EFFECTIVENESS OF VIRTUAL CLASSROOM IN TEACHING AND LEARNING OF SENIOR SECONDARY SCHOOL MATHEMATICS CONCEPTS IN MINNA, NIGERIA.

Falode, O.C*.; Gambari, A.I.; Shittu, T.; Gimba, R.W.; Falode, M.E. & Awoyemi, D.I.
Department of Science Education,Federal University of Technology,Minna,Nigeria.
Email: facominsight2@gmail.com

Abstract
This study was conducted to determine whether a researcher-developed Virtual Mathematics Classroom Package (VMCP) is suitable and effective in teaching and learning of Nigerian senior secondary school mathematics concepts. Three research questions were raised while one hypothesis was tested. The study adopted mix-method (survey and quazi-experimental) design. Twenty mathematics teachers were purposively sampled to evaluate the teaching functions of the package while intact classes of 102 senior secondary school students from two co-educational secondary schools were employed for the experimental exercise. VMCP, mathematics achievement test and virtual mathematics classroom evaluation questionnaire were the research instruments used for the study. The three instruments were validated by instructional design experts, test and measurement expert, mathematics teachers and computer programmers. Findings that emanated from the administration of the instruments indicated that VMCP is suitable in teaching of the concepts treated mathematics. The package was therefore recommended for teachers and students' use as a supplement to conventional classroom instruction in order to greatly improve students' performance in mathematics.and also improved students' achievement in mathematics. The package was therefore recommended for teachers and students' use as a supplement to conventional classroom instruction in order to greatly improve students' performance in mathematics.

INTRODUCTION

The key role of education is to empower students with skills and attitudes that are essential to their success in a dynamic society. Paramount to the attainment of such success is Science, Technology, Mathematics and Engineering Education (Greg, 2005). Mathematics is seen as the dialect used to portray the issues emerging in many limbs of science and technology. Hence, the subject is is enshrined as a fundamental and compulsory subject being offered in Nigerian secondary schools (FRN, 2004; Iyekekpolor & Bulus, 2009).

However, despite the importance of mathematics to the technological growth of Nigeria, students' performance in mathematics examinations being conducted by West African Examinations Council (WAEC), National Examinations Council (NECO), National Business and Technical Examinations Board (NABTEB) and Unified Tertiary Matriculation Examination (UTME) is not encouraging. (Agwagah, 2004; Avong, 2013; Gambari & Fagbemi 2008; Ije & Harbor-Peters, 2005). Some of the major reasons adduced students' poor performance in mathematics are poor teaching methodology, teacher's personality, lack of interest and abstract nature of the subject. Virtual classroom has been proffered to tackle the aforementioned problem of students' poor performance in science subjects.

A virtual classroom is an online learning environment in which the learners and instructors interact together. This definition was buttressed by Finkelstein (2006) who described virtual classroom as a visual contact between participants and instructor in an online environment as if they are engaged in face-to-face classroom setting. It is an environment located within a computer mediated communication system for instruction to take place (Rajnish & Swati, 2003). Some features and compositions that make virtual classroom essential in teaching and learning processes are Assignments folders, Audio features, Blog, Chat room, Video component, Simulation tools, Grading books, Emails, Online calendars,

Examinations and Quizzes (Obasa & Mbing, 2010; Yang & Liu, 2007).

Virtual environments are considered suitable in teaching and learning of science-based subjects (Barbour & Reeves, 2009; Falode, 2014). Effective implementation of virtual classroom has great implication for teaching and learning as it promotes students' interest in learning contents and encourages teachers' efficiency. In a virtual classroom setting, the learners actively engage in synchronous instruction meaning that the teacher and learners are logged into the classroom at the same time just like in a real-world conventional classroom system.

A number of studies carried out on the effectiveness of virtual environments (classroom and laboratory) on students' achievements in science-based subjects indicate that such environments improved students' achievement and that significant differences exist between the achievement of students taught using virtual environments and those taught using conventional method of instruction (Efe & Efe, 2012; Falode, 2014; Gambari, Falode, Fagbemi & Idris, 2012; Mahmoud & Zoltan, 2009; Murniza, Halimah, & Azlina, 2010; Tuysuz, 2010; Kerr, Rynearson, & Kerr, 2004).

Previous studies on effectiveness of virtual environments cited in this study were carried out on students' achievements in other science-based subjects and only very few of them were conducted in Nigeria. Hence, this study was conducted to determine the effectiveness of virtual classroom in teaching and learning of selected senior secondary school mathematics concepts in Minna, Nigeria.

RESEARCH QUESTIONS

The following research questions were raised and answered:
1. Do Mathematics teachers consider the developed virtual mathematics classroom package   suitable for teaching and learning of the selected Nigerian secondary school mathematics   concepts?
2. Does virtual mathematics classroom package has any effect on

the mean achievement   score of senior secondary school students taught the selected mathematics concepts?

3. Is there any difference in the mean achievement score of students taught mathematics   using virtual mathematics classroom package and their counterparts taught using lecture   method?

RESEARCH HYPOTHESIS

HO: There is no significant difference in the mean achievement score of students taught   mathematics using virtual classroom and their counterparts taught using lecture method.

METHODOLOGY

The study adopted mixed-method (survey and quazi-experimental) design. A non-randomized, non-equivalent experimental and control group design was adopted to determine the effect of Virtual Mathematics Classroom Package (VMCP) on secondary school students' achievement in mathematics. The independent variables were the package and conventional classroom instruction while the dependent variable was the post-test achievement score of students. Survey design was adopted to determine the suitability of VMCP in teaching of selected mathematics concepts. Questionnaire was presented to mathematics teachers to evaluate the teaching functions of the virtual classroom package.

The population for this study consisted of all senior secondary school mathematics students and teachers in Minna, Nigeria. Twenty teachers who are currently teaching mathematics in Minna were purposively selected from six secondary schools to evaluate the virtual classroom while One hundred and two students from two co-educational, state government-owned secondary schools were involved in the experimental study. The two schools were selected based on equivalence in terms of facilities and manpower. The schools were randomly assigned to experimental and control groups before intact classes of senior secondary school year one (SSI) were selected. The experimental and control groups had 49 and 53 students respectively.

Three research instruments were used for the study. They are the Virtual Mathematics Classroom Package (VMCP), Mathematics Achievement Test (MAT) and Virtual Mathematics Classroom Evaluation Questionnaire (VMCEQ). VMCP contains eight major sections (Login, Introduction, Objectives, Contents, Video, Library, Chat and User-evaluation sections). The development of the package by the researchers involved the use of CSS programming language, Hypertext Mark-up Language, Standard General Mark-up language (SGML), CamStudio recording software and Cascading Style Sheet (CSS).

VMCEQ was a six-item questionnaire adapted from Falode (2014). It was a 4-point scale and it was used to elicit responses from mathematics teachers on the effectiveness of the virtual classroom in terms of teaching and learning functions. MAT consisted on 40 multiple choice objective questions on three Nigerian secondary school mathematics concepts (Mensuration, Data Presentation and Geometry). Relevant questions on the concepts treated were adapted from past examination question papers of Senior Secondary School Examinations conducted by WAEC and NECO between 2008 and 2014. Each of the questions had four options (A-D) out of which students were expected to indicate the correct answer.
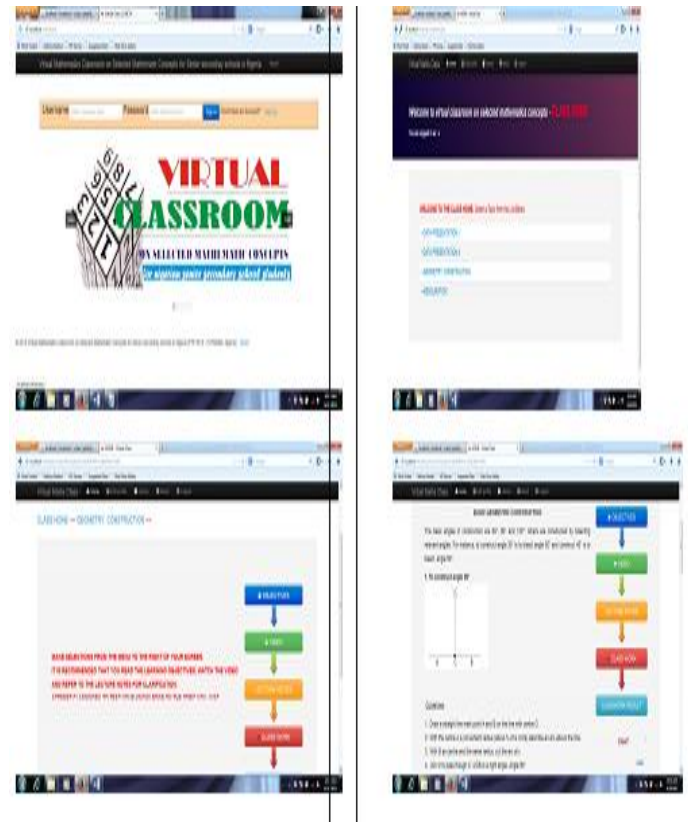
Fig(1)Screen shot of the virtual mathematics classroom package

The three research instruments were validated by two instructional design experts, two computer programmers, two mathematics teachers and one test and measurement expert. A pilot study was conducted in a school within the study area but that was not selected for the real study where four mathematics teachers and ten randomly selected students were sampled. The reliability of MAT and VMCEQ in a single administration was therefore determined as 0.75 and 0.82 using Kudar Richardson (KR-21) formula and Cronbach's alpha formula respectively.

Data gathered from the administration of research instruments during the main study were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). A four-point scale of Strongly Agree (4 points), Agree (3 points), Disagree (2 points) and Strongly Disagree (1 point) was used in weighing mathematics teachers' responses to items in the questionnaire. Hence, a mean average response below 2.50 was considered disagree while a mean response of 2.50 and above was considered agree. The hypothesis was tested using ANCOVA in Statistical Package for Social Sciences (SPSS) version 20.0 and the significance of the statistical analysis were ascertained at 0.05 alpha level.

RESULTS

Research Question 1: Do Mathematics teachers consider the developed virtual classroom suitable for teaching and learning of the selected Nigerian secondary school mathematics concepts?

Table 1 shows the mean response of mathematics teachers on the suitability of virtual classroom in the teaching and learning of mathematics. A mean response of not below 2.50 out of 5.0 was obtained for each of the items except the sixth item which has a mean response of 2.15. With an average mean response of 2.67 out of possible 5.0, the table indicates that mathematics teachers agreed

that the developed virtual classroom is suitable for teaching and learning of the selected Nigerian secondary school mathematics concepts.

Table(1)Mean response of mathematics teachers on the suitability of virtual classroom in the teaching and learning of mathematics

S/N	Statement	N	SA	A	D	SD	Mean	S. Dev.	Decision
1	Virtual mathematics classroom will help to attain the behavioural objectives of the contents treated	20	7	6	5	2	2.90	0.40	Agree
2	Learning through virtual mathematics classroom will help to develop needed cognitive skills in learners	20	6	5	5	4	2.65	0.15	Agree
3	Learning contents of data presentation, mensuration and geometry are adequately covered in virtual mathematics classroom	20	7	5	4	4	2.75	0.25	Agree
4	virtual mathematics classroom put every required steps and procedures of learning the treated mathematics contents into appropriate learning shapes	20	7	7	4	2	2.95	0.45	Agree
5	Learning data presentation, mensuration and geometry through virtual classroom is effective	20	5	6	5	4	2.60	0.10	Agree
6	The use of virtual mathematics classroom in teaching and learning of data presentation, mensuration and geometry is more effective than the use of lecture method	20	3	4	6	7	2.15	0.35	Disagree
	Average Mean						**2.67**		**Agree**

Research Question 2: Does virtual classroom has any effect on the mean achievement score of senior secondary school students taught the selected mathematics concepts?

Table 2: Mean and standard deviation of students' achievement score in pretest and posttest

Test	N	Average Mean	Standard Deviation
Pre Testing	49	23.59	7.53
Post Testing	49	52.00	9.81
Mean Gain		**28.41**	

Table 2 shows the mean and standard deviation of students' score in achievement test before and after learning the selected mathematics concepts through virtual classroom. The table reveals that the mean achievement scores of students increases from 23.59 to 52.00 (an indication of 28.41 improvement). Hence, virtual classroom had positive effect on students' achievement scores in mathematics

Research Hypothesis: There is no significant difference in the mean achievement score of students taught mathematics using virtual classroom and their counterparts taught using lecture method.

Table 3 shows the ANCOVA result of the comparison of Posttest scores of students in experimental and control groups. An examination of the Table shows a significant main effect (F (1, 99) = 61.946, p = 0.000). On the basis of this, the hypothesis is rejected. The result revealed that there is significant difference between the mean achievement scores of students taught mathematics through virtual classroom and those taught using lecture method when covariate effect (pretest) was controlled. The mean gain scores of the two groups are computed and presented in Table 4.

Table(3)Analysis of covariance of posttest scores of experimental and control groups using pretest as covariate

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4446.871	2	2223.436	32.021	0.000
Intercept	13404.330	1	13404.330	193.043	0.000
Covariate (Pretest)	534.404	1	534.404	7.696	0.007
Main Effect (Treatment)	4301.379	1	4301.379	61.946*	0.000
Error	6874.276	99	69.437		
Total	223033.000	102			
Corrected Total	11321.147	101			

*: Significant at 0.05 level

Table 4: Mean gain scores of students in experimental and control groups

Group	Pretest	Posttest	Mean Gain Score
Virtual Classroom	23.59	52.00	28.41
Lecture Method	26.30	39.60	13.30

From Table 4, it can be observed that both groups had improvement as observed in their posttest scores. The experimental group had the highest mean gain scores of 28.41 while the control group had mean gain scores of 13.30. This shows that virtual classroom greatly improves students' achievement in mathematics than lecture method.

DISCUSSION OF FINDINGS

Finding of this study revealed that mathematics teachers consider the developed virtual classroom suitable for teaching and learning of the selected Nigerian secondary school mathematics concepts. This finding is being supported by the earlier finding of Falode (2014) who found that teachers agreed that virtual environment is suitable for teaching and learning of science subjects. Also, the finding is in line with the recommendation of Barbour and Reeves (2009) that virtual learning environment should be perfectly developed to meet the educational needs of learners for meaningful learning to take place.

Finding of this study also revealed that virtual classroom improved students' achievement in mathematics. This agrees with the earlier findings of Falode (2014), Murniza, et al. (2010) and Mahmoud and Zoltan (2009) who found that virtual instruction improved students' academic achievements in science-based subjects. This finding is also being supported by earlier finding of Kerr, et al (2004) who found that students who learnt chemistry performed excellently when virtual environment was used.

Finding that emanated from this study also revealed that there is significant difference in the achievement of students taught mathematics using virtual classroom and those taught using lecture method in favour of the former. This finding is in agreement with the earlier findings of Efe and Efe (2012), Gambari et al. (2012), Tuysuz (2010) and Kerr, et al (2004) who found that students taught science subjects through virtual environments performed significantly better than their counterparts taught through conventional method of instruction. However, the finding is not in agreement with the earlier finding of Falode (2014) who found that no significant difference exist between the achievement of students in physics when virtual

environment and conventional method of instruction were used.

CONCLUSION

From the findings that emanated from this study, it can be deduced that virtual classroom is suitable in teaching and learning of mathematics. It's usage to complement lecture method will greatly improve students' understanding of mathematics with little or no stress in school and even outside the school premises.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Virtual classroom should be employed by teachers to supplement lecture method of teaching. This will facilitate students' understanding of mathematics concepts.

2. Students should explore the learning opportunities offered by virtual classroom. The package can be used in individualized learning of mathematics without the barriers associated with time and space.

3. Teachers should get acquainted with the development of virtual classroom through in- service trainings in form of workshops and seminars. This will enable them to be skillful in the application of ICT innovations that will enhance teaching and learning of mathematics.

References

. 1) Agwagah, N. V. (2004). Sustaining development in secondary school mathematics through constructivist framework: A model lesson plan. *Journal of Mathematical Association of Nigeria* 29(1), 92- 98.

2) Avong, H. N. (2013). Poor performance in mathematics among senior secondary school students in Kaduna State: What is to blame? *Journal of Research in National Development,* 11(2), 319-324.

3) Barbour, M. K. & Reeves, T. C. (2009). The reality of virtual schools: A review of the literature. *Computers and Education,* 52, 402-416.

4) Efe, H. A. & Efe, R. (2011). Evaluating the effect of computer simulations on secondary biology instruction: An application of bloom's taxonomy. *Scientific Research and Essays,* 6 (10), 2137-2146.

5) Falode, O. C. (2014). *A bates' actions evaluation of virtual physics laboratory package for senior secondary school students in Nigeria.* Unpublished Ph.D dissertation, Department of Educational Technology, University of Ilorin, Nigeria.

6) Federal Republic of Nigeria (2004). *National policy on education.* Lagos: NERDC Press.

7) Finkeistein, J. (2006). *Learning in real time.* San Francisco, CA: Jossey-Bass.

8) Gambari, A. I. & Fagbemi, P. O. (2008). Effect of computer-graphics on instructional package on mathematics achievement among primary school pupils in Niger State, *Nigeria Journal of Science Education Technology 1,* (2), 141- 147.

9) Gambari, A. I., Falode, O. C., Fagbemi, P. O. & Idris, B. (2012). *Effect of virtual laboratory strategy on the achievement of secondary school students in Nigeria.* Proceedings of the 33rd Annual Convention and National Conference of Nigeria Association for Educational Media and Technology (NAEMT) held at Emmanuel Alayande College of Education, Oyo, Oyo State. October 8-13.