Assessment Of Chemistry Teachers' Pre- and Post Covid Use of Technologies in Jos, Plateau State Nigeria

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ABSTRACT

The sudden outbreak of the coronavirus disease in 2019 led to the total lockdown of most human activities in various parts of the world including schools. As a result, various e-learning (technologies) platforms became relevant more than ever to enable interaction between teachers and students. This study assessed chemistry teachers' use of technologies before and after the COVID-19 pandemic in Jos, Nigeria. A descriptive survey design was used with a sample of 50 chemistry teachers from the study area. The instrument was a questionnaire (r = 0.81) consisting of seven items drawn from a list of possible technologies that can be used in schools and the possible factors hindering their usage. The teachers responded to each item and the researcher used the data to answer 6 research questions and test 3 null hypotheses. The research questions were answered using descriptive and inferential statistics while Chi Square was used to test the hypotheses and the results presented. Results showed that the frequency of access to technologies was higher for all technologies after the COVID-19. It also found an increase in the perceived ease of usage of the technologies after the pandemic. There was no statistically significant association between teachers' perceived usefulness of technologies before and after COVID-19 pandemic. The study recommended that chemistry teachers should be trained and supported to use technologies for chemistry instructions. School proprietors should equip schools with the necessary technologies for use in teaching and learning since the use of technology in education has become indispensable.

Key Words: COVID-19 Pandemic, Technologies, Assessment

1. INTRODUCTION

Education is a major tool for national socio-economic development and for individual socio-economic empowerment and poverty reduction. Education is vital because it produces the personnel that are required to function in various facets of national life and development process (Ibidapo-Obe, 2007). According to Musa and Bichi (2015), every society requires adequate human and material resources. Education has proven to be a pre-requisite for quality manpower development and creation of wealth, a sure path to success in life and service to humanity. One outstanding aspect of education is the area of science and technology which role in the overall

development of any nation cannot be overemphasized. Any nation with scientifically uneducated citizenry cannot be expected to make any reasonable socio-economic and political development. Science has given man immense knowledge just as technology has made education itself easier. It has provided options like smart classes, multimedia devices, e-libraries, e-books, etc. Information technology, including internet, is an excellent gift of technology. With the help of internet, man does not only get immense knowledge on science and other subjects, but also get to stay connected with friends and family, continuously.

One of the key science subjects that is central to science and technology is Chemistry (Gongden, 2021). Chemistry is one of the three main branches of pure science, the other two being biology and physics. Chemistry deals with the study of matter – its composition, properties and changes that it undergoes. Chemical activities and processes are common in the environment, and they include: lightening a match, cooking; burning of firewood and rusting of nails amongst others. Almost all household materials, such as soap and detergents for washing, hair creams, perfumes and majority of cooking utensils, plastic materials for wide variety of uses are all products of chemical process. Apart from these, chemistry contributes towards providing our basic needs and improving the quality of life in the areas of agriculture, textiles, medicine, housing, oil exploration and processing, chemical and other industries, etc. The career opportunities in chemistry are many and varied (Gongden, 2021)**.** The Chemistry curriculum aimed at satisfying the chemistry requirement of the National Policy on Education revised by the Nigerian Educational Research and Development Council (2009). The objectives of the Chemistry curriculum include facilitating a transition in the use of scientific concepts and techniques acquired in integrated science with chemistry, providing students with basic knowledge in chemical concepts and principles through efficient selection of content and sequencing; showing chemistry in its inter-relationship with other subjects, showing chemistry and its link with industry, everyday life, benefits and hazards, and providing a course which is complete for pupils not proceeding to higher education while it is at the same time a reasonably adequate foundation for a post-secondary chemistry course. The Chemistry curriculum is divided into three sections, corresponding to the three years with senior secondary school level.

Taking cognizance of its place in both human and national development, a lot of facilities, programmes and laudable policies have been made to encourage and promote Chemistry education in Nigeria (NERDC, 2009)**.** This is to enable the solving of some of the problems plaguing the teaching and learning of chemistry among which is the use of the defective conventional method of instruction by chemistry teachers (Nzewi, 2010; Atadoga, Mari & Danjuma, 2016). Various instructional strategies have emerged through research and have proved effective for learning science among which 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.

Technologies refer to machinery and equipment developed from the application of scientific knowledge, but which can be used to enhance teaching and learning. For teachers to integrate digital technologies into their practice, they need an ever-evolving understanding of which technologies exist and their functionalities. According to Inbal and Blonder (2018), the choice of technologies to be used by teachers depend on characteristics such as ease, flexibility, suitability, cost, and organization. The use of technology in teaching or to support learning is becoming more commonplace. Most students have also culturally adapted to the world of smart phones where they

can download an app to practice a scientific skill, sketch and rotate molecules, makes mechanisms, etc (Williams and Pence, 2011). The sudden outbreak of coronavirus disease in 2019 (COVID-19) became a major public health challenge for not only China but also countries all over the world including Nigeria (Samuel, 2020). The pandemic led to the total lockdown of most of the human activities in various parts of the world. The outbreak changed the operating conditions all over the globe within a month. Like other sectors, the COVID-19 pandemic affected education also in many ways (Schleicher, 2020). One of the control measures taken by various governments was was the closure of all schools at various levels in most countries (Schleicher, 2020). With the total shut down of towns and cities during which movements were restricted, the use or access to school textbooks became difficult. Teaching professionals had to think of alternative methods of teaching during this lockdown, and thus it paves the way towards web-based learning or e-learning or online learning. Various e-learning platforms became relevant more than ever to enable interaction between teachers and students. Technological tools became very relevant in teaching and learning as children and students had to rely more on their own resources to continue learning remotely through the internet, television or radio. Teachers also had to adapt to new pedagogical concepts and modes of delivery of teaching, for which they may not have been trained. Examples include video conferencing, smart boards, tablets, zoom meetings, skype, e-mails, WhatsApp, telegrams, clouds servers, 3D-printing, power points, computer software, etc. The need for ICT integration in education became crucial, because with the help of technology, teaching and learning is not only happening in the school environment, but also can happen even if teachers and students are physically distant. This study intends to assess teachers' use of technologies by Chemistry teachers before and after the pandemic in Jos North LGA, Plateau state Nigeria.

1.2   Statement of The Problem

Technology can contribute substantially to active learning, being used as an aid in the teaching and learning process and promote interaction between content and students, students and students and students and teachers. Learning technologies can also increase educational productivity by expanding the learning experience, increasing student's engagement and motivation, and accelerating learning (Balanskat, Blamire, & Kefala, 2006). In turn, schools can use technology resources in various ways to support the educational and schooling process. Information and Communications Technology (ICT) is widely recognized as a valuable tool for enhancing teaching and learning. The use of ICTs in Nigeria and African countries generally is increasing and dramatically growing. However, while there is a great deal of knowledge about how ICTs are being used in developed countries, there is not much information on how ICTs are being used by teachers in developing countries such as Nigeria. Despite the merits of the use of learning technologies in schools, it is not yet ascertained whether Chemistry teachers in Jos metropolis have embraced the practice. 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 Chemistry. The impact of such a change on the academic achievement of the students (if any) has not also been established. The study therefore examined Chemistry teachers' use of technologies in Jos North LGA, Plateau state before and after the COVID-19 pandemic.

1.3   Aim and Objectives of The Study

The aim of the study was to assess the use of technologies by Chemistry teachers in Jos North LGA, Plateau state, before and after the COVID-19 pandemic. The specific objectives of the study were to:

1. Find out which technologies Chemistry teachers had access to before and after the pandemic to teach Chemistry.
2. Find out the technologies considered adequate before and after the pandemic by Chemistry teachers.
3. Find out Chemistry teachers' perceived ease of using the technologies before and after the pandemic.
4. Determine the factors that hindered the use of technologies for teaching Chemistry before and after the pandemic.
5. Find out Chemistry teachers' perception of the usefulness of technologies in teaching Chemistry before and after the pandemic.
6. Ascertain the impact of using technologies on students' achievement in Chemistry before and after the pandemic.

1.4   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 did Chemistry teachers have access to before and after the pandemic to teach Chemistry?
2. Which technologies were considered adequate before and after the pandemic by Chemistry?
3. What are the technologies that Chemistry teachers' perceived easy for use before and after the pandemic?
4. What are some of the factors that hindered the use of technologies for teaching Chemistry before and after the pandemic?
5. What is Chemistry teachers' perception of the usefulness of technologies in teaching Chemistry before and after the pandemic?
6. What is the impact of using technologies on students' achievement in Chemistry before and after the pandemic?

1.5   Research Hypotheses

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

1. There is no significant association between teachers access to technologies in their schools before after COVID-19 pandemic.
2. There is no significant association between teachers' perceived ease of using technologies before and after COVID-19 pandemic.
3. There is no significant association in teachers' perceived usefulness of technologies on students' achievement before and after COVID-19 pandemic.

2.   METHOD AND PROCEDURE

Descriptive survey design was adopted for the study since it had to do with collecting and analyzing data from only a sample considered to be representative of the entire group. All the

Chemistry teachers in Jos North LGA of Plateau state that offer Chemistry as a subject. There were 197 registered schools as at the time of the study with 163 offering Chemistry. The study sample consisted of 50 Chemistry teachers from 50 schools. This number was considered as a fair representative of the population. It is from this sample that data was collected and studied, and the findings applied to the entire population. The sample was obtained through simple random sampling.

The instrument for this study was a questionnaire which was validated appropriately, and the reliability established through test-retest and the reliability coefficient (r) found to be 0.81. The questionnaire consisted of seven items. Each of items 1, 2, 3, 5 and 6 consisted of a list of possible technologies that can be used by teachers. Item 4 consisted of possible factors that can hinder the use of technologies for teaching Chemistry in schools. In each case, respondents were simply expected to respond to each item being guided by the research questions. There were 6 objectives of the study, 6 research questions and 3 null hypotheses in all. The researcher administered the questionnaire to the Chemistry teachers who completed and returned same to the researcher to be used for analyses. The data obtained from the teachers were analyzed using descriptive and inferential Statistics such as. The frequency and percentages of each view or response was used to answer the research questions. Chi Square was however, used to test the hypotheses. The results were presented in tables.

## 3. RESULTS

3.1 Research Questions:

Research Question 1: Which technologies did Chemistry teachers have access to before and after the pandemic to teach Chemistry?
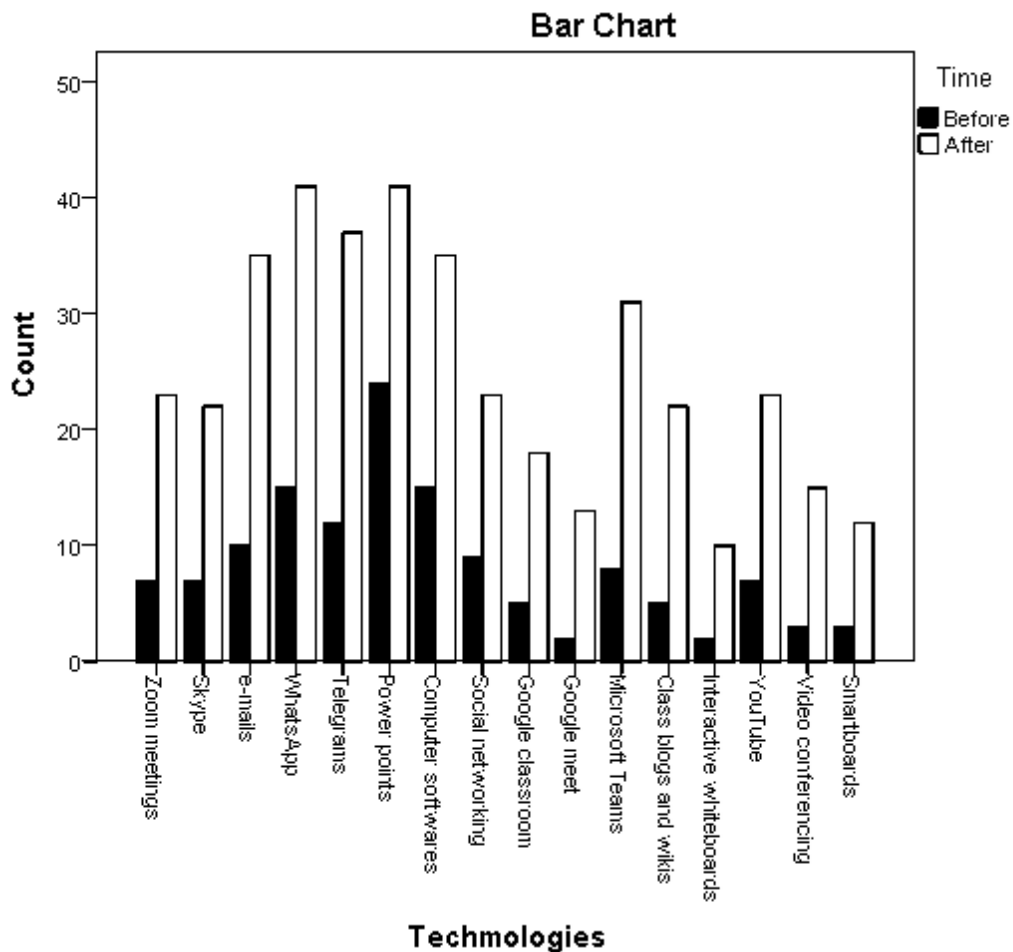
Figure 1: Distribution of teachers' response to access to technologies before and after the pandemic.

The output in figure 1 revealed that teachers had access mostly to the following technologies power points, WhatsApp, computer software and telegrams before the pandemic. After the pandemic, teachers had the most access to power points, WhatsApp, telegrams, computer software, e-mails, and Microsoft teams. Generally, teachers' frequency of access to technologies was higher for all technologies after the pandemic than before the pandemic in varying degrees.

Research question 2: Which technologies were considered adequate before and after the pandemic by Chemistry teachers?
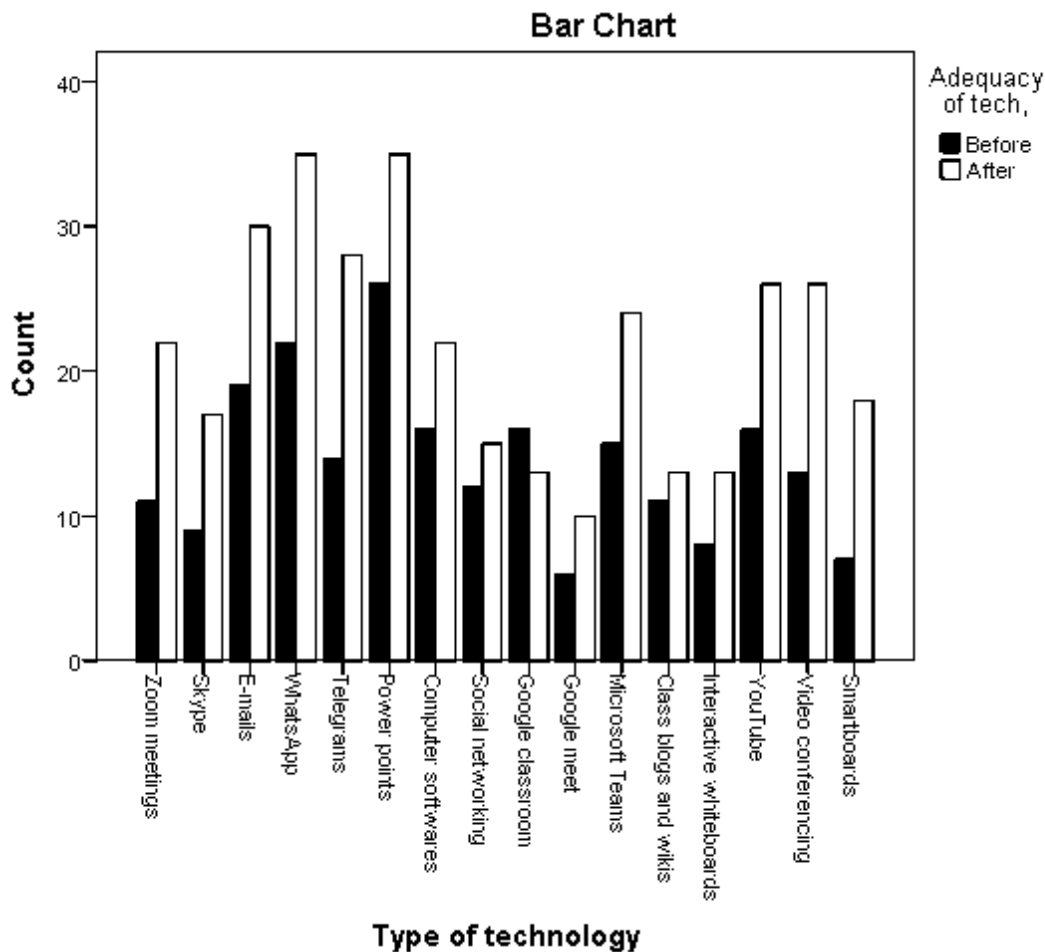
Figure 2: Distribution of adequacy of available technologies before and after COVID-19 pandemic

Figure 2 revealed that Chemistry teachers identified power points, WhatsApp, e-mail, computer software, Google classroom and YouTube as adequate before the pandemic. After the pandemic, they identified power points, WhatsApp, e-mail, telegram, YouTube, video conferencing, and Microsoft teams as the adequate technologies. There was a general increase in the teachers' rating of the adequacies of the technologies after the pandemic.

Research Question 3: What are the technologies that Chemistry teachers' perceived easy for use before and after the pandemic?

Table 1: Perceived ease of using technologies before and after COVID-19

Count

		Perceived ease of using technologies		
		Before	After	Total
Technologies	Zoom meetings	26	28	54
	Skype	28	35	63
	E-mails	42	45	87
	WhatsApp	42	46	88
	Telegrams	35	40	75
	Power points	34	36	70
	Computer software	20	27	47
	Social networking	18	26	44
	Google classroom	21	26	47
	Google meet	19	21	40
	Microsoft Teams	34	44	78
	Class blogs and wikis	19	22	41
	Interactive whiteboards	25	31	56
	YouTube	25	39	64
	Video conferencing	21	38	59
	Smartboards	24	24	48
Total		433	528	961

The output in Table 1 showed that e-mails, WhatsApp, telegrams, power points, and skype are among the technologies that chemistry teachers viewed as easy to use before the pandemic. After the pandemic, the analysis of teachers' response showed that e-mails, WhatsApp, Microsoft teams, telegrams, YouTube, video conferencing, power points, and skype are easy for use. The result revealed an increase in the perceived ease of usage of the technologies after the pandemic.

Research Question 4: What are some of the factors that hindered the use of technologies for teaching Chemistry before and after the pandemic?

Table 2: Factors hindering the use of technology before and after COVID-19 pandemic

Count

		Period		
		Before	After	Total
Factors hindering the use of technology	Feelings of anxiety / fear of failure	29	15	44
	Lack of devices (other gadgets) to attend online classes	34	21	55
	Lack of quiet and separate room to study	13	9	22
	Internet connectivity issues (unstable internet access)	28	17	45
	Lack of knowledge on the use of the device	31	18	49
	Incompetence by teachers or students on online classes	34	20	54
	Inability to acquire data for online classes	34	27	61
	Crowded home schedules / obstruction	24	16	40
	Lack of power/power interruptions	32	19	51
	Isolation from classmates and lack of social interaction	28	23	51
Total		287	185	472

The output in Table 2 above revealed that the common factors that hindered the use of technology before the COVID-19 pandemic include incompetence by teachers, lack of data, lack of devices for use, lack of power/power interruption, lack of knowledge on the use of the device, fear of failure/feelings of anxiety, internet connectivity and isolation from classmates. This showed that there were quite several challenges. After the pandemic, the challenges reduced drastically with only lack of data for online connectivity, lack of devices, isolation (lack of social interaction), incompetence and power being the major hinderances.

Research Question 5: What is Chemistry teachers' perception of the usefulness of technologies in teaching Chemistry before and after the pandemic?
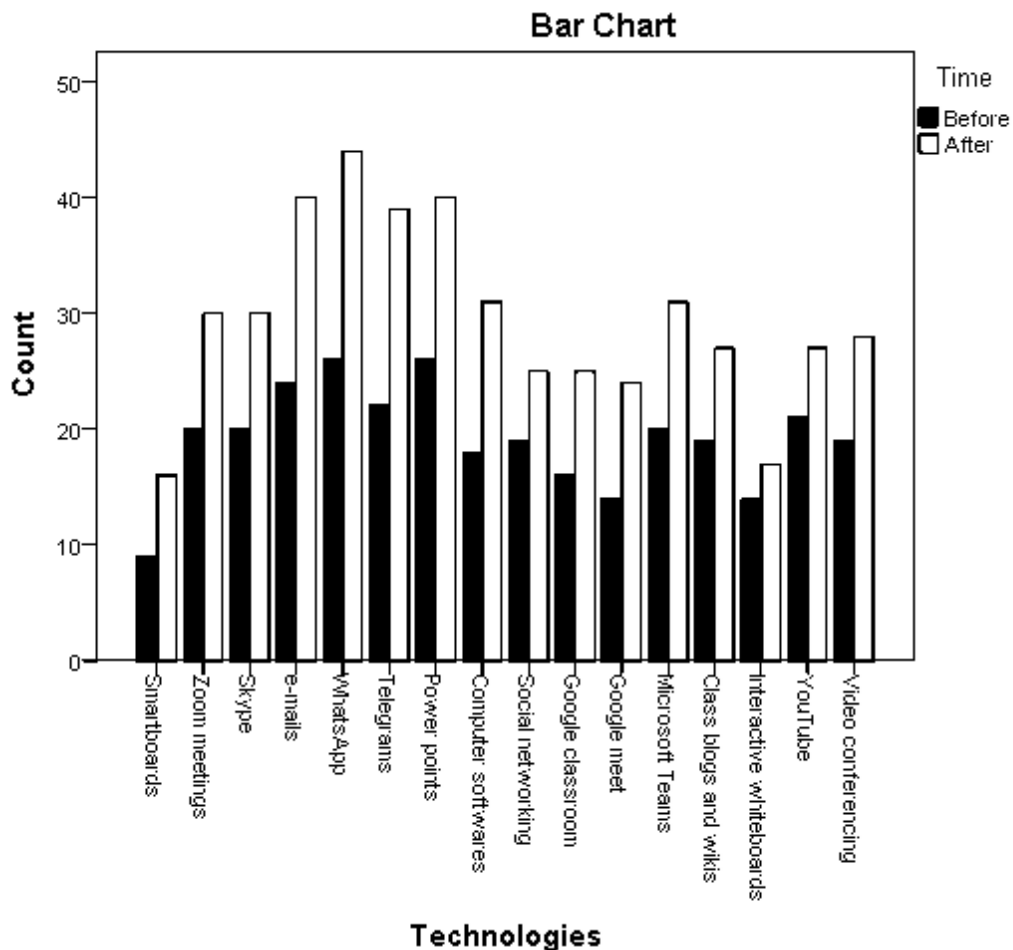
Figure 3: Distribution of teachers' perception of the usefulness of technologies

Figure 3 indicates that most teachers considered technologies such as email, WhatsApp, telegrams, power points, YouTube, skype, zoom meetings and Microsoft team useful before the pandemic. Their Post-COVID response however showed that Chemistry teachers considered all but interactive white boards and smartboards useful. This showed that teachers considered technologies useful in the field of education.

Research Question 6: What is the impact of using technologies on students' achievement in Chemistry before and after the pandemic?
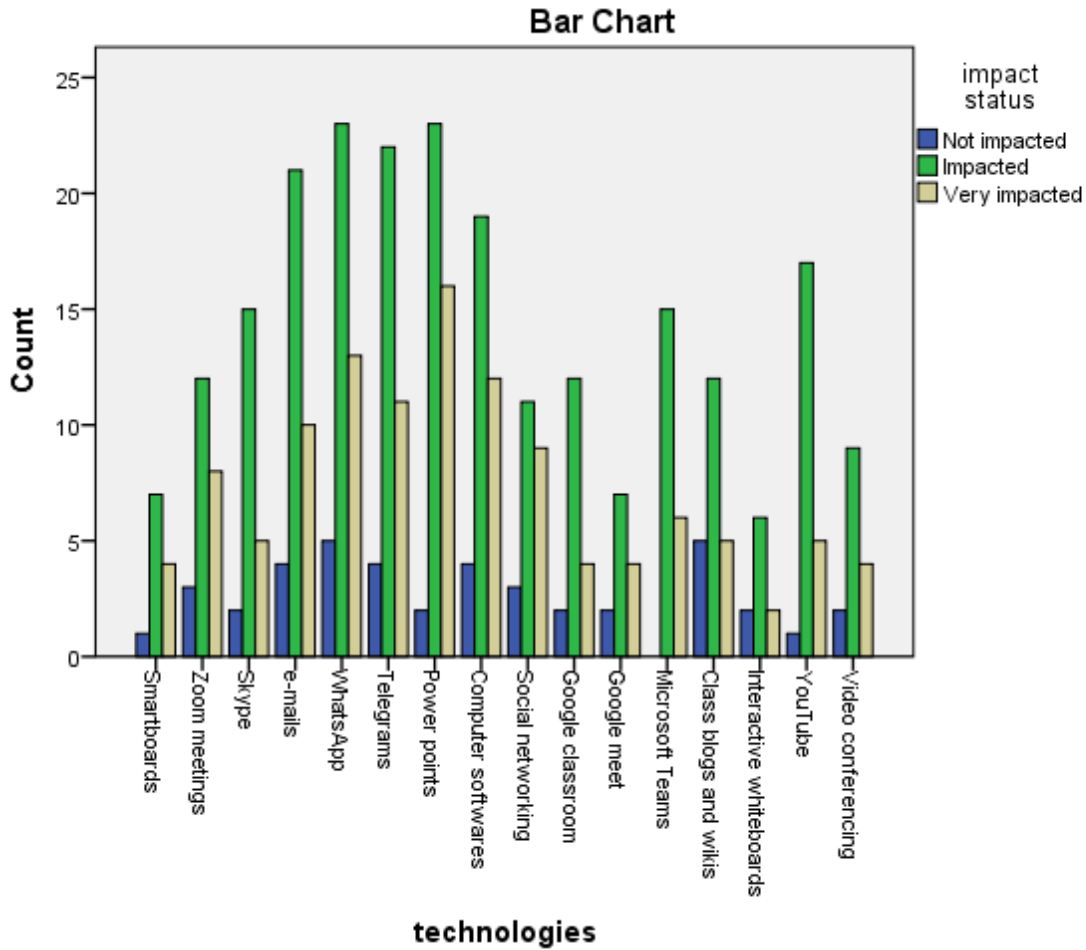
Figure 4: Distribution of impact of technologies on students' achievement

The output in Table 6 revealed that teachers considered power points, WhatsApp, telegrams, e-mails, and computer software to have impact on students' achievement mostly. Others that may be impactful are YouTube, Microsoft teams, zoom meetings, skype and social networking.

3.2 Research Hypotheses:

Research Hypothesis 1: There is no significant association between teachers access to technologies in their schools before after COVID-19 pandemic.

Table 3: Teachers access to technologies before and after the pandemic

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.691ᵃ	15	.839
Likelihood Ratio	9.602	15	.844
Linear-by-Linear Association	1.512	1	.219

N of Valid Cases	535	

a. 4 cells (12.5%) have expected count less than 5.
 The minimum expected count is 3.01.
Chi-square of independent sample test was conducted and the result indicated that teachers did not have access to most technologies before and after COVID-19 pandemic. There is no statistical significant association between technologies access before and after corona the pandemic $\chi2=9.691, p>0.05$. Hence the null hypothesis is accepted since the p-value of $0.839 > 0.05$.

Research Hypothesis 2: There is no significant association between teachers' perceived ease of using technologies before and after COVID-19 pandemic.

Table 4: Teachers perceived ease of using technologies.
 Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.516[a]	15	.970
Likelihood Ratio	6.526	15	.969
Linear-by-Linear Association	1.018	1	.313
N of Valid Cases	937		

a. 0 cells (0.0%) have expected count less than 5.
 The minimum expected count is 18.48.
Chi-square test of independent test conducted, $\chi2=6.516$, p=0.970. This shows that there is no statistically significant relationship between teachers' perceived ease of using technologies before and after pandemic.

Research Hypothesis 3: There is no significant association in teachers' perceived usefulness of technologies on students' achievement before and after COVID-19 pandemic.
Table 5: Teachers perceived usefulness of technologies.
 Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.084[a]	15	0..870
Likelihood Ratio	2.077	15	
			0.780
Linear-by-Linear Association	.639	1	0.424
No of Valid Cases	781		

a. 0 cells (0.0%) have expected count less than 5.
 The minimum expected count is 9.83.
From the Chi-square test of independent sample conducted, it can see that $\chi2=2.084$, $p=0.870$. This means that there is no statistically significant association between teachers' perceived usefulness of technologies before and after COVID-19 pandemic.

4. DISCUSSION OF RESULTS

One of the findings of this study is that there is a general increase in Chemistry teachers' access to technologies after the COVID-19 pandemic than before the advent of COVID-19. Even though the frequency of access to the technologies increased for each one, only a few were most accessible. These include power points, WhatsApp, telegrams, e-mails, computer software, and Microsoft teams. This result may be due to the fact these facilities are not available for access or perhaps the teachers lack the skills to access them. This result agrees with that Lockee (2021) who noticed the increment of use of technology in schools after COVID-19. The same author also noticed that while access remains a significant issue for many, extensive resources have been allocated and processes developed to connect learners with course activities and materials, to facilitate communication between instructors and students, and to manage the administration of online learning. Paths for greater access and opportunities to online education have now been forged, and there is a clear route for the next generation of adopters of online education.

Another finding was that the technologies considered adequate before and after the pandemic were few. Even then, they slightly differ. While computer software, Google classroom and YouTube were considered adequate before the pandemic, they were not after the pandemic. Instead, telegram, YouTube, video conferencing, and Microsoft teams were adjudged the adequate technologies.The study also unveiled e-mails, WhatsApp, telegrams, power points, and skype as the technologies that chemistry teachers considered easy to use before the pandemic. After the pandemic, Microsoft teams, YouTube, video conferencing, were added to the list of technologies that are easy for use (application). This agreed with Walabe (2020) 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) 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. There was no statistical significant relationship association between technologies accessed before and after corona the pandemic.

The study revealed common hindrances to the use of technology before during pre- COVID-19 include incompetence by teachers, lack of data, lack of devices for use, lack of power/power interruption, lack of knowledge on the use of the device, fear of failure/feelings of anxiety, internet connectivity and isolation from classmates. This showed that there were quite several challenges. After the pandemic, the challenges reduced drastically with only lack of data for online connectivity, lack of devices, isolation (lack of social interaction), incompetence and power being

the major hinderances. The result is in line with Alshhri et al. (2020), who noted that there are many challenges associated with the transition from traditional classroom teaching to conducting teaching and learning activities through the internet. Similarly, Lapitanet al. (2021) noted that students experienced technical and personal constraints that might have prevented them from online learning during the lockdown, such as lack of computers/laptops or other gadgets, lack of stable internet access, power interruptions, lack of quiet and isolated room to study, slow and old computers, non-academic responsibilities within the family, and some students may need necessary medical appointments.

Concerning the usefulness of technologies, Chemistry teachers considered all but interactive white boards and smartboards useful after the pandemic. Their view before the pandemic was different. This means that the pandemic led to increased appreciation of the role of technologies in the field of education. The study revealed that teachers considered power points, WhatsApp, telegrams, e-mails, and computer software to have impact on students' achievement mostly. Others that may be impactful are YouTube, Microsoft teams, zoom meetings, skype and social networking.. 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 agrees with that of Tella, Tella, Toyobo and Adika (2007) 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. A similar result to this was also echoed by Onyema, Nwafor,Ezeanya, Eziokwu and Ani (2020) when they found out that the use of e-learning platforms had a statistically significant effects on the learning interests of the experimental group after the treatment.

5.   CONCLUSION AND RECOMMENDATIONS

The advent of the COVID-19 pandemic has led to an increasing awareness regarding the potentials of ICTs in learning. Online learning technologies are here to stay even after the pandemic. The pandemic brought a change in how students learn and how teachers provide instructions. The use of information communication tools such as e-mail, fax, computer and video conferencing have made it possible to overcomes barriers of space and time, and opens new possibilities for learning. Now, hybrid and virtual classrooms are more common than traditional classrooms. These new ways of learning brought about new educational technologies such as Zoom, Canvas, Google Classrooms, and Blackboard Learn. The study revealed how chemistry teachers are gradually embracing these technologies and keying into their usage. It will however, take some time for a nation like Nigeria to fully key into it given the myriads of challenges associated with use of technologies. As these technologies likely aren't going anywhere for a long time, improvements need to be made to ensure the quality of our learning system

This study has shown generally that technologies have far reaching implications in teaching and learning at the secondary school level in Nigeria given the perceived usefulness by teachers. Unfortunately, not all teachers in the country have keyed into the use of technologies. The need for further development and use among teachers particularly at this level is highly necessary. The study therefore recommends that employers of teachers and teachers themselves should take advantage of the several on-going in-service training on ICT by participating with enthusiasm and partnering with organizers in such in-house and on-the-job training for teachers and instructors in the use and application of ICT tools, hardware, and software – which are critical for efficient

teaching and 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. Teachers should be encouraged to acquire technological tools or gadgets such as good android phones and laptops which are essential for online leaning. Where possible, loan should be given the teachers to purchase them. They need to be more engaged in online education so as to become efficient in the use of the technological tools. 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.

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