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Assessment Of Multimedia Presentations In Chemical Equilibrium A Determinant Of Achievement Among Secondary School Chemistry Students In North West, Nigeria

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Abstract: ***The study focused on assessing multimedia presentations on academic achievement in chemical equilibrium among senior secondary school students in North- West Zone, Nigeria. The population consisted of 1952 students drawn from 20 state government owned secondary schools in Kaduna and Kano States. The sample size of the study was 160 chemistry students from the two states drawn through purposive sampling technique. Descriptive Survey and Quasi-experimental design was adopted for the study. Three research questions and two null hypotheses were tested at 0.05 level of significance. Instrument for data collection was the researchers' structured questionnaire of four point Likert type to elicit information. The instrument was face-validated by experts from science education department, Ahmadu Bello University Zaria. Cronbach alpha was used to obtain a reliability coefficient of 0.76. Data collected was analyzed using mean to answer the research questions, t-test and ANOVA statistics to test the hypotheses. The study revealed that: students' proficiency in the use of ICT/Multimedia presentation for learning was very low; significant difference exist between the mean performance scores of students in the experimental schools and those in the control schools (tcal=6.744 > tcrit1.96 and Fcal17.682 >Fcrit 2.60 at P<0.05). It was recommended amongst others that students should be well supervised and monitored in the use of ICT especially where students use ICT for other functions other than for academic activities.***

Keywords: Assessment, Achievement, Multimedia presentation, Computer, chemistry student and Senior Secondary School.

I. INTRODUCTION

A relevant education demands a workforce that understands how to use technology as a tool to increase productivity, achievement and creativity. The digital age has transformed the world and workforce and the governments around the world are focusing on strategies to increase access to and improve the quality of education. The word, digital, refers to computers or the Information Age while Global concerns all parts of the world, international, universal, world-wide.

Technology has made the world to be a global place through information technology. The term, information technology, includes computers, ancillary equipment, software, firmware and similar procedures. It also involves conversations, still pictures, motion pictures and multimedia presentations. Resnick (2002) indicated that information technology (IT) encompasses the methods and techniques used in information handling and retrieval by automatic means. Information technology is therefore an integrated network for acquiring, evolving and sharing information. Deliyannis and Karydis (2011); Muoneme, (2012) added that it involves the extensive use of CD-ROMS. Umaru (2012) indicated that

Information Communication Technology (ICT) provide an enabling environment capable of making changes and reforms in the educational sector and has the potential to develop the learning process as a whole.

Multimedia applications are good tools that help visual understanding and spark creativity; it is an extremely wide area that includes the fields of informatics, telecommunications, audio-visual production sector, cinema and digital media. The term multimedia is used to describe a scientific and creative research field which supports expression or communication through multiple media with the ability to influence and alter the content and context. A multimedia presentation is relevant in many science subjects including chemistry and it enhances the effective delivery of knowledge.

The word science means knowledge and it is a dynamic human activity concerned with understanding the workings of the world. Muzaazi (2013) maintained that the understanding obtained from science helps the scientists to probe further into the nature of things, events, to control, harness such things and events for the benefit of mankind. Science, which has chemistry as one of its branches, and technology is central to national development. Chemistry being a core subject in science should therefore be taught appropriately, incorporating all resources that can enhance its teaching and learning, the most recent resources being ICT (Wang, 2013). Chemistry is a branch of science that deals with the study of matter, its structure, composition, properties and the changes that it undergoes (Ojokuku, 2010). In other words, it involves the study of material substances that occur on the earth and in the universe.

Chemical equilibrium is an aspect of chemistry defined as a state of a system when there is no observable change in the "properties" of the system with respect to time. This aspect of chemistry is very relevant in the school curriculum. Morny (2008) noted that chemistry teaching can only be result-oriented when students are willing and the teachers are favorably disposed, using appropriate methods and resources. Most often lecture method is used in teaching where students are passive and the teacher is the carrier of knowledge (Bichi 2002; Anaso 2008). From the foregoing discussion, it shows that acquisition of the body of knowledge is value- oriented, goal-directed or purposive which means that it has some inherent or inbuilt rewards and benefits both for the individual and the society at large.

Several researches have been conducted including Theirer, (2000); Tobias and Udoh, (2012) who indicated that Multimedia application and ICT is concerned with the way these different uses can work with each other to enhance teaching and learning; and to better the standard of living of people all over the world. Nouri and Clinton (2005) researched on the effect of using PowerPoint in lectures on accounting students' attitude. Muoneme, (2012) carried out a study on Computer-Based Multimedia-Enriched lecture approach on secondary Biology Students. Tobias and Udoh (2012) also investigated into the comparative effectiveness of the traditional and computer assisted lecture methods of accounting students. Alabi (2013) investigated into the challenges of ICT implementation and usage in a college of education.

Today, the world is changing and becoming a global entity. It becomes imperative that science educators incorporate various technologies into their educational toolkits to increase students' academic achievement in chemistry and to remain relevant in a changing society. The place to start laying a sound basis for science and technology is the secondary school. Proper teaching of science at this level would not only help to give proper orientation to future scientist but would also produce scientifically literate citizens who can influence policies that will enhance the development of science and technology in future.

Recently, no attempt has been made to establish the impact of multimedia presentations on students' academic achievement in chemistry. This study is therefore an attempt to fill this gap

The educational system is confronted with the issue of low academic achievement in chemistry among students in certificate examinations. Students' performances in external examinations such as West African Examination Council (WAEC) and National Examination Council (NECO) were reported to be very poor (Abubakar, 2010 ;Ebije, 2010; NECO/WAEC Annual report for 2014-2016 for chemistry). They attributed this poor performance to lack/inadequate use of innovative technologies such as the application of ICT in teaching science subjects at senior secondary classes. An application of ICT ought to have served as an important teaching aid in science subjects, especially chemistry. Bichi (2002), reports that one of the most common methods of teaching science at secondary school level is the use of chalkboard or whiteboard. In order to improve the quality of education in Nigeria, and if the country wants to be a major player in the global science and technological development, there is the need for this study to address the above challenges. The problem addressed by this study, is therefore, the assessment of enriched multimedia presentations and lecture method on the academic achievement of chemistry students in Senior Secondary Schools in North West Zone of Nigeria.

II. PURPOSE OF THE STUDY

The purpose of this study is to assess the influence of enriched- lecture multimedia presentations and see how it relates to their academic achievement in chemical equilibrium. Specifically, the study seeks to:

- ✓ examine chemistry students' perception and views regarding the use of multi-media presentations in their programs;
- ✓ find the difference in academic performance between subjects taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT;

III. RESEARCH QUESTIONS

The following research questions were stated to guide the study.

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What is the level of secondary school students' proficiency in the use of ICT/Multimedia presentation for learning?

What is the difference in academic performance between subjects taught chemistry concepts using lecture method and those taught with multimedia presentations?

What is the mean performance of students from the four schools taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT?

IV. RESEARCH HYPOTHESES

The following null hypotheses were formulated and tested at 0.05 significant levels:

H_O1 There is no significance difference in the academic achievement between subjects taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT.

H_O2 There is no significant difference between the mean performances of students from the four schools taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT.

V. METHODOLOGY

A. RESEARCH DESIGN

The Research Design adopted descriptive survey and Pre-test Post-test quasi-experimental and control group design. The design is used for studies dealing with people's opinion, beliefs, attitudes, motivation and behavior (Osuala, 2005). It also involved a treatment group and a control group for secondary school chemistry students. Survey research design describes situations as they exist in natural setting, and it is used in collecting data at a particular point in time with the intention of describing the existing conditions as well as determining relationships that exist between specific events (Kajang, David and Jatau, 2004). In the present study therefore, the independent variables were methods of teaching, which were manipulated by the investigators. For the experimental group, the independent variable was Multimedia presentation and for the control group, the independent variable was Lecture Method. Dependent variable was academic achievement.

B. AREA AND POPULATION OF THE STUDY

The study was restricted to four selected states (Kano, Kaduna, Jigawa and Zamfara) from North-West Zone of Nigeria. The study was further delimited to cover two states and twenty secondary schools. The population covered all SSSII chemistry students from twenty senior secondary schools that offer chemistry in two states in North-West Zone of Nigeria. The total number of students in the population was 1952 comprising of 1211 males and 741 females. This study involved the use of senior secondary school students who are offering chemistry as one of their major subjects and who are in their second year in the senior secondary schools. These set of students were used in this study for the following reasons: final year students would be preparing for Senior Secondary School Certificate Examinations (SSSCE) and so, were not considered relevant for the study. Secondly, SSS 11 students were rooted and knowledgeable in Chemistry concepts than the SSS 1 students, since this group of students should have been exposed to chemistry concepts for at least one year. Their experience in the use of materials in the study is therefore expected to be fairly good. The age range of the students was between 15 and 19 years.

C. SAMPLE AND SAMPLING TECHNIQUES

From the research area, two states namely Kano and Kaduna were selected through purposive sampling technique. Twenty public secondary schools were selected by means of Stratified random sampling from the research area. The schools were pre-tested out of which four schools with comparative abilities were chosen. On the basis of the scores obtained in pre achievement test, a total of 160 students were used as sample in this study. The whole sample was divided into four groups i.e. Experimental and Control groups of 40 students each. The experimental group was taught through Multimedia presentation i.e. through computer and overhead projector and the control group was taught through conventional method.

D. INSTRUMENTATION

A four-item Likert scale questionnaire on the availability and usage of multi-media applications (first part of the questionnaire) was developed by the researchers and subsequently submitted to experts from the field (for content and face validation). The questionnaire is made up of one section and this was used to generate data for the descriptive survey. Section A sought information about the respondent's bio-data while section B had the items consisting of students' opinion on the use of multi-media presentations in chemistry. The questionnaire had the following response options: Strongly agree (4-point), agree (3-points), disagree (2-points) and strongly disagree (1-point). Three computer experts from science Education, Ahmadu Bello University Zaria face validated the instrument. The reliability of the instrument was 0.76. The cumulative mean response on each set of items in the questionnaire were compared with a standard/decision mean of 2.5 computed based on the four-Likert scale options per questions (4+3+2+1)/4=2.500. Chemical Equilibrium Achievement Test (CEAT) comprising 20 items was also developed and validated by experts in the field to test students' academic performance which was the third part of the questionnaire.

a. PILOT STUDY

Chemical Equilibrium Achievement Test (CEAT) comprising 20 items was subjected to a sample of 80 SSII chemistry students from a different school. The

purpose of the plot study was to ascertain the clarity of the test items and the feasibility of the study.

E. ADMINISTRATION OF INSTRUMENT

The instruments were administered by the researchers to each of the sampled secondary schools. A pre-test was administered to the four groups before the commencement of the treatment in order to determine the equivalence in knowledge of the groups and to ensure that they did not differ significantly. Lesson plans were prepared and methods determined by the researchers were utilized during the teaching. The experimental groups were taught using multimedia software applications while the control groups were taught the same concepts using the lecture method. At the end of the treatment period which lasted for four weeks, a post-test was administered to both experimental and control groups to ascertain the effectiveness of the treatment. The achievement test was marked by the researchers using a prepared marking scheme.

F. DATA ANALYSIS

The data was analyzed using statistical package SPSS Version IBM 23. Data from the questionnaire was analyzed using descriptive statistics like Mean, Standard deviation. t-test statistics was used in testing hypotheses for significant difference of means of measurements made on two groups. In addition, analysis of variance (ANOVA) was also used to measure comparison which detects overall differences in means of measurements made on three or more groups at $p<0.05$ level of significance.

VI. RESULTS

The results obtained from the data analysis are presented in tables 1 to 6

The demographic data includes the sex (male and females)

Gender

Sex	Frequency	Percentage
Male	76	47.5
Female	84	52.5
Total	160	100.0

Table 1: students gender presentation in frequencies and percentages

Table 1 above shows that out of the 160 students that responded to this study, 76 or 47.5% of them were males and the remaining 84 representing 52.5% were females

Research Question 1: What is the level of secondary school students' proficiency in the use of ICT/Multimedia presentation for learning?

s/no	Item	Response categories				MEAN	STD
		SA	A	D	SD		
1	I listen to recorded online chemistry instructional materials on audio	16	34	44	66	2.00	1.01
2	I use printed power materials in my studies	17	35	74	34	2.22	0.91
3	I refer to recorded CD/VCD on chemistry topics	8	47	66	39	2.15	0.85
4	Downloaded chemistry instructions from online are used in my studies.	32	43	66	19	2.55	0.94
5	I watch educative programmes on multimedia to enhance my learning skills.	35	34	68	23	2.51	0.99
6	I make use of computer applications in my study	19	53	57	31	2.38	0.93
7	I use multimedia technology to update my learning	13	61	63	23	2.40	0.83
8	The school has essential amenities like constant electricity	9	43	72	36	2.16	0.84
9	The school has human resources, such as qualified chemistry teachers who are computer literate	18	57	55	30	2.39	0.92
10	The school has overhead projector to facilitate learning	38	35	54	33	2.49	1.07
	CUMULATIVE					***2.420***	

Decision mean=2.500

Table 2: Opinion of respondents on level of secondary school students' proficiency in the use of ICT/Multimedia presentation for learning

The result from table 2 shows the opinion of respondents on level of secondary school students' proficiency in the use of ICT for learning which was found to be quite very low as their cumulative mean response of 2.420 is lower than the decision/standard mean of 2.500. Specifically most of them indicated that they do not listen to recorded online chemistry instructional materials on audio; this had the least mean agreement of 2.000. Only 50 agreed and the rest 110 disagreed. In the same vein majority of the respondents disagreed that the school has essential amenities like constant electricity as this had the second lowest mean agreement score of 2.16; only 51 were in agreement and the rest 108 disagreed.

H_{O1}: "There is no significance difference in the academic achievement between subjects taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT"

The answer to research hypothesis one is summarized in table1

Variables	Groups	N	Mean	Std .Dev	Std. Err	Df	T calculated	T critical	P
Mean Performance	CONTROL	80	5.587	2.168	.2424	158	6.744	1.96	0.00
	EXPERIMENTAL	80	7.962	2.284	.255				

Calculated $p < 0.05$, calculated $t > 1.96$ at df 158

Table 3: Independent t-test statistics difference between the students means Performance in the control group and in the experimental group

Result of the Independent t-test statistics in table 3 reveals that significant difference exists between the mean performance scores of students in the experimental schools and those in the control schools. This is because the calculated p value of 0.001 was found to be lower than the 0.05 alpha

level of significance and the calculated t value of 6.744 was found to be higher than the critical t value of 1.96 at df 158. Their computed mean performance was 5.587 and 7.962 by students in the control schools and those in the experimental schools respectively. This implies a mean difference of 2.37 in favour of those in Experimental Group. This shows that students' mean performance is significantly higher among the experimental group than the control group due to the exposure to the treatment. Therefore the null hypothesis which states that **"**There is no significance difference in the academic achievement between subjects taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT" is hereby rejected, since a significant difference exist between the students' performance in experimental and control schools

H_O2: There is no significant difference between the mean performances of students from the four schools taught chemistry concepts using lecture method and those taught with multimedia presentations/ICT.

The answer to research hypothesis two is summarized in tables 4, 5 and 6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	256.137	3	85.379	17.682	.000
Within Groups	753.263	156	4.829		
Total	1009.400	159			

Table 4: Analysis of variance statistics between the mean performances of students from the four schools

The outcome of the analysis of variance statistics above indicates that significant differences exist in the mean performance of the four schools used in this study (two experimental and two controls). Reasons being that the calculated p value of 0.000 is lower than the 0.05 alpha level of significance while the computed F value of 17.682 is higher than the F critical value of 2.60.

	N	Mean	Std. Deviation	Std. Error
SCHOOL 1 CONTR	40	6.0875	2.12702	.33631
SCHOOL 2 CONTROL	40	5.0875	2.11796	.33488
SCHOOL3 EXPERIMENTAL	40	7.6000	2.29045	.36215
SCHOOL 4 EXPERIMENTAL	40	8.3250	2.24907	.35561
Total	160	6.7750	2.51961	.19919

Table 5: Descriptive mean statistics of the mean performance on experimental and the control group exposed to multimedia presentation and lecture method of SSII chemistry students in the 4 secondary schools

Schools	N	Subset for alpha = 0.05	
		1	2
SCHOOL1 CONTROL	40	5.0875	
SCHOOL 2 CONTROL	40	6.0875	
SCHOOL 3 EXPERIMENTAL	40		7.6000
SCHOOL 4 EXPERIMENTAL	40		8.3250
Sig.		.251	.538

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 40.000.

Table 6: schefe post hoc mean performance of the four schools

The computed mean performances of the students are 5.08, 6.08, 7.60 and 8.32 from school 1 Control, school 2 Control, school 3 Experimental and school 4 experimental respectively. The Post hoc statistics using the scheffe homogeneous subset clarified their means performance positions by placing the two experimental schools in the significantly higher sunset 2 and placing the mean performance of the two control schools in the significantly lower subset 1. This shows that significant difference exist between the experimental and the control schools. Therefore the null hypothesis which states that there is no significant difference in the mean performance of the students from the four schools is hereby rejected.

VII. DISCUSSION

The results of this study have added empirical evidence to the library of data on the efficacy of ICT/multimedia presentation in the teaching and learning of chemical equilibrium concepts. The experimental groups taught chemical equilibrium with multimedia presentations produced higher mean achievement gain than the control groups taught with conventional methods.

Result from Table 1 shows that out of the 160 students that responded to the study, 76 or 47.5% of them were males and the remaining 84 representing 52.5% were females. The result from Table 2 reveals that students' proficiency in the use of ICT/Multimedia presentation for learning was very low especially as they hardly had the opportunity to listen to online chemistry instructional materials on audio and essential materials such as electricity was not in existence in many schools.

From Table 3, it could be seen that significant difference exist between the mean performance scores of students in the experimental schools and those in the control schools. The computed mean performance was 5.587 and 7.962 by students in control schools and those in experimental schools respectively. This implies a mean difference of 2.37 in favour of those in Experimental group. The experimental group produced higher mean achievement scores than the control group taught chemical equilibrium using conventional methods. This difference in achievement in the posttest is in agreement with Bent and Katja (2013) findings who indicated that multimedia can be used to foster learning subject matters and cross-curricular topics.

The results from testing hypothesis 2 showed a significant difference in the mean performance of the four schools used in the study (two experimental and two controls). The computed mean performances of the students from Table 6 were 6.08, 5.08, 7.60 and 8.32 from school 1 Control, school 2 Control, school 3 Experimental and school 4 experimental respectively. The two experimental schools had significantly higher mean performance than the two control schools. The Post hoc statistics using the scheffe homogeneous subset clarified their means performance positions by placing those of the two experimental schools in the significantly higher sunset 2 and placing the mean performance of the two control schools in the significantly lower subset 1.

Ranjit, Kavita and Shamshir (2015) indicated that the development of multimedia technologies for learning offers new ways in which learning can take place in schools and the home.

The findings of this study have implication for chemistry teaching in Nigeria. To reduce the rate at which students fail at external examinations it is important that for students to be well supervised and monitored in the use of ICT and moreso, overhead projectors should be made available in all chemistry laboratories and classes to facilitate teaching and learning especially where students are quite large. The researchers advocate that teachers should not only be given laptops on soft loans to facilitate their use of internet resources for chemistry lessons but uninterrupted internet access should also be made available.

VIII. CONCLUSION

The findings from this study have shown that employing multimedia technologies in learning chemical equilibrium in chemistry boost and motivate students to work harder and achieved academically. Therefore, the use of enriched lecture with multimedia presentation is viable and has the potential of enhancing senior secondary school chemistry students in chemical equilibrium. There is significant difference between students in experimental and control groups in the mean proficiency level on the use of ICT/Multimedia presentation for learning activities. The students in the experimental group exposed to multimedia presentation had higher achievement gain than the students in the control group taught with the conventional method.

IX. RECOMMENDATION

The following recommendations are hereby put forward

- ✓ The schools should provide adequate CD/DVD on audio forms in the chemistry libraries for students use and provide constant power for this to be effectively realized.
- ✓ The teachers should be encouraged to attend ICT workshops on how to use packages such as Microsoft words etc.
- ✓ Chemistry teachers and students should be given uninterrupted internet access to be able to download their materials from the net.

Students should be well supervised and monitored in the use of ICT especially for students who use ICT for other functions instead of using it for academic activities.

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