Prevalence of COVID-19 in Nigeria: Doorway for Digital Learning of Mathematics amid Senior Secondary Science and Mathematics Students

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Abstract

Pedagogical discourse through digital learning is fast becoming a norm most especially during the period of the COVID-19 pandemic. This study answered the question of whether the prevalence of COVID-19 in Nigeria would provide a doorway for digital learning among senior secondary science and mathematics students. Through a descriptive survey research design, data were collected using Google forms from 150 science and mathematics students from three senior secondary schools in Education District II of Lagos State, Nigeria. The collected data were analysed using Cluster analysis. Results showed that science and mathematics students' scores for deploying web 2.0 for digital learning in mathematics in cluster 2 were greater than both clusters 1 and 3. The implication of this is that respondents in clusters with low scores are more probable to show low proficiency levels in the use of web 2.0 technologies and their adoption in connection with digital learning of mathematics during the COVID-19 pandemic. Nevertheless, results indicated that digital learning could serve as a progressive weapon not only to manage home quarantine for students but also to cope with the COVID-19 pandemic in the country as a large proportion of the students deployed smartphones in learning mathematics digitally. In conclusion, stakeholders in the education industry in Nigeria, particularly the policymakers, should make digital learning an enduring characteristic of the school portfolio even after the demise of the COVID-19 pandemic. It is recommended that teachers should be trained on the use of digital learning platforms for online teaching and the Government at all levels should provide infrastructures that support digital learning and make the costs of internet connectivity affordable for all citizens.

Keywords: COVID-19, digital learning, science and mathematics students, senior secondary, Nigeria

Introduction

No doubt that the emergence of Coronavirus in December 2019 in Wuhan, People Republic of China, which causes COVID-19 diseases has spread to every part of the world. The world is currently under the siege of the COVID-19 pandemic with the attendant high rate of death amounting to 585, 727 and about 13, 616, 593 infected with the coronavirus as of 17th July 2020. In Nigeria, the first index case of Coronavirus was recorded on 27th February 2020 and since then the spread of the COVID-19 pandemic has been in geometrical progression (Awofala, Lawal, Isiakpere, Arigbabu & Fatade, 2020). To date 2nd March 2021, Nigeria had recorded 156,496 cases of coronavirus infection with over 1,923 deaths recorded and 135,136 recovered from the disease. In responding to the COVID-19 universal contagion, the government of Nigeria through the minister of education proclaimed the total closure of all schools, colleges and universities throughout the country from March, 23rd, 2020. This action was to forestall the spread of the contagion, which hitherto had claimed lives in many developed countries such as Italy, the United Kingdom and the United States of America to mention but a few. The global lockdown as a result of the pandemic has promoted a paradigm shift in learning globally with most educational institutions worldwide drifting away from the traditional face-to-face classrooms to digital learning, which promotes learning everywhere and anywhere. Because of the lockdown and the enforcement of social distancing by many nations of the world as measures to contain the spread of COVID-19 most students are now learning remotely from home as educational institutions are closed for face-to-face learning. This situation has made digital learning inevitable in most nations of the world and Nigeria is not an exception in ensuring that the closure of schools at all levels of the educational system does not prevent students from learning. In 2020, 4 months of face-to-face learning time had been lost to the COVID-19 pandemic in Nigeria with no definite time to reopen the schools soon. Digital learning will remain a problem in Nigeria because there is no adequate

infrastructure to enable remote learning. Factors that could hinder digital learning in the country include the high cost of data, epileptic electricity, high cost of a smartphone, high cost of the laptop, and high cost of running a generator in case of power failure. Despite these curable problems, the Nigerian government to make the students learn while they remain at home launched free e-learning portals for primary and secondary school students (Schoolgate and the Mobileclassroom.com.ng.App). Presently, most public universities in Nigeria are not engaged in digital learning because they are on strike since February 2020 to press home their demand for the cancellation of the Integrated Payroll and Personnel Information System (IPPIS) used for the payment of their salaries. To them using IPPIS to pay their salaries is a breach of university autonomy. However, the Academic Staff Union of the Universities (ASUU) has since suspended its strike on 24 December 2020 but public universities in Nigeria are currently engaging their students in online teaching and learning due to the ravaging effect of the pandemic. Schools have resumed but with staggered classes to mitigate the effect of the pandemic.

At the senior secondary school level in Nigeria, there are four fields of study viz: Science and Mathematics field; Humanities field; Business Studies field and Technology field (National Policy on Education, 2013). The science and mathematics field was chosen for this study because of Nigeria policy of producing scholars in science and mathematics, which are germane to the technological development of the nation. Corroborating this the National Policy on Education stipulates that not less than 60% of places shall be allocated to science and science-related courses in the conventional universities and not less than 80% in the universities of technology and agriculture. This shows the importance of science and mathematics to nation-building.

The untimely shutdown of all educational institutions in Nigeria was an unswerving and speedy reaction by the Federal Government of Nigeria to maintain pre-emptive actions to shield all students from probable dangers of being infected with COVID-19 since schools' milieus are spaces where the coronavirus could easily spread. Consequently, students were forced to remain at home with their parents. Despite this ill-fated condition, every educational stakeholder in the country expects students to continue their learning with the deployment of web 2.0 technologies. Despite the high cost of computers, smartphones, tablets and laptops in Nigeria, stakeholders in the education sector are very anxious to see pedagogical discourse happening outside the four walls of the schools during this period of the COVID-19 pandemic. This is because digital technologies are influencing every area of life including the education sector, which is currently experiencing a paradigm shift. In line with the restraints enacted by the federal government of Nigeria because of the COVID-19 pandemic, all public schools in Lagos State have diverted to digital or online teaching and learning speedily. Apart from the use of radio and television broadcast for teaching and- learning in public schools in Lagos State, the ministry of education had begun Online Communication with her schools and teachers via WhatsApp, Telegram and Zoom. Virtual teaching and learning through digital technologies are gradually becoming the order of the day in Lagos State where the effect of COVID-19 is seriously alarming. Afterwards, teachers were entreated to expedite action on learning sustenance materials for easy facilitation of pedagogical discourse through the digital learning platforms. Correspondingly, students were persuaded to hook on to the radio and television broadcast daily, register and be connected to the digital learning platforms to prevent them from missing learning. The COVID-19 pandemic in Lagos has forced schoolteachers to learn to deploy digital technologies in their teaching and conveying of content to their virtual learners. Thus, COVID-19 is gradually becoming a promoter of digital technologies, social media platforms, online learning activities and virtual resources.

The extant literature shows that no innovation can take place in the education milieus without the full support of the teachers who are the drivers of the innovation. Presently, eyes are on the teachers to catch the affordances created by digital technologies to close learning holes among students (Perienen, 2020). The process of driving innovation in the education sector during this period of the COVID-19 pandemic requires certain measures as postulated by Burke (2020). The first is to maintain a constant conversation with the students, parents, teachers and other stakeholders via phone calls and e-mails. Second, is to maintain admittance to learning materials like Google Apps e.g. Google drive, dropbox, cloud etc. for education, Moodle Cloud, Edmondo and social media implements such as WhatsApp, Twitter, Facebook, Yahoo, Youtube, Instagram etc. The third is to maintain admittance to data through cloud computing for servers and back up in a location other than the school. At present, there is a shortage of research, which investigated the deployment of digital technologies for the learning of mathematics during the period of the COVID-19 pandemic (Mulenga & Marbán, 2020). More so, it is theoretical to know the kind of digital tools that students of mathematics will deploy during this period of the COVID-19 pandemic since they are required to learn remotely in the comfort of their homes. Based on this knowledge gap, this study intends to investigate whether COVID-19 could catalyze the deployment of digital platforms in learning mathematics in Lagos State schools.

In Nigeria as a whole, digital learning is still at the infancy stage in schools because not many school subjects are taught digitally particularly mathematics. Digital learning in advanced countries of the world is not a problem but it is a problem in low-income countries. Differences in online learning are specifically apparent in less developed countries. A larger percentage of students in sub-Saharan Africa do not have household computers while a larger percentage could not access online contents. Although smartphone possession has increased in Nigeria, many students still live in areas, which are not served with mobile networks. Teachers also are stressed with the hasty shift to digital learning, and this even applies to countries with dependable structure and home connectivity. Teachers require training to provide distance and virtual education. Nigeria as a country in sub-Sahara Africa faces the maximum challenges.

However, this study investigated how students engage in mathematics learning activities through digital platforms. It is noted digital learning as an instructional reaction to the COVID-19 pandemic has precipitated some stimulating and thought-provoking questions. First, will the implementation of digital learning as an educational reaction to COVID-19 fuel the growth of digital learning in mathematics in Nigeria? Second, will the deployment of digital learning in Lagos State schools lead other states of the federation to adopt digital learning as a pedagogy for teaching and learning during the period of the COVID-19 pandemic? Third, will the stakeholders in the education sector such as policymakers and governments re-assess digital learning and its role in mathematics education at all levels of learning during and after the COVID-19 pandemic? Nevertheless, the following research questions guided the study:

RQ1. What are the learning devices deployed for learning digitally by science and mathematics students during the period of the COVID-19 pandemic?

RQ2. What is the level of utilization of web 2.0 technologies by science and mathematics students for learning mathematics digitally during the period of the COVID-19 pandemic?

Methods

Research Design

This study employed a quantitative approach within the blueprint of the descriptive survey research design.

Sample and Sampling Technique

The sample for the study consisted of 150 senior secondary school science and mathematics students selected through a convenience sampling method. These were students studying at three public senior secondary schools (ACGS, AMC, & ABGS) in education district II of Lagos State in the 3rd year of their school programmes and were already preparing for an impending external examination during the 2019-2020 academic session that would lead to the award of senior secondary school certificate. Their age ranged from 14 to 21 years with a mean age of 17.2 years and a standard deviation of 1.4 years. 76 were Christians while 74 were Moslems. 69% of the students were aged 14-17 years and about 31% were aged 18-21 years. 35% of the students were from ACGS, about 45% were from AMC and 20% were from ABGS. 65% of the science and mathematics students were males while about 35% were females. This showed that more males than females are in the science and mathematics field in the selected schools for the study and this could be a replica of the distribution of male and female students in the science and mathematics field in the country.

Instrument

One validated scale was used to collect data for the study. The scale, which measured knowledge of the senior secondary school science and mathematics students' use of digital media technology, was adapted from Moll and Nielsen (2017) in which the science-learning milieu was changed to a mathematics-learning milieu. The scale composed of three main sections namely; demographics, social media use in mathematics and social media use in senior secondary school mathematics learning. The internal reliability coefficient of the scale was calculated using Cronbach alpha and a value of 0.87 was computed for the entire scale. On the scale, participants were expected to rate their level of agreement on the usage of social media platforms on a Likert scale. Participants were also expected to react to statements about particular social media activities they engage in for learning mathematics by specifying how habitually (not ever, occasionally and frequently) specific digital learning platforms were used. The latter part of the scale asked 10 open-ended questions which were reserved for another study. Google forms were used to create the scale loaded on WhatsApp social media for online distribution to the target participants. Each participant would

download the Google forms online, respond to them, and make a submission online. The Google forms were used because presently Nigeria is being ravaged by the COVID-19 pandemic and the restriction on school re-opening and maintaining social distancing would not allow physical distribution of the scale to the target audience. Therefore, the delivery of the scale to the participants was not through face-to-face administration rather the scale was distributed virtually.

The questionnaire created using Google forms was loaded on the WhatsApp platforms of the senior secondary school year three (SSS3) students of three schools with the acronyms ACGS, AMC and ABGS for anonymity. One hundred and fifty (150) science and mathematics students completed the questionnaire and submitted it online and this corresponded to the number of senior secondary school year three science and mathematics students in the three schools. Thus, there was a response rate of 100%.

Data Analysis

The K-means cluster analysis in the SPSS version 20.0 was adopted in the analysis of the collected data. Cluster analysis is an investigative analysis that identifies structures within the data set. A major aim of the research was to bring together data into groups to achieve a high intra-cluster similarity, low inter-cluster similarity and casually find regular assemblages amid participants on how they use social media technology in pedagogical mathematics discourse. Consequently, the study attempted to first figure out how many groupings the data will be assembled into and find the configurations in the data, and which participant groupings required distinct thoughtfulness in the deployment of digital learning. Second, the study set to predict the number of participants who had partaken in the virtual mathematics dialogues and mathematics remote schoolrooms throughout the COVID-19 eruption period.

Results

Research Question One:
What are the learning devices deployed for learning digitally by science and mathematics students during the period of the COVID-19 pandemic?

Table 1.
Learning devices deployed in mathematics during the period of the COVID-19 pandemic

Variable	Description	Frequency	Percent (%)
Devices used	Smartphone	125	83.33
	Laptop	10	6.67
	Home PC	5	3.33
	iPad/Tablet	10	6.67

Table 1 showed that 83% of the science and mathematics students had possession of Smartphones and 6.67% each possessed personal laptops and iPad/Tablet respectively. 3.33% of the science and mathematics students had possession of Home PCs. Thus, Home PCs utilization of the science and mathematics students to access mathematics content digitally was very low. This was followed by personal laptops and iPad/Tablet possession. Science and mathematics students used Smartphones to connect digitally to mathematics learning during the period of the COVID-19 pandemic.

Research Question Two: What is the level of utilization of web 2.0 technologies by science and mathematics students for learning mathematics digitally during the period of the COVID-19 pandemic?

Table 2.
Results of the auto-clustering for science & mathematics students by cluster for each test factor

Test Factors	Cluster	N	Mean	Std	Minimum	Maximum
Social networking (e.g., Facebook)	1	82	2.65	.902	1	4
	2	16	2.96	.912	1	4
	3	52	1.54	.612	1	4
	Total	150	2.63	.781	1	4
Communication (e.g., email, text messaging)	1	82	2.94	.667	1	4
	2	16	3.78	.735	1	4
	3	52	1.42	.612	1	4
	Total	150	2.83	.614	1	4
Blogs (e.g., Tumblr)	1	82	1.24	.401	1	4
	2	16	1.87	.412	1	2
	3	52	1.27	.354	1	4
	Total	150	1.53	.412	1	3
Microblogging (e.g., Twitter)	1	82	1.02	.292	1	2
	2	16	2.76	.502	1	4
	3	52	1.31	.336	1	3
	Total	150	1.42	.423	1	3
Doc. managt &editing tools (e.g. Dropbox)	1	82	2.74	.714	1	3
	2	16	2.99	.403	2	3
	3	52	2.05	.622	1	4
	Total	150	2.08	.702	1	4
Social bookmarking (e.g., Delicious)	1	82	1.19	.234	1	2
	2	16	2.74	.708	1	3
	3	52	1.05	.309	1	3
	Total	150	1.88	.513	1	3
Social news (e.g., Reddit)	1	82	1.52	.514	1	3
	2	16	2.88	.812	1	4
	3	52	1.73	.512	1	3
	Total	150	1.98	.604	1	3
Wikis (e.g., Wikipedia, Wikispaces)	1	82	2.59	.800	1	4
	2	16	2.75	.237	1	3
	3	52	1.05	.492	1	3
	Total	150	2.47	.544	1	3
Video sharing (e.g., YouTube)	1	82	2.96	.690	1	4
	2	16	2.88	.902	1	4
	3	52	1.45	.589	1	4
	Total	150	2.17	.642	1	4
Live casting (e.g., Skype, Lifesize)	1	82	1.36	.237	1	2
	2	16	3.15	.788	1	4
	3	52	1.22	.211	1	2
	Total	150	2.02	.402	1	4
Photography sharing (e.g., Flickr)	1	82	1.56	.223	1	3
	2	16	2.68	.335	2	3
	3	52	1.03	.623	1	4
	Total	150	1.75	.412	1	4
Discussion forums (e.g., Yahoo answers)	1	82	1.82	.684	1	4
	2	16	2.99	.735	2	3
	3	52	1.67	.640	1	3
	Total	150	1.92	.701	1	3
Learning Management System (SMP)	1	82	1.62	.283	1	2
	2	16	1.98	.743	1	2
	3	52	1.14	.203	1	3
	Total	150	1.36	.483	1	2

Table 2 displays the minimum and maximum scores for each web 2.0 tool deployed by each cluster. Multiple iterations were carried out that led to the formation of three clusters for the study. Cluster 1 had 82 cases; cluster 2 had 16 cases while cluster 3 had 52 cases correspondingly. The minimum and maximum social networking (e.g., Facebook) score were 1 for (Cluster 1, 2 and 3) and 4 for (Cluster 1, 2 and 3) respectively. The minimum and maximum communication (e.g.., MSN chat, email, text messaging) score was 1 for (Cluster 1, 2 and 3) and 4 for (Cluster 1, 2 and 3) respectively. The minimum live casting (e.g., Skype, Lifesize) score was 1 for (Cluster 1, 2 and 3) while the maximum live casting (e.g., Skype, Lifesize) score was 2 for (Cluster 1 and 3) and 4 for (Cluster 2). In general, the minimum and maximum scores across the clusters for all the test factors were 1 and 4 correspondingly. Based on the mean scores, table 2 showed that the level of web 2.0 adeptness for senior secondary school science and mathematics students in cluster 2 was the highest. Students in cluster 1 followed this while students in cluster 3 recorded the lowest web 2.0 proficiency for digital learning of mathematics during the COVID-19 pandemic.

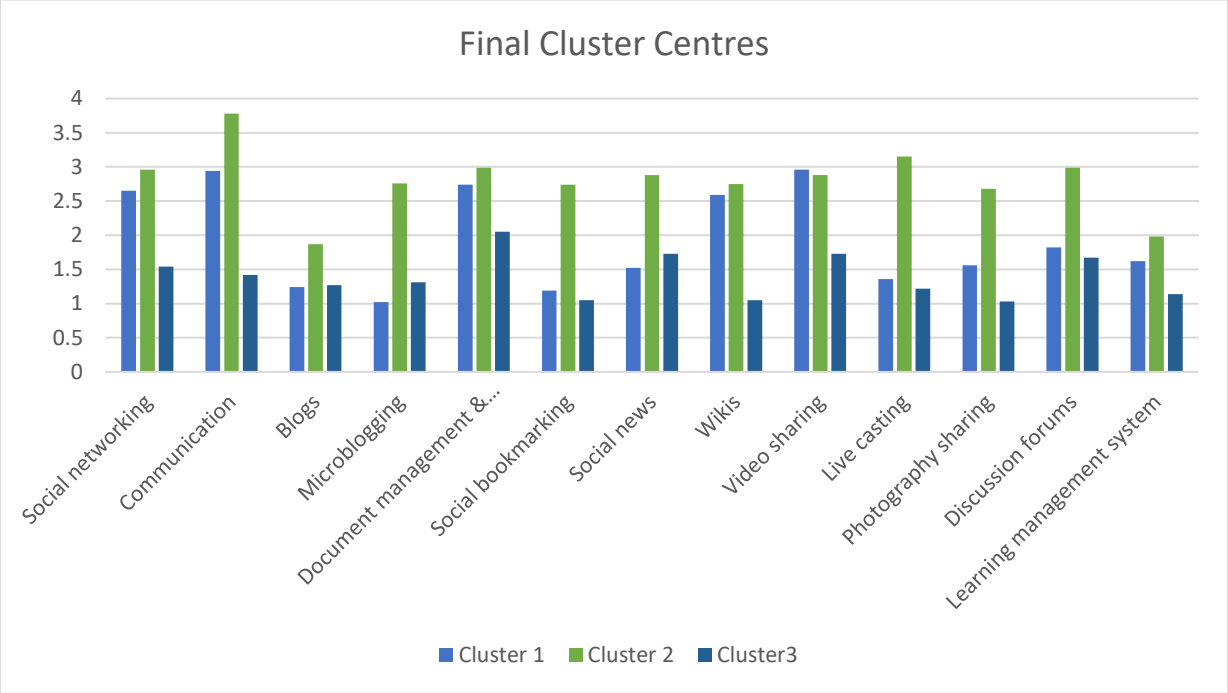

Figure 1. Homogeneous within, Heterogeneous across based on web 2.0 technologies deployed

A pictorial depiction of the three clusters as shown in Figure 1 revealed that these clusters assembled in line with how senior secondary science and mathematics students deploy web 2.0 tools for digital mathematics learning during the period of the COVID-19 pandemic. By way of checkup, Figure 1 revealed that science and mathematics students with analogous features (homogeneous within) in cluster 2 pooled the greatest mean score values but very disparate (heterogeneous across) with the other two clusters. In line with the input variables (13 variables on diverse web 2.0 tools deployed by science and mathematics students in pedagogical discourse in mathematics); the observation of the response of any student in cluster 2 was very disparate to any student in cluster 1 and cluster 3 correspondingly.

Discussion

The results of the study revealed that senior secondary science and mathematics students deployed Smartphones, personal laptops, home PC and iPad/Tablet in learning mathematics digitally during the period of the COVID-19 pandemic. This result aligned with the result of Mulenga and Marbán (2020) who found that the majority of the participants used mobile phones and laptops for learning mathematics digitally. In the present study, senior secondary science and mathematics students used smartphones than any other learning devices in learning mathematics digitally during the period of the COVID-19 pandemic. Home PCs deployment of students in learning mathematics digitally was very low. This showed that most homes do not have PCs for digital learning. Therefore, its use by students to

engage in digital learning of mathematics during the period of the COVID-19 pandemic is minimal due to its unavailability in many homes.

The results of this study also showed that senior secondary science and mathematics students in cluster 3 were more probable to display low proficiency levels in the utilization of web 2.0 technologies and its acceptance in conjunction with digital learning of mathematics. They were also probable to show an undesirable disposition towards the utilization of web 2.0 tools in the digital learning of mathematics. This might be because they do not recognize this societal software tool operator as pleasant and therefore, they do not recognize web 2.0 technologies to be vitally beneficial in virtual learning of mathematics. This seeming gap in knowledge of observed effectiveness and ease of use is a perturbing element that could effortlessly influence science and mathematics students' future intention to incorporate web 2.0 technologies into the learning of mathematics in secondary schools. However, this poses a high difficulty for science and mathematics students to engross in digital learning of mathematics during the period of COVID-19 pandemic closure of all schools in Nigeria. Successively, a great number of science and mathematics students will miss the virtual learning component if the planned web 2.0 technologies are fairly unaccustomed and problematic to utilize during digital learning of mathematics. It is debatable that both clusters 1 and 3 included respondents who had some level of difficulties in the actual deployment of web 2.0 technologies in pedagogical discourse in mathematics. Generally, the three clusters recognized the need for the virtual public to work together and team up to partake in mathematics activities. However, the respondents' intent to deploy web 2.0 tools in line with each cluster might be influenced by outward elements like ease of access to technological tools. Other outward elements might be high internet costs and erratic internet connections, high costs of smartphones and an epileptic supply of electricity.

Conclusion

The deployment of web 2.0 technologies in the teaching and learning of mathematics during the period of this COVID-19 pandemic lockdown afforded the students a rare opportunity to learn mathematics digitally at the luxury of their homes. So far, the students possess the needed web 2.0 technologies for accessing the internet at low cost with reliable electricity, they will be able to learn mathematics virtually at their own pace. The results of this study advocate that digital learning of mathematics by science and mathematics students will allow them to shift mathematics pedagogical discourse from a formalized, demanding and traditional context to a less official context that is student-centred, constructive, enjoyable and fascinating. For students to continue learning mathematics during the period of the COVID-19 pandemic, digital learning is the instant positive response. Deployment of digital learning as a reaction to the COVID-19 pandemic could ginger the evolution of digital learning in secondary school mathematics in Nigeria. This could also help the science and mathematics students gain the required competencies of becoming active and proficient digital students.

This study has implications for further research. First, it may be nice to look at the effect of COVID-19 on education in general. Second, the investigation could be made into the digital resources available for students to engage in digital learning during the period of the COVID-19 pandemic. Other future studies can look at the possibility of replacing face-to-face learning in secondary schools with digital learning. Digital learning during this period of the COVID-19 pandemic is fast becoming a life-long learning process for many students and can be a way of managing home quarantine for all and sundry. The emergence of COVID-19 has paved the way for discoveries in learning despite its adverse effect on school disruption worldwide. Thus, stakeholders in the education industry in Nigeria particularly the policymakers should make digital learning an enduring characteristic of the school portfolio even after the demise of the COVID-19 pandemic.

Recommendations

Based on the findings of this study, the following recommendations are made.
1. Science and mathematics teachers should be trained on the use of digital learning platforms for online teaching
2. Government should provide infrastructures that support digital learning in the country.
3. Costs of internet connectivity should be made affordable for all citizens.
4. Constant power supply should be provided.

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