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Assessment of basic science teachers' use of technologies before and after covid-19 pandemic in Jos metropolis, plateau state – Nigeria

Gongden, Esther Ephraim
Department of Crop Production, University of Jos, P.M.B, Jos - Plateau State, Nigeria

Abstract
This study aimed at assessing the use of technologies by basic science and technology teachers in Jos metropolis before and after the COVID-19 pandemic. A descriptive survey design was used and the population was all the basic science and technology teachers in the study area. The sample consisted of 230 teachers randomly selected from the population. Six research questions and three hypotheses were formulated as guide for the study. A basic science teacher's questionnaire was used to collect data from the teachers. The research questions were answered using mean and standard deviation while the hypotheses were tested using t-test at 0.05 level of significance. The study found out that there was a significant difference in the mean scores of teachers having access to technologies before and after the pandemic in Jos metropolis as teachers used different online platforms to participate in online classes during the COVID-19 pandemic more than before and tend to continue even after the pandemic. It also found out that there was a significant difference in the technologies teachers perceived easy for use before and after the pandemic in Jos metropolis. Finally, there was a significant difference between the technologies that teachers perceived impactful (to students' achievement). The teachers perceived technologies as improving learner's achievement. The study recommended that basic science and technology teachers and students be trained more and more on how to use various technological tools and platforms for active online learning. There is the need for teachers to continue using e-learning technologies in their classes in the post-pandemic period. Finally, government and proprietors should equip schools with the necessary technologies for use in teaching and learning seeing that the use of technology in education has become indispensable in developed nations.

Keywords: COVID-19 pandemic, technologies, assessment, basic science

Introduction

Science and technology have been viewed as the key drivers to the economic, educational and social developments of nations because technological and scientific revolutions underpin economic advances, improvement in health systems, education and infrastructure. Technology is the primary vehicle through which humanity progresses, eliminates hunger, poverty and lack of access to education. Discoveries in information and communication technology (ICT) have reduced the world to a global village with the World Wide Web being an enormous information base. The developing countries need science and technology hence the efforts by many of them to embrace it. The emphasis by the Nigerian government on science and technology as a necessary ingredient for national development as clearly spelt out in the Nigeria National Policy on Education (Federal Ministry of Education -FME, 2013) [4] and vividly portrayed in the increasing number of new Science and Technical Colleges, Polytechnics and Universities of Technology is commendable. The policy laid great emphasis on the teaching of science and technology education at the various levels of education in the country.

At the secondary school, students begin serious encounter with the science and technology when they offer basic science and technology at the Junior Secondary School (JSS) level. The subject introduces them to the main science subjects: chemistry, physics and biology, and to technical subjects like technical drawing, woodwork and metal work. Studies have shown that students' achievement in basic science and technology is a predictor of quality education in biology, physics and chemistry, thereby highlighting the importance of the subject (Enemarie, Ajayi & Ogbeba, 2019) [3]. However, in spite of the important place of basic science and technology, available evidence revealed that poor performance and achievements have been reported in external examinations such as JSCE and BECE (Yakubu, 2018) [15]. The performance of the students in basic science examination in the Junior School Certificate Examination in Plateau state and Jos North LGA respectively for five consecutive years (2011-2017) showed a dismal underachievement. The results show that the highest percentage pass obtained was in 2012 when 71.61% of the students that sat for the BECE in Plateau state got at least, a credit pass in basic science. The achievement of students was worse in 2014. The average percentage pass for the subject was 48%. The average percentage pass for the period 2011-2017 was 33.52% for schools in Jos metropolis within the same period. Generally, the performance of students in the BECE (JSCE) over the years has been not only been fluctuating, but not encouraging. There is no definite direction or consistency.

Many factors have been attributed to the underachievement in science subjects by secondary school students in Nigeria and one that is most common is poor teaching methods (Nsungo & Arikpo, 2013) [11]. Atadoga, Mari and Danjuma (2016) [1] observed that the conventional lecture strategy is usually the dominant approach adopted by most science teachers in Nigeria. Other factors are type of school, lack of

academic and professional qualifications, lack of good laboratories and teaching aids and inadequate motivation of teachers. It is important that the individuals in the society have science literacy, understanding of science and ability of using scientific process.

The lapses of the conventional lecture strategy of teaching basic science and technology, and other sciences has led to the emergence of various instructional strategies which have proved effective for learning science especially at the basic school level. Among these approaches is the use of technologies to enhance both teaching and learning. The new and emerging technologies challenges the traditional process of teaching and learning, and the way education is managed. While information communication technology is an important area of study in its own right, it is having a major impact across all curriculum areas. Easy worldwide communication provides instant access to vast array of data, challenging assimilation and assessment skills (Fowowe, 2006) [5]. Rapid communication plus increased access to ICTs in the home, at work, and in educational establishment, could mean that learning becomes a truly lifelong activity- an activity in which the pace of technological change forces constant evaluation of teaching process itself.

Technologies refer to machinery and equipment developed from the application of scientific knowledge but which can be used to enhance teaching and learning. Examples include: video conferencing, smartboards, tablets, zoom meetings, skype, e-mails, whatsApp, telegrams, clouds servers, 3D-printing, power points, computer softwares, etc. For teachers to integrate digital technologies into their practice, they need an ever-evolving understanding of which technologies exist and their functionalities. The use of technology in teaching or to support learning is becoming more commonplace. There is no debating the fact that students need to be technologically savvy and as educators we are responsible for making our students college and career ready for the 21st century. To support both teaching and learning, technology infuses classrooms with digital learning tools, such as computers and hand-held devices; expands course offerings, experiences, and learning materials; supports learning 24 hours a day, 7 days a week; builds 21st century skills; increases student engagement and motivation; and accelerates learning. Technology also has the power to transform teaching by ushering in a new model of connected teaching. Ioana (2020) [8] reported that students do learn better when the chosen technology is complementary to the school's educational methods.

The sudden outbreak of coronavirus disease in 2019 which originated from the city of Wuhan, China, has become a major public health challenge for not only China but also countries all over the world including Nigeria (Samuel, 2020) [12]. In fact the pandemic has led to the total lockdown of most of the human activities in various parts of the world schools inclusive. The World Health Organization announced that the outbreaks of the novel coronavirus have constituted a public health emergency of international concern. As at June 3, 2021, COVID-19 cases have been reported all over the world. As at the time of carrying out this study, 172,475,460 cases have been reported worldwide with 3,707,992 deaths. As June 26, 2023, Nigeria recorded 266,675 cases with 3,155 deaths and 259,953 recoveries. One of the control measures taken by the Nigerian government through the federal ministry of education was the closure of all schools at various levels. There is no doubt that the interference of the coronavirus pandemic has caused so many challenges on the Nigerian education system. This led some schools to turn to the use and application of various technologies to teach and learn. With the advent of the COVID-19 pandemic, it is not certain whether there has been any change in their use of technologies for teaching basic science and technology. The impact of such a change on the academic achievement of the students (if any) has not also be established. The study therefore examined basic science and technology teachers' use of technologies in Jos metropolis before and after the COVID-19 pandemic.

Aim and Objectives of The Study

The aim of the study was to assess the use of technologies by basic science and technology teachers in Jos metropolis before and after the COVID-19 pandemic in the country. The specific objectives of the study were to:

1. Find out the technologies that teachers had access to before and after the COVID-19 pandemic.
2. Find out teachers' perceived ease of using the technologies before and after the COVID-19 pandemic.
3. Find out the factors hindering teachers' readiness and confidence in using technologies before and after the COVID-19 pandemic.
4. Determine the teachers' perceived usefulness of the technologies before and after the COVID-19 pandemic.
5. Ascertain the teachers' perceived impact of the technologies on students' achievement in basic science and technology.

Research Questions

The following research questions guided the study. Answers to these questions were sought towards accomplishing the aim and objectives of the study:

1. Which technologies do teachers have access to in their schools before and after the pandemic in Jos metropolis?
2. What are some of the teachers' perceived ease of using the technologies before and after the pandemic in Jos metropolitan schools?
3. What are the factors hindering teachers' readiness and confidence in using technologies before and after the pandemic in Jos metropolitan schools?
4. What is the teachers' perception about the perceive usefulness of technologies before and after the pandemic in Jos metropolitan schools?
5. What are technologies teachers perceive impactful on students' achievement in Jos metropolitan schools?

Research Hypotheses

The following null hypotheses were formulated and tested during the research:

1. There is no significant difference in the mean scores of teachers' access to technologies before and after the pandemic in Jos metropolitan schools.
2. There is no significant difference in the mean scores of technologies teachers perceived easy to use before and after the pandemic in Jos metropolitan schools

3. There is no significant difference in the mean scores of technologies teachers perceived impactful on students' achievement in Jos metropolitan schools

Materials and methods

Descriptive survey design was adopted for this study. A survey is a study in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group**.** The population consisted of all Basic science and technology teachers in the Jos metropolitan area. The sample consisted of two hundred and thirty (230) basic science and technology teachers randomly selected from ninety schools. It is from this sample that data was collected and studied and the findings applied to the entire population. The instrument for this study was a Basic science and technology teachers' questionnaire (BSATQ). From the teachers. In each case, respondents were expected to express their best opinion or view concerning the items (questions) with a simple tick (√) or short answer. The BSATQ was validated appropriately and the reliability estimated using test-retest reliability technique. Upon obtaining the permission of the principals, the researcher met with, and solicited the assistance of the basic science and introductory technology teachers of each school. The researcher explained the purpose of the study to the teachers. The researcher then administered the questionnaire to the teachers who completed and returned same to the researcher to be used for analysis, The data obtained from the teachers were analyzed using frequency, mean, standard deviation and percentages. The hypotheses were tested using t-test.

Results

The data obtained were analyzed and some of the results presented in tables.

Table 1: Table showing the technologies teachers accessed in their schools before and after the pandemic in Jos metropolis

Before the pandemic			After the pandemic			
Technologies	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**
Zoom Meetings	167	2.02	1.225	174	2.39	1.367
Skype	96	1.60	.934	130	2.35	1.127
Emails	165	2.47	1.276	149	3.05	1.187
WhatsApp	216	3.00	1.159	209	3.31	1.029
Telegrams	100	2.52	1.251	142	2.68	1.205
Power Points	167	2.47	1.150	147	3.11	1.092
Computer Software	121	2.75	1.178	145	2.98	1.205
Social Networking	139	2.63	1.199	127	3.47	.924
Google Classroom	113	2.27	1.173	118	2.54	1.305
Google Meet	110	1.74	.945	108	2.27	1.309
Microsoft Teams	97	2.03	1.141	111	2.44	1.188
Class Blogs/Wikis	102	2.39	1.195	104	2.40	1.227
Interactive Whiteboards	122	2.48	1.306	118	2.64	1.210
YouTube	123	2.43	1.351	134	3.24	.982
Video Conferencing	103	2.35	1.210	125	2.85	1.148
Smartboards	115	2.10	1.245	104	2.65	1.195

Table 2: T-test for comparing mean scores of teachers' access to technologies before and after the pandemic in Jos metropolitan schools

Paired Differences						
95% confidence Interval of diff. Lower Upper						
Mean scores of teachers' perceived ease to the use of technology after pandemic – mean scores of teachers' perceived ease to use of technology before the pandemic	**Mean**	**S. D**	**S.E mean**	**t**	**df**	**Sig(2-tailed)**
	-.205	.643	.042	-.287	-.123	-4.920

Table 3: Teachers' perceived ease of using the technologies before and after the pandemic in Jos metropolitan schools

Before the pandemic			After the pandemic			
Technologies	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
Zoom Meetings	191	2.69	1.023	187	3.18	.931
Skype	135	2.56	1.070	137	2.91	1.028
Emails	200	3.19	1.042	193	3.36	.891
WhatsApp	220	3.33	.873	219	3.49	.798
Telegrams	166	3.14	.914	151	3.27	.832
Power Points	187	2.65	1.074	188	3.09	.909
Computer Software	175	2.71	1.072	173	2.92	1.123
Social Networking	172	2.76	1.063	171	2.96	1.079
Google Classroom	164	2.34	1.058	153	2.84	1.103
Google Meet	134	2.16	.957	146	2.84	1.096
Microsoft Teams	148	2.40	1.074	152	2.63	1.085
Class Blog/Wikis	159	2.57	1.183	168	2.83	1.065
Interactive Whiteboards	184	2.67	1.194	174	2.86	1.165
YouTube	184	3.03	1.152	175	3.18	.957
Video Conferencing	149	2.58	1.122	141	2.81	1.041

Table 4: Mean scores of the technology's teachers perceived easy to use before and after the pandemic in Jos metropolitan schools

Paired Differences								
95% confidence Interval of diff								
Mean scores of teachers' perceived ease to the use of technology after pandemic – mean scores of teachers' perceived ease to use of technology before the pandemic	Mean	S. D	S.E mean	**Lower**	**Upper**	t	df	**Sig (2tailed)**
	-.265	.675	.044	-.351	-.179	-.351	-.179	**-4.920**

Table 5: Technologies that teachers perceived impactful on students' achievement in Jos metropolitan schools

Technologies	N	Mean	SD
Smartboards	166	2.34	.567
Zoom Meetings	216	2.56	.584
Skype	118	2.36	.734
Emails	193	2.50	.730
WhatsApp	224	2.81	.406
Telegrams	202	2.44	.622
Power Points	194	2.35	.697
Computer Software	199	2.35	.693
Social Networking	190	2.37	.684
Google Classroom	186	2.28	.735
Google Meet	190	2.32	.717
Microsoft Teams	170	2.15	.644
Class Blog/Wikis	176	2.14	.704
Interactive Whiteboards	193	2.29	.714
YouTube	183	2.57	.549
Video Conferencing	200	2.40	.557

Table 6: mean scores of technologies teachers perceived impactful on students' achievement in Jos metropolitan schools

Test Value = 4						
95% confidence interval of diff.						
Technologies that teachers perceived impactful	**t**	**df**	**Sig (2tailed)**	**Mean Diff**	**Lower**	**Upper**
	-53.371	225	.000	-1.5834	-1.52709	-1.4707

Research Question 1

Which technologies do teachers have access to in their schools before and after the pandemic in Jos metropolis?

Table 1 shows that teachers had access to some technologies before the COVID-19 pandemic However, after the pandemic, teachers mostly had more access to ICTs like WhatsApp, computer software and social networking before the covid-19 pandemic but after the covid-19 pandemic, teachers had access to more ICTs like Email, telegram, power point, google classroom, interactive whiteboard, YouTube and video conferencing in addition to what was used before the pandemic

Research Hypothesis One, Ho_1

There is no significant difference in the mean scores of teachers' access to technologies before and after the pandemic in Jos metropolitan schools.

Table 2 shows that the significant value is below 0.05 and the t-value is less than t-critical. Therefore, there is a statistical difference between the mean score of teachers access to technologies before and after the pandemic in Jos metropolis of Plateau state. We can therefore reject the null hypothesis and accept the alternative hypothesis which says that there is a significant difference the mean scores of teachers access to technologies before and after the pandemic in Jos metropolis.

Research Question 2

What are some of the teachers' perceived ease of using the technologies before and after the pandemic in Jos metropolitan schools?

Table 3 shows what ICTs teachers perceived easy to use before and after the COVID-19 pandemic in secondary schools in Jos metropolis of Plateau state. As shown on the table, before the COVID-19 pandemic teachers perceived WhatsApp, telegram, class blogs/wikis, interactive whiteboard and YouTube to be very easy while zoom meetings, skype, PowerPoint, computer software, social networking, google teams and video conferencing were easy but google classroom, google meet was difficult to use. After the COVID-19 pandemic, teacher perceived all technologies became relatively easier to use.

Research Hypothesis Two, Ho_2

There is no significant difference in the mean scores of technologies teachers perceived easy to use before and after the pandemic in Jos metropolitan schools

Table 4 shows that the significant value is below 0.05 and the t-value is less than t-critical therefore there is a statistical difference between the mean score of the technologies teachers perceived easy to use before and after the pandemic in Jos metropolis of Plateau state. We can therefore reject the null hypothesis and accept the alternative hypothesis which says that there is a significant difference the technology's teachers perceived easy to use before and after the pandemic in Jos metropolis of Plateau state.

Research Question 5

What are technologies teachers perceive impactful on students' achievement in Jos metropolitan schools?

Table 5 shows the ICTs teachers perceive to be impactful on students' achievement in secondary schools in Jos metropolis of Plateau state. As shown on the table, all ICTs was perceived by teachers to be very impactful on students' achievement except for smartboard, video conferencing, class blogs/wikis and Microsoft teams.

Research Hypotheses 3

There is no significant difference in the mean scores of technologies teachers perceived impactful on students' achievement in Jos metropolitan schools

Table 6 shows that the significant value is below 0.05 and the t-value is less than t-critical therefore there is a statistical difference between the mean score of technologies teachers perceived impactful in Jos metropolitan schools in Plateau state. We can therefore reject the null hypothesis and accept the alternative hypothesis which says that there is a significant difference the technologies teachers perceived impactful in Jos metropolis of Plateau state.

Further analyses revealed that some factors that hinders teacher's readiness and confidence on the use of ICTs before and after the COVID-19 pandemic in secondary schools in Jos metropolis include lack of devices (other gadgets) to attend online classes, internet connectivity issues, inability to acquire data for online classes and lack of power/ power interruptions. The study also revealed that teachers perceive that all the ICTs are useful for teaching before COVID- 19 pandemic but they perceived all ICTs very useful for teaching and learning after the COVID- 19 pandemic as seen by the mean of the responses.

Discussion of Results

One of the findings of this study is that there is a significant difference in the mean scores of teachers having access to technologies before and after the pandemic in Jos metropolitan schools of Plateau state. The study found out that teachers used different online platforms to participate in online classes during the COVID-19 pandemic more than before. More teachers accessed various educational technologies during the pandemic resulting in their continuing in the use of same than before the pandemic. Common among them were WhatsApp, Telegram and zoom. E-mail, mobile conversations (audio materials) and college websites. This agreed with Walabe (2020) [14] who noted that teachers needed learning platforms (e.g., Collaborate, Zoom, Google classrooms) to post course materials to students for their use and learning during the Covid-19 era. Most of the respondents had access to one device or the other such as android phones, laptops and tablets for online learning of chemistry during COVID-19 pandemic. D'silva, Mohann, and Paulose (2020) [2] had earlier found out that the use of a desktop, laptop, or smart phones and the internet forms a major component of learning during COVID-19 pandemic. Therefore, one can conclude that as unfortunate as the COVID-19 pandemic was, it served to plunge teachers in Jos metropolis of Plateau state into embracing technology more than ever in the classroom.

Another finding is that there is a significant difference in the technologies teachers perceived easy to use before and after the pandemic in Jos metropolitan schools. Many teachers found out that most of the technologies which they considered difficult to use were not actually difficult. Many teachers became masters over the use of some of the technologies. Therefore, the ease of usage of technologies after the pandemic differ from the ease of usage before the pandemic. One of the findings of the study reports that the teachers' perception that the pandemic process has improved their technological self-efficacy stems from the fact that they can only use online meeting platforms in their classrooms in distance education. This is in tandem with results obtained by Hebebci (2023) [7] in which teachers expressed that the pandemic process contributed positively to the technological competencies of teachers as only a few teachers continued their technological experiences in their face-to-face classes after the pandemic. This also agrees with the findings of Gongden (2021) [6] who posited that the COVID-19 pandemic led to rewarding ways of life such as a return to observing simple hygiene, and to need for hard work. Despite the challenges, there is no doubt that the many teachers and students are now more aware of the necessity of online education. Whatever resistance or challenges the system presents, there is every possibility that such shall be overcome as the world (not just education sector) use more and more technologies for day-day businesses, transactions, communications, administration and even COVID-19 pandemic has opened avenues for online teaching with a completely new outlook for chemistry educators and learners. The Impact project (Watson, 1993) and other studies identified a wide range of skills and competencies which teachers felt they needed in order to find ICT easy to use.

Still, the study revealed that there is a significant difference between the technologies that teachers perceived impactful (to students' achievement) in Jos metropolitan schools of Plateau state. Teachers perceived technologies as improving learner's performance; and more so that teachers are affected by knowledge about their own subject. This finding followed the path of some previous researches which found out that the integration of instructional technology, such as lecture videos, online course delivery and online assessments, promote the development of knowledge and skills of instructors and students alike (McConnell, 2006; Kundu & Dey, 2018) [9].The teachers who study found out that the online lessons improved the academic achievement of students. The evidence shows that when teachers use their knowledge both the subject and also how students understand the subject with their use of ICT have more direct effect on students' attainment. The finding also agrees with that of Tella, Tella, Toyobo and Adika (2007) [23] who stated that the evidence shows that when teachers use their knowledge both the subject and also how pupils understand the subject with their use of ICT has a more direct effect on pupils' attainment.

Conclusion and recommendations

The findings of this study conclude that in comparison to teachers access to and usage of ICTs before the covid-19 pandemic, Basic science and technology teachers in Jos metropolis have more access to ICTs and can easily use it in teaching and learning after the covid-19 pandemic. The transformation of teachers in the use of ICTs for effective teaching and learning in secondary schools after the COVID-19 pandemic indicated an improvement. However, some factors like lack of gadgets to use for online classes, poor internet connectivity and poor power supply has consistently become a hinderance to teachers' confidence and readiness on the use if ICTs thereby affecting teachers'

level of competency on the use of ICTs in the teaching and learning process. This study has shown generally that ICT now have far reaching implications in teaching and learning at the secondary school level in Nigeria. This is because teachers themselves have now perceived it usefulness. The study recommended that basic science and technology teachers be trained on how to use various technological tools and platforms for active online learning. There is the need for teachers to continue using e-learning technologies in their classes in the post-pandemic period, even though there are elements that make technology use in classrooms difficult. They need to be more engaged in online education so as to become efficient in the use of the technological tools.

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