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TEACHERS' AWARENESS AND PERCEPTIONS OF VIRTUAL LABORATORIES ON ACQUISITION OF BIOLOGY PRACTICAL SKILLS IN LAGOS STATE

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TEACHERS' AWARENESS AND PERCEPTIONS OF VIRTUAL LABORATORIES ON ACQUISITION OF BIOLOGY PRACTICAL SKILLS IN LAGOS STATE

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Abstract

The study investigated teachers' level of awareness and perception of the use of virtual laboratory on the acquisition of biology practical skills. A descriptive survey design was adopted for the study. The population of the study was over 1,200 biology teachers in Lagos State. A sample size of 138 Biology teachers from the six Educational Districts of Lagos State was selected through a multi-stage sampling technique. Mixed methods were employed involving the use of standardized interviews, video clips to gather qualitative data while a validated structured questionnaire with a reliability coefficient of 0.74 titled 'Virtual laboratory and Biology practical skills' (VLABPS) containing 15 items was used to collect quantitative data. Data were analyzed using frequency count and percentages. Results showed that the level of awareness of virtual laboratory among Biology teachers was generally low as biology teachers showed ignorance of the concept of virtual laboratories on the acquisition of Biology practical skills. Although, enlightenment and awareness were generated with the intervention of the video clip on virtual laboratories. The study, therefore, recommended that Biology teachers should be engaged in workshops on the use of Virtual laboratories to teach Biology practical skills while Pre-service teachers on teaching practice should be encouraged by their supervisors to use virtual laboratories for teaching Biology practical skills. The teacher education curriculum should be enhanced to include the concept and utilization of virtual laboratories.

Introduction

Virtual laboratory (VL) is a learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments (Woodfield, 2005). Virtual laboratories simulate a real laboratory environment and processes. They provide students with meaningful virtual experiences and present important concepts, principles, and processes. Employing virtual laboratories, students have the opportunity of repeating any incorrect experiment or deepen the intended experiences. A virtual laboratory may sometimes be a preferable alternative, or simply a supportive learning environment, to real laboratories. It provides students with opportunities such as enriching their learning experiences; conducting experiments as if they were in real laboratories; and improving their experiment related skills such as manipulating materials and equipment, collecting data, interactively completing the

experimental process (with boundless supplies), and preparing experiment reports (Subramanian and Marsic, 2001). Researchers have determined that instructions carried out with virtual laboratories significantly increase students' achievement levels (Tatli, and Ayas, 2013). Virtual environments allow students to observe the process in more detail, compared to board and chalk activities of the traditional classroom or partially completed experiments of the real laboratory environment. Also, virtual environments foster attention and motivation towards the course by supporting a discussion platform among partners, peers, and students and teachers (Dobson, 2009; Lawrence, 2011).

Furthermore, some researchers even argue that performing experiments within a virtual environment is more effective than performing experiments in real laboratories (Gambari, Balogun & Alfa, 2014). Studies showed that, in traditional learning environments, there are always inconsistencies between student predictions and observations (Josephsen & Kristensen, 2006). Such environments also make students reserved and cause them to refrain from expressing their opinions directly (Sheppard, 2006). In contrast, virtual learning environments enable learners to repeat the events several times without hesitation, to zoom in and out, and to watch in slow motion (Tuyuz, 2010).

Biology serves an essential and foundational subject in the study of natural sciences. The teaching, learning, and acquisition of practical skills are based on adequate completion of all aspects of the curriculum. Motlhabane and Dichaba (2013) reported that globally several studies have shown that practical (laboratory) works play a pivotal role in enhancing the teaching and learning of science concepts. However, acquisition of practical skills is overly marred by teachers' inability to perform practical activities, teachers use of obsolete equipment/apparatus, unqualified Laboratory Technicians, poor budgetary allocation to laboratory activities, and insufficient time allocation to practical activities on the timetable. Physical experiments are rarely performed in some public secondary schools in Nigeria due to a lack of equipment, facilities, and other logistic problems. Besides, the costs of carrying out experiments, arranging the equipment for laboratory activities are very laborious and time-consuming. According to Tuyuz (2010), checking students' performance during laboratory activities can be tasking especially when dealing with large classes.

Statement of the Problem

Students' failure rate in Biology has been traced to a lack of facilities for Biology practical in schools. Just as Olorundare (2014) moaned that students' failure in Biology at Secondary School Certificate Examination (SSCE) can be traced to their poor performance in practical activities which carry 80 marks out of the 200 marks allotted to Paper 1 (Objective), Paper 2 (Theory) and Paper 3 (Practical). Previous studies have also reported that that factors such as safety concerns, lack of self-confidence, an excessive amount of time, the effort required to conduct accurate experiments, and many others are the reasons Biology practical cannot be properly embedded into traditional Biology courses. Researchers have documented the positive effect of the utility of virtual laboratories on teaching and learning but very few reports are available on teachers' usage of virtual laboratories. It is against these backdrops that the present study on teachers' awareness and perceptions of virtual laboratories on the acquisition of biology practical skills in Lagos State is being investigated.

Purpose of the Study

The main purpose of the study is to investigate Biology teachers' level of awareness and perception of a virtual laboratory on an acquisition of Biology practical skills in Lagos State. Specifically, the study will:

1. Examine Biology teachers' awareness of the use of a virtual laboratory for the acquisition of practical skills.
2. Find out how Biology teachers perceive the use of virtual laboratories on the acquisition of practical skills
3. Find out which of the practical skills Biology teachers use virtual laboratories to acquire

Research Questions

The following research questions guided the study:

1. Are Biology teachers' aware of the use of the virtual laboratory for the acquisition of practical skills?
2. How do Biology teachers perceive the use of virtual laboratories on the acquisition of practical skills?
3. Which of the practical skills do Biology teachers use virtual laboratories to acquire?

Literature Review

In the review of empirical studies on the awareness and perception of virtual laboratories, Rajendram (2016) study on teachers' perception of the virtual laboratory in secondary school Chemistry education in England showed that the respondents perceived VL as needing more improvement in the aspect of recapitulation of the traditional laboratory but in terms of quality, it has widened their design scope as to better cater for teachers' need. Falode's (2018) study on perceived ease of use, the attitude among others towards virtual laboratory package utilization in teaching, and learning Physics concepts showed that pre-service teachers found the virtual laboratory easy to use and showed a positive attitude it.

Tatli and Ayas (2013), found significant improvement in the performance of students exposed to the virtual laboratory than their counterparts in the conventional laboratory method. Flint and Stewart (2010) reported that the virtual laboratory was less expensive and ten times faster than a traditional laboratory exercise yet achieved the same learning outcomes for students who were already familiar with laboratory techniques. Tuysuz (2010) found that virtual laboratory package made positive effects on students' achievements and attitudes when compared to conventional laboratory methods. Adeyemi, (2008) found that the teaching by the virtual laboratory package with an applied dynamic system is more successful than the teaching implemented by the traditional laboratory method.

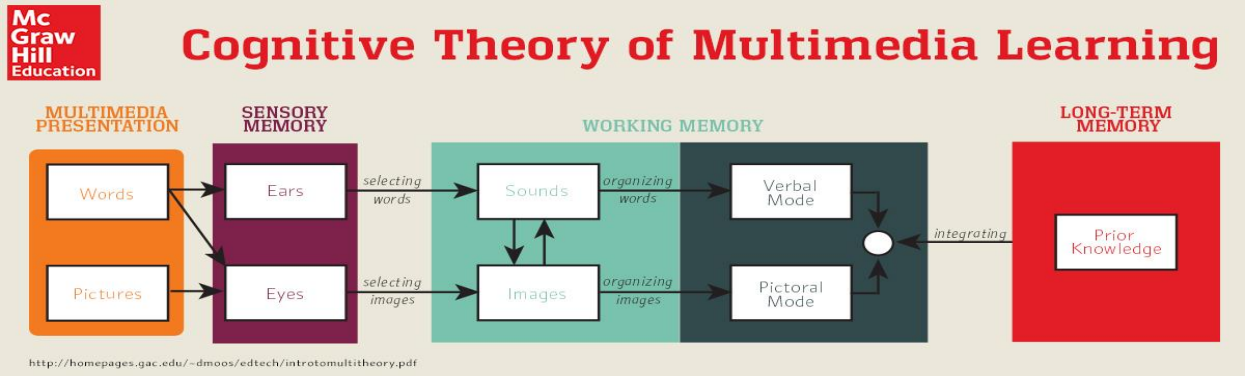
Theoretical Framework of the Study

This study hinges on Mayer's Cognitive Theory of Multimedia Learning. The theory is based on three assumptions which are:

- Two separate channels (auditory and visual) for processing information;

- Limited channel capacity and that
- Learning is an active process of filtering, selecting, organizing, and integrating information.

Mayer discusses the role of three memory stores: sensory, working (or 'schema'), and long-term. This theory presents the idea that the brain selects the elements of a multimedia presentation of words, pictures, and auditory information and organizes them dynamically to produce logical mental constructs. Herein lies the relevance of this theory to the present study which integrates virtual laboratories and teaching to enhance learning and acquisition of practical skills.



Source: mheducation.ca/blog/Richard-mayers-cognitive-theory-of-mulytimedia-learning

Method

A descriptive survey design was employed for the collection of qualitative and quantitative data. The study population comprised approximately the 1,200 Biology teachers in the six Educational Districts of Lagos state. A multi-stage sampling technique was used to group the teachers based on teaching Biology for a minimum of 6 years, having at least first degree in Biology Education, and have presented students for SSCE and WASCE. After which a simple random sampling technique was used to select respondents from each district giving a sampling size of 138 respondents which was used for the study. Table1shows the distribution of respondents in each Educational District in Lagos.

Table 1: Distribution of respondents in each of the Education District**.**

Education Districts (EDs)	Respondents (Biology teachers)
ED 1	23
ED 2	24
ED 3	23
ED 4	27
ED 5	20
ED 6	21
Total	138

The qualitative data collection was through a structured interview session involving a focus group maximum of 10 Biology teachers at a time in which their responses at random were recorded. The interview entailed exploring Biology teachers' awareness and views on the usage of virtual laboratories for practical activities. Immediately after the interview, the Biology teachers watched an 11-minute video clip on Virtual Laboratory by Michael Bodekaer (2016) (https://youtu.be/iF5-aDJOr6U). Thereafter, they responded to a self-developed structured questionnaire titled 'Virtual laboratory and Biology practical skills' (VLABPS) and designed along a five-point Likert scale comprising of fifteen items. The questionnaire consists of two sections. Section A sought information on demographic data about the respondents while section B was made up of the main items reflecting the research questions of the study. The questionnaire was subjected to face validation by three experts, also a reliability coefficient of 0.74 was obtained using Cronbach's alpha formula. The researcher distributed the questionnaire with the assistance of 4 research fellows. The respondents indicated their responses to the items on a 5-point Likert scale. The Data collected was analysed by the use of simple percentage and frequency table.

Results

A total of 138 Biology teachers from the six Education District of Lagos state participated in this study based on teachers' awareness and perception of the virtual laboratory on the acquisition of Biology practical skills in Lagos state. They comprised of 32 males and 106 females.

Research Question 1: Are Biology teachers' aware of the use of a virtual laboratory for the acquisition of practical skills?

Table 2: Biology Teachers' Awareness of Virtual Laboratories

S/N	Items	SA	A	N	D	SD	TOTAL
1.	I have used a virtual lab to teach Biology concept	0 0%	0 0%	18 13%	62 45%	58 42%	138 100%
2.	Am not familiar with a virtual laboratory	86 55%	44 32%	8 6%	0 0%	0 0%	138 100%
3.	A virtual laboratory is a technological innovation but I am yet to understand its concept.	62 45%	44 32%	16 12%	10 7%	6 4%	138 100%
4.	I recently got to find out about the virtual lab online.	41 30%	35 25%	19 14%	23 17%	20 14%	138 100%
5.	A virtual laboratory is very new to the majority of Nigerian students.	26 19%	41 30%	12 9%	21 15%	38 27%	138 100%

Table 2 shows respondents' opinions concerning awareness of virtual laboratory. Results on the table indicate that none of the respondents has used the virtual lab to teach Biology concept, 18(13%) were undecided and 120(87%) disagreed that they have used it. Majority of the respondents have not used the virtual lab to teach Biology concept.

Results also show that 130 respondents (94%) agreed that they are not familiar with virtual laboratory, 8(6%) respondents were indifferent and none disagreed. Majority of the respondents agreed they are not familiar with virtual laboratory.

A total of 106 (77%), respondents agreed that virtual laboratory is technological innovation but they are yet to understand its concept, 16 (12%) were undecided and 16(11%) disagreed.

Majority of the respondents believed that virtual laboratory is a technological innovation but they are yet to understand its concept.
There were 76 respondents (55%) who agreed that they recently got to find out about virtual lab online, (19) (14%) respondents were indifferent and 43(31%) disagreed. Majority of the respondents agreed they recently got to find out about virtual lab online.
From research question one, 67 (49%), respondents agreed that virtual laboratory is very new to the majority of Nigerian students, 12 (9%) were undecided and 59 (42%) disagreed. Majority of the respondents believed that the virtual laboratory is very new to the majority of Nigerian students.

Research Question 2: How do Biology teachers perceive the use of virtual laboratories on the acquisition of practical skills?
Table 3: Biology Teachers' Perception of Acquisition of Practical skills

S/N	Items	SA	A	N	D	SD	TOTAL
1.	The use of virtual laboratory makes Biology teaching more interesting	31 22%	48 35%	15 11%	23 17%	21 15%	138 100%
2.	Availability of virtual laboratory would make teaching and learning of Biology practical more effective than real laboratory	20 14%	71 52%	13 9%	30 22%	04 03%	138 100%
3	The use of virtual laboratory is more cost-effective and user friendly than using the real laboratory	58 42%	36 26%	10 7%	26 19%	08 6%	138 100%
4.	The use of a virtual laboratory in teacher education will revolutionise the teaching and learning of Biology practical	57 41%	26 19%	14 10%	16 12%	25 18%	138 100%
5.	With the capacity of a virtual laboratory to simulate over 90% of Biology experiments, students' performance in Biology would be enhanced	41 30%	32 23%	24 17%	18 13%	23 17%	138 100%

Table 3 shows respondents' opinions concerning the perception of teachers on the use of virtual labs and learning abilities. Results on the table indicated that 79(57%), respondents agreed that the use of virtual laboratory makes Biology teaching more interesting, 15(11%) were undecided and 44(32%) disagreed. Majority of the respondents agreed with the assertion that the use of virtual laboratory makes Biology teaching more interesting.
A total of 91 respondents (66%) agreed that availability of virtual laboratory would make teaching and learning of Biology practical more effective than real laboratory, 13(9%) respondents were indifferent and 34(25%) completely disagreed. Majority of the respondents agreed that the availability of virtual laboratory would make teaching and learning of Biology practical more effective than a real laboratory.
The result also shows that 94(68%), respondents agreed that the use of virtual laboratory is more cost-effective and user friendly than using the real laboratory, 10(7%) were undecided and 34(25%) disagreed. Majority of the respondents agreed with the assertion that the use of virtual laboratory is more cost-effective and user friendly than using the real laboratory.
Furthermore, 83(60%) respondents agreed that the use of virtual laboratory in teacher education will revolutionise the teaching and learning of Biology practical, 14(10%) were undecided and 41(30%) respondents completely disagreed. Hence, majority of the respondents agreed that the

use of virtual laboratory in teacher education will revolutionise the teaching and learning of Biology practical.

Table 2 also shows that 73(53%) respondents agreed that with the capacity of the virtual laboratory to simulate over 90% of Biology experiments, students' performance in Biology would be enhanced, 24(17%) were neutral and 41(30%) respondents, disagreed. Most of the respondents agreed that with the capacity of the virtual laboratory to simulate over 90% of Biology experiments, students' performance in Biology would be enhanced.

Research Question 3: Which of the practical skills do Biology teachers use virtual laboratories to acquire?

Table 4: Biology Practical Skills to be enhanced using Virtual Laboratories

S/N	Items	SA	A	N	D	SD	TOTAL
1.	Critical thinking Skill	65	37	18	08	10	138
		47%	27%	13%	6%	7%	100%
2.	Application of scientific methods and practices	37	45	20	15	21	138
		27%	33%	14%	11%	15%	100%
3.	The use of contemporary instruments and equipment	41	27	15	17	38	138
		30%	20%	11%	12%	27%	100%
4.	Quality research and referencing	59	35	14	15	15	138
		43%	25%	10%	11%	11%	100%
5.	Observation skills	50	31	15	13	29	138
		37%	22%	11%	9%	21%	100%

Table 4 shows respondents' opinions concerning which biology practical skills will be enhanced using virtual laboratories. Results on the table indicated that 102(74%) respondents agreed that the use of virtual lab will enhance independent thinking among Biology students, 18(13%) respondents were indifferent and 18(13%) respondents disagreed with the assertion. Therefore, majority of the respondents agreed that the use of virtual lab will enhance independent thinking among Biology students

There were 82(60%) respondents who agreed that virtual lab will encourage the use of and application of scientific methods and practices, 20(14%) were undecided and 36(26%) respondents completely disagreed. Thus, the vast majority of the respondents agreed that virtual lab will encourage the use of and application of scientific methods and practices.

The result also denotes that 68(50%), respondents were in consonance that the use of virtual lab will promote the use of contemporary instruments and equipment while 15(11%) respondents were undecided and 55(39%) respondents, disagreed. Majority of the respondents agreed with the assertion that the use of virtual lab will promote the use of contemporary instruments and equipment

Also, 94(69%) respondents agreed that virtual labs promote quality research and referencing, 14(10%) respondents were indifferent and 30(22%) respondents completely disagreed. Many of the respondents agreed that virtual labs promote quality research and referencing.

From the table, 81(59%) respondents agreed that virtual labs sharpen biology students' observation skills with 15(11%) respondents undecided and 42(30%) respondents, disagreed. Hence, majority of the respondents agreed that virtual labs sharpen biology students' observation skills.

Discussion

This study has investigated teachers' awareness and perception of virtual laboratories in the acquisition of Biology practical skills in Lagos state. In this part of the globe, the use of virtual laboratories in the teaching and learning of Biology practical is not a popular practice. It was observed that teachers have not used virtual laboratories to teach Biology concepts and they are not familiar with virtual laboratory. The sampled teachers also affirmed that virtual laboratory is a technological innovation which they are yet to understand its concept, that they recently got to find out about virtual laboratories online. These submissions agreed with Fagbemi (2012) who submitted in a Nigerian study that the level of awareness of virtual laboratories among university undergraduates in northern Nigeria is low due to non-availability of such facilities in the universities.

The perception of Biology teachers on the use of virtual laboratories and acquisition of Biology practical skills indicated that the vast majority of the respondents affirmed that: the use of virtual laboratory makes Biology teaching more interesting. This aligns with the work of Aljuhani, Sonbul, Althabiti and Meccawy (2018) who found that the use of virtual science laboratories makes teaching and learning environment more exciting, useful and enjoyable. The perception of teachers also showed that the availability of virtual laboratory would make teaching and learning of Biology practical more effective than a real laboratory. The use of virtual laboratory in teacher education will revolutionise the teaching and learning of Biology practical, and that with the capacity of the virtual laboratory to simulate over 90% of Biology experiments, students' performance in Biology would be enhanced. These findings corroborate the work of Cengiz (2010), who found that teachers believe the use of virtual laboratory will significantly improve students' learning outcomes in secondary school and post-secondary school Biology. Also, the results from Aljuhani (2018) showed that student who used VL were able to understand the concepts of experiments their objectives and the results while the teachers were able to follow and assess students' performance

On the aspect of the use of VL to enhance Biology practical skills results revealed that the teachers agreed that independent thinking, the use of and application of scientific methods and practices; the use of contemporary instruments and equipment; promotion of quality research and referencing and sharper biology observation skills would be enhanced. This is in agreement with Koretsky, Kelly and Gummer (2013) who revealed that students exposed to VL showed a significant increase in critical thinking, categories of experimental design, high cognitive skills and demonstrated psychological presence, leading to the potential for a rich learning experience. Dyrberg, Treusch and Wiegand (2016) also concluded that virtual laboratories have the potential to improve students' pre-laboratory preparation skills.

Conclusion

The study shows that the level of awareness of the use of virtual laboratories among Biology teachers in Lagos state is generally low due to the non-availability of such facilities in most secondary schools. Biology teachers affirmed that the use of virtual laboratory would make teaching and learning of Biology practical more effective than the real laboratory. Biology practical skills such as independent thinking, the use of and application of scientific methods and practices, the use of contemporary instruments and equipment, quality research and referencing and sharper observation skills would be enhanced using virtual laboratories.

Recommendations

From the conclusions emanating from the study, the researchers put forward the following recommendations:
Firstly, since the study has established that the level of awareness of virtual laboratories among Biology teachers in Lagos State is generally low due to non-availability of such facilities in most secondary schools, this study recommends that the government at all level should do all within its capacities to promote the development of science by providing virtual laboratories to public secondary school. Since the study revealed a significant relationship between the use of virtual laboratory and acquisition of practical skills, it is recommended that aside from installing virtual laboratories to support the real laboratories in secondary schools, the government should also make provision for training of Biology teachers and laboratory technicians on how to effectively utilize the virtual laboratory facilities in performing various types of experiment and build their virtual laboratories.

Also, Federal and State ministries of education and other educational agencies such as NERDC, NTI, NUC, UNICEF, UNESCO, and other stakeholders should organize workshops for Science teachers on the use of virtual laboratory package to enhance the performance of secondary school students. Furthermore, the teacher education programme in Nigerian tertiary institutions should be improved upon to prepare teachers who can apply innovative approaches (virtual laboratory instructional package), which will promote effective teaching and learning.

Lastly, the instructional designers, computer programmers, instructional developers should develop relevant virtual laboratory packages for use within the Nigerian school systems.

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