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BIOLOGY TEACHERS' SELF-EFFICACY IN THE USE OF VIRTUAL LABORATORY FOR INSTRUCTIONAL DELIVERY IN SECONDARY SCHOOLS

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Abstract

A virtual laboratory is an interactive environment meant for creating and conducting simulated experiments in real-time in science subjects. This study investigated Biology teachers' self-efficacy in the use of Virtual laboratory for instructional delivery in Secondary Schools in Nigeria. The study was descriptive research using a cross-sectional survey type. The purposive random technique was used to select 261 respondents from fifteen (15) senior secondary schools in Ilorin. The researcher-designed questionnaire was developed and validated by three educational technology experts and two biology experts. The instruments were pilot-tested at Offa Grammar School; Cronbach Alpha was used to test the reliability of the instrument; the coefficient was 0.91. Three research questions were raised and answered. Two hypotheses were formulated and tested at 0.005 level of significance. Findings revealed that Biology teachers' self-efficacy in the use of the virtual laboratory for instruction in Ilorin is high; there is no significant difference between male and female Biology teachers' in their self-efficacy in the use of the virtual laboratory for instruction and there is no significant difference in the Biology teachers' in their self-efficacy in the use of the virtual laboratory for instruction based on the years of experience. The study concluded that females are coming up in matters concerning ICT, so they should not be discriminated against; among others. The study, therefore, recommended strongly that the issue of gender difference in the use of ICT resources for research is gradually becoming narrow.

Introduction

Information and communication technologies are indispensable tools in any educational system. The integration of ICT into the classroom have changed the way and manner teachings are being presented to students at all levels. ICT brings about new methods of teaching and learning among the students and improve their ability to learn effectively (Makinde, Makinde & Shorunke, 2013). ICT as innovative tools in educational institutions have the potential not only to improve education but also to empower people, strengthen governance and galvanize the effort to achieve human development for the country. ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change (Nwakundo, Oguejiofor & Nwankwo, 2016).

The vital role ICT plays in teaching and learning has enhanced the usefulness of computer in an instructional environment. The application of computer technology in the classroom

environment has a significant role in enhancing teaching and learning. The use of computer simulation in teaching and learning is increasingly becoming widespread and has proven to be effective in teaching difficult subjects in science for over two decades (Ezenwa & Yaki, 2013).

Computer simulation is a computer-generated version of real-world objects or processes that can be integrated into teaching and learning. It can take different forms, ranging from computer renderings of 3-dimensional geometric shapes to highly interactive computerized laboratory experiments (Gambari, Falode & Adegbenro, 2014). A virtual laboratory (VL) is an artificial (software) educational environment which involves a set of teaching and learning tools that are designed to enhance students' learning practice through the use of computers and the internet. In other words, it is a virtual studying and learning environment that mimics the real laboratory or classroom environment (Babateen, 2011).

A virtual laboratory is an interactive environment that is meant for creating and conducting simulated experiments in real-time (Harry & Edward, 2016). It provides students with tools, materials and lab sets on a computer to perform experiments saved on Compact disk or website (Nunn, 2018). An example of a virtual laboratory is a collection of digital simulations supported by discussion forums, video demonstrations, hyperlinked glossaries, and e-mail lists organized in a World Wide Web format or on a CD in a shell produced by an authoring language such as Author ware (Scheckler, 2003). The idea of using student-centred instructional methods is widely accepted because it has been realized that teacher-centred, traditional instructional methods give insufficient opportunities for the student to construct their learning (Tatli & Ayas, 2012; Badmus, 2013). This concept of "learning by doing" which allows students to learn by doing within the classroom context, is a departure from traditional methods in science education.
Science Education comprises of basic disciplines such as physics, chemistry, and biology. Essentially, science education would be incomplete without Biology. It has proven its benefits to mankind as almost every human activity (Gambari, 2010). Besides, the importance of laboratories as components of science education to make students gain experience cannot be over-emphasized with the use of a virtual laboratory (Tüysüz, 2010).
Scholars like (Jegede, 2007, Ezenwa & Yaki, 2013, Olorundare, 2013). in science education admitted that laboratory studies increase students' interest and abilities for the science subjects the place of laboratory application in students' learning in science education has some limits and problems especially in Nigeria. Some of these problems attributed to laboratory application include that: the laboratory activities are expensive; planning and application are much time consuming; checking students' performance during the activities can be difficult in over-crowded classes; lack of laboratory, equipment, or insufficient laboratory conditions can limit the teacher to perform a simple laboratory activity (Gambari, Fagbemi, Falode & Idris, 2013; Falode, 2014; Kawu, 2015).

Furthermore, in developing countries like Nigeria, schools face challenges of limited financial resources for acquiring apparatus and materials for imparting effective and efficient science education. At times demonstrational activities are performed and, in some schools, improvised laboratory experimentation is used. This application is opposed to the basic constructivist philosophy of laboratory method which accepts that knowledge can be gained through personal experience and observation (Bayrak, Kanlı, & KandilİngeÇ, 2007; Adejoh, & Ityokyaa, 2009, Idris, 2011). When considering these limitations, the search for appropriate alternatives is inevitable. The use of VL in supporting the laboratory methods could be appropriate in addressing these challenges provided that teachers' roles and other impediments are controlled

(Kevin, & Rod, 2012). Many researchers and educational practitioners believe that VL has provided new insights to support education (Bayrak, Kanlı, & KandilİngeÇ, 2007; Scheckler, 2003; Tüysüz, 2010).

Central to the usage of virtual laboratory, teacher's self-efficacy which emphasizes the interface between learner motivation and cognition is important. Self-efficacy is the judgment of the teachers' level of competence in using VL in executing certain behaviours or achieving the set objective of the Biology concept to be taught. Self-efficacy has been identified as the best predictor of college GPA and among the best predictors of college persistence through meta-analytic research (Robbins, Lauver, Le, Langley, Davis, & Carlstrom, 2004). This judgement can be influenced by a variable such as a gender.

Gender differences in education have also reflected in ICT integration. This has been a great concern to researchers such as (Nsibirano, 2009). Daramola (2011) refers to gender as a social attribute and chance of being male or female in which the mutual relationship which is constructed and learned through socialization process and technology is modifying nature to meet their needs. Studies have suggested that there is a wide gap between male and female use of ICT (Agbonlahor, 2005). Researches on gender differences on the use of ICTs were variously studied in favour of either male or female and both. Adegbija, Bola, Riaz and George (2013) found out gender disparity in ICT achievements in favour of the males than their females' counterparts. Wilson (2017) noted that gender is one of the intervening variables in information retrieval processes.

According to Colley (2013), male teachers more often search for different aspects of ICT applications than female teachers. It is generally accepted that gender is an issue in technology acceptance. Extensive researches have been studied to examine the user's attitude towards ICT and motivations of its usage in general. It is broadly perceived that women are not interested in technologies other than in an instrumental way. Whereas men envision science and technology as a source of fun, enjoyment and pleasure (Sorensen, 2002). UNESCO (2003) opined that unless gender issues are fully incorporated into technology analyses, policy development and programme design; women and men will not benefit equally from ICTs and their applications. Studies showed that males are more enthusiastic and positive about technology adoption than females, while females tend to lag in Internet adoption (Greenspan, 2004). While Ono and Zavodny (2005) reported the significant and evolving gender differences in computer and Internet usage. Subsequently, Hotchkiss (2008) pointed out that differences existed between men and women in the use of many Internet applications.

Statement of the Problems

The urgent need for Nigeria to shift steadily and progressively from the traditional techniques of instructions as an expository, teacher-centred demonstration, and laboratory exercises to demonstrate, visualize or verify known information to those based on Information Communication Technology (ICT) requires a fundamental shift of focus from the teacher to the learner as the centre of instruction, and progressive adoption of a new method of the virtual laboratory. Unfortunately, Nigeria is yet to embrace the concept fully and adopt ICT based methods in teaching, especially at the secondary school level. Hence, there is the paucity of study reports on teachers' self-efficacy in the use of virtual laboratory in teaching Biology in Secondary schools in Kwara-State. In Nigeria, the Biology curricula are structured such that a significant amount of time is set aside for practical demonstration.

The National Policy Statement on Science Education noted that biology education should ensure adequate laboratory and field skills, meaningful and relevant knowledge to everyday life in matters of personal and community health and Agriculture while ensuring reasonable and functional scientific attitude. To ensure the full realization of these interesting objectives, the contents and contexts of the syllabus place great emphasis on field studies, guided discovery, laboratory techniques and skills coupled with conceptual thinking. Unfortunately, available evidence has revealed that students' performance in biology has been quite discouraging (WAEC 2013-2017). West African Examination Council (WAEC) Chief Examiners Reports 2017 and 2018 revealed among other things that candidates' performance was not encouraging. According to the reports, students were unable to make logical inferences from experimental results and attributed the poor performance especially in the practical aspect of Biology to their non-familiarity with the use of simple laboratory equipment. Students need practical experiences to enable them to understand some critical concepts in Biology, therefore, effective use of laboratory equipment and facilities can improve the mastery of Biological concepts. However, most of the public secondary schools in Nigeria are faced with insufficient laboratory and equipment which limits the teachers to perform just simple laboratory activity (Adejoh & Ityokyaa, 2009). Physical experiments are rarely performed in some public secondary schools in Nigeria due to lack of equipment, facilities and other logistic problems (Akinleye, 1987; Gambari, et al 2012). Also, the costs of carrying out experiments, arranging the equipment for laboratory activities are very laborious and time-consuming. Checking students' performance during the laboratory activities can be tasking especially when dealing with a large class (Tuyuz, 2010). When considering all these challenges, looking for appropriate alternatives is necessary, hence, the use of virtual laboratory in supporting the traditional laboratory method or its adoption in the absence of physical laboratory is inevitable.

The objective of the Study

The study investigated biology teachers' self-efficacy in the use of virtual laboratory in instructional delivery secondary schools in Kwara- State. Specifically, the study:

1. Determined teachers' self-efficacy in the use of the virtual laboratory for teaching biology in Kwara-State
2. Determined perceived self teachers' self-efficacy towards the use of the virtual laboratory for teaching biology based on gender.
3. Determined perceived self teachers' self-efficacy towards the use of the virtual laboratory for teaching biology based on years of teaching experience.

Research Questions

The following research questions were generated to guide the conduct of this study;

1. Do teachers differ in their is self-efficacy in the use of the virtual laboratory for teaching biology in Ilorin, Nigeria?

Research Hypotheses

The following hypotheses are generated based on the research questions;

Ho_1: There is no significant difference between male and female teachers' in their self-efficacy to the virtual laboratory for teaching biology;

Ho_2: There is no significant difference between male and female teachers' in their self-efficacy to the virtual laboratory for teaching biology based on years of teaching experience.

Methodology

The study was descriptive research using cross-sectional survey type. The population for this study were all secondary school in Ilorin metropolis. The target populations were all Biology teachers in Kwara-State. Federal, state and private-owned secondary schools participated in the study. Three hundred specific (300) Biology teachers were purposively selected based on the available Biology teachers in all secondary schools in Ilorin metropolis. The instrument for this study was a researchers-designed questionnaire The instrument and it was validated by three educational technology experts. The experts reviewed the questionnaire to determine the appropriateness, content coverage in terms of acceptability, adequacy and relevance to the stated objectives. Their comments, suggestions and corrections were used to produce the final draft of the instrument. The reliability of the questionnaire used in this study was achieved by administering twenty copies of the questionnaire on twenty (20) Biology teachers in Offa Grammar school, Offa. The instruments were pilot-tested and Cronbach Alpha formula was used to test the reliability of the instrument and the coefficient was 0.91. The researchers personally administered 300 copies of the questionnaire to the respondents and were able to collect only 261 that is, 88% from the respondents. The collected data was analyzed using descriptive and inferential statistics. In analyzing the data collected, descriptive statistics were employed; Simple percentage and Mean were used to analyze data for the research questions and The Hypotheses were tested using independent t-test. All hypotheses were tested at 0.05 level of significance.

Results

Research Question One: What is the Biology teachers' self-efficacy in the use of virtual laboratory for instruction in Ilorin metropolis?

Table 1: Biology Teachers' Self-Efficacy in the Use of Virtual Laboratory for Instruction in Kwara-State

S/N	Questionnaire Items	Mean
1	I can type into the tool address bar to surf the web for new instructional scientific resources in Biology.	3.29
2	I can Download useful video scientific experimentation proceeding in educational materials from the web for teaching my Biology students.	2.92
3	I Can download important instructional videos like Wildlife conservation, a distillation of gas from the web to teach my Biology students	3.22
4	I can send pictures, diagrams models on Biology to my students through e-mail	3.08
5	I can use virtual experiments in my teaching	3.18
6	I can use virtual experimentation websites/CD-ROMs to explain a difficult concept to my students	3.06
7	Students understand Biological concepts more readily since I can use virtual experiments	3.13
8	I have knowledge of virtual laboratory experimentation	2.94

9	I can develop or enhances students' science conceptual understating using Virtual experimentation	1.88
10	I can develop Biological CD-ROM based software to teach my students	3.25
	Grand Mean	**2.93**

A grand mean of 2.93 was obtained from Biology teachers' self-efficacy in the use of virtual laboratory for instruction in Kwara State in Table 1. This is above the average mean of 2.5 which implies that Biology teachers' self-efficacy in the use of virtual laboratory for instruction in Ilorin metropolis is high.

Ho_1: There is no significant difference between male and female teachers' in their self-efficacy to the virtual laboratory for teaching biology;

Table 2: t-test of male and Female Biology teachers' in their self-efficacy to the virtual laboratory for Teaching.

Gender	No	$\overline{X}$	SD	df	T	Sig.
Male	125	12.59	3.33	259	.95	.35
Female	136	12.32	3.80			

According to table 2, t (259) = .95, p = .35. That is, the result of t-value of .945 resulting in .35 significance value was greater than 0.05 alpha value. This means that the stated null hypothesis is accepted. By implication the stated null hypothesis was established thus: There is no significant difference between male and female Biology teachers' in their self-efficacy in the use of the virtual laboratory for instruction. Based on the earlier mean score of the Biology teacher's self-efficacy, this means that both male and female Biology teachers had a high self-efficacy.

Hypothesis Two

Ho_2: There is no significant difference in the Biology teachers' self-efficacy towards the use of the virtual laboratory for instruction based on years of teaching experience

Table 3: ANOVA of Biology Teachers on their Self-efficacy Towards the Use of Virtual Laboratory for Teaching

	Sum of squares	Df	Mean square	F	Sig.
Between Groups	63.28	2	15.64	1.62	.20
Within Groups	208.87	260	12.55		
Total	209.15	259			

Table 2 indicates that significant difference in the teachers' self-efficacy towards the use of the virtual laboratory for teaching biology based on years of teaching experience. {F (2, 259) = 1.62, p= .20} That is, the significance value (.20) was found to be greater than the alpha value (0.05). This means that the stated null hypothesis was accepted.

By implication, the null hypothesis was established thus: There was no significant difference in the Biology teachers' self-efficacy towards the use of virtual laboratory for instruction based on years of teaching experience.

Discussions

Biology teachers' self-efficacy in the use of virtual laboratory for teaching biology in Ilorin metropolis was examined using research 1 and hypothesis 1, the result of the analysis indicated that Biology teachers' self-efficacy was high and there was no significant difference between

male and female teachers' in their self-efficacy in the use of the virtual laboratory for instruction. The findings of this study are consistent with the previous study of (Bautista & Boone, 2015) whose study indicated that teachers with high-efficacy are better at teaching several studies described the extensive use of VR as a therapeutic tool or as an element of self-efficacy empowerment.

Findings on teacher's self-efficacy towards the use of the virtual laboratory for instruction in Ilorin metropolis was revealed using question 2 and hypothesis 2. The result of the analysis indicated that Biology teachers' self-efficacy was high and there was no significant difference between male and female teachers' in their self-efficacy in the use of the virtual laboratory for instruction. The study agreed with the previous findings of Martin and Lundstrom (2002) whose study affirmed that almost 60% of the teachers in their study who had under 10 years of teaching experience believed computers in the classroom were essential and hence they use it extensively, while only 25% of teachers with over 20 years of teaching experience shared this belief.

This study also agreed with the previous study of Rosen and Maguire (1990) whose study concluded that teachers teaching experience does not eliminate computer phobias and many experienced teachers display some wariness, discomfort and/or mild anxiety concerning computers. This study contradicts the study of authors whose study contradict the previous study of Most research whose studies showed that teaching experience influences the successful use of ICT in classrooms (Wong & Li, 2008; Giordano, 2007; Hernandez-Ramos, 2005). Nevertheless, Baek, Jong & Kim (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching.

Conclusion

This study on Biology teachers' Self-Efficacy in the use of Virtual Laboratory for instruction in Senior Secondary Schools in Ilorin metropolis, the study concluded that Biology teachers' self-efficacy in the use of virtual laboratory for instruction in Ilorin metropolis was high biology. Also, there is no significant difference between male and female Biology teachers' in their self-efficacy in the use of a virtual laboratory for instruction. This showed that females are also coming up in matters concerning ICT and so should not be discriminated against. Appointments that will involve the use of ICT can thus be given to anybody without gender biases.

Recommendations

The following recommendations were made

1. the lacuna of gender differences in the use of ICT resources for research is gradually becoming narrow between male and female, hence female should no longer be discriminated.
2. Simulated environments involving the use of virtual laboratory should be encouraged and provided for teachers teaching sciences.
3. Science curriculum should be restructured to accommodate the use of virtual laboratory
    1. Less experienced teachers, as well as the experienced, should be encouraged to adopt the use of the virtual laboratory for instruction.

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