# COVID-19 Lockdown-Enhanced Innovations in Mathematics Education in Bayelsa State, Nigeria

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**Abstract.** The immediate consequences of the pandemic might be there, but it has offered a unique turning point as well as provided an opportunity to learn, reshape and rebuild resilience into the educational system of the state. Corona Virus (COVID-19) pandemic has stirred up the need to embed appropriate technology and standards for effective output in the teaching and learning of mathematics at all levels. This paper presents conceptual clarifications on innovations, COVID-19 lockdown, mathematics and mathematics education and lockdown-enhanced innovations. Mathematics education in Bayelsa state before the lockdown was discussed. Lockdown-enhanced innovations in mathematics education in Bayelsa state with regards to the use of Information and Communication Technology (ICT) and Mobile App-based instructional approaches were identified and discussed.

**Keyword:** COVID-19, lockdown-enhanced, innovation, mathematics education

## Introduction

Corona Virus (COVID-19) pandemic has been deemed as the greatest global threat the world has faced since the Second World War. It is not the deadliest or most infectious disease recorded, but its impact on the level of globalization and interconnectedness of the world renders it particularly destructive globally. The immediate consequences of the pandemic might be there, but it has offered a unique turning point as well as provided an opportunity to learn, reshape, and build resilience into the educational system of the state. COVID-19 pandemic has stirred up the need to embed appropriate technology and standards for effective output in the teaching and learning of mathematics at all levels. Perhaps this COVID-19 driven school closure was the crisis we needed to identify and appropriately act to reduce the impact of gaps that existed. Hence, this paper is aimed at highlighting the innovations in mathematics education that emerged as a result of the COVID-19 lockdown in Bayelsa State, Nigeria.

## Conceptual Clarification

### COVID-19 Lockdown

Corona Virus (COVID-19) is an infectious disease caused by the most recently discovered corona virus. This new virus was unknown before the outbreak began in Wuhan, China in December, 2019 which lead to the Pandemic of the COVID-19. The most common symptoms of COVID 19 are fever, tiredness, dry cough and difficulty in breathing. It is highly contagious. Lockdown refers to restrictions of movement of humans within a particular area, with the aim of halting the spread of the pandemic (Ikhuoria, 2020). In Nigeria, the Federal Government introduced lockdown in Abuja, Lagos, and Ogun State, for two weeks starting from March 29, 2020 and extended it again for another two weeks. State governors who had confirmed cases of COVID-19 in their respective states of which Bayelsa state was a part also declared a lockdown. During this time, schools, churches, businesses and offices were closed down and people were compelled to stay at home. This situation has highlighted a critical gap in school-based (learning and teaching) contingency planning and emergency preparedness within the education sector in Bayelsa.

## Innovations

Innovation can be described as a new way of doing things. Luecke and Katz (2013), defined innovation as a process of introducing new techniques of refined products and services. Innovative change starts with the introduction of a policy of continuous improvement, and the determining methods (Heller, 2012). Also, innovation can be viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Maranville, 2019). Innovation is about staying relevant. We are in a time of unprecedented change, as a result, what may have helped an organization to be successful in the past could potentially be the cause of their failure in the future, for the world itself is Volatile, Uncertain, Complex and Ambiguous (VUCA) (Akinoso, 2015).

## Mathematics and Mathematics Education

### *Mathematics*

Mathematics is a precursor of scientific discoveries and inventions. It is described as the touchstone of whit and whetstone of intelligence that aids reasoning. Kurumeh and Chianson (2011) defined mathematics as a science of the methods by which quantities sought are deducible from others known or supposed. Odili (2006) citing Kline (1980) describes Mathematics as man's most extensive and most profound effort to achieve precise and effective thinking and its accomplishment measures the capacity of the human mind. To Odili (2006), Mathematics represents the superb and sublime product of reason as well as the upper limits of what one hopes to attain in all rational domain. Azuka (2012) stated that mathematics is mostly consider as a gizmo that contains the skill for solving real-life situational organizing, simplifying, interpreting data performing calculations that are necessary in fields such as science, business and industry for national development.

The supremacy of Mathematics is extolled by the National Policy of Education (FRN, 2014) which states that Mathematics should be made a core subject in the primary and secondary education levels. Kurumeh and Chianson (2011) opined that for an individual to possess higher order skills and cope with the demands of the present day workforce and navigate complex world, he/she will have a good knowledge of Mathematics. Mathematics is essential for the full comprehension of technological and scientific advances, economic policies and psychological issues.

### *Mathematics Education*

Charles-Owaba, and Moses (2018) defined mathematics education as a field of study that acquaints learners with certain basic knowledge, skill and attitude needed for future work in science, engineering and other related field. Omeodu (2019) defined mathematics education as a field of study concerned with the tools, methods and approaches that facilitate the practice of teaching and learning mathematics. Mathematics education prepares students for quantitative and symbolic reasoning and advanced mathematical skills through general education, services and graduate programmes.

Odili (2012) submitted that mathematicians can be categorized into two groups; mathematicians and mathematics educators. The mathematics educator is concerned with curriculum development, instructional development and the pedagogy of mathematics. Mathematics education basically prepares students to become innovative mathematics instructors, professionally prepared to communicate mathematics to learners at all levels. Mathematics educators see mathematics not simply as a body of knowledge or academics discipline but also as a field of practice. Onwuaji and Abah (2018) citing Kilpatrick (2008) opined that mathematics education is concerned with how mathematics is learned, understood, as well as what it is. Mathematics education looks beyond applications to ways in which people think about mathematics, how they use it in their daily lives and how learners can be brought

to connect the mathematics they see in school with the mathematics in the world around them (Charles-Owaba & Moses 2018).

**Lockdown-Enhanced Innovations**

These are new ways of teaching and learning that emerged as a result of the COVID-19 lockdown. This included teaching and learning online via the internet using the computer – laptop, desktop, palmtop, phone, etc. and the use of Information and Communication Technology (ICT) facilities. Also, some television and radio stations organized some educational programmes to keep the students busy and learning at home, so that the children can be kept safe during the period of the pandemic. Some Non-Governmental Organisations also organized educational programs for the people in different communities to educate them.

**Mathematics Education in Bayelsa State, before the Covid-19 Lockdown**

Bayelsa State educational system is largely built around traditional pedagogical learning system. Low cost secondary schools accounts for over 87% of the schools in the state and are responsible for educating a greater portion of students from low socio-economic background (Amawhelu & Umoh 2020). These schools typically survive by using the traditional face-to-face contact, which in most cases has little or no connection with the use of Information and Communication Technology (ICT) facilities. Also, teachers were comfortable with their inability to use ICT facilities and there were no conditions for ICT competence before employment (Odua, Ikogi & Umoh, 2020). Schooling at all levels in the state was already facing these challenges and at such teaching and learning could not take place during the COVID-19 lockdown period. The COVID-19 lockdown exposed the inadequacies that existed in the system. Only some private schools and federal government colleges in the state were able to utilize e-learning platform during the lockdown.

**Lockdown-Enhanced Innovations in Mathematics Education in Bayelsa State**

Innovations in mathematics education refers to the ways of teaching and learning mathematics that are different from the traditional exposition-and-exercise practices (Charles-Owaba & Moses, 2019), dominant use of textbooks or programmed published materials (Charles-Owaba & Omeodu, 2020). Claudius (2015) submitted that innovation in mathematics education comes in two forms namely;

a) **Innovations of goals and contents in Mathematics curriculum:** This has to do with new concepts and topics to be learnt as well as new competencies to be achieved. In Nigeria particularly, the innovations of goals and contents led to the addition of new contents such as calculus, matrices and determinants, coordinate geometry and modular arithmetic to the curriculum (Odili, 2006).
b) **Innovations in pedagogy in Mathematics Classroom:** Changes in the content of the mathematics curriculum was accompanied by developing and integrating teaching methods that were different and better than the traditional ways of teaching the subject. Major innovations in pedagogy in mathematics classroom are the use of ICT and mobile device.

COVID-19 lockdown-enhanced innovations in mathematics education in Bayelsa state are:

*i. Adoption of Information Communication Technology (ICT)–based instructional Approach*

Sedega (2017) defined ICT-based instructional approach as the use of computer to give course content instruction in the form of drill and practice tutorials and simulations. Agwagah (2019) defined it as an instructional approach where computer is used to communicate the instructional procedures, materials and calculate learning outcomes. Gana (2013) said it refers

to virtually any sort of computer application in instructional settings; comprising of drill and practice, simulations, instructional exercises, supplementary exercises, instructional management, database development, programming composing using word processors and other different applications. These are teaching and learning sequences that make active use of ICT tools to augment learning experience. It is capable of providing adaptive teaching programmes and also stimulates a living dialogue between students and teachers in which the students' relations determine the sequence of presentation, the amount of explanation, assistance and practice which the teacher gets (Arua, 2017). COVID-19 lockdown forced most schools to adopt ICT- based instructional approach in the teaching and learning of mathematics. As a result of this, mathematics teachers were forced to acquire and upgrade their skills on ICT usage in order to be relevant in the system.

ICT-based instructional approach encourages student-centered learning and help learners to be more interactive by engaging their active senses to learning (Adolphus & Omeodu, 2020). ICT-based approach is based on the principle of programmed instruction. Suleman (2017) stated that the major aim of the programmed instruction is to provide individualized instruction to meet special needs of individual learners in an online situation. It uses the computer essentially as assistance for the teacher, that is; the students' interact with the computer directly, usually at a terminal (keyboard/video). There are wide ranges of existing mathematical digital technologies which were readily used by schools in the state during the lockdown period. Such tools according to Omeodu and Charles-Owaba (2020) are:

i. Dynamic graphing tools,
ii. Dynamic geometry tools,
iii. Algorithmic programming languages,
iv. Spreadsheets,
v. Data loggers (motion detectors and GPS), and
vi. Computer Algebra Systems (CAS).

The use of ICT-based instructional approach emphasized the development of mathematics concept and computational competencies among learners using standard rules and procedures at the detriment of genuine understanding. This pedagogy gives learners opportunity to be actively involved in the learning process, thereby acquiring mathematical skills and computer competencies that can improve entrepreneurial and other business skills (Fadere, 2019). The advantages of this method according to Suleman (2017) include:

i. Ensuring the application of proven teaching methods to students,
ii. Offering equal educational opportunities for students by using the same programme,
iii. Changing the role of teacher from teaching capacity to that of a guide.

Abdullahi (2013) stated that ICT gadgets simplify methods and strategies of acquisition of knowledge. These Mathematical Digital Technologies promotes:

i. Students' intellectual qualities in mathematics through problem solving and higher order thinking.
ii. Interactive teaching and learning environment.
iii. Computer generated graphics for easy illustrations of concepts especially the abstract once.
iv. Learner centered and activity oriented teaching and learning environment.

*ii. Adoption of Mobile Application-Based Instructional Technique*

Mobile application-based instructional techniques also known as *mobile application-based instructional techniques* are a series of software designed to assist learners in performing single or various related tasks with the purpose of creating learning. The use of mobile app-based instructional techniques represents a technology that is ubiquitous in nature, wireless, highly portable and endowed with multimedia capabilities bringing a new dimension to curriculum delivery (Charles-Owaba, 2020). The year 2020 have witnessed an impressive

increase in the use of mobile app-based instructional technique in schools as a result of COVID-19 lockdown, in Bayelsa State.

The use of mobile app-based instructional technique gave learners opportunity to engage in problem-solving based learning activities, work on tasks that are goal oriented and open-ended with a strong gaming component and learn from the comfort of their homes during the lockdown. They empower students to develop their own understanding through active involvement and sense-making. Furthermore, learning experiences like digital simulations or manipulations adopted, improved learners capacity via interactivity, thus enhancing cognitive and affective processes (Charles-Owaba, 2020). Common mobile online platform used during this period are: Edmodo, Microsoft teams, Google classroom, etc. Specific mathematics mobile app used are; Apollonius, GeoGebra, Mathematical, marple, MuPAD, Math CAD etc. These online platforms enhances the users' performance by adding the following as noted by Charles-Owaba (2020);

i. Facilitate an activity approach to learning,
ii. Allow students to become involved in discovery and
iii. Consolidate their own knowledge,
iv. Develops conceptual and geometrical understanding and
v. A deeper approach to learning

The use of mobile devices in learning has also increased teachers, students and parents' awareness and the challenges associated with the use of it. Omeodu and Charles-Owaba (2019), reported that teachers and students awareness on the use of mobile app in mathematics education was low. In another vein, Omeodu and Charles-Owaba (2020) reported that the COVID-19 lockdown increased teachers' awareness on the use of mobile devices for teaching and learning.

*iii. It is a Requirement for Employment*

COVID-19 lockdown has made ICT competence a basic requirement for employment, placement and promotion of mathematics teachers in Bayelsa state.

*iv.* The COVID-19 lockdown has caused much greater appreciation for the importance of mathematics teachers. As parents struggle to work with their children at home especially in during mathematics class, due to school closures, public recognition of the essential caretaking role schools play in society has skyrocketed. As young people struggle to learn from home, parents' gratitude for teachers, their skills and invaluable roles in student well-being has risen.

**Future Research**

More research is needed to ascertain the effectiveness of the approaches adopted during and after the COVID-19 lockdown.

**References**

Abdullahi, H. (2013). The Role of ICT in Teaching Science Education in Schools. *International Letters of Social and Humanistic Sciences, 19*, 217-223.

Adolphus, T. & Omeodu, M.D. (2020). Effects of Computer –Assisted Instruction on Students' Achievement in Atomic Nuclear Physics in Senior Secondary Schools in Rivers State. *GSC Advanced Research and Reviews*, *2*(3), 1-8.

Akinoso, S.O. (2015). Teaching Mathematics in a Volatile, Uncertain, Complex and Ambiguous (VUCA) World: The Use of Concrete-Representational-Abstract Instructional Strategy. *Journal of the International Society for Teacher Education, 19*(1), 97-107.

Aruah, S.N. (2017). *Effect of Interactive Whiteboard Instructional Approach on Students Achievement and Interest in Geometry*. Unpublished M.Ed. Thesis, University of Nigeria, Nsukka.

Azuka, B.F. (2012). Improving the Memory of Students in Mathematics Classroom Towards better Performance. *Journal of Mathematic Association of Nigeria (MAN), 37*(1), 65-72.

Charles–Owaba, T. & Moses A.B. (2018) Enhancing the Future of Students in Mathematics for a Sustainable Local Content Policy. *Journal of Oil and Gas, 20*(3), 40-48.

Charles–Owaba, T. & Omeodu, M.D. (2020). Mobile App and Mathematics Education; Awareness and Barriers. *Journal of Assertiveness, 11*(2), 90-98.

Charles–Owaba, T. (2020). *Effects of Mobile App Instructional Technique on Students' Achievement and Interest in Geometry in Bayelsa State*. An Unpublished Doctoral Thesis of the Department of Science Education, Rivers State University Port Harcourt.

Claudius, B. (2015). Trends in the Design of E-learning and Online Learning. *Journal of Online Learning and Teaching, 10*(4), 671-680.

Fadare, A.O. (2019). Mathematics and ICT Tools for Functional Entrepreneurship Education. *Proceeding of 56th Annual National Conference of Mathematics Association of Nigeria*, 640–643.

Federal Republic of Nigeria (2014). *National Policy in Education* (4th ed.). Yaba, Lagos: NERDC Press.

Gana, C. (2013). *Effects of Computer Assisted Instruction with Animation on Achievement and Retention in Geometry*. Unpublished Ph.D. Thesis, Department of Science Education, University of Nigeria, Nsukka.

Heller, R. (2012). *Manager's Handbook: Everything You Need to Know about How Business and Management Work.* London: Darling Kingsley Limited.

Kumar, A. & Kumarun, S. (2018). Use of Mathematics Software for Teaching and Learning Mathematics *ICME II proceedings*, 373-388.

Kurumeh, M.S. & Chianson, M.M. (2011) Enhancing the Future of Children in Mathematics Science and Technology for Sustainable Development. *Journal of Science Association of Nigeria*, 46(2), 90–95.

Luecke, R. & Katz, R. (2013). *Managing Creativity and Innovation*. Boston, MA: Harvard Business School Press.

Maranville, S. (2019). Entrepreneurship in the Business Curriculum. *Journal of Education for Business, 68*(1), 27-31.

Odili, G.A. (2006). *Mathematics in Nigeria Secondary Schools: A Teaching Perspective.* Port Harcourt: Rex Charles & Patrick Ltd

Odili, G.A. (2012). Towards a New Paradigm of Teaching Mathematics in Nigerian Universities: The Role of Mathematics Educators. *Online Journal of Science Teachers Association of Nigerian, 47*(1).

Omeodu, M. D. & Charles-Owaba, T. (2019). Utilizing Mobile App Instructional Techniques for a Sustainable Paperless Culture in Nigeria. *Niger Delta Journal of Education*, *12*(2), 300–318.

Omeodu, M. D. & Charles-Owaba, T. (2020). COVID 19 Lockdown and Mathematics Education Using Online Platform: Overcoming the Challenges. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS), 11*(6), 227-229.

Omeodu, M.D. (2020). Gender Parity in Mathematics and Entrepreneurship Education for National Development. *International Journal of Education, Learning and Development*, *7*(12), 1-10.

Onwuaji, C.O. & Abah, A.J. (2018). Mathematics Education for All through Information Technology Innovations. *ABACUS*, *43*(1), 89–100.

Sedega, B. (2017). Effects of Computer Assisted Instruction on Students Achievement in Geometry. *British Journal of Education*, *5*(9), 45-68.

Suleman, Q. (2017). Effects of Computer Assisted Instruction (CAI) on Students Academic Achievement in Physics in Niger State. *Journal of Intelligent Systems, 8*(7), 9-17.