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Effects of Lecture Method Supplemented with Music and Computer Animation on Senior Secondary School Students' Academic Achievement 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' academic achievement in electrochemistry in Makurdi metropolis. Six research questions and six 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. The groups were compared on achievement toward electrochemistry. 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. The EAT, LMM, LMC and lesson plans were validated by experts in chemistry, science education, measurement evaluation, music and computer science. 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 Students taught electrochemistry using LMM had higher achievement score (40.35 ± 3.86) than their counterparts taught using LMC (39.44 ± 3.88). The results of the study revealed that there was no statistically significant main effect ($p > 0.05$) for instructional methods on mean achievement score of students taught electrochemistry. Females taught electrochemistry had higher achievement score (40.45 ± 3.42) than their male counterparts (39.29 ± 4.25). The results revealed that there was no statistically significant main effect ($p > 0.05$) of gender on students' achievement. It is suggested that chemistry concepts should be taught using LMM and LMC, or lecture method should be supplemented with other student-centred approaches; text writers and curriculum developers should adopt LMM and LMC as teaching strategies. It was also recommended that artists in the music industry should be encouraged to write and produce music that has cognitive meaning.
Keywords: Academic achievement, music, computer animation, lecture method, gender.

1.1 Introduction

In the recent time, attention has been focused on some aspects of chemistry in order to find out what exactly was responsible for high failure rate in chemistry. Chemistry, being one of the science subjects taught in the Senior Secondary Schools in Nigeria is an important subject. The combination of chemistry and chemists to social, industrial and economic life of the world in general and Nigeria in particular have been felt on all phases of human life. The knowledge of chemistry has enabled the provision of good water, food, and healthcare delivery, various materials for construction in industries, roads, automobiles, and houses. Chemistry is used in solving problems resulting from human interaction with the environment like water and pollution. Despite the relevance of knowledge of chemistry to the society, achievements of students in chemistry as measured by their scores in senior secondary school certificate examination have been very poor. This is detrimental to the development of chemistry in Nigeria. To Ezeliora (2009) and Akpoghol (2001), it appears that without chemistry there can hardly be science because, the scientific development of any nation is determined by the quality of chemistry education in its schools. Chemistry enables learners to understand what happens around them.

According to Akinsola & Igwe (2002) it is as a result of the recognition given to the vital role chemistry plays in the development of the individual and the nation that the subject is made compulsory among the natural sciences and other science- related courses in the Nigerian education system. Its inclusion as a core subject in science in the secondary school calls for the need to teach it effectively. Chemistry also serves as a prerequisite for the study of medicine, pharmacy, agriculture, engineering, textile and clothing, implying that chemistry is involved in industrial set-up and the improvement of quality of life of the citizenry, hence it is said

to be a catalyst of sustainable national growth and development (Akinsola & Igwe, 2002).

According to Akpoghol, Samba and Asemave (2013), despite the importance of chemistry, the achievement of students in the subject have been very poor. Low achievement of students in chemistry has continued to be a major cause of concern to all, particularly chemistry teachers in Nigeria. The minimum entry requirement into Nigerian tertiary institutions is that candidates wishing to study science courses must possess credit passes in ordinary leve subjects, which include chemistry. In Benue State, indices from examinations orgniased by WAEC and NECO showed both low enrolment and poor achievement in chemistry. Chemistry results of the May/June West African Senior School Certificate Examination (WASSCE) and June/July Natioanal Examinations Council Senior School Certificate Examination (NECO/SSCE) for Benue State from 2009 to 2013 reveals a low percentage pass at credit level. In 2009, 2588 candidates enrolled for Chemistry in the WASSCE, 1133 candidates passed at credit level representing 43.8% while 1066 candidates passed at ordinary pass level representing 41.2%. In 2010, 3813 candidates enrolled, 2441 candidates passed at credit level representing 64.0% while 1364 candidates passed at ordinary pass level representing 35.8%. In 2011, 4900 candidates enrolled, 2507 candidates passed at credit level representing 51.2% while 1733 candidates passed at ordinary pass level representing 35.4%. In 2012, 5268 candidates sat for chemistry, 2203 candidates passed at credit level representing 41.8% while 2261 candidates passed at ordinary pass level representing 42.9%. 5389 candidates enrolled for chemistry in 2013, 2379 candidates passed at credit level representing 44.1% while 2206 candidates passed at ordinary pass level representing 40.9%.

For NECO/SSCE, 2588 candidates enrolled for chemistry in 2009, 1133 candidates passed at credit level representing 43.8% while 1066 candidates passed at ordinary pass level representing 41.2%. In 2010, 4040 enrolled, 1790 candidates passed at credit level representing 44.3% while 1789 candidates passed at ordinary pass level representing 44.3%. In 2011, 3966 candidates enrolled, 1384 candidates passed at credit level representing 34.9% while 2422 candidates passed at ordinary pass level representing 61.1%. In 2012, 4009 candidates enrolled for chemistry, 2152 candidates passed at credit level representing 53.7% while 1755 candidates passed at ordinary pass level representing 43.8%. In 2013, 4518 candidates enrolled for chemistry, 2281 candidates passed at credit level representing 50.5% while 2135 candidates passed at ordinary pass level representing 47.3%. The WASSCE and NECO/SSCE over these periods indicate low achievement in chemistry which implies that either the teachers are not teaching the subject properly or the students do not understand the subject.

Some studies have been carried out to establish causes and probably to proffer solutions to the problem of students' poor achievement in chemistry but not much has been achieved since students still fail the subject poorly. Some of the studies have reported that students tag certain topics in chemistry as difficult topics (Akpan, 2008; Ibole-Onyegecha, 2010). Accoding to Udo and Eshiet (2007) students avoid answering questions from these areas or perform poorly if attempted at-all during internal/external WAEC and NECO examinations. Babarinde (2009) noted that teachers need to actively engage students in teaching-learning process; hence teachers should employ students centred teaching strategies to overcome this difficulty.

It is now being recognized that there are better ways of teaching than the traditional methods of instruction (Akpoghol, et al, 2013). Many of the standard methods of conveying knowledge have been shown to be relatively ineffective on the students' ability to master and then retain important concepts. Learning through some methods of teaching is passive rather than active (Ifeakor, Njelita and Udogu, 2008). The traditional methods (lecture, laboratory, recitation methods) do not tend to foster critical and creative thinking, and collaborative problem-solving. It may need to be pointed that no one method of teaching chemistry is ideal all the time, (Ifeakor, Njelita and Udogu, 2008).

Guidelines from the Federal Mininstry of Education for the inspection of chemistry teaching in the senior secondary schools and technical colleges recommends participatory methods for effective teaching and learning chemistry in secondary schools (FME, 2002). However, many chemistry teachers have not been able to apply innovative methods to teach but rather rely on the lecture method (Mohammad, 2011). Even though there are interesting learning methods that enable students to have an active control over their own learning and also enhance academic achievement (Mohammad, 2011).

Inyang & Ekpenyong (2000) and Akpoghol, et al (2013) noted that students do not only find chemistry very difficult but uninteresting and that the few students that enrol for chemistry, sometimes perform poorly. This implies that chemistry teachers must be aware of the topics that students tag 'difficult', hence select and use teaching strategies that are appropriate (Ramsden, 2003); one of such difficult topics is electrochemistry as reported by WAEC Chief Examiners' Reports (WAEC,2009, 2010, 2011, 2012, 2013 & 2014). According to Ojaleye (1998), some concepts are tagged difficult when students have consistently shown lack of sufficient knowledge, skills and strategies in tackling problems and understanding the concepts. The resultant effect is that the concepts are either neglected or poorly taught, and students continually perform poorly in such areas or dogde them during internal and external examinations.

Electrochemistry is a topic in chemistry that is taught at the senior secondary school level II. It is found

in the chemistry curriculum and syllabus of WAEC and NECO as sub-topics: oxidation and reduction, electrolysis, electrode potentials and elelctrochemical cells. These sub-topics are taught in details in tertiary institutions, and most of the sub-topics serve as pre-requisite to others. Electrochemistry is a branch of chemistry that studies relationship between electricity and chemical changes (Ibole-Onyegecha, 2010). Dhingra (2006) defines electrochemistry as the study of conversion of chemical energy to electrical energy and vice-versa. Construction, working of electrochemical and electrolytic cells and the reactions involved are studied in it. Ibole-Onyegecha (2010) reported that whenever students are requested to list the difficult topics in chemistry, electrolysis is always listed as one of the problematic areas.

Questions on electrochemistry have continued to pose difficulty for candidates as noted by WAEC Chief Examiners Report (WAEC, 2009, 2010, 2011, 2012, 2013 & 2014). A survey was carried out by the researcher on some SSII chemistry students of Government Model School, Makurdi and Government Girls College, Makurdi in order to confirm or refute this assertion that electrochemistry is 'difficult'. The researcher posed the following question to students: "Which topic in chemistry is the most difficult for students of SSII to grasp?" Survey report from both schools indicated that, electrochemistry was ranked the most difficult topic in SSII to study; next was energy changes. This implies that much attention should be given to this topic by chemistry teachers; hence the need for innovative and improved student centred teaching techniques to enhance teaching and learning of electrochemistry.

According to Samba (2010), teacher's ideas of conception of knowledge and learning are the foundations on which successful teaching is built. The teacher's knowledge about students helps in understanding different kinds of learners. Effective teaching connotes the ability of the teachers to communicate effectively and this cannot be done without knowing the characteristics of a learner and his problem and also by using the appropriate methods. Therefore, in order to alleviate the problem of teaching of chemistry concepts, particularly electrochemistry, the use of Lecture Method supplemented with Music (LMM) and Lecture Method supplemented with Computer Animation (LMC) have been suggested by the researcher as innovative teaching methods.

According to Akpoghol, et al (2013), the lecture method is one of the conventional methods of teaching; it involves only oral presentation of ideas. The teacher does most of the activities in form of talking while the students are passive 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, hence 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 an essential 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. The part of the brain that processes sound has frequency specific neurons that turn on and turn off based upon what sound the person is experiencing. Eventually these frequency neurons form groups of similar cells, and these results in a sound map in the brain (Demorest & Morrison, 2000). Music also has the ability to increase spatial reasoning and stimulate thought processes, which are both necessary components for academic achievement (Demorest & Morrison, 2000). 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.

According to Tielemans & Collis (1999), computer gives opportunities to both students and teachers to learn by their speed and combine active learning with computer technology. There are a lot of important reasons for using computer in chemistry education. It enables the teacher to gather many materials from various centres such as: text, graph, audio, video, picture, animation and simulation in the same media to students. Many studies also supported the idea that learning through computer has positive effect on students' achievements (Chang, 2002; Sanger & Greenbowe, 2000).

Emphatically, 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; UNESCO, 2004). It is a self-instructional device with the principle of atomization. Computer Assisted Instruction as "Computer applications applied to traditional teaching methods such as 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).

As stated earlier, several questions from WASSCE and NECO/SSCE are asked from electrochemistry. Electrochemistry is a perquisite topic for the understanding of some other chemical processes. Although the lecture method may be the most prevalent teaching technique, however it is an ineffective method that facilitates teaching (Mohammad, 2011). According to Nwagbo (1999), the lecture approach is method in which the the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials.

Gender is one other factor that interacts with achievement in chemistry, and other subjects (Ezeudu & Obi, 2013; Okeke, 2008; Jegede, 2007); this is because a lot of concern has been shown by researchers. These reseachers have reported contradictory reports on the influnce of gender on students' achievement. With the contracdictions and lack of clear trend in gender influence in students' achievement, more investigation has become necessary. This necessitated the present study to investigate if both gender will benefit equally in achievement test when taught with Lecture Method supplemented with Music (LMM) and Lecture Method supplemented with Computer Animation (LMC).

1.2 Statement of the Problem

Research reports on the status of teaching chemistry education in schools in Nigeria show that chemistry classroom activities are still dominated by teacher-centred methods, such as lecture and teacher demonstration methods, which have been found to be ineffective in promoting science learning at the primary and secondary school levels. The resultant effect has been students' persistent poor achievement in chemistry at both internal and external examinations, in Nigeria. A combination of student-centred and activity-based approaches with lecture has been advocated for, so as to enhance better understanding of electrochemistry. Music and computer animation could be a welcome solution. But, how effective are these techniques when they are combined with the lecture method? This study is aimed at determining the relative effectiveness of lecture method supplemented with music and computer animation on students' achievement in electrochemistry at the secondary school level.

The statement of the problem is therefore put in question: What will be the relative effect of Lecture Method supplemented with Music (LMM) and Computer Animation (LMC) on academic achievement in electrochemistry amongst senior schools chemistry students?

1.3 Scope of the Study

The study was carried out in schools in Makurdi Local Government Area, Benue State as its geographical scope. The study was confined to Senior Secondary Science Students (SS II). The choice of SSII students is based on the condition 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 measures of students' behaviour involved in this study were only the cognitive domain.

The LMM and LMC were used to teach electrochemistry. The study also seeks to determine the effects of these strategies on achieveme

1.4 Research Questions

This following research questions guided the conduct of the study:

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

1.5 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 achievement scores of students taught electrochemistry using LMM and LMC.

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

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

2.0 Design of the study

The design of the study was quasi-experimental design specifically the pre-test, post-test non-equivalent control group design.

The design is represented symbolically as follows:

Group	Pretest	Treatment	Post-test
EG_1 →	O_1	X_1	O_2
	---	---	---
EG_2 →	O_1	X_2	O_2

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
X_1 is treatment for experimental group 1
X_2 is treatment for experimental group 2

3.1 Area of the Study

The area of the study is Makurdi Local Government Area of Benue State. Makurdi is the capital of Benue State. Makurdi Local Government Area is made up of 2 state constituencies namely; North bank and South bank with 11 council wards.

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).

3.2 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).

Senior Secondary II chemistry students were suitable for the study because the electrochemistry is found in the chemistry SSII curriculum.

3.4 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.

3.5 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' achievement. 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.

Other instruments developed were lesson plans on Lecture Method Supplemented with Music (LMM) and Lecture Method Supplemented with Computer with Animation (LMC).

The Five (5) songs composed on electrochemistry to supplement the Lecture Method

The first track enumerates guidelines that can be used in solving problems in electrochemistry; the track also explains the meaning, terminologies in electrolysis. This track also states Faraday's first and second laws of electrolysis.

The second track explains the electrolysis of acidified water and dilute sodium chloride, and the reactions that occur at the electrodes.

The third track is on electrolysis of aqueous Copper (II) Tetraoxosulphate (VI) and the reactions that occur thereof.

The fourth track is on applications of electrolysis. The song explains purify metals, electroplating as a process of depositing a layer of metal on another substance, and the extraction of metals.

The fifth song is on electrochemical cells, the track also lists the cations and anions in the electrochemical series based on their positions; also included in the fifth track are the factors responsible for the preferential discharge of ions.

Development of the five (5) songs

The five songs on electrochemistry were developed by the researcher in line with the SSII curriculum and they featured electrolysis, electrolytic cells, electrochemical cells and electrochemical series.The contents of the songs were lifted from Chemistry Textbooks.

The reasearcher, one music expert and one secondary school chemistry teacher scrutinised the songs before going to the studio for recording. Two attempts were made in producing the songs, the first attempt yielded only 3 songs were on oxidation and reduction, electrolysis, electrochemical cells but after listening to the songs the researcher discovered that some important details that would explain the concepts were missing. The three songs did not include examples. The second attempt yielded 5 songs; the 5 songs featured all the important details and examples that were needed in teaching/learning electrochemistry at secondary school level.

The beats of all the tracks were a mix of Nigerian traditional flare and western music. The tracks have direct definitions and explanations of the concepts, however new ideas were not included in the tracks.

The Lecture Method Supplemented with Computer Animation (LMC)

The first video enumerates guidelines that can be used in solving problems in electrochemistry; it also explains the meaning, terminologies in electrolysis. It also states Faraday's first and second laws of electrolysis.

The second video explains the electrolysis of acidified water with animation and dilute sodium chloride with animation, and the reactions that occur at the electrodes.

The third video is on electrolysis of aqueous Copper (II) Tetraoxosulphate (VI) with animation and the reactions that occur thereof.

The fourth video is on applications of electrolysis, it explains the electroplating of silver on stainless spoon (with animation). The video explains purify metals, electroplating as a process of depositing a layer of metal on another substance, and the extraction of metals.

The fifth video explains the electrochemical series, it also lists the cations and anions in the electrochemical series based on their positions; also included in the fifth video are the factors responsible for the preferential discharge of ions.

The sixth video has animations on electrochemical cells, different types of electrochemical cells and similarities. It also explains the applications of electrochemical cells.

The computer animation comprises of 18 animations, all illustrating the concept of electrochemistry.

3.6 Reliability of the Instrument

Trial testing was conducted to test the appropriateness of the EAT instrument. 51 SSII chemistry students of Government Model School, Makurdi were used for the trial testing. This was to enable the researcher to determine the appropriateness of the instrument. The reliability estimate of the EAT was determined using the Kuder-Richardson KR_{20}. The calculated KR_{20} estimate for EAT is 0.876

3.7 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).

3.8 Treatment Procedure

Experimental group 1

The experimental group 1 (EG_1) were given the pre-test before the treatment commenced. Thereafter the EG_1 were treated with the LMM strategy as directed by the lesson plans. In each lesson, the teachers played the songs at intervals and then pulse, and then allow the students interact with the songs.The teachers accepted correct answers and interpretations from students and thereafter use lesson notes to explain more. The treatment lasted for three weeks.

Experimental group 2

The experimental group 2 (EG_2) were given the pre-test before the treatment would commence. Thereafter the EG_2 were treated with the LMC strategy as directed by the lesson plans. In each lesson, the teachers played computer animations at intervals, pulse, and then allow the students interact with the computer animations. The teachers accepted correct answers and interpretations from students and thereafter use the lesson notes to explain more. The treatment lasted for three weeks.

3.9 Method of Data Analysis

The statistical tools used in answering research questions were means and standard deviations. Analysis of covariance (ANCOVA) was used to test all the formulated hypotheses at 0.05 percent level of significance.

4.0 Presentation of Results

Research Question 1:

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

Data used in answering the research question is presented in table 1.

Data in Table 1 showed that students taught electrochemistry using LMC had posttest mean score of 39.44 with a standard deviation of 3.88 and adjusted mean score of 39.42 while their conterparts taught electrochemistry using LMM had posttest mean score of 40.35 with a standard deviation of 3.86 and adjusted mean score of 40.37. The result indicates that students taught electrochemistry using LMM had a slightly higher adjusted mean score than their counterparts taught Electrochemistry using LMC.

Hypothesis 1:

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

Table 2 showed that the effect of instructional methods were not significant on mean achievement scores of students in electrochemistry. This is because 0.156 is greater than the 0.05 level of significance, the null hypothesis was not rejected indicating that the difference in the mean achievement scores of students taught electrochemistry using LMC and LMM was not significant.

Research Question 2:

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

Table 3 revealed that male students taught electrochemistry had post test mean score of 39.29 with a standard deviation of 4.25 and an adjusted mean score of 39.30, while their female counterparts had post test mean score of 40.45 with a standard deviation of 3.42 and an adjusted mean of 40.46. This indicates that female students taught electrochemistry achieved higher than their male counterparts at posttest.

Hypothesis 3:

The mean achievement scores of gender do not differ at post test when taught electrochemistry.

Table 2 showed that the effect of gender on posttest mean scores of students in electrochemistry was not significant. Since the probability value of 0.052 is greater than the 0.05 level of significance, the null hypotheses was not rejected indicating that the posttest mean scores of gender were not significant.

Research Question 3:

What is the interaction effect of gender and instructional strategies on students' mean achievement scores in electrochemistry?

Data in table 4 reveals a higher mean achievement score of 39.65 with standard deviation of 4.18 and adjusted mean score of 39.61 for male students taught using LMC, while male students taught electrochemistry with LMM had mean achievement score of 38.76 with a standard deviation of 4.37 and adjusted mean score of 38.74. On the hand, female students taught electrochemistry using LMC had an achievement mean score of 39.14 with a standard deviation of 3.47 and an adjusted mean score of 39.20 while their female students taught electrochemistry using LMM had an achievement mean score of 41.47 with a standard deviation of 3.04 and adjusted mean score of 41.48. The result implies that male students taught electrochemistry with LMC achieved higher than male students taught with LMM. However, female students taught electrochemistry with LMM achieved higher than the female students taught with LMC. On the whole, the male and female students taught electrochemistry with LMM had a higher grand mean score of 40.35 than the male and female students of LMC

who had a mean score of 39.43.

Hypothesis Three:

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

Data in Table 2 showed that the two-way interaction (method*gender) is a significant factor on students mean achievement scores at P = 0.010. This is because 0.010 is less than 0.05 whch leads to the rejection of the null hypothesis in favour of the alternative. This indicates that the interaction effect of the instructional strategies and gender was significant as shown in figure 3.

4.1 Summary of Findings

The following were deduced from the results of the data analysis

1. Students taught electrochemistry using LMM had a slightly higher mean achievement score than their counterparts taught electrochemistry using LMC. However, inferential statistics concludes that the effect was not significant.
2. Female students taught electrochemistry had higher mean achievement score than their male counterparts. However, inferential statistics revealed that the effect of gender was not significant.
3. Male students taught electrochemistry with LMC achieved higher than male students taught with LMM. The result also showed that the female students taught electrochemistry using LMM achieved higher than female students taught with LMC. This implies that there is significant interaction effect.

4.2 Discussion of Findings

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

Data in table 1 showed that students taught electrochemistry using Lecture Method Supplemented with Music (LMM) achieved slightly higher than those taught electrochemistry using Lecture Method Supplemented with Computer Animation (LMC). The result also showed that students taught electrochemistry with LMM had a slightly higher adjusted mean score than their counterparts taught electrochemistry with LMC. This result is in line with the findings of McCammon (2008) and Huber (2009) which revealed that music based teaching enhances achievement.

However, further analysis as presented in table 2 revealed that the effect was not significant. This implies that both LMM and LMC instructions were found to be effective. The improvement in their scores was due to the fact that the two approaches to teaching electrochemistry were student-centred, which gave rise to more meaningful and effective learning. The approaches ensured active participation of students in teaching learning process. Moreover, activities of the two groups were carried out by the students themselves and guided by the teacher; the active participation of the students involving several sense organs invariably should lead to greater learning going by Multiple Intelligence theory of Gardner.

It is worthy to note that when the treatment began, one of the research assistants of the LMM group immediately reported that many students were uncomfortable with the sudden change in teaching approach. However, two weeks into the treatment, most of the worry had disappeared, and the students were passionate participants in this innovative method of teaching and learning. The relative slight superiority of the LMM over the LMC in enhancing students' achievement in electrochemistry could be attributed to the enthusiasism and active participation in the LMM class and that the students had adjusted to the new style of learning.

Influence of Gender on Achievement of Students in Electrochemistry.

Data in table 3 showed that female students taught electrochemistry had a higher post test mean score than their male counterparts. This indicates that female students taught electrochemistry achieved higher than male students. It is worthy to note that the girls in the LMM took the lessons more seriously than the boys because they related the songs to the topic more than the boys. The boys took the music for entertainment while the girls' jotted down some points they heard from the music. However, further analysis as presented in table 2 revealed that the influence of gender was not significant. The result is in line with Achor and Ukwuru (2014), Nbina and Wagbara (2012), Nwachukwu (2009) and Okonkwo (2009) who in their separate studies revealed that gender influenced achievement in the favour of females.

However, this current study is not in line with the studies of Mari (2002) and Akpoghol (2001), who reported in their separate studies that male students had a higher achievement in chemistry than females. This implies that the influence of gender on achievement is inconclusive; therefore there is need for further research to ascertain the influence of gender on achievement.

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

Data in table 4 showed that the male students taught electrochemistry with LMC achieved higher than male students taught with LMM at posttest. The result also showed that at posttest female students taught electrochemistry using LMM achieved higher than the female students taught with LMC. Also with regard to the

overall gender effect, the female mean achievement score was found to be higher than the male achievement score in both methods. This implies that there is interaction effect of gender and instructional strategies (LMM & LMC) on students' mean achievement scores. Further analysis as presented in table 2 also showed that there is significant interaction effect of gender and the teaching strategies (LMM & LMC) on students' mean achievement scores in electrochemistry. The result of this study is in line with Akpoghol et al. (2013) and Ezema (2013) who found out that the effectiveness of interaction was reliant on gender.

5.0 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 in electrochemistry in makurdi metropolis, the following conclusions were drawn:

1. Students taught electrochemistry using LMM had a slightly higher mean achievement score than their counterparts taught electrochemistry using LMC. However, further analysis concludes that the effect was not significant.
2. Female students taught electrochemistry had higher mean achievement score than their male counterparts. However, further analysis revealed that the influence of gender was not significant.
3. Male students taught electrochemistry with LMC achieved higher than male students taught with LMM. The result also showed that the female students taught electrochemistry using LMM achieved higher than female students taught with LMC. This implies that the interaction between gender and teaching strategies on achievement was significant.

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

Instructional Strategies	Pretest		Post-test		Adjusted Mean
	N	Mean S.D	Mean	S.D	
LMC	85	18.05 5.35	39.44	3.88	39.42
LMM	80	21.28 5.09	40.35	3.86	40.37

Table 2: Analysis of Covarience of students' means achievement scores in electrochemistry.

Sources of variation	Sum of squares	DF	Mean square	F	Sig
Corrected model	196.000	4	49.000	3.439	.010
Intercept	17372.650	1	17372.650	1219.360	.000
Pretest	13.595	1	13.595	0.954	.330
Strategy	28.994	1	28.994	2.035	.156
Gender	54.599	1	54.599	3.832	.042
Gender*Method	96.622	1	96.622	6.782	.010
Error	2279.576	160	14.247		
Total	264878.000	165			
Corrected Total	2475.576	164			

Table 3: Mean ($\overline{X}$) and Standard Deviation (SD) on influence of gender on the mean achievement scores of students in electrochemistry

Gender	Posttest		Adjusted Mean
	N	Mean S.D	
Male	82	39.29 4.25	39.30
Female	83	40.45 3.42	40.46

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

Instructional Strategies	LMC			LMM		
	N	Mean	S.D	N	Mean	S.D
Pretest						
Male	49	17.04	5.45	33	21.00	5.29
Female	36	19.42	4.96	47	21.47	4.99
Posttest						
Male	49	39.65(39.61)	4.18	33	38.76(38.74)	4.37
Female	36	39.14(39.20)	3.47	47	41.47(41.48)	3.04
Grand mean	85	39.43		80	40.35	

Note: Adjusted mean scores are in parentheses.

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