

**VIEWS OF TERTIARY INSTITUTION SCIENCE LABORATORY  
TECHNOLOGISTS ON VIRTUAL LABORATORY AMIDST COVID-19  
OUTBREAK IN NIGERIA**

**By**

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**Abstract**

*Usage and switching from physical to virtual laboratories is fast growing and gaining more momentum and popularity among the teachers, students and technologists as a result of advancement and improvement in Information and Communication Technology (ICT) in this 21<sup>st</sup> century otherwise known as digital age which is also necessitated by the spread of Covid-19. The design for this study was descriptive study. The study sampled thirteen (13) laboratory technologists who were conveniently selected across the federal and state tertiary institutions in Nigeria responded to the Google form questionnaire link shared on their various WhatsApp platform. The instrument used for this study was adapted and tagged “views of Science Laboratory Technologist on Virtual Labs Questionnaire” with three possible Likert scales (Agree, Neutral and Disagree). The face and construct validity of the instrument was determined by ICT experts and analyzed with a validity and reliability indexes of 0.72 & 0.68. The data collected were analyzed using descriptive statistics (frequency, percentages and chart diagram) Overall feedback shows that most laboratory scientists’ (75%) concluded that virtual laboratories aid teaching-learning process, especially during the period of Corona Virus pandemic lockdown and to a greater extent, it helps the application of students’ theoretical knowledge into practice, it promotes students self-learning, prepare students to get more*

*familiar with experiments' and also helps them to handle the equipment correctly before entering physical labs.*

**Keywords:** Covid-19, Virtual laboratory, Physical Laboratory, and Science Laboratory Technologists

## **Introduction**

Africa like every other continents of the world is plagued with corona virus disease (Covid-19) pandemic. The pandemic has forced countries of the world to enforce total and partial lockdown which schools, gatherings, market places, worship centres, economics centres were not left out that was later resulted to serious economic crisis and recession. One of the numerous measures and safety rules put in place by the health apex body World Health Organization (WHO) to curtail the spread of the deadly virus is to ensure social/physical distancing which make it impossible to have physical classroom lessons and interaction across the affected countries. Nigeria as one of the affected country through her National Educational Council and Presidential Task force on Covid-19 suggested that the nation educational sector should subscribe to virtual classroom using virtual learning tools and educational apps to teach, learn and disseminate information. The usage of virtual classes included the laboratory work for all categories of students.

Usage and switching from physical to virtual laboratory is gaining more popularity as a result of advancement and improvement in Information and Communication Technology (ICT) in this 21<sup>st</sup> century otherwise known as digital age which is also necessitated by the spread of Covid-19. Hand-on and Mind-on, practical and experiments are essential organs of science and technology targeted to equip the students with valuable skills for their tasks in and outside academics environment.

Vasiliadou (2020) opined that students perform experiments at home occasioned by corona virus disease outbreak conveniently with the introduction of virtual laboratories. The scholar further asserted that not all physical laboratories skills can be replaced by virtual laboratories. However, virtual laboratories work encourages online experiments without time limitations, receive instant result, and familiarize with laboratory safety and health rules, repetition of activities without wasting laboratory wares and generation of data for assessment.

Chiu, Dejaegher and Chao (2015) defines virtual science laboratories as software based tools created to mimic scientific and experiments processes as possible in a traditional science

laboratory. This can be developed in forms of multimedia and simulation that are frequently used in many aspects of science and applied science such as physics, chemistry, biology, astronomy and earth sciences.

Virtual experiments delivered with either of the virtual labs using Information and Communication Technology (ICT) tools add value to physical hand-on experiments by allowing the students to explore unobservable phenomenon (Jong, Linn, & Zacharia, 2013). Virtual laboratory is found useful in improving students' positive performance in science especially in a situation where the reagents and equipment are limited and expensive, lack of technical know-how, poor handling of sophisticated equipment/apparatus and use of hazardous substances that may cause temporary and permanent deformity (Rakhi, et al. 2014). Chaturvedi and Dharwadkar (2011) described the criteria in designing experiments in virtual labs. They are:

- i. The salient features of each physical experiment must be preserved in the physical to virtual domain mapping;
- ii. The objectives, experimental procedure, data acquisition and expected outcomes of the experiments are replicated with the reasonable care so that the virtual experiment can serve as a proxy for the physical experiment during the pre-lab practice session.
- iii. The virtual labs experiment must be interactive and allow for online and offline practice session;
- iv. The operation of virtual labs experiment including manipulation of a key components, must be based either on empirical data collected from physical experiment.

The Massachusetts Institute of Technology and Harvard University specify the advantages and hiccups of visual laboratory over the physical laboratory.

1. Benefit of savings: virtual lab provides a cost efficient way for schools and universities to organized high quality laboratory work in science, technology and engineering disciplines;
2. Flexibility: different visual experiments involving diverse components can be created easily;
3. Multiple access: several students can use the same virtual equipment at the same time;

4. Change in the system configuration: it is possible to modify parameters that often cannot be changed in a real system in a robotic lab;
5. Damage resistance;
6. Making the “unseen” seen.

Virtual laboratories otherwise known as simulation laboratory are mainly used for two purposes in science education. It is being used to avail the students at all categories with visual representations of science concepts and to prepare them for physical laboratory and virtual labs;

**Table 1**

*Types of Science Laboratory*

Types of lab	Advantages	Disadvantages
Physical lab	<ol style="list-style-type: none"> <li>1. Access to real equipment</li> <li>2. Access to real data</li> <li>3. Face to face interaction with teachers/instructors/technologists</li> </ol>	<ol style="list-style-type: none"> <li>1. Scheduled lab hours</li> <li>2. Need trained personnel</li> <li>3. Cost of equipment</li> <li>4. Maintenance issues</li> <li>5. Prone to accident</li> </ol>
Animation based labs	<ol style="list-style-type: none"> <li>1. Visual demonstration of experiments and detailed step – by-step explanation</li> <li>2. Close proximity to real lab scenario</li> <li>3. No ethical issues</li> </ol>	<ol style="list-style-type: none"> <li>1. Only visual presentation is provided to users</li> <li>2. Idealistic results</li> <li>3. Need basic knowledge operating of computers</li> </ol>
Simulation based labs	<ol style="list-style-type: none"> <li>1. High degree of interactivity</li> <li>2. Users can change the variables, which emulated real data</li> </ol>	<ol style="list-style-type: none"> <li>1. Understand the instructions</li> </ol>

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	3. Helps to analyze critical mistakes one could perform in a physics set up	before practicing experiments
	4. Repeatability	2. Need basic knowledge for operating computers
Remote triggered lab	1. Access to real and costly equipment	1. Network related issues
	2. Anytime access and repeatability	2. Single user at a time (slot booking).
	3. Instrument damage comparatively low	

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Source: Adapted from Diwakar, et al. (2016)

This present study suggests the science laboratory technologists' views on virtual labs. This study was necessitated as a result of first, second third and fourth ( Also known as Delta Variant) waves of corona virus disease pandemic that has forced all sectors of economy to enforce lockdown and also discourages face to face classroom lessons.

Erdan, *et al.* (2020) carried out a study on effects of virtual laboratory on learners' academic achievement and perceived learning. The study was a sequential explanatory mixed methods design involving both qualitative and quantitative. The study sampled 65 students which 33 were tagged group A and 32 tagged group B. Group A was exposed to hand-on physical laboratory and group B were exposed to virtual laboratory activities. At the end of the laboratory activities, selected students were interviewed on the experience gained so far. The quantitative data collected was analyzed using the Analysis of Covariance (ANCOVA) and qualitative data was analyzed using thematic descriptive analysis which includes creating codes and then developing the themes of set of codes. The result of the study revealed that virtual lab students (group B) expressed that the virtual laboratory practical experience contributed to their knowledge except two students out of 65 students who find it difficult to cope and learned how to conduct experiments setting by practicing with virtual laboratory.

Diwakar, et al (2016) worked on assessing students and teachers experience on simulation and remote biotechnology virtual labs: a case study with a light microscopy experiment. The study sampled 250 students and 100 teachers who are exposed to hands-on

workshops. The findings of the study revealed that 48% of students supported interactive simulations with the reasons that it helped them to apply their theoretical knowledge into practice. 44% of students suggested that continuous use of simulations in their workshop motivated the use of ICT enabled tools in their education. 56% of students suggested that they got a real feel of experiments and equipment as in a physical hands-on laboratory, with the claim that there was a high degree of interactivity between users and computers while performing simulations. Virtual laboratories offer learners the crucial infrastructure needed to aid task completion especially the distance education learners without attending physical laboratory facilities (Hassan, et al., 2022).

Corona virus pandemic ravaging the world forced many schools at all level of education to close down and subscribe to virtual learning. This study tends to assess the views of science laboratory technologists on virtual labs. Virtual laboratory application in the teaching and learning module of laboratory activities in the fields of both basic physics, electronics, sciences and technology as whole were found efficient and effective( Sriadhi, et al., 2022).

This study assessed the views of science laboratory technologists on virtual laboratory. Specifically, the study tends to assessed:

1. Science laboratory technologists' awareness of virtual laboratory
2. Science laboratory technologists' views on virtual laboratory

### **Research Questions**

1. What is level of science laboratory technologists' awareness of virtual laboratory?
2. What are the views of science laboratory technologists on virtual laboratory?

### **Methodology**

The study was carried out to assess the views of science laboratory technologists of Federal and state tertiary institutions on virtual laboratories. Fifteen (15) science laboratory technologists were sampled using convenience sampling technique. An adapted questionnaire tagged "Views of Science Laboratory Technologist on Virtual Labs Questionnaire" Descriptive statistics (Pie chart and Percentage) was used to answer the research questions. The design for this study was descriptive study. The study sampled fifteen (15) conveniently selected technologists across the federal and state tertiary institutions in Nigeria while thirteen (13) responded to the questionnaire.

The instrument used for this study was adapted and tagged “Views of Science Laboratory Technologist on Virtual Labs Questionnaire” with three possible Likert scales (Agree, Neutral and Disagree). The face and content validity of the instrument was determined by ICT experts and the responses were analyzed using Pearson Product Moment Correlation (PPMC). The validity and reliability indexes of the instrument was 0.72 and 0.68 respectively. The instrument questionnaire was prepared on Google form and shared via a link through respective respondents WhatsApp platform for easy and possible responses.

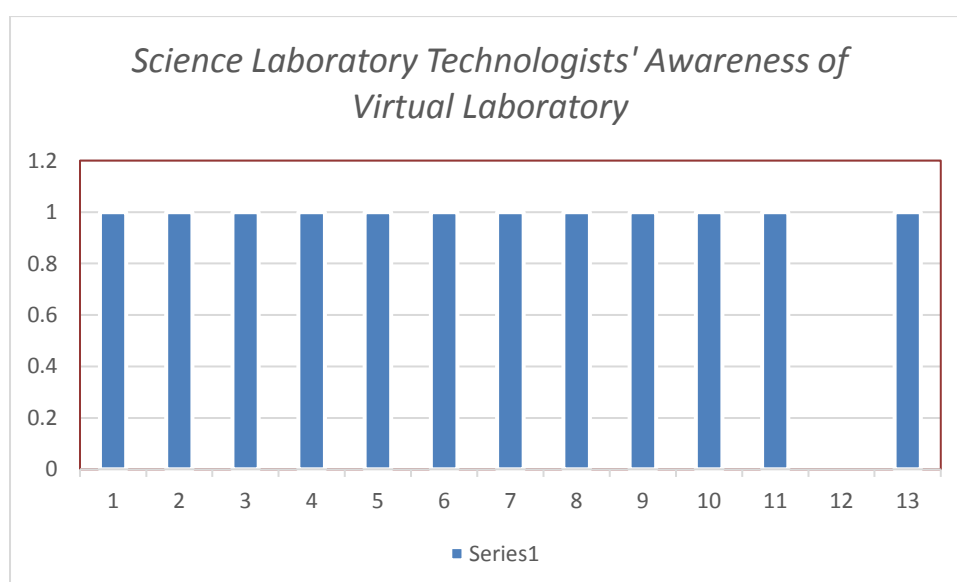
## **Results**

Table 2 and figure.1 shows the science laboratory technologists’ awareness of virtual laboratory. The chart below shows that thirteen (13) respondents but one (1) out of the thirteen respondents was not aware of virtual laboratory activities.

**Table 2**

*Science Laboratory Technologists' Awareness of Virtual Laboratory*

Awareness	Frequency	Percent	Valid Percent	Cumulative percent
Aware	12	92.3	92.3	92.3
Not aware	1	7.7	7.7	100.0
Total	13	100.0	100.0	



Source: Researchers field study (2022).

The second objective of this study that sought to investigate views of science laboratory technologists on virtual labs. Twelve responses were analyzed here because two out of the respondents didn't send the feedback and respond to the questionnaire sent to their WhatsApp platform as at the time of writing this report. Other one technologist chooses not to be aware of the visual labs and the technologist view was not captured in ensuring sincere report.

**Table 3**

*Science laboratory scientists view on virtual labs*

Questionnaire Items	Agree	Neutral	Disagree
Visual learning and simulation tools are available in my institution	33.3% (4)	8.3% (1)	58.3% (7)
Visual labs application helps students theoretical knowledge to practice	75% (9)	-	25% (3)
Virtual labs application motivate students to use ICT tools	83.3% (10)	-	16.7% (2)
Virtual labs promote students centered learning approach	33.3% (4)	16.7% (2)	50% (6)
Virtual labs are more consistent in view of easy access and realistic data	50% (6)	8.3% (1)	41.7% (5)
Virtual labs provides a close proximity to real lab experience	66.7% (8)	-	33.3% (4)
Virtual labs are helpful in teaching basic lab techniques easily with standardized protocols and enhance, intensify and motivate students in learning	83.3% (10)	-	16.7% (2)



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Virtual labs are helpful to teach step-by-step procedure of an experiment and prepare students to operate equipment correctly before entering to physical lab	66.7% (8)	8.3% (1)	25% (3)
Virtual labs are supplementary tools that can easily access to train students at any time	83.3% (10)	8.3% (1)	8.3% (1)
Virtual labs imitates an experiment exactly like doing in physical lab with respect to materials and results	25% (3)	8.3% (1)	66.7% (8)

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Source: Researchers field study (2022).

The result presented in Table 3 revealed the science laboratory technologists' views on virtual laboratories. The findings show that the virtual laboratories prepare students for the physical laboratory, enable them to get familiar on laboratory activity, how to interact with laboratory equipment and protocols.

### **Discussion**

In this study, views of the science laboratory technologists were collated and analyzed. The study used direct links and approach via social media platform (WhatsApp.) to acquire responses from the respondents. Data collected, collated and analyzed from the overall study indicated that science laboratory technologists were aware of existence of virtual laboratory except one technologist who has no idea of virtual laboratory existence. Overall feedback shows that most laboratory scientists' (75%) concluded that virtual laboratories aid teaching-learning process, especially during the period of Corona Virus pandemic and to a greater extent, it helps the application of students' theoretical knowledge into practice, it promotes students self-learning, prepare students to get more familiar with experiments' and also helps them to handle the equipment correctly before entering physical labs. The use of all forms of virtual laboratory is highly recommended for teaching-learning process at all level of education to aid students' access to timely practical experience.

### **Conclusion**

Virtual learning has been made easy through the intervention of online search engines that initiate and housed many educative models, pictures, video and even gives rooms for many educative and non-educative simulations developer to harness their resources in promoting all sectors of economy. It is very essential that the present period that is plague with Corona Virus disease in which the number of the students or audiences in a function or classroom are reduced to barest minimum to reduce the spread of this deadly disease and need to keep abreast the learners, teachers and the laboratory scientists

the inclusion of virtual laboratory/simulation into learning and teaching processes. The findings of the study revealed that most laboratory scientists are aware of virtual laboratory existence and such should be used for teaching of practical activities in our various schools for the time being.

### **Recommendations**

1. The virtual laboratory will go a long way in helping the students to acquire basic skills in practical class.
2. The use of virtual/simulation laboratory should be used by the teachers and laboratory scientists to teach students.
3. The schools should try to adopt/adapt or create simulations activities that are relevant to what the students need to learn in school.

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