noted that the acquisition of these skills is expected to be addressed in pre-service teacher training and built on and enhanced in-service. The possession of ICT skills is a perquisite for teaching qualification in western countries like Malaysia, and the United Kingdom. Even the most fluent ICT teachers need to continuously upgrade their skills and keep abreast of the latest developments and best practices. This is done to make teachers more effective in their roles in the classroom as the learning process becomes more learner-centered. Furthermore, the provision of necessary technical support specialists for successful integration of ICT-enabled programmes possesses a challenge to schools. Technical support specialists whether provided from among school staff or from external service providers is essential to the sustainability of ICT-enabled programmes in Nigerian higher institutions. Without on-site technical support, much time and money may be lost due to technical breakdowns. This is the case with Nigeria as ICT technicians are hardly reached within the country, and pose a threat in times of systems breakdown (Esoswo, 2011).

vi. **Inadequate Constant Training and Retraining Programmes for both Staff and Students**: Just as capacity building, for effective adoption and utilization of OECTs both the teachers and students must receive constant training and retraining in this process. However, because teachers and students lack the basic knowledge and skills to use technological facilities, as a result of inadequate training and retraining programmes, this hinders their use of OECTs in schools. Aina, Okunnu and Dapo-Asaju (2014) and Oghenetega, Umeji and Obue (2014) identifying the challenges facing academic libraries to the use of e-learning technology pointed out the issue of poor/lack of training and retraining of librarians.

vii. **Staff and Students' Incompetency towards the Use of Online Emerging Technologies**: Effective use of OECTs depends largely on the teacher's and students' capacity and competency to use the ICT facilities to enhance teaching and learning. The use of ICT facilities in the educational institutions depends largely on the numbers of ICT instructors or teachers the schools are having at a particular time. However, lack of ICT competency of both teachers and students in educational institutions is affecting the effective utilization of OECTs in schools. Research has it that shortage of professional ICT teachers and lack of readiness on the part of teachers and students is preventing the effective implementation of computer education in schools in Nigeria (Jegede, Ebio & Iroegbu, 2019). Dzidonu (2010) and Jegede, Ebio and Iroegbu (2019) submitted that in many African countries, lack of well-trained teachers and low levels of teachers' ICT skill and knowledge has been recognized as a major obstacle in the implementation of ICT in schools. This situation of teachers' low knowledge, inadequate skills and incompetency towards the use of OECTs also has implication on their attitude and acceptability to use these technologies in the classroom (Johnson, Jacovina, Russell & Soto, 2016).

viii. **Lack of School Authorities Support**: Lack of support from school authority contributes a barrier towards the use of emerging online technologies. Walson and Okanu-Igwela (2019) opined that the possession of ICT skills by school administrators is

essential as leadership plays a key role in ICT integration in education. Many teacher or student initiated ICT projects have been undermined by lack of support from the school administrators. Esoswo (2011) noted that for ICT-enabled integration programme to be effective and sustained, education administrators must be competent in the use of technology, and they must have a broad understanding of the technical, curricular, administrative, financial, and social dimension of ICT use in education.

ix. **Equality of Access Challenge and Digital Divide:** The U.K Joint Information Systems Committee (JISC, 2021) asserted that designing a course or class around students using their own technologies can raise issues of equity and access. Poorer students may not be able to afford up-to-date devices, and students living in areas where mobile signals are very weak or non-existent are potentially at a disadvantage. According to Walson and Okanu-Igwela (2019), this challenge is viewed on the background of how many students can easily access and use these media technologies on individualized basis in the learning process to enable them understand and apply the knowledge so gained in similar instances. The digital divide among students during their schooling influences their employable chances in the world of works and reinforces socio-economic inequalities in the society. Institutions therefore, need to consider how they can provide an equitable experience, and they may need to provide alternative routes into either content or learning activities to improve on equality of access and digital divide (JISC, 2021).

x. **Poor Maintenance Culture of ICT Facilities by School Leadership**: Maintenance culture viewed by Tijani, Adeyemi and Omotehinshe (2016) suggests the habit of regularly and consistently keeping a building, machine, facilities, equipment, infrastructure, etc in good and working condition. But in the case of Nigerian educational administrators, they lack the culture to effectively manage and maintain school facilities under their care. If the education system must develop, it is imperative that installation as well as maintenance of its existing facilities be given priority. Oghenetega, Umeji and Obue (2014) opined that most of the equipment procured for the information technology was purchased from foreign countries and as a result of the nation's backwardness. In the use of ICT facilities, they lack information and experienced personnel to effect repairs on the system during break down. Also when complains are passed to higher quarters or the government for consideration it goes through as long bureaucratic process.

xi. **Challenge of Keeping Information Secure:** Online students might as well expect that all the information and services available on campus will automatically be available to them online or via their mobile device, including personal information such as grades. This presents a challenge, as institutions do need to keep their systems and information secure. As well as information and guidance about this, students may also need help to use their own devices.

Ways to Improve the Use of Online Emerging Computer Technologies (OECTs) for Effective Teaching and Learning in Schools During COVID-19 Pandemic

To address the issues raised regarding the challenges to the use of OECTs, which is crucial for effective teaching and learning during the COVID-19 pandemic, the following under listed has been suggested as a way forward for improvement.

1. There is need for effective implementation of ICT policy which must be supported with adequate funding at all the levels of the Nigerian education system. Jegede, Ebio and Iroegbu (2019) and Walson and Okanu-Igwela (2019) stated that proper funding of education system in Nigeria would mitigate the financial restrained factors limiting the infusion of ICT-enabled technologies in educational administration. According to Walson and Okanu-Igwela (2019), the following are potential sources of funds for education to integrate ICT-enabled educational programmes. They are: Grants, Public

subsidies, Private donations, fund raising events, Educational services, business services, and community support. Walson and Okanu-Igwela (2019) pointed out seven sources of financing education to mitigate their dwindling revenue base as: Research partnership with industry, Research contract, Endowment of professional chairs, Research partnership for graduate students and academic staffs, Industry lecturers hands-on, Co-supervision of research projects to solve societal problems, and Sabbatical leaves in the industries.

2. All educational institutional leadership should support the use of OECTs through the provision of necessary infrastructure. Oghenetega, Umeji and Obue (2014) opined that the educational administrators need to provide the necessary hardware, software and internet connection, because if the institutions are continuously updated with the necessary technological resources, then instructors and students would be able to implement the online learning effectively.

3. Government including the private organizations should support schools/institutions with the requisite ICT facilities that will promote the use of OECTs in the education sector. With this support, educational institutions can afford those costly ICT facilities that will promote the use of online technologies in schools.

4. School administrators should build strong networks through constant upgrading outdated devices, improvement in equipment and provision of fast internet access and connectivity, so as to resolve the issue of poor access to internet network and connectivity problem (Johnson, Jacovina, Russell & Soto, 2016).

5. Adequate capacity development and constant retraining programmes through conferences, seminars, and workshops, should be constantly provided for both staff and students to enable them use ICT facilities coupled with the OECTs for teaching and learning in various schools. Walson and Okanu-Igwela (2019) observed that teachers need specific professional development opportunities in order to increase their abilities to use ICT and online technologies for formative learning, assessments, individualized instruction, accessing online resources, and fostering students' interaction and collaboration. Such ICT training according to Ogbenevwogaga and Ogbenevwogaga cited in Walson and Okanu-Igwela (2019) should positively impact on teachers' general attitude towards the use of technologies in classroom as well as provide specific guidance on ICT teaching and learning within each discipline.

8. School authorities should be given maximum assistance through training in order to support the use of OECTs in school. Walson and Okanu-Igwela (2019) observed that while giving teachers the necessary support as they change their teaching, it is also essential for education managers, school administrators, supervisors and decision makers to be trained in the use of OECTs. Through this means, they will know the importance and benefits of OECTs in teaching and learning, therefore, give their support in the use of this model in school.

9. The issue of equality of access challenge and digital divide should be addressed through adequate funding, facility provision and policy implementation. Eleke (2019) opined that policies to bridge the inequality in access and digital divide to bring media, internet and digital literacy to all staff and students in educational institutions should be encouraged. In many countries, digital literacy is being built through the incorporation of information and communication technology (ICT) in schools. In Nigeria, there are recent clamor to make internet a separate subject in schools.

10. School leadership should adopt effective maintenance strategies such as the corrective, emergency, preventive and predictive strategies so as to maintain the ICT facilities in school. Tijani, Adeyemi and Omotehinshe (2016) opined that school administrators need to have a strategy on how to maintain their infrastructural facilities to ensure sustainability of same. This can be achieved through

effective maintenance culture which is said to have a correlation with school development.

Conclusion

The importance and benefits of using Online Emerging Computer Technologies (OECTs) for effective teaching and learning at all levels of the Nigerian education system during the COVID-19 pandemic cannot be over emphasized. The use of OECTs for effective instruction delivery in schools is a sure way of promoting quality education and institutional best practices for training a competitive workforce. However, much needs to be done in order to curb the challenges jeopardizing the use of these OECTs for effective teaching and learning in the institutions through adequate funding, provision of necessary infrastructure, private sector support, continuous capacity development, training and retraining programmes for school personnel like teachers, administrators and students, among others. Although providing these avenues for effective use of OECTs in educational administration is costly, but the benefits are greater in improving the quality of education provided in schools, enhancing the image of Nigerian educational institutions and making teaching-learning more effective.

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