

**Effects of Video and Simulated Strategies of Virtual Laboratory on Undergraduate's
Attitudes towards Pharmacology in North-Central Nigeria**

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Abstract

The study investigated the effect of video and simulated strategies of virtual laboratory on undergraduates' attitudes in Pharmacology. The moderating effects of gender was also investigated. Experiential Learning Theory (EXL) guided the study. The study adopted a non-equivalent quasi-experimental design involving a pretest, posttest and a control group. Intact classes comprising 135 undergraduate students from three universities in North-Central Nigeria were purposefully selected for the study. Two null hypotheses were formulated, and tested at 0.05 level of significance. Four Instruments: The Students' Attitude Towards Pharmacology Virtual Laboratory Questionnaire (SAPV L Q), Virtual Laboratory Video Package (VLVP), Virtual Laboratory Simulation Package (VLSP), and Physical Laboratory (PL) were developed and used for the study which lasted eight (8) weeks. Analysis of covariance (ANCOVA) with Scheffe post hoc tests were used. The findings revealed a significant main effect of treatment significantly affected students' attitudes towards Pharmacology test ($F_{(2, 115)} = 274.37; p < .05; \eta^2 = .99$). Students in the VLV and VLS obtained higher mean score towards Pharmacology ($\bar{x} = 120.10$), ($\bar{x} = 111.22$) than the Control group ($\bar{x} = 49.95$). Gender had no significant effect ($F_{(1, 115)} = .33; p > .05; \eta^2 = .09$). The study recommended that since virtual laboratories; simulated modes and videos have improved students' attitudes toward pharmacology, lecturers and laboratory technologists/scientists in charge of the practical should be encouraged to use them to overcome the fears identified.

Keywords: Virtual Laboratory Video, Virtual Laboratory Simulation, Laboratory Instruction, Pharmacology, Undergraduates' Attitude

Introduction

Educational technology is the combined use of computer hardware, software, and educational theory and practice to facilitate learning. It is the process of integrating technology into education in a positive manner that promotes a more diverse learning environment and a way for students to learn how to use technology. The obvious difficulty in Nigerian university education is the availability and effective use of new technological tools that could enable graduates to meet the challenges of a rapidly changing world to compete on a global scale, new technological devices are redefining science laboratory practicals and experiments (Anjorin,2022). The virtual laboratory which is an aspect of educational technology enables an interactive environment for creating and conducting simulated experiments, it allows users to perform experiments on real systems and allow the sharing of laboratory resources among large community geographically while limiting set-up and operational costs. It introduces a balance between theory learned in the class setting and knowledge gained by experiments carried out in the laboratory. (Okoro *et al.*, 2015).

The learner is immersed in an artificial world that looks real, this aspect of. With the help of educational technology, students can receive advanced, personalized instruction that fully satisfies their learning needs and offers a high degree of flexibility and independence from time restraints and continuous materials updating to attain learning objectives and interests. Virtual laboratory in Educational Technology enhances understanding of core discipline concepts, allows repetition of experiments, and gives room for mistakes. Unfeasible experiments, experiments that cannot be replicated due to resources, time, and safety issues are possible with a virtual laboratory (Chan, & Fok. 2009; Seiler, Ptasik & Sell (2011). For universities, a virtual laboratory can reduce the costs associated with running a laboratory and can give access to modern laboratory equipment and learning tools, beyond what many teaching institutions would be able to provide physically, due to financial or practical constraints (De Jong, Linn & Zacharia, (2013). There are more emphasis in this computerized age on life-long learning to enhance undergraduates' attitude and the universities are expected to do this using new technologies in educational technology like the virtual laboratory simulation and videos. Orobor and Orobor, (2020) proposed the necessity for tertiary educational institutions in developing countries including Nigeria to adopt the use of the virtual laboratory to supplement the deficiencies of their science laboratory.

According to Anyaehie *et al.*,(2014) student interest in laboratory exercises appears poor and the reasons were mainly lack of equipment/manpower support and a large group. Also, a previous report Silverthorne (2000) , has demonstrated that traditional laboratory exercises put students through a strict programmed regimen that they are expected to follow, engaging them only physically and not mentally. Thus, student comprehension of the overarching concepts in practical sessions is poor, and their main focus is on getting the desired results and producing the required reports

Virtual laboratory experiments are an effective way to enhance student understanding pharmacological concepts and experimental processes. Most time Pharmacology animal practical are not concluded due to time constraints. The virtual laboratory can be used as an alternative to animal and tissue experiments and undergraduates can use it for animal practical. (Veena *et al.*, 2016; Dural 2019; Quiroga *et al.*, 2019).

Attitude can be perceived as a tendency to respond favorably or unfavorably concerning a given subject (Okobia & Ogumogu, 2012). Attitude is often seen as established conduct or mode of performance, which has to do with the interpretation of emotion or belief. The development of students' favorable attitudes toward science is one of the objectives of the science curriculum (Hofstein & Mamlok, 2011). The results of the attitude component are as crucial to the cognitive results. (Wan & Lee, 2017). Unfortunately, the cognitive domain is the only emphasis of most traditional science teaching. Teachers pay less attention to the affective learning domain. The secret to concept mastery is actually the students' attitude and desire in studying. Previous research found a strong correlation between science achievement and attitude toward the subject, with students who had a positive attitude performing better academically. (Sofiani *et al.*, 2017).

Conceptualized attitude as a mix of an individual's surveyed decision around a given element. Keter (2016), established that one way of improving students' attitudes towards sciences is through the use of laboratory apparatus present in physical laboratories as well as in simulations or videos present in virtual laboratories. A few studies have reported that students have a positive attitude and arrest attention when using a virtual laboratory programme (Gambari *et al.*, 2013). Attitudes can be improved positively in terms of liking as well as interest in performing experiments in virtual laboratories. Falode (2015), reported that students showed a preference towards the chemistry virtual laboratory than the physical laboratory. The study of Salawu and Oyarinde (2012), on student attitude shows there is no significant difference for learners expose to computer assisted instruction. While Ratamun and Osman (2018), concluded that attitudes in both physical and virtual laboratories when compared are the same. Although, information is scanty on students' attitudes and performance in respect of virtual laboratories in the area of pharmacology most of the study reviewed are from developed countries, and in respect to gender, it becomes an interest of research in this study.

Statement of the Problem

Experimental laboratory-based practical classes have been the cornerstone of undergraduate pharmacology; it supports the development of scientific and research skills in students, such as experimental design, data analysis, statistics, and report writing. Not all universities in Nigeria seem to have the facilities students need to build confidence in experimental methods. There are also issues with the difficulty of conducting animal experiments (John, 2013; Okeke *et al.*, 2014). The conventional laboratory is coming under increasing pressure due to the increase in student's population with no provision for expansion as a result of funding difficulties and poor

infrastructure. All these are required to provide hands-on experience, and a better attitude of students. This may affect student attitude and could also have an adverse impact on their performance.

New technologies could significantly improve students' attitude towards Pharmacology laboratory. Thus, this study determined the effect of video and simulated strategies of virtual laboratory in the teaching and learning of pharmacology. It also determined the effects of moderator variables gender (male and female) on student's attitude

Objectives of the Study

The main objective of this study was to determine the effects of video and simulated strategies of virtual laboratory on undergraduates' attitude toward pharmacology laboratory teaching and learning in North-Central Nigeria. The specific objectives include to:

- 1) Determine the pretest and posttest mean attitude scores among undergraduates exposed to the video virtual laboratory, simulated virtual laboratory, and traditional laboratory towards Pharmacology
- 2) Determine the pretest and posttest mean attitude scores of male and female undergraduates in Pharmacology exposed to the video virtual laboratory, simulated virtual laboratory, and traditional laboratory

Null Hypotheses

The following null hypotheses tested at 0.05 level of significance, were proposed:

H₀₁: There is no significant main effect of Treatment (video and simulated modes of virtual laboratory) on undergraduates' attitude towards Pharmacology laboratory

H₀₂: There is no significant main effect of gender on undergraduates' attitude in Pharmacology

Conceptual Framework

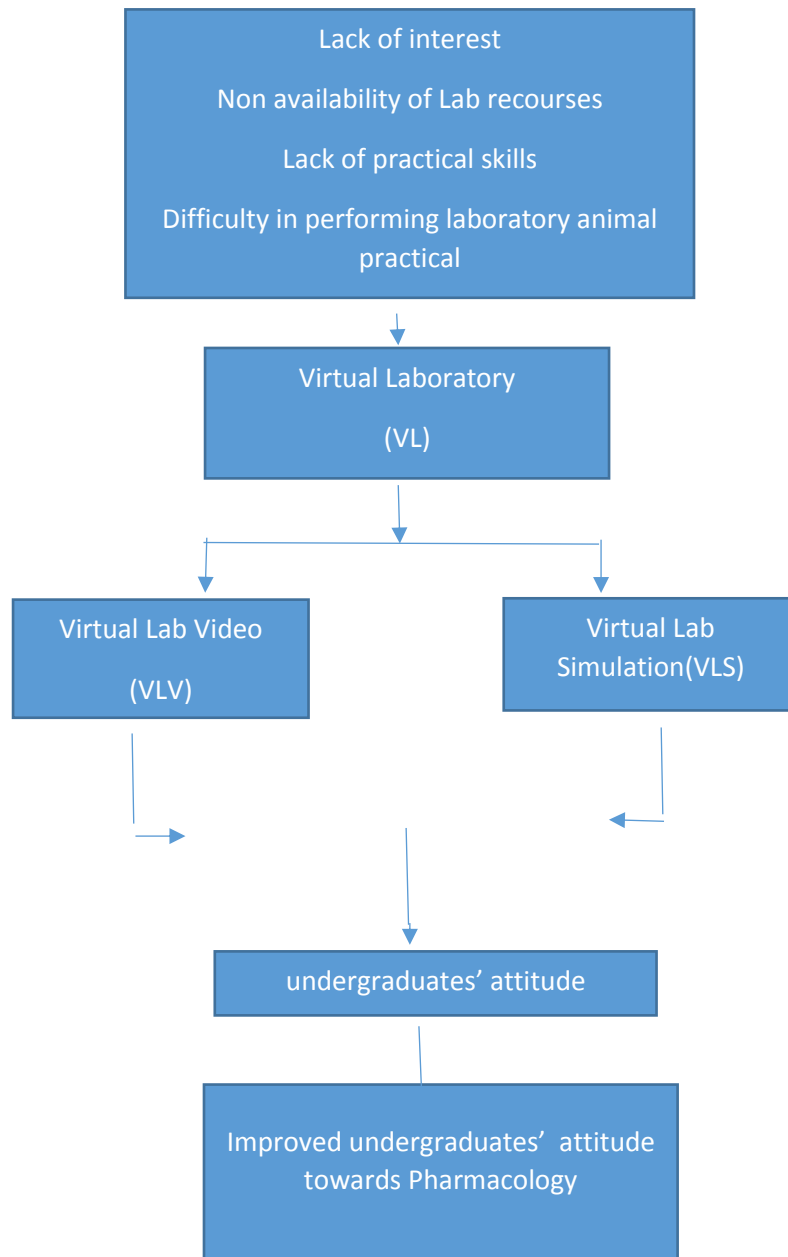


Figure1: Diagrammatic Representation of Conceptual Frame Work Model
Source: Field Work 2023

Figure 1 shows the relationship of variables determining the effects of virtual laboratory simulation and video strategies on undergraduates' attitude towards Pharmacology. The dependent

variable is influenced by various factors. They include non-availability of laboratory recourses, lack of manipulative skills, lack of interest, difficulty in performing laboratory animal experiments in Pharmacology and non-founding of Nigerian Universities are shown in the figure. The independent variables are the virtual laboratory simulation and the virtual laboratory video as the laboratory teaching and learning strategies in pharmacology laboratory There is also the effects of moderating variables: gender. The theoretical reinforcement of this study was derived from the following theories; Experiential learning theory and Gagne's theory of instructional design for sciences.

Methodology

The study adopted quasi-experimental a pretest posttest control group, research design, this design has been found to be among the most effective approaches in carrying out studies of this nature because it controls and minimizes the effect of regression, experimental mortality, instrumentation attrition, and testing (Adekola, 2016). the independent variable was varied at three levels; virtual laboratory simulation (treatment), virtual laboratory videos (treatment), and conventional(physical) laboratory (control), dependent variable Students' attitude, moderator variable: gender (male and female).

The population of this study comprised all the 400-level undergraduate students in three universities (University of Jos, University of Abuja and University of Ilorin) in the north-central geographical zone of Nigeria. The researcher took stock of Universities in the North-Central that offer all three programmes: Medical Sciences, Veterinary Sciences and Nursing Sciences, which was what made them eligible for the study The population of undergraduates in the three universities to whom this study was generalized is 788. The 400level undergraduates were used because they had not been exposed to such treatment. Multi-stage sampling technique was used in the first stage, three universities were purposefully sampled. In the second stage, the purposive sampling technique was used to select Universities in North- Central that offer the three programmes: Medical Sciences, Veterinary Sciences and Nursing Sciences, Lastly, intact class was used for each of the experimental groups and control groups per university. Universities were randomly assigned to treatments. A total size of 135 undergraduates participated in the study.

Instrument for Data Collection

Four research instruments were used for data collection for this study. They are classified into;

- 1) Procedural Instruments :(Virtual Laboratory Simulation Software Package (VLSP), Virtual Laboratory Video Package(VLVP) and Physical Laboratory (Conventional Laboratory) (PL)
- 2) Measuring Instruments :Students' Attitude towards Pharmacology Virtual Laboratory Questionnaire (SAPVLQ).

1. Virtual Pharmacology Laboratory Simulation Software (VLSP)

The virtual laboratory simulation for undergraduate Pharmacology is a software package adapted.

2. Virtual Pharmacology Laboratory Video Package(VLVP)

The virtual Pharmacology Laboratory Video Package developed by the researcher is the virtual videos of Pharmacology experiments from practical laboratory manual of the three Universities

3. Physical Pharmacology Laboratory (PL)This is a traditional (conventional) Science laboratory where students performed hands-on practical experiments on the practical topics chosen The control group were exposed to this treatment

4. Students' Attitude towards Pharmacology Virtual Laboratory Questionnaire (SAPV_LQ)

This is a 31-item instrument adapted from the work of Kind, Jones and Barnby (2007), designed to measure participants' affective learning outcomes. It consists of positive and negative statements concerning liking of and enthusiasm for Virtual Laboratory and confidence in Virtual Laboratory classes. It consisted two sections, A and B. Section A consists of personal information about students like Gender, Age. Section B consisted statement items. The statements were rated on a four-point rating scale

Pre-Treatment Phase

This phase involved the administration of pre-test. The Students' Attitude towards Pharmacology Virtual Laboratory Questionnaire (SAPV_LQ was administered to undergraduates' in pharmacology. All scripts were retrieved, marked and recorded, the scores were collated for further processing

Treatment Phase

The treatment phase involves the administration of all the procedural instruments: Virtual Laboratory Simulation Software Package (VLSP), Virtual Laboratory Video Package (VLVP) Physical Laboratory (PL)

Post Treatment Phase

This involves the administration of posttest, the Students' Attitude towards Pharmacology Virtual Laboratory Questionnaire (SAPV_LQ) was administered to undergraduates' in Pharmacology after the treatment to see if there was any effect of the use of the VLSP, VLVP, PL on undergraduates' attitude towards Pharmacology

Validation and Reliability of Instruments

Four research instruments were validated and used for this study

Data Analysis

The data was analyzed using the Statistical Package for the Social Sciences (SPSS Version 26). With the pre-test score as covariates to answer the research questions and test hypotheses Analysis of covariance (ANCOVA) was used to single out the initial group differences. Also, the Estimated Marginal Mean (EMM) of the ANCOVA was used to detect the magnitude and direction of difference where a significant main effect was detected, Scheffe post hoc was employed

Results

The presentation of the results of this study was done in accordance with the hypotheses formulated for the study.

H₀ 1: There is no significant main effect of Treatment (video and simulated modes of virtual laboratory) on undergraduates' attitude towards Pharmacology laboratory

Table 1: Summary of Analysis of Covariance (ANCOVA) of Posttest Attitude to Pharmacology by Treatment, Gender and Programme of Study

Source		Type III Sum of Square	Df	Mean Square	F	Sig	Partial Eta Square
Intercept	Hypothesis	26301.21	1	26301.21	250.44	.00	.91
	Error	2521.45	24.01	105.02			
Pretest	Hypothesis	173.02	1	173.02	2.17	.14	.02
	Error	9187.47	115	79.89			
Treatment	Hypothesis	71311.45	2	35655.72	274.37	.03*	.99
	Error	146.01	1.12	129.95			
Gender	Hypothesis	344.65	1	344.65	3.12	.43	.84

*Sig at p<.05

Table 1 shows that there is significant effect of treatment on undergraduates' attitude to Pharmacology ($F_{(2, 115)} = 274.37$; $p < .05$; $\eta^2 = .99$). The class effect size is .99. This means that there is a significant effect of treatment on the posttest attitude mean scores of undergraduates' in Pharmacology. The null hypothesis 1 is, therefore, rejected.

Table 1 presents the mean scores for the three levels of treatment group.

Table 2 presents the attitude scores corresponding to the respective treatment and control groups.

Table 2: Estimated Marginal Means for Undergraduates' Attitude to Pharmacology Scores in the Three Groups

Grand mean =93.76

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Virtual Video lab	120.10	.98	98.85	130.16
Virtual Simula Lab	111.22	.54	95.24	120.72
Control	49.95	.68	35.25	58.84

From Table 2, undergraduates' exposed to the Video Virtual Laboratory obtained higher estimated marginal attitude score towards Pharmacology ($\bar{x} = 120.10$) than those in the Virtual laboratory Simulation group ($\bar{x} = 111.22$) and the control group ($\bar{x} = 49.95$). Treatment has therefore improved students' attitude to Pharmacology in the two experimental groups than the control. In order to trace the actual sources of the significant effect of treatment on attitude, post hoc tests Scheffe procedure was used. Table 3 presents the summary of post hoc tests using the Scheffe procedure.

Table 3: Scheffe Pairwise Comparisons of Estimated Attitude Means Scores for Treatment

Treatment	N	Mean	Treatment Groups		
			Virtual Video Lab	Virtual Simulation Lab.	Conventional
1. Virtual Video Lab	53	120.10			*
2. Virtual Simulation Lab	41	111.22			*
3. Control	41	49.95	*	*	

*Significant Pairwise Comparison

Table 3 shows that the group exposed to the Video Virtual Lab ($\bar{x} = 120.10$) and the Virtual Simulation Lab ($\bar{x} = 111.22$) significantly differ from the control group in terms of attitude scores ($\bar{x} = 49.95$). The two experimental groups however did not differ from one another to any significant extent. The significant pairwise differences show that the significant effect of treatment

on students' attitude to Pharmacology is due to the differences between each of the experimental groups and control.

Ho 2: There is no significant main effect of gender on undergraduates' attitude to Pharmacology. From Table 3. there is no significant effect of gender on undergraduates' attitude to Pharmacology ($F_{(1, 115)} = 3.12$; $p > .05$; $\eta^2 = .84$). Hypothesis 2 is therefore, not rejected.

Table 4: Summary of Estimated Marginal Means for Male and Female Students' Attitude Scores

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	86.84	.42	87.16	90.00
Female	90.82	.38	96.42	97.81

From Table 4, the estimated posttest mean attitude scores for the female students is slightly higher ($\bar{x} = 90.82$) than that of their male counterparts ($\bar{x} = 86.84$).

Discussion of Findings

The findings of this study revealed a significant effect of treatment on undergraduates' attitude toward Pharmacology laboratory practical, undergraduates exposed to the Video virtual laboratory group and virtual laboratory simulation group significantly differed from the control in terms of attitude. This study has shown that treatment has improved students' attitude in the two experimental groups than the control group.

Attitude is often seen as established conduct or mode of performance. This finding is in line with Gambari *et al.* (2013) in this regard. Falode and Olasunya, (2015) showed in their studies that attitudes can be improved positively in terms of liking as well as interest in performing experiments in virtual laboratories. Pyatt *et al.* (2012) reported that students showed a preference towards the video virtual laboratory than the physical laboratory. This study has also corroborated the findings of Alneyadi, (2019) that virtual labs had reasonable effects on students' attitudes.

The study of Keter, (2016), alink with this study, he concluded that improving the attitude of students towards science can be done through the use of laboratory apparatus present in physical laboratories as well as in simulations present in virtual laboratories Gambari *et al.*(2018) reported that students have a positive attitude and arrest attention when using a virtual laboratory which

supports this study. Attitudes can be improved positively in terms of liking as well as interest in performing experiments in virtual laboratories. Falode & Olasunya, (2015). Pyatt *et al.* (2012), asserted that students showed a preference towards the chemistry virtual laboratory over the physical laboratory, which bring into line with this study. Ratamun and Osman (2018), concluded that both traditional and virtual laboratory elicited positive attitudes which are in line with this study. The study of Ayodele (2018), aligns with this study, student's attitude towards simulation was improved in chemistry which is in line with this study

The results of this study revealed that there was no significant effect of gender on undergraduates' attitude towards Pharmacology and that male students were at a slight advantage ahead of their female peers. These complement findings reported in the study by Safiani *et al.* (2017). They investigated students' attitude towards science and the effect of gender on students' attitude. Results showed that students' positive attitude towards science was at medium level and there was no significant difference in attitude towards science between the female and male students. The study is of great significance to science lecturers and laboratory scientist/technologist not to be gender biased when teaching science laboratory experiment

Conclusions

The use of VLV and VLS has improved undergraduates' science attitude towards Pharmacology. This has shown that there is a great vision in VLV and VLS as laboratory instructional strategy that can increase student attitude positively towards Pharmacology,

Recommendations

1. The Educational technologist in various institutions should create more awareness on the use of virtual laboratories for teaching and learning in the laboratories. The universities management should implement this.
2. Professional bodies like the Nigeria Institute of Science Laboratory Technology (NISLT), Association of Medical Laboratory Science Council of Nigeria (MLSCN) and Educational Media Technology of Nigeria (EMTAN) and other Professional bodies should encouraged members in the institutions laboratory on the use of virtual laboratories simulations and videos for students to facilitate learning where the laboratory equipment and recourses are limited
3. The University management/ Dean, HODs, Programme Coordinators should embrace and support the use of virtual laboratory simulation technologies.

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