Pre-service Teachers' Perceived Ease of Use, Perceived Usefulness, Attitude and Intentions Towards Virtual Laboratory Package Utilization in Teaching and Learning of Physics

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ABSTRACT

This study was carried out to investigate pre-service teachers' perceived ease of use, perceived usefulness, attitude and intentions towards the utilization of virtual laboratory package in teaching and learning of Nigerian secondary school physics concepts. Descriptive survey research was employed and 66 fourth and fifth year Physics education students were purposively used as research sample. Four research questions guided the study and a 16-item questionnaire was used as instrument for data collection. The questionnaire was validated by educational technology experts, physics expert and guidance and counselling experts. Pilot study was carried out on year three physics education students and a reliability coefficients ranging from 0.76 to 0.89 was obtained for each of the four sections of the questionnaire. Data collected from the administration of the research instruments were analyzed using descriptive statistics of Mean and Standard Deviation. A decision rule was set, in which, a mean score of 2.50 and above was considered Agreed while a mean score below 2.50 was considered Disagreed. Findings revealed that pre-service physics teachers perceived the virtual laboratory package easy to use and useful with mean scores of 3.18 and 3.34 respectively. Also, respondents' attitude and intentions to use the package in teaching and learning of physics were positive with mean scores of 3.21 and 3.37 respectively. Based on these findings, it was recommended among others that administrators should equip schools with adequate Information and Communication Technology facilities that would aid students and teachers' utilization of virtual-based learning environments in teaching and learning process.

Keywords: *Virtual laboratory package, Ease of use, Perceived usefulness, Attitude, Behavioural intentions, Technology acceptance model*

INTRODUCTION

The application of computer technology in classroom environment has a significant role in enhancing teaching and learning. For instance, the use of artificial educational environment such as simulations and virtual reality in teaching and learning is increasingly becoming widespread and has proven to be effective in teaching difficult subjects in science (Babateen, 2011). 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 (Yusuf, 2005).

In science and engineering education, virtual laboratories have emerged as alternative or supplementary tools of the hands-on laboratory education (Mahmoud & Zoltan, 2009). Virtual laboratory is an interactive environment without real laboratory tools meant for creating and conducting simulated experiments (Babateen, 2011; Harry & Edward, 2005). It provides students with tools and materials set on computer in order to perform experiments saved on CDs or on web site (Babateen, 2011; Nunn, 2009).

The roles of virtual laboratory in teaching and learning process cannot be over-emphasized. The rapid increase in the use of educational computer has led to changes in the teaching and learning process, curricula and teachers' approach to instruction (Loveless & Ellis, 2002). These changes in instructional techniques are shaped by the fact that computer-assisted learning increases student's motivation and creates better learning environments in which rote- learning is minimized and meaningful learning can occur (Renshaw & Taylor, 2000).

Virtual laboratory makes students become active in their learning, provide opportunities for students to construct and understand difficult concepts more easily and it allows students to repeat demonstrations that they do not understand or as a review for examinations. Empirical studies on the effects of virtual laboratory on students' academic performance revealed the effectiveness of virtual laboratory in teaching and learning process, especially in science subjects (Efe & Efe, 2011; Kevin & Rod, 2012; Mahmoud & Zoltan, 2009; Tuysuz, 2010; Yuen-Kuang & Yu-wen, 2007).

The technological development of any nation lies in the study of science. Science is the foundation upon which the present day technological breakthrough and innovations are built and every nation of the world is striving to develop and be relevant globally both scientifically and technologically (Falode, 2014). One of the core science subjects is physics and it is a requirement for many specialized science and engineering courses at the universities and other tertiary institutions.

Facilities in many conventional physics laboratories in Nigerian secondary schools are inadequate and where they are adequate, the laboratory is only opened to learners during the school working hours thereby hindering students from engaging in independent and self-paced learning of physics. To tackle the menace therefore, Falode (2014) developed a Virtual Laboratory Package on Nigerian secondary school physics concepts, evaluated its' effectiveness and found that students' performance was greatly improved when they learnt the subject through the package.

Effective utilization of the developed Virtual Laboratory Package in Nigerian secondary schools would depend largely on the level of acceptance of the package among physics teachers. Technology Acceptance Model by Davis (1989) is believed to be one of the most influential models widely used in the studies of the determinant of technology acceptance. TAM determines the user acceptance of any technology perceived usefulness, perceived ease of use, attitude and behavioural intentions to use such technology (Abu-Dalbouh, 2013).

Perceived usefulness is regarded as the degree to which an individual believes that using a particular technology will enhance his task performance. Perceived Ease of Use is described as the degree to which an individual believes that using a particular technology is free of physical and mental effort. Attitude towards technology usage determines the kind of intention to usage of a particular technology while an individuals' intention to use technology determines the actual usage (Abu-Dalbouh, 2013; Davis & Venkatesh, 2004; Davis *et al*., 1989).

A few studies on users' perceived ease of use, perceived usefulness, attitude and behavioural intentions towards technology usage were reviewed. For instance, Alharbi and Drew (2014) carried out a study on using the technology acceptance model in understanding academics' behavioural intention to use learning management systems. Findings revealed that respondents perceived ease of use, perceived usefulness, attitude and behavioural intentions towards usage of electronic learning was positive. Also, Ndubisi et al. (2001) in a study on model testing and examining usage determinants, found that users perceived usefulness of computer technology determines the actual usage of such technology. Bijeikiene, Rasinskiene and Zutkiene (2011) investigated teachers' attitudes towards the use of blended learning in the

classroom and found that teachers' attitude towards electronic learning was positive.

Though the developed virtual laboratory package was found effective in teaching and learning of secondary school physics by Falode (2014), it is not clear whether physics teachers would accept and use the package in the actual teaching of the subject. Hence, this study sought pre-service teachers' perceived ease of use, perceived usefulness, attitude and behavioural intentions towards the usage of the package in teaching and learning of physics.

Research Questions

The following research questions guided the study:

1. What is the perception of pre-service physics teachers on the ease of using virtual laboratory package?

2. What is the perception of pre-service teachers on the usefulness of virtual laboratory package in teaching and learning of physics?

3. What is the attitude of pre-service teachers towards virtual laboratory package utilization in teaching and learning of physics?

4. What is the behavioural intention of pre-service teachers on virtual laboratory package utilization in teaching and learning of physics?

METHODOLOGY

This study adopted descriptive survey research design. The methodology involved the use of questionnaire to elicit needed responses from pre-service teachers on their perceived ease of use, perceived usefulness, attitude and behavioural intentions towards virtual laboratory package utilization in teaching and learning of physics.

The population of the study comprised of all physics education students in Federal University of Technology, Minna, Nigeria. This was because within the study area, only the University offers bachelor's degree programme in physics education. Purposive sampling technique was used to select all the physics education students in their 4th and 5th year in the University. This was because, students in their fourth year were imminently preparing to go for a mandatory six-month teaching practice exercise in secondary schools across Nigeria while students in the 5th year just returned to the university after completing the same six-month exercise. Hence, students in the two classes were considered to have been prepared for teaching profession. A total of 66 (all the 32 students in 4th year and all the 34 students in the 5th year) was therefore selected as sample for this study.

Two research instruments were used for the study. They are: Questionnaire on Pre-service Teachers' Perception of Virtual Physics Package Utilization (QPTPVLPU) and Virtual Laboratory Package (VLP). QPTPVLPU was adapted from Alharbi and Drew (2014) Questionnaire on Technology Acceptance Model and it consists of five sections (Sections A-E). Section A was used to collect demographic data of the respondents, Section B consists of six items on perception of respondents on ease of using VLP, Section C consists of five items on respondents' perceived usefulness of VLP, Section D consists of three items on attitude of respondents towards VLP utilization while Section E consists of two items on respondents' behavioural intentions towards VLP utilization in teaching and learning of physics. A four-point rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree was used in weighing responses to the questionnaire items.

VLP was adopted from Falode (2014). It was developed using Adobe Flash CS6. The programming language used was Actions script 3.0 while the Graphic User Interface (GUI) was created using Adobe Fireworks CS6. Box2D was used for the physics simulation engine and Camstudio software was used in recording the video tutorial. The package is meant for performing secondary school physics experiments

(simple pendulum experiment, Hooke's law experiment and momentum experiment). The entrance menu of the package consisted of introduction/student's registration edifice, list of practical lessons (Lessons 1, 2 & 3) and exit button. The main menu is divided into three sections, namely, lesson note section, where the learner is able to study the content for the experiments; Video section, where the learner is able to watch tutorial of how to use the package; and laboratory section where the learner is able to perform the experiments.

The questionnaire was validated by two physics lecturers, two educational technology experts and two guidance and counselling experts. Their suggestions were used to modify and improve the items. To determine the internal consistency among the items of the questionnaire, a pilot study was carried out using 3rd year physics education students at Federal University of Technology, Minna, Nigeria. The questionnaire was administered once on the pilot study sample and Cronbach Alpha's formula that was used to determine its' reliability yielded 0.89, 0.78, 0.81 and *0.76* coefficients for Sections A, B, C and D respectively. Hence, the questionnaire was considered suitable for the main study.

The virtual laboratory package as well as its user's manual are available to the study population in the university departmental library. Hence, they always have access to it before, during and after the study. However, the same package was projected to the respondents for the purpose of this study before they were requested to complete the questionnaire. The duly completed questionnaires were retrieved same day they were administered.

Data gathered from the administered questionnaires were analyzed using descriptive statistics. Mean and standard deviation were used to answer the four research questions. A four-point rating scale of Strongly Agree (SA, 4 points), Agree (A, 3 points), Disagree (D, 2 points) and Strongly Disagree (SD, 1 point) was used in weighing responses to items in the questionnaire. Responses on each questionnaire item were analyzed according to frequencies and mean rankings. First of all, total responses in each scale category (frequency) of every item were tabulated. Next, the number of points allocated to each category was multiplied by the frequency of each category (n). Lastly, the sum of these scores was divided by the sum of the frequency for each category (ΣN).

$$\text{Mean} = \frac{[4 \text{ x } \text{N(SA)}] \ + \ [3 \text{ X } \text{N(A)}] \ + \ [2 \text{ x } \text{N(D)}] \ + \ [1 \text{ x } \text{N(SD)}]}{\Sigma \text{ N}}$$

A mean response below 2.50 was considered disagreement while a mean response of 2.50 and above was considered as agreement.

RESULTS

In this section, Table 1-4 are presented with their interpretations tailored towards providing answers to the research questions raised to guide this study.

Table 1: Mean and standard deviation of pre-service physics teachers' response on perceived ease of using virtual laboratory package

S/N	Item	N	SA	A	D	SD	Mean	St. Dev	Decision
1	I feel that using virtual laboratory package would be easy for me.	66	24	42	0	0	3.36	0.86	Agree
2	I feel that my interaction with virtual laboratory package would be clear.	66	20	46	0	0	3.30	0.80	Agree
3	I feel that it would be easy to become skillful at using virtual laboratory package.	66	26	36	4	0	3.21	0.71	Agree
4	I would find virtual laboratory package flexible to interact with.	66	24	36	6	0	3.09	0.59	Agree
5	Learning to operate virtual laboratory package would be easy for me.	66	26	38	2	0	3.30	0.80	Agree
6	It would be easy for me to get virtual laboratory package to teach physics.	66	12	34	16	4	2.81	0.31	Agree
	Grand Mean						3.18		Agree

Table 1 shows the Mean and Standard Deviation of pre-service teachers' response on their perceived ease of using Virtual Laboratory Package. The table reveals the computed mean score of 3.36 with Standard Deviation of 0.86 for item one, 3.30 with Standard Deviation of 0.80 for item two, 3.21 with Standard Deviation of 0.71 for item three, 3.09 with Standard Deviation of 0.59 for item four, 3.30 with Standard Deviation of 0.80 for item five and 2.81 with Standard Deviation of 0.31 for item six. The table reveals further that, the grand mean score of responses to the six items was 3.18 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and perceived Virtual Laboratory Package easy to use in teaching and learning of physics.

Table 2: Mean and standard deviation of pre-service teachers' response on perceived usefulness of virtual laboratory package

S/N	Item	N	SA	A	D	SD	Mean	St. Dev	Decision
1	Using virtual laboratory package in my teaching career would enable me to accomplish tasks more quickly.	66	40	22	4	0	3.55	1.55	Agree
2	Using virtual laboratory package would improve my teaching performance.	66	18	48	0	0	3.27	0.77	Agree
3	Using virtual laboratory package as a teacher would increase my productivity.	66	20	44	0	2	3.24	0.74	Agree
4	Using virtual laboratory package would enhance my effectiveness as a physics teacher.	66	28	32	6	0	3.33	0.83	Agree
5	Using virtual laboratory package would make it easier to teach physics.	66	26	36	4	0	3.33	0.83	Agree
	Grand Mean						3.34		Agree

Table 2 shows the Mean and Standard Deviation of pre-service teachers' response on their perceived usefulness of Virtual Laboratory Package. The table reveals the computed mean score of 3.55 with Standard Deviation of 1.55 for item one, 3.27 with Standard Deviation of 0.77 for item two, 3.24 with Standard Deviation of 0.74 for item three, 3.33 with Standard Deviation of 0.83 for item four, and 3.33 with Standard Deviation of 0.83 for item five. The table reveals further that, the grand mean score of responses to the five items was 3.34 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and perceived Virtual Laboratory Package useful in teaching and learning of physics.

Table 3: Mean and standard deviation of pre-service teachers' response on attitude towards virtual laboratory package

S/N	Item	N	SA	A	D	SD	Mean	St. Dev	Decision
1	I believe it is a good idea to use virtual laboratory package in teaching of physics	66	24	34	8	0	3.00	0.50	Agree
2	I like the idea of using virtual laboratory package in physics classroom.	66	26	30	8	2	3.21	0.71	Agree
3	Using virtual laboratory package is a positive idea in teaching and learning of physics.	66	30	34	2	0	3.42	0.92	Agree
	Grand Mean						3.21		Agree

Table 3 shows the Mean and Standard Deviation of pre-service teachers' response on attitude towards Virtual Laboratory Package. The table reveals the computed mean score of 3.0 with Standard Deviation of 0.50 for item one, 3.21 with Standard Deviation of 0.71 for item two, and 3.42 with Standard Deviation of 0.92 for item three. The table reveals further that, the grand mean score of responses to the three items was 3.21 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and have positive attitude towards the utilization of Virtual Laboratory Package in teaching and learning of physics.

Table 4: Mean and standard deviation of pre-service teachers' response on behavioural intentions to use virtual laboratory package

S/N	Item	N	SA (4)	A (3)	D (2)	SD (1)	Mean	St. Dev	Decision
1	I plan to use virtual laboratory package when I become a teacher.	66	26	36	4	0	3.33	0.83	Agree
2	Assuming that I have access to virtual laboratory package, I intend to use it in teaching of physics.	66	28	38	0	0	3.42	0.92	Agree
	Grand Mean						3.37		Agree

Table 4 shows the Mean and Standard Deviation of pre-service teachers' response on behavioural intentions to use Virtual Laboratory Package. The table reveals the computed mean score of 3.33 with Standard Deviation of 0.83 for item one, and 3.42 with Standard Deviation of 0.92 for item two. The table reveals further that, the grand mean score of responses to the two items was 3.37 which was greater than the decision mean score of 2.50. This implies that pre-service teachers agreed to the items generated and have behavioural intentions to use Virtual Laboratory Package in teaching and learning of physics.

DISCUSSION OF FINDINGS

Findings on ease of using virtual laboratory package reveals that respondents perceived the package easy to use. This finding was in line with the recommendation of Davis (1989) who developed the Technology Acceptance Model (TAM), the views of Davis and Venkatesh (2004) and that of Abu-Dalbouh (2013) that using a particular technology must be free of physical and mental effort. This finding is in agreement with the earlier finding of Alharbi and Drew (2014) who found that academics perceived Learning Management System easy to use. The perceived ease of using virtual laboratory package by pre-service physics teachers was because they have been using electronic means to learn some of their university courses. Therefore, it was not difficult for them to operate and navigate through the package.

Findings on the usefulness of virtual laboratory package reveals that pre-service teachers perceived the package to be useful in teaching and learning of secondary school physics concepts. This finding was in line with the recommendation of Davis (1989) and the views of Davis and Venkatesh (2004) and that of Abu-Dalbouh (2013) that users of a particular technology must perceive it to be useful in enhancing their performance before they can actually use it. The finding also agrees with the earlier finding of Alharbi and Drew (2014) who found that academics' perception of the usefulness of Learning Management System was positive. Furthermore, this present finding confirms the earlier submission of Ndubisi et al. (2001) that users perceived usefulness of computer technology determines the actual usage of such technology by users. Pre-service teachers perceived the virtual laboratory package useful because they know it would enhance their teaching and make them efficient in teaching of physics.

The finding of this study on attitude reveals that pre-service teachers have positive attitude towards the use of virtual laboratory package in teaching and learning of physics. This finding is not at contrast to the views of Davis (1989), Davis and Venkatesh (2004) and Abu-Dalbouh (2013) that attitude towards technology usage determines the kind of intention to usage of such technology. This present finding is in agreement with the earlier finding of Bijeikiene, *et al*. (2011) that teachers' attitudes towards the use of electronic learning in the classroom was positive. In addition, it agrees with the finding of Alharbi and Drew (2014) who found that academics' attitude towards electronic learning was positive. The positive attitude of pre-service teachers towards the use of virtual laboratory package was as a result of their perceived simplicity and enormous benefits of the package to enrich students' understanding in the classroom.

Another finding that emanated from this study reveals that pre-service teachers are willing and have positive intentions to use virtual laboratory package in teaching and learning of physics. This finding is in line with the views of Davis (1989), Davis and Venkatesh (2004) and Abu-Dalbouh (2013) that an individual's intention to use a particular technology determines the actual usage of such. This present finding does not contradict the earlier finding of Alharbi and Drew (2014) who found that behavioural intentions of academics towards usage of electronic learning was positive. Pre-service teachers' willingness and intentions to use the virtual laboratory package in teaching and learning of physics was as a result of their positive attitude towards the package.

CONCLUSION

This study has revealed that pre-service teachers perceived Virtual Laboratory Package easy to use and useful in teaching and learning of Nigerian secondary school physics concepts. It reveals further that the attitude of pre-service teachers to the use of the package was positive just as they have intentions to use the package upon completion of their teaching education in the University. The use of the package would in no doubt improve students' achievement in physics and make teachers more efficient in teaching of the subject if proper measures are put in place.

RECOMMENDATIONS

Based on findings that emanated from this study, it is recommended that:

1. Developers of virtual-based learning environments such as Virtual Physics Laboratory Package should ensure they develop packages that are easy to use and perceived useful by teachers. This would enable them have positive attitude and intention to utilize such in teaching and learning process.

2. Administrators should equip schools with adequate Information and Communication Technology facilities that would aid students and teachers' utilization of virtual-based learning environments such as Virtual Physics Laboratory Package in teaching and learning process.

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