Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.7, No.4, 2016

Relative Effect of Lecture Method Supplemented with Music and Computer Animation on Senior Secondary School Students' Retention in Electrochemistry.

Akpoghol, T.V[1]* Ezeudu, F.O[2] Adzape, J.N[3] Otor, E.E[4]
1.Department of Chemistry, Benue State University, Makurdi
2.Department of Science Education, University of Nigeria, Nsukka
3.Government Girls' College, Makurdi
4.Department of Curriculum and Teaching, Benue State University, Makurdi

Abstract
The study investigated the effects of Lecture Method Supplemented with Music (LMM) and Computer Animation (LMC) on senior secondary school students' retention in electrochemistry in Makurdi metropolis. Three research questions and three hypotheses guided the study. The design of the study was quasi experimental, specifically the pre-test, post-test non-equivalent control group design was adopted. One hundred and sixty five (165) Senior Secondary Two (SS2) Chemistry Students drawn from 4 schools were purposively sampled from seventy six (76) accredited secondary schools in Makurdi Local Government Area. The first experimental group were electrochemistry with LMM while the experimental group 2 were taught using LMC. The LMM group consisted of 80 students while those in LMC consisted of 85 students. An instrument known as Electrochemistry Achievement Test (EAT) which had 50 questions adopted from WAEC, NECO and UTME past question papers were used for the study. Reliability (KR_{20}) estimate of 0.876 was obtained for EAT. LMM and LMC were used to treat the experimental groups 1 and 2 respectively. Scores on achievement tests were collected at the beginning of the study as pre-test and after the treatment (3 weeks) as post-test. The research questions were answered using mean and standard deviation, while hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Findings showed that Students taught electrochemistry using LMM had higher retention score (41.55 ± 3.74) than their counterparts taught using LMC (40.00 ± 3.69). There was a statistically significant main effect ($p < 0.05$) for instructional methods on mean retention score of students in electrochemistry. Females had higher retention score (41.75 ± 3.43) than their male counterparts (39.74 ± 3.87). There was statistically significant main effect ($p < 0.05$) of gender on students' retention. Male students taught with LMM had higher retention score (39.84 ± 4.19) than males taught with LMC (39.67 ± 3.68). Female students taught with LMM had higher retention score (42.74 ± 2.87) than the females taught with LMC (40.44 ± 3.69). The results further revealed that there was no significant interaction effect ($p < 0.05$) of the instructional strategies and gender on retention.

Introduction

Qualitative chemistry education can be evident in the academic achievement of students emphasising their cognitive level. Academic achievement can be measured by examination or continuous assessment. According to Aremu and Sokam (2003) secondary education is the foundation level for further education and if a poor foundation is laid, there is likely going to be problem at subsequent levels. Achievement in chemistry for a candidate who sat for WASSCE or NECO/SSCE is said to be good when the pass is at credit level. This is the basic entry requirement into tertiary institutions for candidates who intends to study science courses and have sat for Unified Tertiary Matriculation Examination (UTME) as stipulated in the Joint Admissions and Matriculations Board (JAMB Brochure, 2014). Examining bodies such as West African Examination Council (WAEC) and National Examination Council (NECO) have lamented the poor achievement in chemistry. This has been expressed in the achievement report of students in WAEC Chief Examiners Report (2014) and NECO Chief Examiners Report (2014) issued annually, from these bodies. Despite the presence of these examining bodies – WAEC and NECO, the students' achievement in the SSCE have continued to drop, so much that students combine the two results of WASSCE and NECO SSCE to make up for the minimum admission requirements for universities and other higher institutions. This calls for serious worry.

According to Akpoghol, Samba and Asemave (2013) the several identified factors contributing to the low achievement include low morale and poor preparation of teachers, over crowded classroom/inadequacy of laboratory and workshop facilities, poor attitude of students to work, gross underfunding and inadequacy of rewards for excellence in science teaching and learning among others. Other reasons include: poor and ineffective teaching (Agbo, 2005) poor exposure of students, inability of teachers to pay attention to their students are also causes of poor achievement as noted by Ifeakor (2006). Ezeudu and Obi (2013); Akpoghol, et al (2013); Osedum, (2008) and Orji & Ebele (2005) also attributed low achievement in chemistry to poor and ineffective science teaching approaches. All these lead to poor understanding and retention. These authors

suggested that various teaching strategies which enable learners to feel secure in the learning environment, to enrich teaching and to assist the learning process should be utilized. Moreover, classroom activities should be encouraging and should eliminate the learner's redundant fears and anxiety. For this reason, they added that new teaching approaches are put forward to eliminate the limitations of the traditional way of teaching and improve the quality of instruction, and enhance retention of knowledge. Ineffective teaching approaches have dominated the reasons for poor achievement in chemistry; this study seeks to explore the lecture method being supplemented by music and computer animation as very promising approaches to teaching chemistry.

According to Akpoghol, et al (2013), the lecture method involves the teacher orally presentating his ideas. The students are inert listeners or slightly involved. This kind of method leads to rote learning. This method which involves mostly talk-chalk approach will not be effective for teaching chemistry since it does not promote meaningful learning, it lacks retentive quality. However, it could be improved upon by supplementing it with other effective approaches (Akinsola and Igwe, 1999) like music (McCammon, 2008; Huber, 2009) and computer animation (Chang, 2002; Tielemans & Collis 1999) for effective lesson delivery and understanding. According to Akinsola and Igwe (1999) a combination of the lecture teaching technique with other approaches may improve the understanding and application of chemistry concepts. It will be more learner-friendly and student-centred. It may remove the notion that lecture method is weak, thus increasing understanding and hence better achievement in chemistry. This implies that teachers should use the lecture method and supplement it with other innovative methods that may improve the students' achievement and recall.

Music can be a vital and effective tool to achieve active learners' participation in chemistry when used appropriately in the classroom (Demorest & Morrison, 2000). Music not only engages students but it also moves their brains. McCammon (2008) agrees and further suggests that teachers should talk less to students and have them sing more. McCammon postulates that having students sing promotes active involvement and engagement in the curriculum.

According to McCammon (2008) and Huber (2009), students are involved in the world of music outside the classroom; therefore, it is evident that most students grow up with music as a large part of their cultural identities. In the classroom, this process consists of teachers implementing music-centered lessons where songs are used to teach content and students interact with the music in the classroom in a number of ways. The method requires the teacher doing more than the students listening to the music, but does not require any musical skill, as the method is not dependant on music training. The teacher either composes or downloads the music from the internet; and either gives the students the pre-recoreded music to listen before or during the lesson.

Computer Assisted Instruction with Animation is a form of simulation instructional method that implies the use of computer animation, graphic and cartoons in classroom instruction. The use of computer in the classroom has given rise to Computer Assisted Instruction software packages for classroom instructional purposes. According to Umaru (2003), Computer Assisted Instruction is a program of instruction or package presented as computer software for instructional purpose. Therefore, the position of chemistrty as a vital science subject makes it necessary for the use of innovative pedagogical strategy that will enable teachers meet the challenges of teaching and learning of the subject especially in this era of information age. Several researches have shown that using Computer-Assisted Instruction (CAI) has a positive effect on students achievement compared to traditional methods. Computer has been used in both junior and senior secondary schools to teach chemistry (Okoro and Etukudo, 2001). According to Ezeliora (2002), the use of CAI provides the learner with different backgrounds and characteristics. Using teaching software such as CAI, concepts are presented to the students in such a well organized manner that makes for greater clarity and easier understanding. They confirmed that CAI is seen to be effective in enhancing students' performance than the conventional classroom instruction. Computer assisted instruction is becoming more and more widespread and it has been important especially at difficult concepts.

The use of Computers by teachers to teach the students is highly advantageous. This is because it enables them to demonstrate understanding of the opportunities and implications of the uses for learning and teaching in the curriculum context; plan, implement, and manage learning and teaching in open and flexible learning environment (Anyamene, Nwokolo, Anyachebelu, & Anemelu, 2012; Yusuf & Afolabi,2010). It is a self-instructional device with the principle of atomization. Computer Assisted Instruction as "Computer applications applied to traditional teaching methods such as lecture, drill, tutorial, demonstration, simulation and instructional games". It is an effective media and an indispensable aid in the teaching-learning process. The instructional process carried out with the help of computer is known as Computer Assisted Instruction. It is not merely a sophisticated type of programmed instruction but a different kind of instruction altogether. It uses programmed instruction electronic data processing, data communication, concepts of audio-visual and media theory (Sivakumar & Kirubanadhini, 2014). The computer assisted instruction used in the study includes animation, it is hoped that it will improve on their retention.

Retention is the ability of the students' to remember things, assignment, or material learned (such as, electrolysis and electrochemical). Meaningful learning is explained in terms of retention, it conotes that learning

has been maintained overtime. This implies that retention may be displayed through recognition or recall. It is the endurance of behaviours, which have been learned, or acquired when the behaviour is not being utilized. Bichi (2002) and Kundu & Tutoo (2002) see retention as the ability to retain and later recall information or knowledge gained after learning. According to Mukherjee (2002), Mangal (2010) and Suleiman (2011), retention is the ability of an individual to reproduce past learning. Every individual shows some degree of mastery to reproduce past learning or experience. For this to happen, three stages of human behaviour have to be considered, thus (a) There must be some initial learning experience, (b) there must be an intervening period during which individual stores the learned materials and experience, and (c) there is the final stage of reproduction or retrieval of the initially learned materials or experience.

Retention of learned materials, as a variable in students' learning, can be measured. Aggarwal (2008) identifies four methods of measuring retention. These are: Recall or reproduction; Relearning or saving method (this involve calculating the number of trials taken to learn materials in the beginning and note down the savings of trials relearning it after some lapse of time); Recognition; and; Reconstruction. A good memory and retention lead to meaningful learning leading to production of a series of changes within the entire cognitive structure, modifying existing concepts, and forming new linkages between concepts. If there is no sufficient instruction, there can be no retention.

Several factors influence retention. For example, Blair and Simon (1998), states that anything that aid learning should improve retention while things that lead to confusion, or interference among learning materials decrease the speed and efficiency of learning and accelerates forgetting. Interference may exist in several forms such as retroactive inhibition, or emotional inhibition. Retroactive inhibition occurs when things are learned, the result of that learning usually occurs after a passage time. In the intervening period, many other things are learned. This introduced learning interferes with the memory of the original materials and the interference is known as retroactive inhibition (Suleiman, 2011).

Aggarwal (2008), stated that, one of the important aims of school instruction is to encourage the students to acquire and to retain the knowledge imparted in school for future use in school life and in meeting out-of school life problems of the present and future, hence it is very essential to take proper steps to enable students retain and recall easily. This can be achieved only when teacher centred class is discouraged. Teaching approaches which enable learners to feel secure in the learning situation, to enrich teaching and support the learning process should be applied and encouraged.

Teachers need to allocate time for rehearsal/practice, do some singing during classroom lessons, watch animations Teaching too much information too rapidly is likely to be ineffective because, unless students are given time to mentally rehearse each new piece of information, later information is likely to drive it out of their working memories. When teachers stop a lesson to ask students whether they have any questions, they are giving students a few moments to think over and mentally rehearse what they have just learned.

Ezeudu (2013) noted that knowledge retention is very necessary in the teaching of chemistry. Therefore teachers' approach to teaching should be more in line with enhancing knowledge retention. Researchers have been advocating for active, students participatory and student centred lessons so that higher levels of the cognitive domain, such as synthesis and evaluation will be achieved. This kind of learning occurs when students talk, listen, sing, play games, read, write, watch visuals and reflect (Okonkwo, 2009; Darwin, 2003).

This implies that since teachers are more familiar and used to the lecture method, there cannot be a complete shift from the lecture method but rather there should be a combination of other strategies with the lecture method to enhance students' participation. It is hoped that Lecture Method supplemented with Music (LMM) and Lecture Method supplemented with Computer Animation (LMC) will boost achievement and retention, which has incited this research.

Statement of the Problem

The problem of underachievement in chemistry has been blamed on poor teaching methods as a major factor.The concept of electrochemistry has been established as difficult to students. Activity oriented classes are needed to enhance better understanding of the concept This activity based teaching is lacking in the teaching of this topic as is evident in literature that most teachers depend on the traditional method.

Evidence has also shown that knowledge retention is a necessary factor for achievement and this is lacking in the case of chemistry students who learn without activity which should ginger them to learn. Lastly, gender stereo-typing has not helped matters. To this end, the researcher adopted lecture method supplemented with music and computer animation teaching strategy as a means to ease the problem of knowledge retention in chemistry.

Purpose of the Study

Specifically, this study is designed to ascertain the

1. relative effect of LMM and LMC on the mean retention scores of students' in electrochemistry.
2. influence of gender on mean retention scores of students in electrochemistry.
3. interaction effect of gender and the teaching strategies on students' mean retention scores in electrochemistry.

Research Questions

This following research questions guided the conduct of the study:

4. What is the relative effect of LMM and LMC on students' mean retention scores in electrochemistry?
5. What is the influence of gender on mean retention scores of students in electrochemistry?
6. What is the interaction effect of gender and the teaching strategies on students' mean retention scores in electrochemistry?

Hypotheses

The following null hypotheses were formulated to guide this study, and tested at 0.05 level of significance:

HO_1: There is no significant difference in the mean retention scores of students taught electrochemistry using LMM and LMC.

HO_2: The mean retention scores of gender do not differ at post delayed test when taught electrochemistry.

HO_3: There is no significant interaction effect of gender and the teaching strategies on students' mean retention scores in electrochemistry.

Design of the study

The design of the study was quasi-experimental design specifically the pre-test, post-test non-equivalent control group design. This design was adopted because the design does not have full control of the characteristics of students. In this design intact classes were used as groups, therefore students were not randomized to avoid interfering with school activities.

The design is represented symbolically as follows:

Group	Pretest	Treatment	Post-test	Post Delayed test (Retention)
EG_1 ⟶	O_1	X_1	O_2	O_3
	---	---	---	---
EG_2 ⟶	O_1	X_2	O_2	O_3

Where:

EG_1 is experimental group 1
EG_2 is experimental group 2
O_1 is pre-test for the experimental groups 1 and 2
O_2 is post-test for experimental group 1and 2
O_3 is the Post Delayed (Retention) test for experimental groups 1and 2
X_1 is treatment for experimental group 1
X_2 is treatment for experimental group 2

Area and Scope of the Study

The area of the study is Makurdi Local Government Area of Benue State. There are seventy six (76) accredited/government approved Senior Secondary Schools in Makurdi Local Governement Area, in which science is being taught (Benue State Teaching Service Board, 2014). The study was confined to Senior Secondary Science Students (SS II). The choice of SSII students is based fact that the topic electrochemistry is in SS II scheme of work. The study also concerned itself with the following electrocheomistry sub-topics as its content scope: electrolysis and electrochemical cells. The LMM and LMC were used to teach electrochemistry. The study also seeks to determine the effects of these strategies on students' retention.

Population of the Study

The population was four thousand, three hundred and sixty nine (4,369) Senior Secondary II chemistry students. The population comprised of two thousand, four hundred and thirty nine (2,439) male chemistry students and, one thousand, nine hundred and thirty (1,930) female chemistry students. (Source: Benue State Ministry of Education, 2014).

Sample and Sampling Techniques

The sample size for this study was four (4) schools purposively sampled from the 76 accredited senior secondary science schools. The criteria for the purposive sampling was based on the fact that the schools had a computer laboratory with at least 30 functional computers; the schools were co-educational; the schools offered chemistry as an SSCE subject; the schools had presented candidates for at least five years for West African Examination

Senior School Certificate (WASSCE) and National Examinations Council (NECO/SSCE) or the equivalent and, has an SSII science student's population of not less than 30. The two (4) secondary schools each were randomly assigned into LMM group and LMC group.

Instrument for Data Collection

The instrument used in this study is the Electrochemistry Achievement Test (EAT). The EAT contain fifty (50) multiple choice questions that will test the students' retention. The items in the EAT were a collection of standard examination questions from three examination bodies namely the West African Examination Council (WAEC), National Examinations Council (NECO) and Unified Tertiary Matriculation Examination (UTME). The EAT is based on the SSII curriculum and covers two sub-topics in electrochemistry namely electrolysis and electrochemical cell. The EAT was structured based on cognitive domain of all the six levels of the Bloom's Taxonomy of Education. Each question was generated with four options A-D to cover the topic in the study. Each correct answer in the EAT scored one (1) mark and each wrong answer scored zero (0).

Other instruments developed were lesson plans on Lecture Method Supplemented with Music (LMM) and Lecture Method Supplemented with Computer with Animation (LMC). These were the medium of instruction for the experimental group 1 and experimental group 2.

Validation/Reliabilityof the Instrument

Fifty (50) objective items EAT were validated by three experts. For **c**ontent validity of the instrument, a well constructed table of specification was used in the construction of the items based on six levels of Bloom's taxonomy of education The LMM amd LMC were also validated by validated three experts.

The reliability estimate of the EAT was determined using the Kuder-Richardson KR_{20}. The calculated KR_{20} estimate for EAT is 0.876.

Method of Data Collection

Data for electrochemistry was collected using the EAT. The EAT was administered to both experimental group 1 and experimental group 2 as pretest before the beginning of the treatment, which served as pretest score. After the treatments, the posttest was administered to students using the EAT (reshuffled), the same test was administered as post delayed test (reshuffled) four weeks after to determine retention.

PRESENTATION OF RESULTS

Research Question 1:

What is the relative effect of LMM and LMC on students' mean retention scores in electrochemistry?

Data in table 1 showed that students taught Electrochemistry with LMC had mean retention score of 40.00 with a standard deviation of 3.69 and adjusted mean score of 40.14 while their counterparts taught electrochemistry with LMM had mean retention score of 41.55 with a standard deviation of 3.74 and an adjusted mean score of of 41.39.

Hypothesis 1:

There is no significant difference in the mean retention scores of students taught electrochemistry using LMM and LMC.

Table 2 showed that the methods were significant on mean retention scores of students in electrochemistry at $P<0.05$. This is because the probability value of 0.030 is less than the 0.05 level of significance, the null hypothesis was rejected indicating that the difference in the mean retention scores of students taught electrochemistry was significant; hence the effect was in favour of LMM.

Research Question 2:

What is the influence of gender on retention mean scores of students in electrochemistry?

Data in table 3 showed that males taught electrochemistry had mean retention score of 39.74 with standard deviation of 3.87 and adjusted mean score of 38.84, while their female counterparts had mean retention score of 41.75 with standard deviation of 3.43 and adjusted mean score of 41.64.

Hypothesis 2:

The mean retention scores of gender do not differ at post delayed test when taught electrochemistry with LMM and LMC.

Table 2 showed that the difference in mean retention scores of gender taught electrochemistry is significant. Since the probability value of 0.001 is less than the 0.05 level of significance, the null hypothesis was rejected indicating that the difference in retention means scores of gender when taught electrochemistry was significant.

Research Question 3:

What is the interaction effect of gender and the teaching strategies on students' mean retention scores in electrochemistry.

Data in table 4 reveals that male students taught with LMC had mean retention score of 39.67 with

standard deviation of 3.68 and an adjusted mean retention score of 39.67 while male students taught with LMM had mean retention score of 39.84 with standard deviation of 4.19 and adjusted mean of 39.84. The result has revealed that female students taught with LMC had a mean retention score of 40.44 with standard deviation of 3.69 with adjusted retention mean score of 42.74, while female students taught with LMM had a mean retention score of 42.74 with standard deviation of 2.87 and adjusted mean of 42.74. On the whole the students taught electrochemistry with LMM had a higher retention grand mean score of 41.55 than those taught with LMC who had retention grand mean score of 40.00.

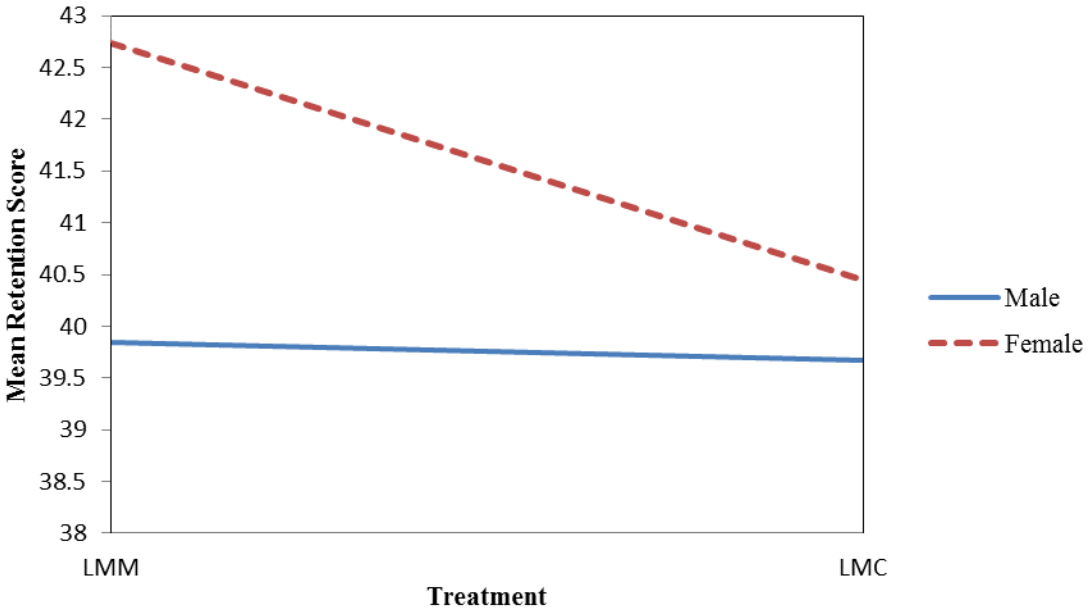

Figure 1: Interaction effect of gender and teaching strategies on students' mean retention score.

Hypothesis 3:

There is no significant interaction effect of gender and the teaching strategies on students' mean retention scores in electrochemistry.

Data in table 2 showed that the two-way intereaction (method*gender) is not a significant factor on students mean retention scores at P=0.063. The null hypothesis was not rejected because 0.063 is greater than 0.05, which leads to the conclusion that there is no interaction effect of the instructional strategies and gender on mean retention scores as shown in figure 1.

Summary of Findings

The following were deduced from the results of the data analysis

4. Students taught electrochemistry using LMM had a slightly higher retention mean score than their counterparts taught elecrochemistry using LMC. Inferential statistics also indicates that the effect was significant.
5. Female students taught electrochemistry had higher retention mean score than male conterparts. The inferential statistics revealed that the effect of gender was significant.
6. Male students taught using LMC had a higher adjusted mean than male students who were taught electrochemistry with LMM. Female students who were taught electrochemistry using LMC had lower adjusted mean score than female students taught using LMM. This implies that there is no significant interaction effect.

Discussion

Relative Effect of LMM and LMC on Students' Retention in Electrochemistry.

Data in table 1 showed that students taught electrochemistry with LMM had higher mean retention score than their counterparts taught with LMC. The involvement of the students in the teaching/learning process was achieved by student-centred lesson practice through regular singing of the lyrics. Further analysis as presented in table 2 showed that the effect of LMM over LMC was significant.

Influence of Gender on Students Retention in Electrochemistry

Data in table 3 showed that female students achieved slightly higher than the male students in their retention of

electrochemistry concept. The result in table 6 indicates that the influence was significant. The superiority of girls over male students during retention test is as a result of the zeal shown by the girls during treatment.
The research assistants of the two schools that taught electrochemistry with LMM had reported that the female students showed so much enthusiasm than the male students during and after the treatment. The female students in the LMM would be seen rehearsing their songs at any given free time. While the research assistants who taught electrochemistry with LMC reported that female students were more enthusiastic than the male students. The male students in the LMC glanced through the animations without joting points while the female students glanced and jotted some points. These reasons could be responsible for improvement in female students' over the male students' scores. The result is in line with Akpoghol et al (2013) who found out that the girls performed better than boys at retention test.

Interaction of Gender and the Teaching Strategies (LMM & LMC) on Students' Retention in Electrochemistry.

Data in table 2 showed that male students who were taught electrochemistry with LMM achieved higher than the male students taught with LMC at the retention test. The result also showed that the female students taught with LMM achieved higher than the female students taught with LMC at retention test. Also with regard to the overall gender effect, the female mean retention score was also found to be higher than the male mean retention score in both methods. This result showed that there is interaction effect of gender and instructional strategies (LMM & LMC) on students' mean retention scores. Further analysis in table 2 also confirmed that there is no significant interaction effect of gender and the teaching strategies (LMM & LMC) on students' retention in electrochemistry. This implies that gender had no much influence on retention. In other words, the effect of the treatment was different (i.e not consistent) for males and females.

Females tend to benefit more than males from the treatment. The result is in line with Mari (2002) who conducted a study on gender related difference in acquisitions of formal reasoning schemata in chemistry using process-based approach, and found out that there was no significant interaction effect between the method and gender on students' retention score.

Conclusion

This study has contributed in a number of ways to the teaching and learning of chemistry. The study showed that LMM and LMC could enhance teaching of chemistry, providing student-centred strategies to teaching/learning of chemistry. More significantly, this study has improved on the lecture method to teaching/learning chemistry using LMM and LMC. This research has therefore added to existing literature in the teaching of difficult concepts in Nigeria, and has exposed the teaching and learning of chemistry in Nigeria to current global trends which have been proven to improve on understanding of difficult concepts in other parts of the world.

Based on the findings of the study on the effects of lecture method supplemented with music and lecture method supplemented with computer animation on students' academic achievement and retention in electrochemistry in makurdi metropolis, the following conclusions were drawn:

4. Students taught with Lecture Method Supplemented with Music (LMM) achieved higher than those taught with Lecture Method Supplemented with Computer Animation (LMC) at retention test. Further analysis also indicates that the effect was significant in favour of LMM.
5. Female students taught electrochemistry had higher retention mean score than their male counterparts. Further analysis revealed that students' retention was significant in favour of female students.
6. Male students taught using LMC had a higher adjusted mean than male students who were taught electrochemistry with LMM. Female students who were taught electrochemistry using LMC had lower adjusted mean score than female students taught using LMM. This implies that the interaction between gender and teaching strategies on retention was not significant.

REFERENCES

Aggarwal, J.C. (2008). *Essentials of Educational Psychology.* Delhi. VKAS Publishing House PVT Ltd. 287-292.

Agbo, F. (2005). *Teaching practice and classroom movement.* Jos, Nigeria: Deka Publications.

Akinsola, M.K. & Igwe, I. O. (1999). Students Perception of Degree of Difficulty of Chemistry Concept in Technical Colleges of Education in Nigeria. *Development Issues in Africa (A Book of Reading in Olaniyan, D. A. (Ed.)* pp. 132 - 149.

Akpoghol, T, Samba, R.M.O. & Asemave, K (2013). Effect of Problem Solving Strategy on Students' Achievement and Retention in Secondary School Chemistry in Makurdi metropolis. *Research Journal in Curriculum & Teaching,* 7, (1), 529-537.

Anyamene, A, Nwokolo, C, Anyachebelu, A. & Anemelu, V (2012). Effect of Computer-Assisted Packages on the Performance of Senior Secondary Students in Mathematics in Awka, Anambra State, Nigeria.

American International Journal of Contemporary Research Vol. 2 No. 7; July 2012

Aremu, O.A & Sokan, B.O (2003). *A muliti-causal evaluation of academic performance of Nigerian learners: Issues and implications for National Development.* Department of Guidance and Counselling, University of Ibadan, Ibadan.

Benue State Teaching Service Board (2014). *Summary of accredited/ government approved Senior Secondary Schools in Makurdi.*

Bichi S. (2002). *Effects of Problem Solving Strategy and Enriched Curriculum on Students' Achievement in Evolution Concepts among Secondary School Students.* Unpublished Doctoral Dissertation Faculty of Education, Ahmadu Bello University, Zaria.

Blair G.M. Jones, R.S. and Simon, R.H.(2008). *Educational Psychology*. London, the Macmillan Company.

Chang, C.Y. (2002). Does computer-assisted instruction + problem solving= improved science outcome? A pioneer study. *Journal of Educational Research,* 95(3), 143- 150.

Darwin, P. H (2003). The concept of knowledge and how to measure it. *Journal of Intellectual Capital,* 4(1), 100-113.

Demorest, M. S., & Morrison, S. J. (2000). Does Music Make You Smarter? *Music Educators Journal,* 87, 2.

Ezeliora, B. (2002). Improving Chemistry Teaching and learning using Computer. *41st Annual Conference Proceeding of Science Teachers Association of Nigeria (STAN),* 186 -187.

Ezeudu, F.O. (2013). Influence of concept Maps on students' achievement and retention of senior secondary school students in Organic Chemistry. *Journal of Education and Practice, IISTE* 4(19), 35-43.

Ezeudu, F.O. & Obi, T, N (2013). Effect of gender and location on students' achievement in chemistry in secondary schools in Nsukka Local Government Area of Enugu, Nigeria. *Research on Humanities and Social Sciences,* 3(15) 50-55.

Huber, J.J (2009). *Music instruction and the reading achievement of middle school students.* Doctoral dissertation, Liberty University.

Ifeakor, A.C. (2006). The status of resources for effective teaching of chemistry in Nigerian secondary schools. In U. Nzewi (Ed.), Resources for science technology and mathematics (STM) education. *47th annual conference of the science teachers association of Nigerian proceedings* (pp. 91-96). *Ibadan: Heinemann Educational Books.*

Joint Admissions and Matriculations Board (2014). *Unified Tertiary Matriculation Examination Brochure.*

Kundu, C.L & Tutoo, N.N (2002). *Educational Psychology.* Sterling Publishers: New Delhi.

Mangal, S.K (2010). *Essentials of Educational Psychology.* New Delhi: PHI Learning Private Limited. 351-359.

McCammon, W.L. (2008). *Chemistry to Music: Discovering how Music-Based Teaching Affects Academic Achievement and Student Motivation in an 8th Grade Science Class.* Paper presented at the annual meeting of the American educational research association, New York, NY.

Mukherjee, A. (2002). *Educational Psychology.* Zaria: Asekome and O publishers. Pg 65-81.

National Examinations Council. (2014). *Chemistry Chief Examiners Report.*

Okonkwo, I.G.A. (2009). Effects of concept mapping and simulation game on students' achievement and interest in environmental concepts in chemistry. Unpublished doctoral dissertation, University of Nigeria, Nsukka.

Okoro, C. A. & Etukudo, U. E. (2001). CAI versus extrinsic motivation based traditional method: It's effect on female genders' performance in chemistry. A paper presented at *42nd STAN conference* in Ilorin.

Opateye, J.A. (2009). Developing diagnostic adaptive testing skills to improve teaching and learning of senior secondary school electrochemistry. In N.A. Udofia (Ed.), *50th annual conference of the Science Teachers' Association of Nigeria proceedings* (pp. 147-151). *Ibadan: Heinemann Educational Books.*

Orji, A.B. & Ebele, F.U. (2005). Personalized system of instruction and students' academic performance in integrated science. *The Journal of Education,* 7 (2), 130-136.

Osedum, R.O. (2008). *The effect of small group instructional technique on computational ability of SS II chemistry students in quantitative analysis acid-base volumetric reaction.* M.Sc. (Ed.) thesis, University of Jos.

Sivakumar, R. & Kirubanadhini, M. (2014). Computer Assisted Instruction in Chemistry. *International Journal of Teacher Educational Research (IJTER)* Vol.3 No.5.

Suleiman, A.M. (2011). *Effects of Inquiry Teaching Method on Academic Achievement, Retention and Attitudes Towards Chemistry among Diploma Students of Kano State Polytechnic.* Unpublished M.Ed Thesis. Department of Science Education, Ahmadu Bello University Zaria.

Tıelemans, G., & Collis, B. (1999). *Strategic requirements for a system to generate and support WWW based environments for a faculty*. Proceedings of Ed-Media99 Charlottesville, VA: AACE.

Umaru, J. (2003). *Introduction to Computer Studies Book 2.* Ilorin: Nathedex Publishers.

West African Examinations Council. (2014). *Chemistry Chief Examiners Report*. Lagos: WAEC.

Yusuf, M. O & Afolabi, A. O (2010). Efects of computer assisted instruction on secondary school students'

performance in Biology.*TOJET: The Turkish Online Journal of Educational Technology*, volume 9, Issue 1.

TABLES

Table 1: Mean ($\overline{X}$) and Standard Deviation (SD) on relative effect of LMM and LMC on students' mean retention score in electrochemistry.

Instructional		Posttest		Retention		Adjusted
Strategies	N	Mean	S.D	Mean	S.D	Mean
LMC	85	39.44	3.88	40.00	3.69	40.14
LMM	80	40.35	3.86	41.55	3.74	41.39

Table 2: Analysis of Covariance of students' means retention scores in electrochemistry.

Sources of variation	Sum of squares	DF	Mean square	F level	Sig
Corrected model	273.969	3	91.323	7.093	.000
Intercept	265371.071	1	265371.071	20611.664	.000
Strategy	61.413	1	61.413	4.770	.030
Gender	134.797	1	134.797	10.470	.001
Gender*Method	45.272	1	45.272	3.516	.063
Error	2072.843	161	12.875		
Total	276360.000	165			
Corrected Total	4883.176	164			

Table 3: Mean ($\overline{X}$) and standard deviation (SD) of mean retention scores by gender.

Gender		Posttest		Retention		Adjusted
	N	Mean	S.D	Mean	S.D	mean
Male	82	39.29	4.24	39.74	3.87	39.84
Female	83	40.45	3.42	41.75	3.43	41.64

Table 4: Mean ($\overline{X}$) and standard deviation (SD) on interaction effect of instructional strategies and gender on students' mean retention scores in electrochemistry.

Instructional		LMC			LMM	
Strategies	N	$\overline{X}$	S.D	N	$\overline{X}$	S.D
Posttest						
Male	49	39.65	4.18	33	38.76	4.37
Female	36	39.14	3.47	47	41.47	3.04
Retention						
Male	49	39.67(39.67)	3.68	33	39.84(39.84)	4.19
Female	36	40.44(40.44)	3.69	47	42.74(42.74)	2.87
Grand mean	85	40.00		80	41.55	

Note: Adjusted mean scores are in parentheses.