

STRATEGIES FOR IMPROVING ONLINE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS IN A PANDEMIC ERA IN KOGI STATE, NIGERIA

BY

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Abstract

This study looked for ways to enhance chemistry instruction online during a pandemic in Kogi State's secondary education system. The study used a descriptive survey research design. There were 122 chemistry teachers in the study population. Using a multi-stage sampling technique, 93 chemistry teachers from two education zones made up the study's sample size. Two research questions and two null hypotheses served as the study's compass. The structured questionnaire known as the "strategies for improving online teaching and learning questionnaire" (SIOTLQ) was used as the data gathering tool. Using Cronbach Alpha, the instrument's dependability index was found to be 0.91. Statistics such as mean, standard deviation, and t-test were used to examine the acquired data. The findings showed that the majority of the items on the list—including setting up social media platforms, allowing for feedback, and maintaining a steady supply of electricity—were effective methods for enhancing online chemistry instruction during a pandemic. However, the majority of the other items on the list—such as the infrequent training of chemistry teachers, the absence of technical support, and a lack of motivation—were barriers that educators had to overcome in order to improve chemistry instruction in secondary schools during a pandemic. Based on the findings, the study recommends among others that government and other stakeholders in education should create adequate strategies that would improve online teaching and learning of chemistry in secondary schools which would make the students to derive motivation in their study so as to ensure maximum productivity and efficiency in chemistry subject.

Keywords: Chemistry, Strategy, Pandemic, online teaching and learning

Introduction

A body of information, a method of inquiry, and a way of thinking that are all aimed at comprehending nature and phenomena associated with it are together referred to as science. According to Aniodoh (2018), science is a collection of knowledge derived via methodical, systematic procedures based on speculative observation and experimentation. An important part of human society is science. It is acceptable to state that science has a major role in shaping cultural, socioeconomic, political, technological, and even religious activities.

Without science, modern methods of living would not be feasible. Over time, scientific advancements have permeated and impacted every facet of human effort, making it exceedingly difficult for someone who lacks scientific literacy to thrive in modern society (Basilaia, 2020). Any country that wants to see the kind of rapid growth and advancement in science that we are seeing today needs to raise the bar for its educational system. Since human engagement with science is inescapable, the importance and worth of science in the modern world cannot be overstated (Ekpo, 2016). Opuh (2014) asserts that the world as we know it now would not exist without science. A scientific study conducted in 2018 by Eze and Ezemagu reveals that many secondary schools in Nigeria still use face-to-face training in a classroom, which is based on traditional teaching methods. The majority of educators choose a didactic style of instruction, failing to engage students in the kind of active learning that science promotes. Among the basic science subjects are biology, chemistry, and physics.

One of the fundamental science courses in the Federal Ministry of Education's high school curriculum is chemistry (2007). Achimugu et al. (2023) state that it is concerned with the study of matter, including its composition, characteristics, applications, and transformations under various circumstances. It is the branch of science that studies the qualities, composition, structure, and changes that atoms go through when they interact with other molecules. According to Mary (2017), it is also the study of matter and its characteristics, as well as how and why different substances mix or separate to create new ones and how they relate to energy. In many different areas, including food production, clothing, housing, transportation, nursing, medical, pharmacy, agriculture, engineering, and geology, chemistry plays a major role in the growth of the country. Chemistry students in Nigerian secondary schools today are few in number and perform quite poorly as a result of some teachers' incapacity to apply effective teaching strategies, which causes students to form false beliefs about the subject of chemistry (Okafor, 2013).

As was previously said, chemistry is a fundamental science subject taught in all senior secondary schools in Nigeria, with the understanding that it is abstract in nature. It is the duty of secondary school chemistry teachers to use a range of instructional tactics, such as online teaching and learning strategies, to help pupils relate to and understand the subject matter (Achimugu, 2016). Teachers use many teaching tactics to help students advance in their career pathways by teaching chemistry.

The clever distribution of resources using a special system of actions to accomplish a goal is known as strategy. A strategy is a set of activities that work together to accomplish a specific goal. A strategy is a long-term plan of action intended to accomplish a specific objective, usually winning and/or outperforming the competition. It is the process of creating a special combination of actions to accomplish a task. The use of online learning to support secondary school achievement is one of the recognized strategies in secondary education (Okafor et al., 2019). Among these uses for online teaching and learning are the configuration of MOODLE, the learning management system, and the utilization of application technologies like Zoom and Google Meet. According to Basilaia and Kvavadze (2020), these applications have improved secondary school students' performance at various institutions and helped stop the COVID-19 virus from spreading. A few Nigerian colleges have included blended learning—online instruction combined with traditional in-person instruction—into their curricula. In order to meet the technological problems posed by the introduction of technology into the

education sector, this adoption was imperative. However, how well the education sector uses its technical resources may influence how successful this adaptation is. Determining solutions that could enhance the use of online teaching and learning becomes crucial as a result.

The term "online teaching and learning" refers to any type of learning that happens virtually. Stated differently, it refers to any type of education that does not occur in a conventional classroom. Other terms for it include remote learning, virtual learning, and e-learning. It entails teachers instructing their students using electronic devices or the World Wide Web (www). According to Okafor (2021), online education is quickly becoming more and more popular in Nigeria and around the world. Following the last pandemic, there was a sudden and intense interest in digital learning platforms among instructors and students as a substitute for traditional classroom settings and whiteboard instruction. The search for virtual education will most likely go on after the epidemic, assuming it doesn't happen again anytime soon. Thus, there is a chance for Africa's burgeoning startup scene to offer the necessary online education option. Chemistry instruction has shifted from traditional face-to-face classroom settings to online learning environments, which is a symptom of the emerging knowledge economy (Arkofu & Abaidoo, 2014). Because of the intrinsic exponential growth of information and communication technologies, one of the advantages of the advancement of chemistry is this kind of learning. Due to network issues or limitations, many teaching and learning gadgets have a limited amount of time or connectivity. The radio therefore proved to be most workable and used since it is not easily restricted by network unavailability.

Scholars have put up recommendations for enhancing virtual education. For instance, ideas were put out to improve secondary school students' online instruction and learning during the epidemic by setting up an e-classroom (Okafor et al, 2019). Suggested methods for teaching and learning chemistry online were discussed in a Facebook group dedicated to the subject. These methods were based on the technology teaching content knowledge framework (Ramesh, 2021). The benefits of online learning were comfort, accessibility, and remote learning; nevertheless, it was constrained by inefficiency and the challenge of student supervision (Dhawan, 2020). Teachers should attempt to keep an eye on their students and increase their learning efficiency when they are teaching online. Online educators may also observe several elements that impact the quality of online learning. Anxiety among students in online learning during the epidemic has a negative correlation with their liking of foreign languages. During the epidemic, their coping mechanisms, negative emotions, and good emotions coexisted in online learning. Their coping strategies and stressors were significantly impacted by internet resources, reflection, and overall happiness (Liguori & Winker, 2021). Therefore, it is critical that online course designers give these interrelated issues adequate consideration. Online education, however, may have detrimental effects on students' attitudes and health. Due to their frequent participation in online learning during the epidemic, children may experience eye strain (Ode et al, 2020).

The knowledge and experience that educators and students have with information and communications technology (ICT) may influence the selection of an appropriate and pertinent online learning strategy. Compared to traditional teaching techniques, online learning has several advantages, such as enhancing students' motivation, perceptions, interaction, and communication (Chin, 2020). Learner satisfaction, online participation, active engagement with learning, indulgences with learning, perceptions of learning, and academic success are all related to

students' motivation in an online environment (Dignan, 2020). For many students, particularly those who are timid, online courses offer an additional benefit (Okafor, 2013). According to Stoyanva and Youkov (2016), some of the objectives of online teaching and learning are: to offer a viable alternative route to more opportunities in education, particularly in secondary education; to offer educational resources to people who view education as a lifelong endeavor; to deliver high-quality instruction and learning; to satisfy students' learning requirements; and to enhance user accessibility and time flexibility to involve learners in the process. According to Mahanta and Ahmed (2012), online learning increases engagement, offers flexible scheduling, and facilitates work-based learning. In order to meet the goals of the education sector, more effective solutions that may be found in research studies must be used to improve the usage of online teaching and learning.

Finding methods to enhance its use in the teaching and learning of chemistry has not yet received enough attention, despite a number of studies on the challenges and potential of online teaching and learning in secondary schools (Aboderin, 2015). Bello and Okike (2020) report that although Nigerian academics have expressed interest in adopting online teaching and learning resources, the amount of online time teachers spend using these resources in Nigerian secondary schools is still low, which presents a significant issue, particularly in the context of a pandemic. There are things to take into account for the effective improvement of online teaching and learning during pandemic periods in order to improve online teaching and learning tactics in secondary schools. They include but not limited to, types of technology, nature of curriculum, mode of delivery, administrative issues and competency framework.

An outbreak, whether national or international, is known as a pandemic era. It is a period of time when a disease that spreads widely by air sweeps across the globe or country. The pandemic typically causes disruptions to the traditional teaching approach, requiring students to attend classes virtually (Carey, 2020). At all educational levels, the pandemic has contributed to a drop in pupils' chemistry learning outcomes (Okafor, 2021). Unless there is a radical shift in the global strategy for managing infectious diseases, future pandemics will appear more frequently, spread faster, do greater harm to the global economy, and kill more people than COVID-19. It might significantly affect learners, teachers, and educational institutions everywhere in the world (Vaibhav, 2020). A pandemic typically spreads quickly, striking nearly every nation and territory on earth. One such example is the Covid-19 pandemic, which was initially discovered in Wuhan, China, in December 2019. Every nation in the world issued a warning to the populace during this pandemic to exercise responsive care. Hand washing, donning face masks, physically separating oneself, and avoiding large gatherings and meetings were among the public health tactics.

Globally, the pandemic era was a challenging time. Nations' economies came to a halt, travel across borders and between countries was prohibited, and education suffered greatly, particularly in developing nations like Nigeria where there was a decrease in educational standards (Harasim, 2017). Beginning on August 1, 2020, the entire country was placed under lockdown (Ramesh, 2021). In the interim, people could move around, businesses started operating, and schools and institutions resumed online instruction for some students while reopening for others. The effects were extensive and continued to have an impact on learning throughout that academic year. During that time, a number of institutions, universities, and schools stopped offering in-person instruction. The world had already seen a great deal of it, and this was truly enlightening for all teachers, encouraging them to embrace tactics that enhance instruction should they encounter

similar difficulties in the future. For online teaching and learning, new and improved instructional approaches must be developed and put into practice immediately. We have a chance to improve online teaching and learning because of the pandemic (Dhawan, 2020). Liguori and Winkler (2018) assert that the only way to address the issue of teaching and learning chemistry in the context of a pandemic is to switch to online instruction. It is critical to implement online teaching and learning methodologies in order to recognize the variety of needs that students have for their online education. Accordingly, the purpose of this project is to look into ways to enhance chemistry instruction online in secondary schools during a pandemic.

Statement of the problem

Researchers have determined that chemistry is abstract in nature, and that teachers must use appropriate teaching tactics to help pupils understand it (Achimugu, 2016). Because they believe that online instruction reduces opportunities for teacher-student connection, educators have not used a range of teaching methodologies, including online teaching for the delivery of chemistry. The COVID-19 pandemic of 2020 opened everyone's eyes, even chemistry stakeholders in the field of education. Research indicated that the pandemic played a role in the reduction of students' chemistry learning outcomes. What would happen if the pandemic happened again in the future, is a mystery. This study looks for ways to enhance online teaching and learning approaches, particularly in the field of chemistry. Based on the foregoing, the problem of this study put in question form is: what are the strategies for improving online teaching and learning of chemistry in a pandemic era?

Research Questions

The following research questions guided the study:

1. What are the strategies for improving online teaching and learning of chemistry in secondary school in a pandemic era?
2. What are the constraints faced by teachers on the strategies for improving online teaching and learning of chemistry in secondary school in a pandemic era?

Research Hypotheses

Based on the research questions of the study, the following null hypotheses were tested at 0.05 level of significance in this study.

H₀₁: There is no significant difference between the mean responses of male and female teachers on strategies for improving online teaching and learning of chemistry in secondary schools in pandemic era.

Methodology

The research design used in the study was descriptive. 122 chemistry teachers from Kogi State's 254 public secondary schools made up the study's population. The sampling technique used in the study was a multi-stage procedure. Ninety-three chemistry teachers made up the sample size used in the study. Taro-Yamane's formula for determining sample size was utilized to ascertain the sample size. The "Strategies for Improving Online Teaching and Learning Questionnaire" (SIOTLQ), a self-created questionnaire, was used in the data collection procedure. Three specialists, two from the Prince Abubakar Audu University school of education's Science Education department and one from the Measurement and Evaluation department, carefully reviewed the researcher's self-developed questionnaire. A

trial test was carried out at a few secondary schools that weren't included in the sampled schools to assess the instrument's reliability. Thirty chemistry professors received copies of the questionnaire during this trial. The instrument's internal consistency was evaluated using the Cronch Alpha coefficient, yielding an overall reliability score of 0.91. The mean and standard deviation, two descriptive statistics, were used to address the research topic. Using t-test statistics and a significance threshold of 0.05, the hypotheses were investigated.

Results

Research Question One: What are the strategies for improving online teaching and learning of Chemistry in a pandemic era?

Table 1

Mean ratings and Standard Deviations of respondents on strategies for improving online teaching and learning of Chemistry in a pandemic era.

S/N	Item Statement	Mean	SD	Decision
1	Creating social media platforms for online teaching and learning of chemistry.	3.74	.624	agreed
2	Structure timeframe for online teaching/learning of chemistry at senior secondary schools during pandemic era.	2.23	.420	disagreed
3	There be provision for feedback from the students	2.53	.420	agreed
4	Chemistry teachers be able to build digital collaborations with peers	2.55	.715	agreed
5	Build a clear communication stream with your students' family.	2.78	.413	agreed
6	Chemistry teachers be involved in the video lecture delivery	2.65	.654	Agreed
7	Both teachers and students be actively engaged in online activities	2.93	.554	agreed
8	Equipped schools with networking materials	3.06	.247	agreed
9	Chemistry teachers be well trained on the use of online facilities.	2.59	.660	Agreed
10	Chemistry teachers always administer online assignment to their students.	2.65	.702	agreed
11	Government is to provide adequate funds for	2.82	.756	Agreed

Key: N: number of respondents, SD, standard deviation

The mean and standard deviations of the tactics for enhancing Chemistry online instruction and learning in a pandemic period are displayed in Table 1. The majority of the things in table 1 above, according to the respondents, are effective tactics for enhancing Chemistry instruction delivered online during a pandemic. This is because these items' mean ratings are higher than the 2.50 threshold that was established.

Research Question Two: What are the constraints faced by teachers on the strategies for improving online teaching and learning of chemistry in senior secondary school in a pandemic era?

Table 2: Mean ratings and Standard Deviations of respondents on constraints faced by teachers on the strategies for improving online teaching and learning of chemistry in senior secondary school in a pandemic era.

N = 93				
S/N	Item Statement	Mean	SD	Decision
12	Irregular training of chemistry teachers on the improvement of online knowledge in teaching and learning of chemistry.	2.55	.500	Agreed
13	Inability of chemistry teachers to utilize online teaching materials.	2.53	.827	Agreed
14	Inadequate power supply	2.53	.554	Agreed
15	Lack of self-motivation toward utilization of online resources	2.66	.567	Agreed
16	Lack of sufficient funds for the purchasing of online gadgets by the Government	2.42	.665	Disagreed
17	Unavailable technical support from the school administrators to the teachers.	2.57	.826	Agreed
18	Unorganized time management	2.51	.816	Agreed
19	Lack of interest in teachers about the use of online materials	2.52	.880	Agreed
20	Inability to maintain discipline in online classes	2.45	.801	Disagreed
21	Low internet network in Kogi State.	2.62	.908	Agreed
22	Lack of provision of free networking facilities eg Free Wifi devices.	3.13	.958	Agreed
23	Lack of technological software knowledge	2.67	.665	Agreed

Key: **N**: number of respondents, **SD**, standard deviation

The results in Table 2 illustrate the means and standard deviations of the challenges teachers faced when trying to improve Chemistry instruction online during a pandemic. The participants reached a consensus that the things listed in Table 2 above represent the obstacles that educators must overcome in order to enhance Chemistry education through online means during a pandemic. This is because these items' mean ratings are higher than the 2.50 threshold that was established.

HO₁: There is no significant difference in the mean responses of male and female teachers on strategies for improving online teaching and learning of chemistry in senior secondary schools in pandemic era.

Table 5

t-test analysis of the significant difference between the mean ratings of male and female chemistry teachers on strategies for improving online teaching and learning of chemistry in senior secondary schools in pandemic era

Gender	N	Mean	SD	Df	t-value	p-value
Male	45	2.50	0.49	91	2.03	0.13
Female	48	2.65	0.44			

Result in Table 5 shows the t-test result of the significant difference in the mean ratings of male and female chemistry teachers on strategies for improving online teaching and learning of chemistry in senior secondary schools in pandemic era. Result shows that t-test of 2.03 was obtained with a probability value of 0.13. This probability value was compared with 0.05 set as level of significance and it was found not to be significant. Thus, the null hypothesis was not rejected. Inference drawn therefore is that male and female respondents did not differ significantly in their opinion on the strategies for improving online teaching and learning of chemistry in senior secondary schools in pandemic era.

Discussions of the Findings

Strategies for improving online teaching and learning of Chemistry in a pandemic era

By calculating the mean and standard deviations, the tactics for enhancing Chemistry instruction online in secondary schools during a pandemic were evaluated. Table 1's summary of results showed that, with the exception of item 2, all of the items are acknowledged or agreed upon as effective ways for enhancing Chemistry education delivered online during a pandemic. The outcome is consistent with the research conducted by Adolphus et al. (2022), which showed that students at the National Open University of Nigeria (NOUN) believe the tactics used to enhance online teaching and learning are

successful. The results of the study are in line with those of Okeoghene (2021), who looked at how to improve online teaching and learning in university systems using the Zoom platform and discovered that while it is a good platform for delivering online lectures, it lacks the functionality to administer and grade assessments. The results of the study are consistent with those of Uzomba and Franklyn (2022), who looked at ways to enhance the knowledge and abilities of online educators for successful virtual instruction. They also identified six noteworthy virtual teaching technologies and applications, including Facebook, Zoom, Google Classroom, and Interactive Whiteboards. Similarly, the outcome aligns with the research conducted by Akhtar et al. (2023) on online teaching and learning approaches in the field of engineering: Teacher Perspective on Challenges Faced and Recommendations, and found that virtual teaching in the context of COVID-19 for closing the achievement gap and guiding students' futures in difficult times should be accepted as a strategy for improving online teaching and learning. In summary the strategies for improving online teaching and learning of Chemistry in a pandemic era include; creating social media platforms such as WhatsApp, chrome, facebook, telegram among others.

The adoption and utilization of these online teaching and learning platforms are very significant in education as they have a lot of advantages over traditional mode of instruction including flexibility, convenience and global research among others.

The constraints faced by teachers on the strategies for improving online teaching and learning of chemistry in senior secondary school in a pandemic era

Table 2's mean and standard deviations were used to evaluate the limitations teachers experienced when attempting to improve Chemistry instruction online during a pandemic. The results of the respondents' survey indicated that the items are the barriers that educators must overcome in order to improve senior secondary school chemistry instruction online during a pandemic. The findings are consistent with those of Diovu and Onyejele (2021), who examined the availability and use of digital technology tools for teaching and learning in secondary schools in the Nsukka local government area during the COVID-19 pandemic lockdown. They discovered that while more advanced digital technology tools, like internet access, projectors, and interactive whiteboards, were lacking in the sampled schools, digital technology tools like computers, printers, and mobile phones were present and in use. These are a some of the obstacles that educators in the current era of online Chemistry instruction must overcome. The findings are consistent with Yung's (2021) investigation into the impact of the COVID-19 pandemic and the challenges faced by educators on the online learning habits of Taiwanese university students. Yung concluded that the pandemic had an effect on students' online learning habits and suggested the use of asynchronous online learning strategies as a means of preserving students' academic progress during the pandemic. This indicates that chemistry teachers are not regularly trained in the advancement of online information in chemistry teaching and learning, they are unable to make use of online teaching resources, Insufficient power supply, a lack of motivation to use online resources, a lack of funding to allow the government to buy internet devices, Lack of technical assistance provided to teachers by school administration Teachers in the epidemic era have a number of challenges, including disorganized time management and a lack of interest in using internet resources. Consequently, internet platforms help educators and students stay productively and

educationally engaged, preventing boredom from becoming a factor that could lead to irresponsibility during lockdowns for current and future pandemics.

Conclusion

Based on the study's findings, Kogi State's online chemistry instruction during a pandemic is linked to a number of tactics, including the development of social media platforms, the availability of feedback, and a consistent supply of energy. Based on the results, it is also possible to conclude that secondary school pupils in the study area have access to efficacious chemistry teaching methodologies. Therefore, if the goal of the subject is to be met, all hands must be on deck by the involved parties in order to overcome the pandemic problem linked with online teaching and learning chemistry in the study area.

Recommendations

On the basis of the findings of this study, the following recommendations are made.

1. In order to promote online teaching and learning of Chemistry, government and other stakeholders in education should create adequate strategies that would improve online teaching and learning of chemistry in secondary schools which will make the students to derive motivation in their study so as to ensure maximum productivity and efficiency in chemistry subject.
2. The findings of the study could be made available to authorities responsible for making educational policies and a reference point on policy decisions on online teaching and learning of chemistry in secondary schools.
3. All other researchers in the area of online teaching and learning should adapt this instrument and use it as a major reference point especially in collecting data on teachers and students towards online teaching and learning of Chemistry.

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