

MATHEMATICS EDUCATION AS A SOLUTION TO COVID-19 INFLICTED EDUCATION DIVIDE PROBLEMS

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Abstract

This study discusses the outbreak of coronavirus pandemic as it has affected Nigerian schools and the challenges encountered in deploying various e-learning platforms to help ensure the academic calendar runs to an end. Specific areas of deployment of information technology innovations in mathematics education like internet, online instructional learning tools, open and distance learning, and open educational resources were discussed. Implications of ICT integration for the stakeholders in mathematics education such as students, teachers, school administrators, and policy makers in education as well as ways forward to education divide problems exposed by coronavirus pandemic were also discussed.

Keywords: Mathematics education, Information and Communication Technology (ICT), Coronavirus, Teaching and Learning.

Introduction

Practical or utilitarian value of Mathematics cannot be over-emphasized. Any common man can get on sometimes very well without the knowledge of reading and writing, but he can never do well without learning how to count and calculate. Such a person will be at the mercy of others and can be easily cheated. The knowledge of fundamental Mathematical processes and the skills to use them are the prerequisite of any human being these days. These knowledge and skills can only be carried out in an orderly manner by teaching the subject in schools. Counting, addition, subtraction, multiplication, division, weighing, measuring, selling, buying, notation etc. are examples of fundamental processes of Mathematics which are very useful in our day-to-day activities. A lot of occupations such as book-keeping, carpentry and joinery, business, tailoring, insurance, computer applications, taxation, bricklaying etc. make use of the knowledge of Mathematics to fulfill their daily needs directly or indirectly (Kulbir, 2012).

Mathematics is the body of knowledge centred on concepts such as quantity, structure, space and change as well as the academic discipline that studies them (Osafehinti, 2015). The subject can also be described as an organized active thinking which involves the search for patterns and relationship that may be expressed in reason and the desire for aesthetic perfection. Mathematics is a useful school subject for the full comprehension of scientific and technological advances, economic policies, business decisions as well as other complexity of social and psychological issues. Besides, Mathematics education is a field of study which involves the tools, methods and approaches that facilitate the practice of teaching and learning Mathematics. Most especially, Mathematics education at the higher level of education prepares students for quantitative and symbolic reasoning and advanced mathematical skills through general education, services and graduate programmes.

According to Odili (2012), Mathematics education is a discipline that

prepares students to become innovative instructors. The researcher explains further that mathematicians are categorized into two groups; Mathematics educators and the professional mathematicians. The Mathematics educators are concerned with curriculum development, instructional development and the pedagogy of Mathematics while professional mathematicians prepare students to communicate Mathematics to learners at all levels of education. Kilpatrick and Findell (2001) point out that Mathematics educators view Mathematics not simply as a body of knowledge or as an academic discipline but also as a field of practice. This is because they take a comprehensive look at and are concerned with how Mathematics is learned, understood and used. Mathematics education as a field of study looks beyond applications to ways in which people think about Mathematics, how they use it in their daily activities, and how learners can connect the Mathematics they learned in the classroom with the Mathematics in the environment around them (Kilpatrick & Findell, 2001). Mathematics education, which is concerned with curriculum development, is equipped to adapt to new methods of learning. These methods are capable of solving education divide between students in urban and rural/underserved communities in Nigeria caused by coronavirus (covid-19) pandemic.

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome. It was first identified in December 2019 in Wuhan, Hubei, China, and has resulted in pandemic. As at 31 August 2020, more than 25.3million cases have been reported across 188 countries and territories. This resulted in more than 848,000 deaths and over 16.6 million people have recovered. Common symptoms of the Coronavirus include fever, cough, fatigue, shortness of breath or breathing difficulties and loss of smell and

taste. The time from exposure to onset of symptom is around five days, but may range from two to fourteen days. The virus is spread primarily via nose and mouth secretions including small droplets produced by coughing, sneezing and talking. The droplets usually do not travel through air over long distances. Hence, those standing in close proximity may inhale these droplets and become infected. People may also become infected by touching a contaminated surfaces and then touching their face.

The first confirmed case in Nigeria was announced on 27 February 2020, when an Italian citizen in Lagos tested positive for coronavirus. On 9 March 2020, a second case was reported in Ewekoro, Ogun State, where a Nigerian citizen had contact with an Italian. This led to the closure of schools on 19 March 2020 by the Federal Ministry of Education as a response to the pandemic. Some states in the federation replaced normal school teaching through the State Ministry of Education with a schedule of radio and television lessons for students in public schools. This was due to many weeks of lock down. Families that cannot afford the purchase of radio and television due to their low level of income and harsh economic realities caused by lockdown are being left behind. One major issue that may arise from this inequality is that these students who currently cannot keep up with their peers because of inaccessibility to digital tools may never catch up and will continue to feel the effect of this gap long after the pandemic.

Confirmed cases of covid-19 in Nigeria were 54,008; active cases were 11,357, recovered were 41,638 and deaths were 1,013 as at 31 August 2020 (Government website). Table 1 gives full details of confirmed cases, active cases, those recovered and deaths in the thirty-six (36) states as well as the Federal Capital Territory (FCT) of Nigeria.

GENERAL FACT SHEET-DATA AS AT 31ST AUGUST 2020**Table 1: States in Nigeria with reported laboratory-confirmed COVID-19 cases, recoveries, deaths and days since last reported case**

Source: covid19.ncdc.gov.ng

S T A T E S	CONFIRMED CASES		DISCHARGED CASES		D E A T H S		TOTAL ACTIVE CASES	DAYS SINCE LAST REPORTED CASE
	TOTAL	NEW	TOTAL	NEW	TOTAL	NEW		
L a g o s	18,138	1 9	15,231	3	2 0 2	0	2,705	0
F C T	5,169	1 3	1,536	5	5 0	0	3,583	0
O y o	3,118	0	1,954	2	3 7	0	1,127	1
E d o	2,584	6	2,325	2 5	1 0 0	0	1 5 9	0
Plateau	2,533	3 5	1,395	2 1	2 9	0	1,109	0
Kaduna	2,141	2 1	1,991	1 4	1 2	0	1 3 8	0
Rivers	2,141	0	1,971	2	5 7	0	1 1 3	1
D e l t a	1,744	0	1,540	0	4 7	0	1 5 7	2
K a n o	1,727	2	1,537	0	5 4	0	1 3 6	0
O g u n	1,648	2	1,515	2 6	2 6	0	1 0 7	0
O n d o	1,539	0	1,380	0	3 1	0	1 2 8	1
E n u g u	1,162	7	9 0 7	0	2 1	0	2 3 4	0
E b o n y i	9 9 3	9	9 3 1	0	2 7	0	3 5	0
K w a r a	9 6 6	5	7 8 4	1 1	2 5	0	1 5 7	0
Katsina	7 9 6	7	4 5 7	0	2 4	0	3 1 5	0
O s u n	7 8 2	3	7 3 4	2	1 7	0	3 1	0
A b i a	7 7 1	0	6 9 7	0	0 8	0	6 6	1
B o r n o	7 4 1	1	6 7 1	4	3 6	0	3 4	0
G o m b e	7 2 3	0	6 3 6	0	2 3	0	6 4	2
B a u c h i	6 6 7	0	5 8 1	0	1 4	0	7 2	1
I m o	5 2 7	0	1 9 3	0	1 1	0	3 2 3	2
B e n u e	4 5 3	1	2 1 6	0	0 9	0	2 2 8	0
Nasarawa	4 3 4	0	2 9 8	0	1 2	0	1 2 4	2
Bayelsa	3 9 1	0	3 4 8	3	2 1	0	2 2	2
J i g a w a	3 2 2	0	3 0 8	0	1 1	0	0 3	4 6
Akwalbom	2 7 8	0	2 3 2	3	0 8	0	3 8	4
E k i t i	2 6 2	0	2 0 3	0	0 4	0	5 5	2
N i g e r	2 4 3	2	2 1 6	2	1 2	0	1 5	0
Adamawa	2 2 8	7	1 8 0	0	1 5	0	3 3	0
Anambra	2 1 6	2	1 6 8	0	1 8	0	3 0	0
S o k o t o	1 5 9	1	1 4 0	2	1 6	0	0 3	0
K e b b i	9 3	0	8 2	0	0 8	0	0 3	3
T a r a b a	8 7	0	7 3	0	0 5	0	0 9	6
Cross River	8 2	0	7 3	0	0 8	0	0 1	7
Zamfara	7 8	0	7 3	0	0 5	0	0	1 1
Y o b e	6 7	0	5 9	0	0 8	0	0	3 2
K o g i	0 5	0	0 3	0	0 2	0	0	5 9
T o t a l	54,008	1 4 3	41,638	1 2 5	1,013	0	11,357	

As a result of schools and universities closure by the Federal Ministry of Education, higher education institutions in Nigeria had thought over their approach to teaching and learning to become digital and to shift to online platforms. This new approach exposed

unpreparedness of many of them to migrate to online teaching. The leadership and managers of higher education institutions have seen the need for empowering students to prepare for a future where coronavirus or other pandemics or other disruptions should

become a part of our daily lives. In other words, we should embrace change in teaching and learning. However, despite the efforts to ensure smooth teaching and learning via migration to online platforms, students continue to face several challenges. According to United Nations Educational, Scientific and Cultural Organization (UNESCO) which focuses on the formal education of children, youth and adults across the globe by year 2015, eighty-six percent (86%) of students in sub-Saharan Africa do not have access to household computers and eighty-two percent (82%) lack internet access. This is an indication that these online classes cannot cater for all students.

The current study intends to present a holistic view of Mathematics education delivery for all students through effective strategies for teaching Mathematics. The paper first considered some importance of Information Communication Technology (ICT) in Mathematics education along with implications for the stakeholders in Mathematics education and to explore options for the ways forward of the coronavirus pandemic (COVID-19). In this study, technology is viewed as the group of networks, devices, applications and digital content used to communicate with others in order to obtain, generate or share information (Broadband Commission Working Group on Education, 2013).

Information and Communication Technology as agent of change in teaching and learning Mathematics

Information and Communication Technology (ICT) means converting, accessing, finding, sharing, processing, editing, protecting, transmitting, retrieving, presenting and communicating information through electronic computers and computer software (Yogesh, 2014). ICT has become one of the fundamental building blocks in the modern society. Mastering of the basic skills and concepts of ICT in many countries of the world has become unavoidable part of the core of education. Hence, various new models of Mathematics education are coming up in response to the new opportunities that are becoming available by integrating ICT and in particular Web-based technologies into the teaching and learning of Mathematics.

However, effective integration of such applications depends, to a large extent, on Mathematics teachers' understanding and ability with the IT teaching and learning environment. Mathematics teachers need to understand how ICT is used as teaching and learning tools in the Mathematics classroom, for their own personal use and to help their students to use them with the aim of increasing the effectiveness of teaching and improving students' learning.

Ensuring smooth teaching and learning and eradicating challenges which both the teachers and students might encountered via migration to online platforms requires ICT basic skills, access to computer and access to internet. These are highly essential for many activities to take place. The students should then be able to apply the pedagogical principles of ICT integration in education and use them efficiently in research, problem-solving and project-based learning in Mathematics. Oblinger (2012) viewed information technology as a game changer, changing the educational experience through simulations, game, haptic devices that allows users to "feel", augmented, reality, and more. The researcher explained further that information technology administered in education can make administrative process faster. Furthermore, many areas of technology impact in education include change in the learning experience, guidance and personalization, learner-centred design, research, open solutions and scaling (Oblinger, 2012). In support of this submission, Iji, Abah and Anyor (2014) revealed that impactful applications of information technology in education are gradually closing the digital divide across the globe.

The use of technology in teaching Mathematics cannot be overemphasized. Technology provides students with access to many online resources, encouraging them to carry out research which makes them become independent. It simplifies Mathematics concepts by making use of instructional video which makes it more meaningful. There are various learning styles when technology is employed in teaching Mathematics which traditional education may not be able to cater for. There are some

mathematical concepts students find difficult when being taught using the traditional method, but the use of technology is crucial in holding students' attention to allow them absorb such information better. Technology provides students with a higher quality of education. Technology has made it possible for students to gain qualifications online and educate themselves through institutes that offer online courses. Students can learn from home without traveling from their home to their school or vice versa. Hence, students can be working and at the same time can attend school to pursue further education without having to give up their full time jobs. This has made education accessible to everybody be it online learning or showing video in a classroom. Technology has changed education and the way people learn as well as the way they retain information.

Despite the usefulness of ICT which has changed the whole world and brought the world into a digital age, some institutions are inaccessible to digital tools. Meanwhile, closing the "digital divide" alone cannot transform learning. United State (U.S.) Department of Education – Office of Educational Technology (2016) observed that effort should be made to also close the "digital use divide" by ensuring that all students understand how to use technology as a tool to engage in creativity, productive, lifelong learning rather than simply consuming passive content. There are forms of ICT knowledge required for effective teaching and learning of Mathematics such as Word Processing, Multimedia, Email and Internet to mention but a few. Word Processing and Internet require attention of this write up.

Yogesh (2014) suggested that teachers need to know several features of word processing software in order to teach effectively. The teachers', students' and administrators' knowledge of word processing should include:

1. Creating, opening, saving, closing, deleting and printing documents.
2. Selecting font, font size, colour, style, line spacing and justification.
3. Altering default font, font size, colour, background colour, margins, page size and orientations.
4. Inserting, deleting, selecting, cutting, copying, pasting and undoing.
5. Inserting bullet points, tables, clip art, borders, shading and columns.
6. Altering page orientation (landscape, portrait) and margins
7. Forcing page breaks.
8. Utilizing tabs and indents.
9. Utilizing spelling and grammar checkers, thesaurus, print preview, highlighter and find & replace.
10. Connecting alternative input devices (overlay keyboards, touch screens).
11. Inserting page numbers.
12. Inserting text, graphics, tables, and documents from other applications (Yogesh, 2014).

The Internet is a vast network that connects computers all over the world. Through the Internet, people can share information and communicate from anywhere with an Internet connection. The Internet provides a capability so powerful and general that it can be used for almost any purpose that depends on information, and it is accessible by every individual who connects to one of its networks. It supports human communication via social media, electronic mail (e-mail), news groups and audio and video transmission. The Internet allows people to work collaboratively at many different locations. It supports access to digital information by many applications, including the World Wide Web (Robert, 2020). According to Sharp, Beach, Muhlemann, Price and Paterson (2011), the use of internet in the present time in teaching and learning processes is unavoidable. The researchers explained the need to know several features of the internet and suggested the following measures for teachers and students as well as the administrators:

1. How to access the internet and how to access and use browsers.
2. How to access, search, and navigate the World Wide Web.
3. How to design, create, save, modify and publish on the World Wide Web.
4. Use of e-mail for teaching and learning.
5. Detailed knowledge of the school's policy and protocols for internet usage.

- 6 Book marking favourite websites.
- 7 Copying and pasting text, images and materials from web pages into other applications.
- 8 Downloading and saving websites and files.
- 9 Checking for, and preventing damage from viruses.
- 10 Altering default browser settings.
- 11 Utilizing cache facilities (Sharp, et al., 2011).

Improving the outcome of technology usage in fostering these skills requires smart partnerships from within and across education that have share purpose and a strategic and holistic approach, and bring about change in organizational processes (Voogt&Knezek, 2016). These smart partnerships are to use technology to improve the quality of education and acknowledge the role of technology in the emergent processes. Lister (2014) observed that innovative technologies have continuously widened the reach of e-learning and online platforms. These innovative technologies of teaching and learning foster compact and efficient course structure, content presentation, collaboration and interaction, and timely feedback. In support of this assertion, Lee (2016) pointed out that innovative technology also lead to personal commitment to study and the resulting cognitive engagement with content often contribute to high degree of learning autonomy. Innovative technology ensures that the best and the latest knowledge available all around the world are easily accessible to the teachers and the students. Technology oriented learners like virtual learners and e-learners have demonstrated increased retention rates and better utilization of content, resulting in better achievement of knowledge, skills and attitudes (Chitra, 2014).

Implementation of ICT Innovations in Mathematics Education

The internet is an inevitable medium if looking for a quick way to find necessary information related to any area of human activity. It is now an essential part of every home and workplace including schools. Haddad and Draxler (2002) explained that

integrating technology in education is a very sophisticated and multifaceted process just like any other innovation. The researchers explained further that it should not be introduced without piloting its different components. Clement and Joshua (2018) submitted that innovations must be verified for appropriateness, suitability, classroom implementation ability, learning effectiveness, and cost benefit ratio. In Mathematics education, some aspects of ICT innovations that have been designed, developed, tested and deployed for use in different branches include online instructional learning tools and platforms, ICT- based instructional approaches, implementation of open and distance learning (ODL), circulation of open educational resources (OERs) and dissemination of research findings.

Online instructional learning tools and platforms are tools to perform calculations, draw graphs and help solve problems. A good example of using ICT in this way is when students use a calculator to perform more challenging numbers. However, spreadsheets, computer algebra systems, graphical calculators can be used to solve problems by tests and improvement or retrieval methods. Mathematics students can use graphical calculators or graph plotters instead of algebra to graphically solve an equation. Students can smoothly perform a statistical analysis of the data collected using the extensive statistical features of the graphical calculator. ICT as a tool helps students to search things out, solve problems and then prove a geometric problem. It can be used to solve quadratic equation of the form $x^2 + 2x = 12$ by using a spreadsheet or graphical calculator. ICT as a tool also helps in general geometric and trigonometric applications such as drawing a triangle, cube, cuboid etc.

Another ICT tool is Maxima which is algebra solver software. The program is based on Computer Lisp and works with all POSIX principles such as Linux, Unix OSX, and BSD for drawing which make use of Gnuplot. Furthermore, Geogebra is math software that is useful for teaching and learning for the teachers and students. It is a robust platform which helps preschoolers to learn Mathematics effectively and solve

Mathematics problems on different topics which include algebra, vectors, calculus, statistics, complex numbers, linear programming etc. Clark-Wilson, Oldknow and Sutherland (2011) listed innovation-based tools such as algorithmic programming languages (APL), data loggers (motion detectors and GPS) and computer algebra systems (CAS) among other tools used by schools all over the globe for teaching and learning. Kumar and Kumaresan (2008) explained computer algebra systems such as Mathematica, Maple, MuPAD, MathCAD, Derive and Maxima as tools that have potential to facilitate active approach to learning. These ICT tools allow students to become involved in discovery and consolidate their own knowledge. Class Learning Interactions- Observation (CLI-O) tool is a new dimension of ICT innovation in mathematics education, which enables a systematic observation and monitoring of interactions that take place within the classroom (Manny-Ikan, Tikochinski & Bashan, 2013).

Furthermore, Open and Distance Learning (ODL) is a well-known area of integrating ICT innovations in mathematics education. Clement and Joshua (2018) viewed Massive Open Online Courses (MOOCs) as the first among the ODL. The researchers explained MOOCs as courses designed for large number of participants, which can be connected by anyone anywhere through the internet. MOOCs are opened to everyone without entry qualifications and anyone can offer a complete course of study online freely (Clement & Joshua, 2018). It allows for the production of digital resources such as digital libraries, where students, teachers, and professionals can access the study material and course material from anywhere at any time (Kaushik, 2019). ODL programmes such as virtual environment, simulator, digital libraries, computer-mediated conferencing, videoconferencing, emulator etc. are designed to establish social and cognitive presences via the World Wide Web (Hanover Research Council, 2009). Kaushik (2019) suggested that for a practical subject like mathematics, Online Virtual Laboratory (OVL) when implemented in mathematics education will result in sufficient training for practical skills. This Lab

enriches students' experience, mastery of learning and development of new ideas during training.

Open Educational Resources (OER) are digital texts, multimedia, and other resources like textbooks, workbooks and tutorials that are designed to be free for cost, have minimal barriers to access, and licensed to be readily reused and remixed. Traditional education materials like textbooks can be outdated but open education resources on the other hand can be updated, adapted, and improved continually, so they cannot be out of date. OER are the most advanced version of educational resources. They encourage active participation in creation and collaboration between teachers, students, and educational institutions. Most prestigious universities and colleges of the world are working to create and disseminate OER to support scholars and students. Good examples of OER are open courseware, learning modules, open textbooks, streaming videos, open access journals, online tutorials, and digital learning objects. Hallmark of an open education resources give freedom to create, remix, and adapt it to your needs. According to Pressbooks (2017), authors and publishers publish books with pressbooks which is simple book production software. It allows writing a book using the software or imports a manuscript, choose a book design theme, and export into all the file formats (Pressbooks, 2017).

In the area of dissemination of research findings, mathematics education has recorded great success in technological innovations in the contemporary time. Researcher values creativity and originality, thus, ICT tools provide great autonomy to the researcher in identifying and solving research problems in most creative ways. It provides easy communication with peers, which make instantaneous information exchange possible despite geographical distances, costless accumulation of data and documents, and improvements in the precision of knowledge production. The use of ICT tools in mathematics education makes adaption of the methods of instruction delivery that have been tested and reported in one geographical area easy in another area within a very short period of time. This has made the flow of mathematical knowledge

moving smoothly ever than before. It also makes more mathematics education research journals available online. This also eases research collaborations and knowledge sharing among academics from different cultures and backgrounds. ICT tools help researchers to identify appropriate sources of information, how to critically analyse information, how to research effectively as well as how to manage information.

As a medium of communication, ICT tools provide powerful communication channels mostly text based but increasingly enhanced with moving and still images as well as sound, which is a little better than traditional medium of interaction. In the area of data analysis ICT tools are available for researchers in mathematics education. An open source statistical software programming languages which are available at www.gliffy.com/, www.mindmeister.com etc. are very useful to researchers. Mathematics educator can now submitting collected field data to specialist online firms for statistical analysis and interpretations therefore getting valid and reliable results. Research Portfolio or Newsletter as ICT tools make research outcomes get to large numbers of stake holders through internet. Likewise, events happening across the globe on the theme of research can be found out easily through the internet.

Implications of ICT integration for the stakeholders in Mathematics Education

Information communication technology innovations adapted to the needs of mathematics education are being produced in different forms on daily basis. Availability of different types of smart phones with different capacities to run mathematics apps among students of mathematics education requires careful consideration for mathematics educators, students, school administrators, and policy makers in mathematics education.

Mathematics education professionals should be up-to-date in term of creativity, initiatives, and critical thinking. As technology is advancing everyday across the globe, mathematics education professionals should not lack behind. They should be relevant and ready to compete with information technology professionals. Attempts should be made by mathematics

education professionals towards improving the conceptual clarity regarding various thinking skills such as analytical thinking, problem solving, creative thinking and critical thinking with various strategies. They should be ready to take charge of designing future-oriented technological tools that are adequate enough to adapt to change. Mathematics education professionals should embrace any available technological innovations to augment mathematics teacher's proficiency in pedagogical, social, and organizational skills. Therefore, they should be able to meet the needs of the society.

Students in general and mathematics education students in particular should not be left behind in embracing information technological innovations. Mathematics education students should be ready to use digital technological innovations maximally to improve quality of learning. Since the original aim of education is to make young ones ready for their future life and to train them how to tackle the day to day problems of life, they should direct their efforts into creative thinking and take part in the global information technological innovations to develop mathematical tools that will augment mathematics learning. Mathematics students should be encouraged to develop web site among them and make use of online instructional platforms to increase their mathematical, entrepreneurship, and life sustenance skills.

Although teachers are no longer the only source of information for the students, students can access information from many places, but they have a role to help students access credible and valid sources. Mathematics teachers need to update their knowledge, skills to use the new digital tools and resources through policy makers in mathematics education. By using and acquiring the knowledge of ICT, teacher will become effective in discharging his/her duties. It is only through the knowledge of ICT that teachers can create a bright future for the students. Administrators of educational institutions should make necessary arrangement to design, maintain and improve technological infrastructures in their institutions for usage in mathematics learning.

Ways forward to education divide problems caused by corona virus pandemic

The original aim of education is to make young ones ready for their future life and to train them how to tackle the day to day problems of life. Definitely, corona virus pandemic is one of the day to day problems of life which we must tackle and overcome. In developing countries like Nigeria, education should be the government priority, government should help citizens (especially the young ones and those from low income families) to be educated. This duty is an investment in human capital for such country and it will benefit the country's economy in the future, for the fact that the more educated a country is, the more productive. At the peak of corona virus, students were affected by some forms of school restrictions across the globe. Its long term effects can only be eased by digitalizing education. Both "digital divide" and "digital use divide" problems exposed by corona virus during the closure of schools, education institutions, and universities must be taken care of by the stakeholders in education in general and mathematics education in particular.

Accessibility to resources by the students is one of the solutions to the problems caused by corona virus pandemic. UNESCO (2015) explained that eighty-six percent (86%) of students in sub-Saharan Africa do not have access to household computers and eighty-two percent (82%) lack internet access. In Nigeria, many students even in the university live in households without access to a laptop or desktop computer or smart phone. Within a single household, students are also facing the problem of sharing a single device with one's brother or sister. No or poor access to both the internet and devices increases for lower income students. School closure might only be for months even years but the effects are not to be underestimated because disadvantaged students will still fall further behind. Without the vital resources that schools and universities provide, students will be left behind.

Due to the fact that ICT is a vital tool for teaching and learning are not available in many schools and universities, online classes cannot cater for all students as we are not on

equal economic level. Hence, to complete the rest of their school year safely schools can recreate space. Recreation of space will serve as future solution to the problems. Creation of more space will reduce congestion and overcrowding in classrooms which may require more time and funds. Space creation calls for redesigning of future schooling because one of the major areas where we can really learn is from education. Our old method of education system where every student sits in a classroom is not going to work in the time to come. The pandemic has shown that we cannot continue to do things the same way as we used to and things ought to change in the nearest future. This calls for all the stakeholders within the educational sector to brainstorm and explore options for the way forward. In other words, we should embrace change in teaching and learning.

There is no doubt that e-learning has come to stay and it ought to be one of the requirements that at every semester, one of the courses a student must take must be fully carried out online. In this case, there should not be face to face contact between the student and teacher. Everything from registration of courses, teaching and learning interaction and examination must be done online. This process will help to test the soundness in ICT usage, get rid of the fear of the unknown and help identify all the challenges and find ways of solving them step by step until we get to perfection.

Conclusion

This paper has attempted to bring to the notice of public the critical role of information and communication technology (ICT) innovations in mathematics education. Actually, points mentioned and discussed in this paper may not be exhibiting all the facts in view of the wide scope of the topic under consideration, but they are reasonable and convincing aspects of the trends in (ICT) integration in mathematics education. The paper also discussed both "digital divide" and "digital use divide" problems exposed by corona virus during the closure of schools, education institutions, and universities. In conclusion, ways forward to education divide problems were provided.

References

- Broadband Commission Working Group on Education (2013). *Technology, broad band and education: Advancing the education for all agenda*. Paris. UNESCO. Pp. 40
- Chitra, S. (2014). Technology based education for future classroom. In S. K. Panner (Ed.), *Teaching – Learning Paradigms*. New Delhi -110 002 (India): Random Publications. (pp. 108 – 116).
- Clark-Wilson, A., Oldknow, A. & Sutherland, R. (2011). *Digital technologies and mathematics education*. A report from the working group of the Joint Mathematical Council of the United Kingdom, pp 1-32.
- Clement, O. & Joshua, A. A. (2018). Mathematics education for all through information technology innovations. *Abacus the journal of the Mathematical Association of Nigeria*, 43(1), 89-100.
- Government website (2020). Covid19. ncdc.gov.ng. Retrieved on 31st August, 2020 from <https://en.m.wikipedia.org>
- Haddad, W. D. & Draxler, A. (2002). *Technologies for education: Potentials, parameters, and prospects*. Paris: UNESCO. (pp 1-198).
- Hanover Research Council (2009). *Best practices in online teaching strategies*. Washington DC: Hanover Research Council. pp 1-35
- Iji, C. O., Abah, J. A. & Anyor, J. W. (2014). Enhancing national competitiveness through the utilization of cloud services to improve the learning of school Mathematics. In J. S. Sadiku (Ed.), *Proceeding of the September 2014 National Conference of the Mathematical Association of Nigeria (MAN)*, pp. 230 – 243.
- Kumar, A. & Kumaresan, S. (2008). Use of mathematical software for teaching and learning mathematics. *ICME 11 Proceedings*, 373-387.
- Kilpatrick, J. & Findell, B. (2001). *Adding it up: Helping children learn mathematics*. Washington, D. C. National Academy Press.
- Lee, L. (2016). Autonomous learning through task-based instruction in fully online language courses. *Language Learning & Technology*, 20(2), 81-97.
- Lister, M. (2014). Trends in the design of e-learning and online learning. *MERLOT Journal of online Learning and Teaching*, 10(4), 671-680.
- Oblinger, D. G. (2012). *Introduction*. In D. G. Oblinger (Ed.), *Game Changers: Education and Information Technology*. Louisville, CO: EDUCAUSE. (pp. 1 – 381).
- Odili, G. O. (2012). Towards a new paradigm of teaching mathematics in Nigeria Universities: The role of Mathematics educators. *Online Journal of Science Teachers Association of Nigerian (STAN)*, 47(1).
- Osafehinti, I. O. (2015). Mathematics in adult education: The Nigerian experience. Retrieved on 28th August, 2020 from [Mhttp://www.almonline.net/images/ALM/conference/ALM15/proceedings](http://www.almonline.net/images/ALM/conference/ALM15/proceedings).
- U. S. Department of Education – Office of Educational Technology (2016). *Future ready learning: Reimagining the role of technology in education*. Washington, DC: U.S. Department of Education. Pp. 1-101.
- UNESCO (2015). *Education 2030 Incheon declaration and framework for action: Towards inclusive and equitable quality education and lifelong learning for all*. Paris: UNESCO. Pp. 1-32.
- Robert, K. (2020). Encyclopedia Britannica, Inc. Retrieved on 31st August, 2020 from <https://www.merriam-webster.com>.
- Sharp, J. A., Beach, R., Muhlemann, A. P., Price, D. H. R., & Paterson, A. (2011). A review of manufacturing flexibility. *European Journal of Operational Research*, 122 (1), 41-57.
- Voogt, J. & Knezek, G. (2016). Technology enhanced quality education for all: Outcomes from EDUsumMIT 2015. *Educational Technology & Society*, 19(3), 1-4.
- Yogesh, S. (2014). *Teaching-Learning Paradigms in the Globalized World*. In S. K. Panner (Ed.), *Teaching – Learning Paradigms*. New Delhi -110 002 (India): Random Publications. (pp. 94 – 107).
- Manny-Ikan, E., Tikochinski, T. B. & Bashan, Z. (2013). Does use of ICT-based teaching

encourage innovative interactions in the classroom? Presentation of the CLI-O: Class learning interactions observation tool. *Interdisciplinary Journal of E-Learning and Learning Objects*, 9, 219-232.

Kaushik, D. (2019). Role of ICT for better mathematics teaching. *International Journal of Education*, 7(4), 19-28.

Pressbooks (2017). Open Education Resources. Retrieved online from <https://libraryguides.lib.iup.edu/oer>