Acquiring Basic Chemistry Concepts through Virtual learning in Nigerian

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Abstract

Virtual learning has emerged as an ideal platform for learning. Different e-learning packages has been developed to solve instructional problems globally, but in Nigeria few instructors are aware of the usage of this technologies. Therefore, the study examined the acquisition of basic chemistry practical through virtual among Senior Secondary School students in Ado Ekiti, Ekiti State. Nigeria. The study further considered gender and achievement level of the students taught with virtual learning. A survey designed method was adopted, sample constituted of 28 Senior Secondary School II Chemistry students, of which fourteen (14) were male and fourteen (14) also female. The results reveal that virtual learning enhances students' understanding of laboratory chemistry concepts, acquisition and improve performances in chemistry as an alternative to actual chemistry laboratory in Nigerian Senior Secondary Schools.

Introduction

Information Communication and Technology (ICT) referred to tactic for collecting, collating, organizing, manipulating and drawing of assumption on data. It is also an exchange of information amid of people from one location to another. Ede and Ariyo (2014) and Fabunmi (2012) explained that ICT have become increasingly relevant tools to accelerate social, economic and educational sectors. Rosandich (2014) stated that ICT serves as the engine that is rotating the wheel of today's economy, government and education. The influence of ICT on teaching and learning is enormous. Nwoke and Akukwe (2012) stressed that ICT gives learners unique opportunities to learn individually according to their own level of understanding and provides for them instant feedback on their intellectual act. Rienhoff, Hopwood, Fischer, Strauss, Baker and Schorer, (2014) and Yang and Heh (2007) concluded that positive effects of ICT in teaching and learning as unquantifiable.

Hettiarachchi and Wickramasinghe (2016) expressed that Information Technology approach to instructions, has brought a great shift from teacher centered which is traditional learning methodology to learner centered method of teaching especially sciences. Chemistry is known to be a branch of science that processed the fundamental ingredients to technology dealing directly with both practical and experimental understanding of basic natural phenomena (Arokoyu & Ugonwa 2012). It was said that chemistry contributed greatly to value of life and nation building which cannot be over emphasised in all aspects (Olibie, Ezoem & Ekene, 2014).

Teaching of sciences are facing quite a lot of problem, studies have itemized some of them in different direction, for example, WAEC (2013) reported that poor performance of chemistry students in both internal and external examinations yearly are not encouraging. Njoku (2007) noted that secondary and tertiary chemistry students also exhibits poor and deplorable results over the years. Copriady (2014) stated that teaching chemistry in secondary

schools is often link with many challenges of which teachers' competency is inclusive. The study of Schutt and Linegar (2013) also Omorogbe and Celestine (2013) mentioned the abstract nature of the chemistry concepts and topics in the curriculum as another strong factor. Also, poor methodology (Machina, 2012). Lack of motivation is also identified as another crucial factor of poor performance in sciences (Glynn, Taasoobshirazi, & Brickman, 2009) and (Herga, Čagran & Dinevski 2016). In essence, Celestine (2013) stressed that inadequate qualified hands to train the science teachers is also a factor on the poor students' performances of sciences. Lawrence (2011) and Nikolaev and Chugunov (2012) lamented of the situation of education as complicated in respect of problems resulting from the national economic and political instability of the State.

In respect to these challenges, suggestions for improvement and to address these challenges are been examined by the scholars. For example, the study of Rajasingham (2007) mentioned field work, e- learning and project works as a method of instruction that can easily facilitate to alleviate aforementioned problems. Hume and Berry, (2013) suggested that constant laboratory work and utilization of content design is way to solve learning problems in sciences. More so, Lawrence (2011) mentioned the usefulness and solving problems of teaching of sciences through virtual laboratory as of paramount in recent time. In essence, Gambari and Yusuf, (2014) explained that virtual learning is an innovative techniques of instruction that is very useful for teaching and learning of sciences especially chemistry. French (2014) concluded that learning is more of experiments within a virtual environment and it is more effective than in real laboratories. In essence, virtual learning may be used and at same times be preferred for alternative and supportive for chemistry instruction.

In this regards, researches have examined the meaning of virtual learning, many scholars have discussed virtual learning in different perspective. For instance, Unanma, Abugu, Dike and Umeobika, (2013) explained that virtual learning is a reality arena that offers

repeatable, safe and conducive environment for skills that are not possible to undergoes in real-world. The study of Jeschke, Richter and Zorn, (2010) clarified virtual laboratories as a stimulants, providers and offers the students with significant practical experiences. Also, Abeldina, Moldumarova, Abeldina and Moldumarova, (2015) submitted that a virtual learning environment consists of a designed software and a system of instruction for educational establishment and organisation monitored under the auspices of an experts which creates communication border for the teachers and as well for students in facilitating learning process. Jasieński (2014) concluded that a virtual classroom can duplicate a normal classroom of brick and mortar for instructional purposes. Moreover, virtual learning environment is learning that is acquired through interaction with digitally devices for delivery of learning content. It is also the learning that carried out via integration of electronic dialogue for example activities on web platforms (Bouchard, 2011) and (Tirp, Steingröver, Wattie, Baker & Schorer, 2015). For this reason, Hettiarachchi and Wickramasinghe, (2016) explicated that virtual learning environment is an online learning podium that allows instructors to share instructional content with both male and female students through the web, example of these are WebCT, Moodle and Blackboard.

On gender and sciences, it has been identified by many studies that gender as a factor influence greatly the performances of the science students in senior secondary school level in Nigeria. The study of Jimoh (2004) and Khairulanuar, Nazre, Sairabanu and Norasikin, (2010) reported that gender differences in the favour of male science students. In contrast, Martin, and Parker, (2014) expressed the concern of faculty female using virtual environment than male. Also, Ajaja, and Eravwoke, (2010) stated that gender had no influence on the academic performance of learners. In essence, Olson (2002) confirmed that male students were performing less than their female counterparts in sciences. These aforementioned study have contradictory establishments and had led to considering gender

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as a moderating variable in this study. The reviewed showed the inconclusiveness of the findings on gender and performances of the science students.

Furthermore, studies have focused on the gender ability level and achievement of the students. According to West African Examination Council results reported in the year 2015, male students performed better than female in Chemistry subject in the last five years, this revealed that good performance of male students over the female students (Yang & Heh, 2007). The study of Miyake (2010) observed that the disparity between female and male science scholars especially in achievements in higher education revealed that female are few in science oriented courses than when compare to their male counterpart.

Many studies have revealed positive impact of virtual learning to students. For example, the study of Rosandich (2014) researched on the transferring of a motor skill within and between basketball and darts. Also, Unanma, Abugu, Dike, and Umeobika (2013) worked on virtual realities in learning environment that stimulates efficiency and difference in training. More so, Abeldina, Moldumarova, Abeldina, and Moldumarova, (2015) examined the virtual environment for teaching science subjects in schools. Yang, and Heh, (2007) looked at the effect of virtual physics laboratory on the scientific process skills, they concluded that the experimental group performed significantly than the traditional laboratory activities. Unanma, Abugu, Dike, and Umeobika (2013) researched into the skill in the virtual and actual learning environments on throwing, the study stressed the significant differences in condition and interaction test were take the measured in enhancing the virtual group. Altun, Feyzioğlu, and Demirağ, (2011) studied the effectiveness of virtual chemistry laboratory teaching on scientific process skills of students, the study revealed that virtual chemistry laboratory was effective in teaching of scientific process skills. In essence, virtual learning is established as a good method of instruction which promotes effective instruction through web.

Scholars have argued that virtual learning provide the students opportunity to assist and influence each other. In other words, studies have confirmed the usefulness of virtual in learning different discipline on the school curriculum. For instance, Dede, Salzman and Loftin (1994) mentioned that the virtual laboratory is an alternative environment to laboratory that provides full involvement of learner individual or collaboratively. Herga, Čagran and Dinevski, (2016) expressed that virtual laboratory provides picky reward that present teaching and learning in meaningful way. Domingues, Rocha, Dourado, Alves and Ferreira (2010) opined that both virtual and real world experience provides laudable experiences. In essence, It is clear that one can deduced that virtual learning brings positive and effective classroom instruction to the door step of the learners.

However, there is a need for the nation to adopt Information Communication Technology (ICT) oriented method of instruction for schools and colleges. Unfortunately, awareness and utilisation of this method of instructions, that is virtual learning are yet to be fully embraced by the primary and secondary school teachers in Nigeria. It is on this note that the study examined the acquisition of basic chemistry practical through virtual laboratory among Senior Secondary School students in Ado Ekiti, Nigeria. The study further considered at gender and achievement level of the students taught with virtual learning.

Research Question

These research questions have been raised to guide the study.

(i)   What is the difference in the performances of chemistry students taught with virtual learning and those taught with conventional method?.

(ii)   Is there any difference in the performances of male and female chemistry students taught with virtual learning?

(iii) What is the significant difference in the mean scores of low, medium and high ability of chemistry students taught with virtual learning?.

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Research Hypotheses

These hypotheses were formulated for the study;

Ho$_1$ There is no significant difference in the performances of chemistry students taught with virtual learning and those taught with conventional method.

Ho$_2$ There is no significant difference in the performances of male and female chemistry students taught with virtual learning.

Ho$_3$ There is no significant difference in the mean scores of high, medium and low ability of chemistry students taught with virtual learning.

Methodology

The study used Quasi-experimental type of post-test design which involves administering a specify summative objective test items after the treatment to the selected sample. The population for this study was taken from the entire public Senior Secondary School II Chemistry students in Ado Ekiti, Ekiti State, Nigeria. In essence, the study sampled twenty eight (28) students, fourteen (14) were male and fourteen (14) also female. The schools used for the study were selected purposively based on these criteria; equivalence (facilities and teachers, chemistry laboratories), gender composition (mixed schools), school type (public schools). Other were ICT equipment (computer laboratories under the close monitoring of School Net programme) and exposure (teachers and student exposure to the use of computer in their schools). Also, two equivalent mixed schools were assigned to both the experimental (the treated group, that is students taught with virtual learning environment) and control group (chemistry students taught with normal teaching and learning in the classroom with appropriate instructional materials) the students were sampling based on randomise technique and stratified sampling technique was also utilised to group the students to male and female and the ability levels of high, medium and low guided by the students performances in the last summative promotion examinations in chemistry (in

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Senior Secondary I) with this yardstick; Upper (75-100%), Higher which is (50 - 74%) Medium, (49-24%) and Low (0-25%).

The Experimental Procedure were taken care, the objectives and process of the experiments were well stated in the operational manual that were given to both the students and the instructors. The learners were exposed to virtual instruction, through the computers for the experimental groups. Students were instructed to be conscious and mindful of the instruction. The instruments used (package and test) were adapted from Ogunlowo (2016) named as the Laboratory Software Package (LSP) and test instrument that is Practical Chemistry Test (PCT). The test instrument used in producing data for the study consisted of fifty (50) multiple choice objective items premeditated to measure specified learning outcomes related to the virtual learning environment. A stem is followed by five (5) options lettered (A-E) out of which only "one" was absolutely correct. Chemistry students were therefore instructed to select the only one option as answer for each given item. All the options were nearly answers to the item. In essence the total correct marks of the each student is placed over fifty (50).

The researcher handles the available Information and Communication Technology facilities on the ground for the teaching of the experimental group assign each computer to a student for the process of teaching. Laboratory Software Package is a Web based instructional media distributed through online / network to all available computers. Students logged through typing their usernames and passwords at the home page. The menu options on the left include topic option, The topic information contained a brief summary of the topics, bringing the user to the main menu, where the topics are listed on the top left hand side of home page. Having logged in through selection of a topic. A series of instruction are automatically displayed along with the topic, students follows the sequence, after satisfy with the page, the next menu is clicked continuously till the end of the topic in last page. The

assignments section were of homework based for learners to practice with the topic of instructions.

While the Chemistry teachers in the two schools with the research assistants were employed to team teach the conventional group in the given topics (Mole concept, Electrolysis, chemical equilibrium, isomerism, IUPAC nomenclature) for six weeks of two periods per weeks, each period consists of 40 minutes.   The first week starts with the instructions guiding the course of study.   The lesson starts fully in the second week with the experimental group accomplishing the virtual learning through the Laboratory Software Package in the chemistry laboratory and the other group the conventional group taught with conventional teaching compliment with appropriate teaching materials in line with the stated objectives in the planned lesson note written prior and examined by the a lecturer in the Department of Science Education, University of Ilorin. Ilorin. Nigeria. After the thorough teaching of prescribed topics for four   weeks, with the two groups, the students were gathered   together   and   the adapted objective test instrument were administered as a summative in the Chemistry Laboratory to students on paper based and score each student over fifty marks.

Results

Research Question 1: What is the difference in the performances of chemistry students taught with virtual environment and those taught with conventional method?.

The above question is answered as follows in table 1.

Table 1

The means scores of the performances of chemistry students taught with virtual environment and those taught with conventional method.

Variable	N	Mean	Std.D.
Experimental	14	35.0000	5.00000
Conventional	14	33.0000	5.37742

Table 1 revealed that the mean of the experimental chemistry students taught with virtual environment was 35.0000 and the mean of conventional chemistry students taught with conventional method was 33.0000, in favour of experimental group.

Research Question 2:   Is there any difference in the performances of male and female chemistry students taught with virtual environment?

The question is answered as follows in table 2.

Table 2:
The means scores of the performances of male and female chemistry students taught with virtual environment

Variable	N	Mean	Std. Deviation
Male	14	35.0000	.00000
Female	14	31.2000	5.55278

Table 2 shows that the mean of male chemistry students taught with virtual learning environment with male chemistry students mean of 35.0000 and the female chemistry students with 31.2000, in favour of male students.

Data Analysis

Hypotheses testing

Ho$_1$: There is no significant difference in the performance of chemistry students taught with virtual environment and those taught with conventional method.

To test this hypothesis, t-test statistics was used, result is reported as in Table 3.

Table 3

t-test Mean of both Experimental and Conventional Chemistry Groups.

Variable	No	Mean	Std D.	Df	T-value	Sig. (2-tailed)
School. A	14	35.000	5.00000	26	612	546
School. B	14	33.000	5.37742			

Table 3, presents the comparison of the post-test mean scores of experimental group taught with virtual learning and those taught with the conventional teaching method. The calculated F value of 612 is significant because the significant value of .546 is higher than 0.05 alpha levels. This result implies that there is no significant difference between the post-test mean scores of the treatment and conventional group.   That is, the scores did not differ significantly from the experimental and control groups. Therefore, the null hypothesis is accepted, meaning there is no significant difference in students performance taught with either virtual or conventional methods.

Ho$_2$: There is no significant difference in the performances of male and female chemistry students taught with virtual environment.

To test this hypothesis, t-test statistics was used to compare the means score of the male and female experimental group. This result is as stated in Table 4.

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Table 4:
t-test statistics comparing the means score of the male and female experimental group.

Variable	No	Mean	Std D.	Df	T-value	Sig. (2-tailed)
Male	14	35. 000	5.00000	26	1.166	254
Female	14	31.000	5.37742			

Table 4, indicates that the calculated t value of 1.166 is significant because the significant value of .254 is greater bigger than 0.05 alpha levels. The result implies that there is no significant difference in mean scores of both male and female in experimental group. Therefore, the null hypothesis is not rejected but accepted. In other words the result suggested that male and female do perform equally in the test given.

Ho_3 : There is no significant difference in the mean scores of upper, high, medium and low ability level of chemistry students taught with virtual environment.

To test this hypothesis, Analysis of variance (ANOVA) statistics was used to compare the scores of the low, medium, High and Upper ability level in experimental group. This result is revealed in Table 5.

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Table 5

ANNOVA statistics comparing the scores of the low, medium and High in experimental group

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1894.944[a]	2	947.472	24.458	.000
Intercept	51995.487	1	51995.487	1342.186	.000
FACTOR	1894.944	2	947.472	24.458	.000
Error	968.485	25	38.739		
Total	125360.000	28			
Corrected Total	2863.429	27			

a. R Squared = .662 (Adjusted R Squared = .635)

Table 5, presents the comparison of the post-test mean scores of Upper, High, Medium and Low performance levels of the experimental group. The calculated F value of 24.458 is not significant because the significant value of .000 is lesser than 0.05 alpha levels. This result implies that there is significant difference between the mean scores of high, medium and low. That is, the scores did differ significantly from the experimental groups. The null hypothesis therefore is rejected.

Discussion of the Findings

The study is aimed to investigate acquired basic chemistry concepts through virtual learning in Nigerian Senior Secondary Schools. Based on the results, the report of analysis on hypothesis one (1) on the performances of chemistry students taught with virtual learning and those taught with conventional method was accepted. The finding conformed with Mutlu and Şeşen (2016) who reported that virtual chemistry laboratory provided a positive scientific skills and researches for learners. Moreover, this finding is also supported the conclusion of Altun, Feyzioğlu and Demirağ (2011) who succumbed that virtual chemistry laboratory significantly promote theoretical and practical learning. Furthermore, the finding also agreed with Yohon and Zimmerman (2006) who established that virtual laboratory instruction were more effective for increasing students' cognitive learning.

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Moreover, the findings agreed with Lopukhova and Makeeva, (2017) who stated that virtual learning gives opportunities and promotes effective learning environment that fosters and increase students' intellect. Also the study further supported Rosandich (2014) who submitted that virtual learning significantly useful for acquiring basic techniques of skills in basketball and darts. This corroborate with finding of French (2014) who reported the acquisition of functional of online classroom instruction and home instructional strategies through virtual learning. In essence, the study conform with Dalgarno, Bishop and Bedgood, (2003) who suggested that learners do gain more experiences and skills via virtual environment.

In the same vein the study of Jasieński (2014) who suggested that learners should be encouraged and the sense of anonymity through virtual learning. The finding agrees with Meisner, Hoffman and Turner, (2008) who established that virtual environment is a driven exemplary method and viable alternative for students learning practical physics. However, the finding negates the finding of Yohon and Zimmerman, (2006) who reported the significant difference in favour of the experimental group. Similarly, the finding did not support the finding of Herga, Čagran and Dinevski, (2016) who confirmed the significance difference in experimental and conventional groups. In essence, it is true that virtual learning improve cognitive skills of the learners.

On gender, the hypothesis two (2) the report of analysis on the performances of male and female chemistry students taught with virtual environment were rejected. The findings is agreed with Martin and Parker, (2014) who uncovered that female are more than male faculty in adopting and utilising virtual environment among the faculty members. The finding agreed with Fabunmi (2012) who originated that male students had knowledge of virtual learning than female students. More so, the findings agrees with Craig (1999). who established that female students acquire more knowledge through exposure to virtual

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learning. However, the findings disagrees with the findings of Khairulanuar, Nazre, Sairabanu, and Norasikin, (2010) who reaffirmed that gender differences in favour of male students.

On students achievement, the report of analysis on hypothesis on the performances of high, medium and low achievement taught with virtual environment were not rejected. The findings disagreed with the findings of Ajaja and Eravwoke, (2010) who mentioned that the students attitude towards learning may brings differences in their achievement level. The findings agreed with Meisner, Hoffman and Turner (2008) who established that male students performed averagely higher than the regular students in term of their achievement tests. Similarly, the finding concurs with Olibie, Ezoem and Ekene, (2014) who stressed that categories of students achievement were collapsed due to low counts in respects of some variables. The finding also in line with Olibie, Ezoem, and Ekene, (2014) who established the low percentages marks of students were recorded when exposed to virtual learning. In essence, the findings is favoured Herga, Čagran and Dinevski, (2016) who established that there is statistically significant difference in the means of pupils in the pupils achievement. However, it can be deduced that gender is not a factor for virtual learning.

Conclusions

One can concluded that the study of virtual learning enhances students' understanding of laboratory chemistry concepts, acquisition and improve performances in chemistry as an alternative to actual chemistry laboratory in Nigerian Senior Secondary Schools. It is as well profitable for male and female Chemistry students of the same environment, to learn chemistry through virtual application could prop up their interest for enhanced performance of chemistry students in Nigeria.

Recommendations

The following recommendations from study are made:

- Virtual learning should be encouraged in teaching chemistry concepts in Nigeria Senior Secondary Schools.   This could be done through corporate bodies, government support and educational agencies to schools and individuals.

- Educational Technologists should be encouraged to develop varieties of virtual learning applications for students in chemistry.

- Seminars, in-service training, conferences and workshops should be organized for teachers to enable them acquire necessary skills and also update their knowledge about the development and proper use of virtual learning for classroom instructions.

- Chemistry text authors or other textbook writers should be advised to develop virtual learning-App to complement their various textbooks used in the senior secondary schools.

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