Effect of Multimedia Integrated Lessons on Students' Achievement and Retention in Chemistry

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Abstract

The study examined the effect of multimedia integrated lessons on students' achievement and retention in chemistry. The quasi-experimental pre-test posttest non-equivalent control group design was used. A sample of 105 Senior Secondary School year one (SSS 1) Chemistry students from Onitsha Education Zone of Anambra State was used in the study. Chemistry Achievement Test (CAT) validated by lecturers in science education and reliability index of 0.92 was used as instrument. The data obtained was analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The results revealed that there is a significant difference between the mean achievement chemistry scores of students exposed to multimedia integrated lessons and the convectional group. The Multimedia group which had a significantly higher retention score, performed better than those in the convectional group taught with modified lecture method. It was therefore recommended that special training on how to use multimedia technology tools in teaching should be organized for secondary school teachers to help them become competent in the use of multimedia tools.

Key words: Multimedia, Achievement, Retention

Introduction

Technological advancements seem to be eluding the Nigerian educational sector as there is observably, very poor usage of these technologies in teaching and learning. The possible causes of this lack in integrating educationally adaptable technologies into the classroom and the teaching process are implicated by a number of factors. Prominent among them are: teachers' lack of the awareness of the use of information and communication technology (ICT) and its integration in the learning process, lack of the required technological skills for competent usage, poor orientation for teachers on how to adapt the available technologies into the classroom, lack in the provision of technological equipment's for usage in schools and power fluctuation (Nwanze, 2014; Gyang, 2008). These factors have seriously contributed in impeding the integration of very

beneficial technological tools like multimedia systems in the classroom. Multimedia bears beneficial boost not only for the teachers but also for the students taught using them.

Multimedia are various media formats which could be in the forms of motion text and pictures, videos, simulations, animations, sound and a combination of any of these. Multimedia integrated instruction is one in which the teacher employs the use of various multimedia technological tools adaptable for educational purpose in the teaching and learning process. Multimedia integrated instruction is now permeating the educational system all over the world as a tool for effective teaching and learning and for providing richer environments for in a wide variety of formats learning (Adegoke, 2011). Studies in the area of multimedia usage in the classroom have soon that multimedia significantly improve academic achievement (Tatli & Ayas, 2013; Adegoke, 2011; Yuen-Kuang & Yu-wen, 2007). The use of multimedia in the teaching and learning process provides a variety of medium for students to process the concepts being taught. Simulations and animations can be used to enhance understanding and facilitate proper conceptualization of the materials being learnt. These ideas are supported by the Mayer's cognitive theory of multimedia learning and Paivio's Dual coding theory. Both theories supports the idea that meaningful learning occurs when more senses are involved in the learning process. The integration of multimedia systems in the classroom therefore, can be very beneficial for teaching various difficult and abstract concepts in the field of science like chemistry.

Chemistry is the branch of science that deals with the properties, synthesis and uses of matter. Chemistry like other science subjects trains the learners to acquire the science process skills of observing, experimenting, manipulation, classifying, communicating, inferring, hypothesizing, interacting with data and formulating models. It also develops in the learners functional knowledge of science concepts and principles, explanation of simple natural phenomena, develop scientific attitudes (including curiosity, critical reflection and objectivity) and application of the skills and knowledge gained in problem solving (develop self-confidence and self-reliance through problem solving) and development of a functional awareness to the orderliness of the beauty of nature (FRN, 2004). The importance of chemistry notwithstanding, the students' achievement in chemistry has remained poor (Achor & Kalu, 2014). This continual underachievement according to Achor and

Kalu (2014) have watered the interest in chemistry and resulted in a consequent poor enrolment in the number of chemistry students. One major factor adduced to this problem is lack of laboratory activities and practical's (Durmus & Bayraktar, 2010). The use of multimedia integrated instruction has been suggested as a way out of this multi-facet problem (Owolabi, & Oginni, 2014). This suggestion is not only based on the beneficial improvement of academic achievement resident in the use of multimedia, but also because of the effects on students' retention.

Retention is the ability to recall what is taught or learnt by a student. Students' retention of lesson content is a function of student ability to properly conceptualize what is learnt or being taught. The use of multimedia technologies in the classroom have been shown in a number of studies to impact positively on the students' retention (Amosa, Akawo, Eli, & Queen, 2014; Adegoke, 2011). This is because students' can hardly forget lesson contents that involve many of their senses when various multimedia formats are used as against when conventional teaching method such as lecture method is employed.

Lecture method of teaching is a teacher directed method of teaching where students receive instruction from the teacher with little or no participation. The lecture method has the advantage of being used for large number of learners and for covering large content but makes for students' passivity during lessons. There is need to adopt innovative teaching method to check mate students' underachievement in chemistry and other science related subject areas. The use of multimedia technology in the classroom has been investigated in a number of studies. None of the studies however have tried to compare the approach against good instructional methods. They are few studies also directed in the subject area of chemistry. This study therefore sought to investigate multimedia integrated instruction and its achievement on students' achievement and retention in chemistry by comparing it against an improved method of modified lecture method.

The concept of modified lecture method defines a teaching strategy where students participate in the learning process under the directives of the teacher. The changes in the nature of the formal lecture method of teaching resident in modified lecture method may help to improve on the students' achievement in a similar

manner as in multimedia instruction. Multimedia integrated instruction when not appropriately used, for instance when the teacher is not skilled in its use, may distract the students and cause a reduced interest in the lesson. However, when its used is effectively planned and used in a lesson, it may facilitate students' retention. This therefore investigated the effect of multimedia integrated lessons on students' achievement and retention in chemistry.

Research questions

1. What is the difference in the mean achievement scores of students taught chemistry with multimedia integrated instructions and those students taught with modified lecture method?
2. What is the difference in the mean retention scores of students taught chemistry with multimedia integrated instructions and those students taught with modified lecture method?

Hypothesis

1. There is no significant difference in mean achievement scores of students taught chemistry with multimedia integrated instruction and those students taught with modified lecture method
2. There is no significant difference in the mean retention scores of students taught chemistry with multimedia integrated instruction and those students taught with modified lecture method

Method

The design of the study is quasi-experimental, specifically the pretest-posttest non-equivalent control group design was used. The area of the study is Onitsha education zone of Anambra State. The zone is made up of Onitsha North, Onitsha South and Ogbaru local government area. The population of the study consisted of the 3115 (2418 Males and 697 Females) SS 1 students in Public school Onitsha Education zone. The sample size for the study is 105 SS1 chemistry students obtained using purposive sampling technique. The experimental group had only one intact class made up of 57 students (40 girls, 17 boys) and the control group also had one intact class made up of 48 students (19 girls and 29 boys). The instrument for the study is a chemistry Achievement Test (CAT) constructed by the researcher. CAT items were constructed based on two topics in Chemistry (Particulate Nature of Matter and Chemical Bonding) as contained in the senior secondary school

chemistry curriculum and lesson packages designed with multimedia integration and modified lecture method. The validation of instruments was done by two experienced Chemistry secondary school teachers and two lecturers in Science Education Department of Delta state University. These validators were requested to vet the items for clarity of words, plausibility of the distractors and appropriateness to the level of the students. The reliability of the instrument was established using the Kudder-Richardson formula 21 (Kr 21). This is because the level of difficulty in the question items is homogenous and they are dichotomously scored. Consequently, the instrument was administered to forty respondents outside the study area. The obtained scores were tested for reliability co-efficient using the Kr-21 formula. The reliability of the instrument was found to be 0.92 indicating that the instrument is reliable. For the experimentation, the intact classes chosen for the study were exposed to multimedia integrated instruction and modified lecture method respectively. The study exercise took place in the school classroom at the time of normal classes. CAT was given to the students to answer in the first week before starting the teaching and students were given no feedback on the pre-test achievement. The classes both in the experimental and control groups were taught by the regular classroom teachers trained by the researcher using multimedia integrated instruction (MII) and modified lecture instruction plans respectively. This helped in controlling for teacher variables and hawthorne effects of extraneous variables.

The teaching exercise at its end was followed by a Posttest. After the posttest, the students in both groups were given a summary lesson on the topics taught. The retention test was done at the beginning of the next term using the same instrument reshuffled both in the serial numbering of the question and the answer options. Descriptive statistics was used to provide answers to the research questions. In order to establish if the observed differences were statistically significant, the hypotheses were tested using Analysis of Covariance (ANCOVA).

Results

The results of the analysis of data obtained from the achievement test are summarized below:

Research question 1

What is the difference in the mean achievement scores of students taught chemistry with multimedia integrated instructions and those students taught with modified lecture method?

Table 1: Mean Pre-Test and Posttest Achievement Scores of Students taught Chemistry with Multimedia Integrated Instruction and those taught with Modified Lecture Method

Groups	N	Test	Sum	Mean	Mean gain	Overall mean difference	Std. Deviation
Multimedia integrated instruction	57	Post	2224	39.02	7.79	7.06	13.90
		Pre	1780	31.23			12.00
Modified lecture method	48	Post	1575	32.81	0.73		11.94
		Pre	1540	32.08			13.32

Table 1 shows posttest mean score is 39.02 with a pretest mean score of 31.22 and mean gain of 7.79 for students exposed to multimedia integrated instruction and a posttest mean score of 32.81, pretest mean score of 32.08 and mean gain of 0.73 for students exposed to modified lecture method. The overall mean difference between the two groups is 7.06. The data contained in the table showed the students exposed to multimedia integrated instruction scored higher than those exposed to modified lecture method. Also, while the use of MII increased the spread of scores among students, the use of modified lecture method reduced the score variation among students.

Research question 2

What is the difference in the mean retention scores of students taught chemistry with multimedia integrated instructions and those students taught with modified lecture method?

Table 2: Mean Pre-Test and Posttest Retention Scores of Students taught Chemistry with Multimedia Integrated Instruction and those taught with Modified Lecture

Groups	N	Sum	Mean	Overall mean difference	Std. Deviation
Multimedia integrated instruction	57	2170	38.07	7.76	13.36
Modified lecture method	48	1455	30.31		13.27

From table 2, the mean retention score of the MII group is 38.07 with a standard deviation 13.36 and the mean retention score of 30.32 and standard deviation of 13.27 for students in the modified lecture method group. The

overall mean retention difference between the two groups is 7.76. This showed that the students in the MII group retained the lesson material more than their counterparts in the control group.

Hypothesis 1

There is no significant difference in mean achievement scores of students taught chemistry with multimedia integrated instruction and those students taught with modified lecture method.

Table 3: Summary of Analysis of Covariance for testing Difference in Achievement between the Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1608.516[a]	2	804.258	4.835	.010
Intercept	12625.906	1	12625.906	75.900	.000
Pretest	599.568	1	599.568	3.604	.060
Method	1061.433	1	1061.433	6.381	.013
Error	16967.674	102	166.350		
Total	156100.000	105			
Corrected Total	18576.190	104			

a. R Squared = .087 (Adjusted R Squared = .069)

Table 3 shows that there was a significant main effect of the treatment which accounted for 69 percent of the variance in the achievement scores of the students, F (1, 102) = 6.381, P <0.05. Thus, the null hypothesis was rejected. There is a significant difference in mean achievement scores of students taught chemistry with integrated instruction and those students taught with modified lecture method.

Hypothesis 2

There is no significant difference in the mean retention scores of students taught chemistry with multimedia integrated instruction and those students taught with modified lecture method.

Table 4: Summary of Analysis of Covariance (ANCOVA) for testing difference in Retention between the groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1750.344[a]	2	875.172	4.938	.009
Intercept	13470.806	1	13470.806	76.014	.000

Pretest	182.185	1	182.185	1.028	.313
Method	1602.945	1	1602.945	9.045	.003
Error	18075.846	102	177.214		
Total	144975.000	105			
Corrected Total	19826.190	104			

a. R Squared = .088 (Adjusted R Squared = .070)

Table 4 shows that there was a significant main effect of the treatment which accounted for 70 percent of the variance in the retention scores of the students, $F(1, 102) = 9.045$, $P < 0.05$. Thus, the null hypothesis was rejected. Therefore, there is a significant difference in the mean retention scores of students taught chemistry with multimedia integrated instruction and those students taught with modified lecture method.

Discussion and Conclusion

The results of the study showed that the multimedia integrated lesson greatly improved students' achievement score in chemistry. The findings of this study lend credence to the report of Yuen-Kuang and Yu-wen (2007) that multimedia positively affects students achievement more than the traditional instruction methods. This is further supported by the works of Adegoke who consecutively reported in 2010 and 2011 and Mubaraq (2009) that students who learnt physics in computer-based multimedia environment had better learning outcomes in physics than their colleagues who learnt physics under teacher-based environment. According to Tatli and Ayas (2013), the use of multimedia in the form of visual chemistry laboratory is as effective as real chemistry laboratory.

The results of the study further revealed a significant main effect of the treatment on students' retention. The use of multimedia accounted for as much as 70 percent of the variance in the students' retention scores. It showed that multimedia had a very significant effect on the students' retention in chemistry This lends credence to the findings of the study of Adegoke (2011) that multimedia instruction improves retention scores positively. The use of multimedia reduces the level of abstraction associated with chemistry concepts. Students can visualize an animation of the concepts being taught much like they do with movies. This helps in both conceptual comprehension and interaction of senses, enabling the students to easily retain what has been taught. In this study, although, the retention test was done weeks after the posttest, the students showed a good

retention as expressed in their retention scores. This indeed shows that multimedia not only improves their retention but may have made such an impression in their memory which facilitated easy retention.

Recommendation

In the light of the above findings, it is recommended that:

1. Science teachers should adopt the use of multimedia integrated instruction in teaching and interpreting the science curriculum. They should integrate available electronics into the learning process of the students by making recorded video tutorials for their consumption.
2. Special training on how to use multimedia technologies in the classroom should always be organized for teachers, so as to help them become competent in the use of multimedia in the teaching and learning process.

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