

IMPACT OF COVID-19 PANDEMIC SCHOOL CLOSURE ON EFFECTIVE TEACHING AND LEARNING OF STEM

Okonkwo, I.G.A and Samuel, N.N.C

Science Education Department,³Department of Psychology,

Nnamdi Azikiwe University, Awka

Corresponding author's e-mail: ig.okonwo@unizik.edu.ng

ABSTRACT

The education sector was brutally affected generally but Science Technology Engineering and Mathematics (STEM) education which before the advent of COVID-19 was already bedeviled by enormous challenges whose solution appears illusionary, may be the worst hit. The study investigated the impact of COVID-19 school closure on the teaching and learning of STEM. The survey design was adopted, sample consisted 240 STEM students and 72 STEM teachers randomly selected from 12 secondary schools in Anambra State, Nigeria. Two questionnaires; COVID-19 pandemic School closure Impact on STEM-Education (CSIS-E), (one for teachers and one for students) were used for data collection while mean, frequencies and percentages were used for data analysis. Result showed that the COVID-19 school closure posed a lot of challenges to the already fragile STEM education, some of which include, poor learning delivery, occasioned by unequal access to On-Line education, poor digital literacy and requisite skills, technology devices, poor availability, affordability and connectivity to the internet, lack of training and funding, among others. Consequently, the closure impacted negatively on STEM education in the areas of students getting frustrated and dropping out of the sciences, no practical activities were conducted, achievement gaps were widened, students with special needs could not be effectively attended to, assessment and evaluation for transition was not spared. Based on the findings, some recommendations were made among which is that government and all stakeholders in education should urgently overhaul the existing curricula at all levels, and incorporate remote learning enabled components, semi-blended and self-paced elements without disadvantaging any child.

Keywords: Covid-19 pandemic, effective teaching and learning, STEM, school closure

Introduction

The quality of the products of the school system to a large extent depends on the quality and quantity of classroom interactions between the teacher and the student, thus making the teacher a partner in the business of learning. To effectively discharge this onerous responsibility, the teacher needs to be adequately trained and engage in constant learning to be up to date. Researchers have consistently reported declining quality and standard of Science, Technology, Engineering and Mathematics (STEM) teaching in Nigerian public

secondary schools and consequently, the performance of students in national and international examinations has equally been reported to be consistently unimpressive, despite the relatively huge investments in human and material resources. Greater worry, is the pivotal position and importance of these subjects for admission into allied professions direly needed for scientific and technological development of the nation. Many problems have also been identified as clogs in the wheel of progress of effective STEM education in Nigeria which include but not limited to, inadequate funding, lack of qualified STEM teachers, lack of adequate science laboratories and equipment, as well as lack of political will to implement policies due to corruption. An average science class in Nigeria is a mockery of the ideal science class. These problems could have contributed to the reported poor performance of students. Without fear of contradiction, one can say that STEM education in Nigeria has been on the sick bed before the shocking outbreak of Corona Virus pandemic and the accompanying lockdown and closure of schools. The problems of low enrolment, declining interest and achievement as well as poor attitude in STEM which has already been reported as serious challenges to stakeholders may further be heightened by the COVID-19 pandemic school closure. This worry prompted this investigation.

Corona virus according to Ogunode (2020) is a family of viruses that causes illnesses ranging from common cold to more severe diseases such as severe respiratory syndrome, and these viruses are originally transmitted from animals to humans. The current Corona virus first emerged in Wuhan, China in 2019 and was later coded COVID-19 by the World Health Organization (WHO) which stands for Corona Virus Disease 2019. The symptoms include; sore throat, fever, runny nose, dry cough, sneezing, shortness of breath, and breathing difficulties. In very serious cases, it can lead to pneumonia, multiple organ failures and even death. The incubation period ranges from 1-14 days -the period between infection and the manifestation of symptoms. Ogunode (2020) reported that some people can be asymptomatic, meaning that they do not show any symptoms despite having the virus in their systems. The human-to-human transmission routes are droplet inhalation, direct transmission through coughing and sneezing, as well as contact transmission such as feco – oral, nasal and eye mucous membrane contacts, (Ogolodum, Mbaba, Alazigha, Erundu, Egbe, Golden, Ugwuanyi, Achu & Eke, 2020). The majority of severe cases and deaths were observed among the elderly and people with underlying chronic health conditions like diabetes, hypertension, cancer, and cardiovascular diseases (WHO,2020). Presently, treatment of COVID-19 patients is mainly supportive as there is yet no specific antiviral therapy or curative vaccine formulated, though series of research are ongoing across the world towards finding a clinically curative vaccine. At the meantime, behavioral changes such as avoiding touching of the nose, hence the use of face mask, improved habit and personal hygiene-washing of hands frequently with soap, use of sanitizers and social distancing are used to curtail the spread of the virus.

COVID-19 has no boundaries and spreads very fast. Within few months of its outbreak, millions of people worldwide, were reported to have been killed by the virus, with more

testing positive to it. Countries world over made frantic efforts to halt the spread of the virus and on March 11, 2020, WHO declared the crisis as pandemic. In response to increasing cases of death and infection due to the virus, countries world over, went on lockdown. Consequently, businesses, schools and even religious worship places were shut down. The lifestyle of the entire world automatically changed drastically, forcing billions of people to stay at home, observe self-isolation, work and learn from home. In fact, the out-break affected all aspects of human activities globally; education, sports, entertainment, transportation, worship, social gathering, economy, business, politics and many more.

The Nigerian government responded swiftly to the incident case through the National Centre for Disease Control (NCDC) empowered to test and confirm new cases, trace the contacts of confirmed cases and put them in designated isolation centers across the country. As the number of cases of infection and deaths continued to increase in the country, the Nigerian government on March 19, 2020, joined the growing league of countries in the world that have shut down academic activities due to the virus through the directive from the Federal Ministry of Education (FME), that all educational institutions at all levels be shut down and students should go to their respective homes. According to UNESCO monitoring team, school closure impacted about 98% of the world's student population, while the United Nations (UN) (2020) reported that as at July 2020, 98.6% of world learners were affected by the pandemic, representing 1.725 billion children and youth, from pre-primary to higher education, thus making learning from home, the need of the hour. In justification, it should be noted that school closure is not an entirely new thing in the world system, it could be caused by a pandemic, labor strikes, emergencies, war, disasters or deliberately to reposition a school or curb crime or address some identified gaps in a given institution or environment. This has happened in Nigeria severally and for varied reasons.

School closure for whatever reason has a lot of adverse consequences. UNESCO (2020) reported that it carries very high social, educational and economic costs and the disruptions caused, touch people across communities but their impact is particularly severe for disadvantaged people and their families. Similarly, Pokhrel & Chhetri (2021) opined that the unplanned school closure can cause severe problems for students, educators, parents and the society at large. It could affect negatively, the interest and performance of students academically. Moreover, if students are not engaged productively, idleness and boredom may set in which leads to involvement in crimes, loss of interest and poor performance in academics, dropping out of school, and for the females, it could additionally result in early marriage, sexual abuse, unwanted pregnancies, abortion and even death. Furthermore, school closures can affect the quantity and quality of teaching and learning, resultantly the academic achievement, particularly for students with special needs or those with learning difficulties that require more physical attention and guidance from the teacher (Pokhrel & Chhetri, 2021)

Research works on the effect/impact of COVID-19 school closure on academic programs are presently dearth. In corroboration, Sintema (2020) reported that available data in literature are mostly directly related to medical sciences and practices and therefore advised that the impact of the disease should be incorporated into educational studies for governments, at all levels across the globe, to make adequate provisions for teachers and students because the school closure has enormous implications to the educational sector just as the disease is to the health sector. This study contributed towards filling this gap by investigating the impact of COVID-19 school closure on the effective teaching and learning of STEM.

According to Oluwatoyin (2020) there is a possibility of further drop in the 'pass' rate of senior secondary students in external examinations if the pandemic is to contend with, when he investigated the possible impact of COVID-19 on senior secondary school students' performances in sciences in external examinations. Similarly, Ogunode (2020) investigated the effect of COVID-19 school closure on academic programs of senior secondary schools in Abuja area council using 80 teachers and reported that the closure affected adversely the academic programs and also lead to suspension of teaching and learning. On the contrary, Gonzalez, Rubia, Cosmas-Lopez, Subirat, Fort & Sacha (2020) worked on the influence of COVID-19 confinement on students' performance in higher education in Spain using 458 undergraduates and reported a significant positive effect of COVID-19 confinement on students' performance indicating a change in students' learning performance strategies to a more continuous habit thereby increasing their efficacy. The study equally reported extensive use of learning technologies by the students during the confinement. In another development, Ede, Nwafor, Obafemi, Shuvro Sen, Fyeface, Aabha, &Alhuseen (2020) investigated the impact of COVID-19 on education with 200 respondents comprising teachers, students, parents and policy makers selected from different countries, Nigeria inclusive, reported that COVID-19 has adverse effects on education which includes; learning and teaching disruptions, decreased access to education and research facilities, job losses and increased student debts. Continuing, they reported that many students and educators relied on technology to ensure continued learning but equally noted that the on-line education was hindered by a lot of problems such as poor infrastructure and poor digital skills among others. In another instance, Aina ,Abdurrahman& Opeyemi (2020) acknowledged that the various modes of e-learning require a face to face lecturing especially in the practical activities for greater effectiveness and the researchers wonder if this was possible during the school closure.

There are as many as 263 secondary schools in Anambra state and all were shut down due to the COVID-19 pandemic and to mitigate the effect of the school closure, the state government joined the league of other educators / stakeholders relying on the use of

technology tools and platforms to ensure continued education by introducing ‘Anambra Teaching on Air’ program via the Anambra Broadcasting Service (ABS), radio and television. Initially, the program concentrated on the examination classes; Upper Basic 9 (JSS3) and Senior Secondary3 (SS3), but later on, other classes in both primary and secondary schools were equally accommodated. Unarguably, educational technology platforms could be integral to student–teacher connection and communication especially in moments of isolation. However, the transition may pose serious challenges to both teachers and students, and also affect the effectiveness of the teaching and learning process. It is important to note that before this period of pandemic that students are not allowed to come to school with any electronic gadget-phones, laptops or tablets as this could earn them suspension or even expulsion and this is corroborated by Eze, Sefotho, Onyishi&Ezeadi, (2021). Now it is necessary for these technological gadgets to be used by the students in furtherance of their academics, how are these students going to cope? In addition to digital divide, location among others may be of consequence, as those in the rural areas, the less privileged, and students with special needs may not have the needed expertise and facilities to join in the remote learning. STEM education is inclusive, and these subjects (biology, chemistry, physics, computer studies, home economics, food and nutrition, basic science and technology) are taught in both rural and urban locations, and to students both privileged and marginalized. What happened to STEM education during the school closure? Where and how was the practical aspects of these subjects which strengthen the understanding of the concepts taught in the courses done? The researchers therefore investigated the impact of the unplanned COVID-19 pandemic school closure on the effective teaching and learning of STEM.

Statement of the Problem

The outbreak of Corona virus known as COVID-19 pandemic and the unplanned lockdown and school closure devastated all sectors of the global economy. The educational system of the world was halted because of social distancing and lockdown. Conventional teaching and learning suffered a severe setback with obvious far-reaching consequences because the effects of measures adopted to slow down the rate of spread of the virus were very severe on the education system. Parents, not only struggled to provide for the home, but also to perform supervisory tasks of ensuring that their children learn at/from home while some students whose parents are illiterates and so could not guide, lacked any form of supervision, while there are others whose parents were simply too busy working from home.

Governments, world over, closed down educational institutions proactively without warning, the whole approach to education through face-to-face classroom teaching became unavailable with little or nothing planned to replace it. Most governments, and other stakeholders in education switched over to the use of learning technologies, for distance and e-learning platforms and on a sad note, (Tadesse &Muluye ,2020) reported that the

approach has a devastating effect which is more severe in most African countries, Nigeria inclusive, due to wide disparity in provisions for the 'elite' and the less privileged people mostly in the rural areas.

Disruptions to instructional time in the classroom may have severe impact on a child's ability to learn and the longer marginalized children are out of school, the less likely they are to return when schools reopen (Basilaia&Kvavadze, 2020). The Anambra State government like others, equally switched over to the use of technology in learning through her Anambra Teaching on Air. Most teachers as well as the students may have been inadequately prepared and equipped for this paradigm shift considering that the closure was unplanned being an emergency response to a life- threatening situation. This becomes very worrisome in a situation where, as noted earlier, students are prohibited from coming to school with any electronic gadget, phones, laptops, and tablets, inclusive, before the pandemic school closure. How did the teachers and students cope with this situation and how effective was their teaching and learning of STEM during the COVID-19 pandemic school closure? Science subjects cannot be effectively taught without practical sessions in the laboratory. How was practical done during the teaching on Air in Anambra state? Was the COVID-19 school closure a blunt instrument applied to the already fragile STEM education? This study answered these questions by investigating the impact of COVID-19 pandemic school closure on effective teaching and learning of STEM in Anambra state, Nigeria.

Purpose of the Study

The main purpose of this study was to determine the impact of COVID-19 pandemic school closure on the effective teaching and learning of STEM, the study also investigated the challenges (if any) that hindered continued education through the use of technology platforms during the pandemic in Anambra state, Nigeria.

Research Questions

The following research questions guided the study.

1. How has the COVID-19 pandemic school closure affected the teaching of STEM?
2. How did the COVID-19 pandemic school closure affect the students learning of STEM?
3. How often did teachers use learning technologies in teaching during the pandemic school closure?
4. Which learning technologies were used by teachers in teaching and students in learning STEM during the school closure
5. How often were practical activities carried out during the pandemic?

Method

The study adopted a descriptive survey design. The population was all the 738 STEM teachers and 24,098 students in the 263 public secondary schools in the six education zones in Anambra state. A multistage sampling procedure was adopted. The schools were first classified into urban and rural in each of the zones and subsequently, 2 urban and 2 rural schools were randomly selected from each zone, giving a total of 24 schools and all the STEM teachers in the sampled schools, totaling, 72 (50 urban, 22 rural) participated in the study. 20 STEM students were randomly selected from each of the sampled school and that gave a total of 480 students. Data was collected using two sets of questionnaires, COVID-19 pandemic School closure Impact on STEM-education (CSIS-E) (one for the students and the other for the teachers) designed by the researchers and validated by two experts, one from science education and the other from educational foundations both in Nnamdi Azikiwe university, Awka. Reliability coefficient was established at 0.83. Data was analyzed using arithmetic mean, frequencies, standard deviation and percentages.

Result

Research question 1. How has the COVID-19 pandemic school closure affected the teaching of STEM?

Table 1: Mean rating and Standard Deviation of students' response on how COVID-19 school closure has affected their learning in STEM as measured by CSIS-E

S/N	ITEM	N	MEAN	STD DEVIATION	REMARKS
CHALLENGES					
1	Lessons were disrupted	240	3.30	1.190	Agreed
2	I could no longer interact with my fellow students	240	3.21	.721	Agreed
3	I could no longer interact with my teachers	240	2.91	1.284	Agreed
4	Learning at home was easy because I could get help from my parents	240	1.74	1.194	Disagreed
5	Learning at home was difficult due to poor learning environment	240	2.9	.610	Agreed
6	I had no access to learning materials	240	3.23	.792	Agreed
7	I did not study much during the lockdown	240	2.62	1.044	Agreed
8	I sincerely considered dropping	240	2.77	.783	Agreed

	out of school to face other spheres of life					
9	I joined most of the lessons on TV & Radio	240	2.24	.780		Disagreed
10	I missed the TV & Radio lessons due to no electricity supply	240	3.60	.832		Agreed
11	I missed the lessons because we do not have a TV set	240	2.16	.602		Disagreed
12	I missed the lessons because they were boring	240	1.90	.661		Disagreed
13	I missed the lessons because I was always engaged in house chores and errands	240	2.13	.513		Disagreed
14	I engaged in on line learning.	240	1.20	.459		Disagreed
15	I do not have access to technology for on line learning.	240	3.10	.788		Agreed
16	I am not digitally literate enough for on line learning	240	2.51	.818		Agreed
17	I did not do any practical activity during the school closure	240	2.68	.858		Agreed
18	All the TV & Radio lessons were theoretical only	240	3.55	.625		Agreed
19	I want to drop the sciences because I can no longer cope	240	3.52	.868		Agreed
20	My parents cannot afford internet connectivity	240	3.48	.867		Agreed
	IMPACTS					
21	I have forgotten most of what I have learnt	240	3.50	.771		Agreed
22	It reduced my practical skills	240	3.47	.811		Agreed
23	Has affected assessments, tests, and promotions	240	3.72	.768		Agreed
24	Leads to poor academic achievement	240	2.89	.615		Agreed
25	Limits social ties between teachers, learners and friends	240	3.75	.966		Agreed
26	Increased dropout rate and low	240	2.93	.806		Agreed

	enrolment in stem subjects					
27	Led to forced marriages amongst the females especially and some cases of unwanted pregnancies	240	2.59	.774		Agreed
28	Led to loss of interest in the sciences	240	2.81	.849		Agreed

Table 1. shows the responses of mean rating and standard deviation of students' response on how COVID-19 school closure has affected their learning in STEM. The standard deviation of the items indicating the challenges posed by the school closure were all clustered around the mean, showing that the students had same challenges irrespective of the location, parental background or status. All were faced with poor learning environment, no access to learning materials, lessons were disrupted due to poor internet facilities, poor learning materials, inability to join the lesson due to lack of electricity supply, none availability of TV and Radio sets at home, lack of internet facility and connectivity. The standard deviation was tightly clustered around the mean ranging from 1.284 to .513. The item which had standard deviation less than .50 was only item 14 (.459) indicating that the students had no prior knowledge of online learning before the Covid -19 school closure. Students' response to Items 11,12,13 showed the students were eager to learn through medium introduced irrespective of the challenges of not having a TV set, house chores, lack of hands-on exercise but for the lack of electricity. Hence the section of table 1 indicating the impact (items 21-28) as seen with standard deviations clustered around the mean also indicate that the impact is common to all subjects involved.

Research question 2. How did the COVID-19 pandemic school closure affect the students learning of STEM?

Table 2: Mean rating and Standard Deviation of Teachers' responses on how they carried out their responsibilities during COVID-19 pandemic school closure for the effective teaching of STEM as measured by CSIS-E

	ITEM (CHALLENGES)	N	MEAN	SD	REMARKS
1	Support students learning in STEM generally.	72	1.93	.845	Disagreed
2	Use teaching aids/materials to facilitate learning	72	2.0	.948	Disagreed
3	Use a variety of activity- oriented teaching strategies	72	6	1.069	Disagreed
4	Teaching the students according to learning styles	72	2.11	1.06	Disagreed
5	Bring science lessons to life with real world applications	72	2.39	.995	Disagreed

6	Adjust science lesson plans based on students' assessment/evaluation activities	72	2.35	.995	Disagreed
7	Engage in professional improvement opportunities/programs	72	2.31	1.043	Disagreed
8	Carry out practical activities	72	2.14	.997	Disagreed
9	Cater for students with different needs, abilities and sensitivities	72	1.99	1.103.	Disagreed
10	Provide guidance to students with special needs.	72	2.28	1.047	Disagreed
11	Supervise students learning.	72	1.88	1.103	Disagreed
12	Interact with students.	72	1.83	1.047	Disagreed
13	Asses/make judgements about students learning	72	2.35	1.138	Disagreed
14	Gather evidence of learning – evaluation	72	2.40	1.140	Disagreed
	Could not use learning technologies in teaching due to;				
15	Poor digital literacy	72	2.92	.931	Agreed
16	Lack of access to technology/devices	72	3.08	.946	Agreed
17	Non availability/poor electricity supply	72	2.76	.911	Agreed
18	Non-availability of connectivity (no internet connection)	72	2.93	.791	Agreed
19	Lack of training on the use of learning technologies	72	2.85	.899	Agreed
20	Lack of financial and material support for teaching from government	72	3.06	.948	Agreed
	IMPACTS				
1	Increased dropout rate in the sciences and enrollment in STEM	72	3.63	.817	Agreed
2	Poor academic achievement/mass failure in STEM	72	2.94	.737	Agreed
3	Lack of evaluation and assessment for transition indices	72	3.52	.584	Agreed
4	STEM students are losing interest in the sciences	72	3.09	.917	Agreed

5	STEM students are forgetting what they learnt earlier	72	2.95	.898	Agreed
6	Leads to widening of inequality gap in Education	72	2.45	.832	Agreed
7	Difficulty in assessing students	72	3.77	.619	Agreed
8	Led to irrational life choices amongst STEM students (early marriages, unwanted pregnancies, bad company and so on)	72	2.8	.792	Agreed

Table 2 above shows that the teachers were not able to effectively carry out their responsibilities during the school closure as indicated by their responses to items 1-14 with all having mean scores below the average mean score of 2.50. Items 6-20 had mean responses above the average mean and therefore are accepted as serious challenges faced by the teachers during the period. Furthermore, the 8 items on impact were also accepted as they all had mean scores above the average mean of 2.50

Research question 3. How often did teachers use learning technologies in teaching during the pandemic school closure?

Table 3: Frequency of use of Technology in Teaching during the Pandemic.

	Never did lesson)	occasionally few lessons	Often (most lessons)	Very Often (every lesson)
N	65	7	-	-
%	90.3	9.7	-	-

Table 3. shows that 90.3% (N=65) of the teachers did not use any learning technology at all during the period implying they did not teach at all considering the school closure while only 9.7% (N=7) indicated they used technology to teach during the period.

Research question 4. Which learning technologies were used by teachers in teaching and students in learning STEM during the school closure?

Table 4: Type of Technology used in Teaching during the Pandemic.

	Zoom	E-mail	Google apps	WhatsApp	Television	Edi-Modo	Radio	Others (Specify)	None
N	-	-	-	4	3	-	-		65
%	-	-	-	5.6	4.2	-	-		90.3

Table 4 shows that 90.3% (N=65) did not use any technology at all, 5.6% (N=4) used WhatsApp, while 4.2% (N=3) used Television. Zoom, radio, google apps, e-mail, edi modo or any other teaching technology was not used by any of the teachers.

Research question 5.How often were practical activities carried out during the pandemic?

Table 5: Number of Times Practical Exercises were conducted during the Pandemic.

	Never	Occasionally	Always-Very Often
N	72	-	-
%	100	-	-

Table 5. shows above that none of the teachers conducted any practical exercise during the period

Findings/Discussion

The covid-19 pandemic school closure posed a lot of challenges to effective STEM education such as total school closure/loss of academic session, poor learning/unequal access to education opportunities, poor/non availability/affordability/connectivity, poor digital literacy, lack of learning technology materials/devices and poor learning environment due to difficulties associated with home schooling. These findings are in agreement with the findings of Eze et al (2021), Pokhrel & Chhetri, (2021), Basilaia et al, (2020), Edeh et al (2020), Tadesse &Muluye, (2020) , but at variance with Gonzalez et al (2020) who reported a significant positive effect of covid-19 confinement on students’ performance indicating a change in students’ learning strategies to a more continuous habit which resulted in their improved efficiency. However, the authors noted that the students and teachers were well exposed and skilled with relevant materials prior to the outbreak of the pandemic. This finding confirms Tadesse &Muluye (2020) report that on-line teaching and learning is not a new mode of education for developed and some developing countries, and equally acknowledged that shifting from face-to-face to on-line learning posses lots of challenges to teachers, students and families due to lack of knowledge/skill and resources. In corroboration, Eze, et al (2021) reported that on-line learning in Nigeria presently can not completely stand in for the regular school contacts for obvious reasons, and consequently, the On-line/TV/Radio learning medium was poorly utilized by both teachers and learners during the pandemic school closure. About 90% of the STEM teachers in this study reported they did not use any learning technology to teach during the school closure, implying they were not involved in the TV/Radio lessons. It may be that the TV and Radio lessons were handled by a couple of teachers who are not the current subject teachers for particular classes, some of whom may have retired from active service. This may explain why some students did not see the lesson as obligatory and are not satisfied with it. Further inquiries revealed that the TV lessons did not follow the order and sequence in the curriculum and could at best be seen as a stopgap/makeshift arrangement. This is in line with Tadesse&Muluye (2020), Eze, et al (2021) reports that the duration of the lesson broadcast was short, teaching units broadcast were not detailed and in asynchrony with the classes attended by the students in school.

The identified poor and unequal access to education can be attributed to the fact that students from disadvantaged backgrounds (rural areas, poor socio-economic status) could neither afford the necessary technology materials nor access remote education due to digital illiteracy and poverty, some were even forced to help their poor families in cattle rearing, hawking, farming and many more, the females were exposed to a high risk of sexual abuse, unwanted pregnancy, early marriage and forced labor; the males equally had their fair share of exposure to bad companies while their counterparts from rich homes had better access and skill to technology and so, are advantaged though equally exposed to potentially harmful and violent contents, and consequently the former spend less time learning, are more stressed, anxious and prone to depression disorders due to lack of motivation. All these impacted negatively on STEM education; some of the students dropped out of the science classes while some dropped out of school entirely

Home schooling was also identified as a major challenge, because its effectiveness depends to a large extent on the parents' educational level, socioeconomic factors as well as attitude towards education generally and therefore, the conducive nature of the home environment is not uniform for all the learners. Many of the students reported unhealthy home learning environment. Many of them had to join their parents in farm work, trading and even hawking all in an attempt to cushion the harsh economic conditions resulting from the coping measures adopted. STEM students with special needs that require additional support and guidance were adversely affected as many parents and caregivers at home are not able to adequately and professionally cater for such needs, thereby hindering the learning of this group of students. Domestic violence and child abuse are serious disadvantage of home schooling because the perpetrators are oftentimes, at home or in the neighborhood and this constitutes mental distraction as well as threats to students

Authentic assessment and evaluation of the students and timely feedback are essential components of learning. This was found to be challenging to the STEM teachers in this study due to lack of digital literacy, on-line teaching infrastructure, professional development non participative nature of the students

Results of this study also show that no practical activities were done by both students and teachers and this is detrimental to effective STEM education. The Television lessons were purely theoretical and adjudged as boring, shallow and vague by some of the participants. However, Tadesse&Muluye (2020) noted that some courses /subjects/units are difficult or almost impossible to teach via on-line and science laboratory exercises fall within this category.

Implications

The COVID-19 pandemic impacted adversely on the fragile STEM education in a variety of ways some of which include the following.

1. The school closure resulted in some of the students dropping out of the science subjects, some dropping out of school entirely due to teenage pregnancy, business and other distractions.
2. Loss of interest in STEM subjects, widened achievement gaps and inequality in access to education
3. Students with learning disabilities or from low socioeconomic backgrounds, and those in rural areas experience unequal challenges to their learning compared to their counterparts without disabilities, from high socioeconomic backgrounds and urban areas.
4. Poor academic achievement; findings show that the protracted school closure will result in students achieving less in external and internal examinations, because many of them forgot and lost what they have learnt before the school closure due to a long stay at home, according to Oboh, Ighiwiyisi and Oboh (2020), Ubulom, Kayii and Dambo (2016), e-learning in secondary schools in Nigeria have been rated as a very poor method of teaching and so it is likely that most students may not make effective use of it.
5. Practical activities which is the backbone of STEM education was not done at all during the period under review by 100% of the teachers who participated in the study. This led to loss of the already acquired science process skills due to lack of practice. Most of the students reported to have forgotten some of what they have learnt before the closure.
6. Evaluation, assessment and transition from one grade to another also suffered greatly.

Recommendations.

From the findings, the researchers are of the view that as a matter of urgency, government should develop infrastructure for 21st century education. The experience of covid-19 pandemic should be seen as a wake-up call that exposed the many inadequacies and inequalities in our education system, ranging from access to the broadband and computers needed for on-line education, training for acquisition of digital literacy, supportive environments needed to focus on learning, up to misalignment between resources and needs, and the need to stimulate technology assisted learning across the education sector. The following are therefore recommended;

- 1) Government should communicate with internet providers for reasonable pricing of their services to students and institutions.
- 2) Taxes and dues on technology and media equipment and devices including private radios, TV channels, Mobile services, and all learning technology materials should be lifted/reduced.
- 3) Government should draw up, publish, and consult widely on crisis management plans to ensure the continuity of education in any future crisis.
- 4) The training of teachers, and students in the use of technology and in conducting lessons on-line should be given a priority attention and this should be incorporated in the teacher training curriculum.

- 5) Government to review the policy of banning the use of phones and other electronic gadgets by secondary students. In connection with this there is need for government to embark on a robust sensitization of parents and students to raise awareness of the benefits of distance and technology assisted learning.
- 6) Government and stakeholders in education should review and redesign the curriculum to suit on-line learning by incorporating remote learning enabled components into it, taking semi-blended, self-paced elements into all learning, without disadvantaging any child. The need for this total transformation of the education system cannot be over emphasized as the end of the pandemic is not in sight
- 7) In addition to training, teachers should be mandated to be ICT compliant within a time frame, they should be assisted to acquire quality laptops, PCs, Tablets.
- 8) Government should equip all educational institutions with appropriate technologies for remote learning, train existing staff on how to use technology to teach and make digital literacy as a compulsory/ additional requisite qualification needed to be possessed before being hired to teach at all levels of the education system

References

- Aina Jacob Kola & Abdurrahman AbdulgaforOpeyemi (2020). Mitigating the Impact of COVID-19 on the Teaching and Learning of Science in Nigerian Higher Education. *International Journal of Research and Innovation in Social Sciences (IJRTSS)* 4,(4) 334-337
- Aljazeera (2020) Corona Virus All You Need to Know About Symptoms and Risks.[https://www.aljazeera.com/news/2020/01/coronavirus-symptoms-vaccines-](https://www.aljazeera.com/news/2020/01/coronavirus-symptoms-vaccines)
- Basilsis, G &Kvavadze D (2020) Transition to On-Line Education in Schools During a SAR-COV-2 Coronavirus (COVID-19) Pandemic in Georgia. *Pedagogical Research*; 5(4), 10. <https://doi.org/10.29333/pr/7937>
- Duraku, Z H & Hoxha, L. (2020). The Impact of COVID-19 on Education and on the Wellbeing of Teachers, Parents and Students; Challenges related to Remote (On-line) learning and opportunities for advancing the quality of education
- Edeh M O, Nwafor C E, Obafemi F A, Shuvro Sen, Fyneface G A, Aabha Sharma, &Alhuseen Omar Alsayed (2020).Impact of COVID-19 on Education. *Journal of Education and Practice* Vol. 11, No. 13. 108-121. ISSN 2222-288x (online)
- EdTech^{Hub}, e-learning for Africa (2020). The effect of COVID-19 on Education in Africa and its Implications for the use of Technology: A Survey of the Experience and Opinion of Educators and Technology Specialists. DOI:10.5281/zenodo.4018774
- Eze, U.N., Sefotho,M.M., OnyishiC.N. &Eseadi, C. (2021) Impact of COVID-19 pandemic on Education in Nigeria: Implications for Policy and Practice of e-learning. *Library Philosophy and Practice (e-journal)* .5651 [hppts://digitalcommons.unl.edu/libphilprac/5651](https://digitalcommons.unl.edu/libphilprac/5651)

- Gonzalez T, de la Rubia M, A, Hinez K P, Cosmos-Lopez M, Subirat L, Fort S & Sacha G M.(2020). Influence of COVID-19 Confinement on Students' Performance in Higher Education in Spain. <https://doi.org/10.1371/journal.pone.0239490>
- Luis Espno-Diaz, Gemma Fernandez-Casinerio, Carma-Mama Hernandez-Lloret, Hugo Gonzalez-Gonzalez & Jose-Luis Alverez-Castilo (2020). Analyzing the Impact of COVID-19 on Education Professionals. Towards a Paradigm Shift: ICT and Neuroeducation as a Binomial of Action. *Sustainability*. 2020,
- Oboh, S.O., Ighiwiyisi, B.O. & Oboh, O.J. (2020) Investigating the availability and use of I.C.T. among secondary school students' learning during the COVID-19 pandemic outbreak in Benin City, Edo State, Nigeria. *Journal of Education and Practice*, 16, 80-87.
- OECD (2020) Flattening the COVID-19 Peak: Containment and Mitigation Policies. https://read.oecd-ilibrary.org/view/?ref=124_124999- Retrieved on 14th August 2021
- Ogolodom M P, Mbaba A N, Alazigha N, Erondu O F, Egbe N O, Golden I, Ugwanyi D C, Achi G I & Eke C M (2020) Knowledge, Attitudes and Fears of Healthcare Workers Towards the Corona Virus Disease (COVID-19) Pandemic in South South Nigeria. *Health Science Journal ISSN 1791-809x*
- OgunodeNiyi Jacob (2020) Effect of COVID-19 Schools Closedown on Academic Program of Senior Secondary School in Abuja Area Council of Federal Capital Territory Abuja, Nigeria. *Electronic Research Journal of Social Sciences and Humanities. Issue 2706-8242 www.eresearchjournal.com 2 (11) 84-94*
- Olaitan Anifewoshe, Abdullahi T Aborode, TolorunjuIfeoluwa Ayodele, Akinjo Rebecca Iritiayo&Ogunjemilua Oluwafemi David (2020). Impact of COVIN-19 on Education in Sub-Saharan Africa [doi:10,20944|preprints202007.0027.v1](https://doi.org/10.20944/preprints202007.0027.v1)
- Oluwatoyin Mary Oyinloye (2020). Possible Impact of COVID-19 on Senior Secondary School Students; Performance in Science Education in Nigeria. *Journal of Pedagogical Sociology and Psychology*. .2(2), 80-86.
- Pokhrel S& Chhetri R (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*8(1) 133–141, 2021© 2021 The Kerala StateHigher Education Council
- Ruth Chadwick & Eilish McLoughlin (2020) Impact of COVID-19 Crisis on Science Teaching and Facilitation of Practical Activities in Irish Schools
- Sintema, E, J. (2020) Effect of COVID-19 on the Performance of Grade 12 students; Implications for STEM Education. *EURASIA Journal of Mathematics, Science and Technology Education*. 16(7) em 1851. <https://doi.org/10.29333/ejmstel/7893>
- Sumitra Pokhrel & Roshan Chhetri (2021) A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the future-SAGE journals*. <https://doi.org/10.1177/2347631120983481>. 8(1), 133-141

- Tadesse, S & Muluye, W. (2020) The impact of COVID-19 Pandemic on Education System in Developing Countries: A Review. *Open Journal of Social Sciences* 8, 159-170. <https://doi.org/10.4236/jss.2020.810011>
- Ubulun, W. J., Kayii, N. & Dambo, B. I. (2016) ICT and Business Studies Students' Academic performance in Upper basic education in Tai Local Government, Rivers State, Nigeria. *International Journal of Innovative Social and Science Education Research*, 4, 1-7
- UNESCO (2020) Covid-19 Recovery. Education: from school closure to recovery <https://www.unesco.org/en/covid-19/education-response>
- United Nations (2020). Policy Brief During COVID-19 and Beyond. *United Nations*. <https://www.un.org/development/desa/dspd/wp->
- Wikipedia.org (2020) Impact of the 2019-20 Corona virus Pandemic on Education. https://en.wikipedia.org/wiki/impact_of_the_2019%E2%80%9320_coronavirus_pandemic_on_education
- World Health Organization (WHO) (2020). Situation Reports: Coronavirus disease (COVID-19) Weekly Epidemiological Updates and Monthly Operational Updates. Retrieved 23/3/2021. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>