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Effect of video practical method on secondary school student's academic achievement in chemistry in Anambra state

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Abstract

This study became necessary because of the search for more effective methods of teaching and learning of chemistry. Thus, this study investigated the effects of video-taped practical method on secondary school students' academic achievement in chemistry in Anambra state of Nigeria. Two research questions guided the study and two null hypotheses were tested at 0.05 alpha level. The study adopted a quasi-experimental pretest posttest non-equivalent control group design. The population consists of 808 senior secondary school year two (SS2) chemistry students from 16 public secondary schools in Orumba South L.G.A. A sample of 87 SS2 chemistry students was used for the study. A purposive sampling technique was used to select eight co-educational secondary schools and a simple random sampling technique with replacement was used to draw two schools out of the eight co-educational schools. The schools were assigned to serve as experimental and control groups using a toss of coin and intact classes were used. Chemistry Achievement Test (CAT) and was validated and used as instrument for data collection. The reliability coefficient of 0.76 was established for CAT using Kuder Richardson 20 (K-R 20). The experimental group was taught the concepts of chemical reaction and equilibrium using Video-taped practical method (VTPM) for six weeks while the control group was taught the same concepts with Conventional Method (CM). Mean and standard deviation were used to answer the research questions while analysis of co-variance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed that VTPM was more effective in enhancing the students' academic achievement in chemistry than the CM. There was no significant difference in the academic achievement of chemistry students due to gender. Therefore, chemistry teacher should adopt the use of VTPM in teaching students since it yielded a more viable result on academic achievement among secondary school chemistry students. In light of the findings from this study, it was recommended that chemistry and science teachers should structure lessons to provide hands-on activities, with a hope to enhance gender equality and to discourage gender stereotyping in teaching and learning of chemistry, the students' understanding of chemistry concepts.

Keywords: academic achievement, teaching chemistry, Anambra state

Introduction

Education is recognized as the nation's greatest asset towards the quick development of its scientific potentials, sociological and human resources, hence it focuses on the integration of the individual into a sound and effective citizen. The Federal Republic of Nigeria, (FRN, 2013) (national policy on education) expressed the national goals of education to include: the acquisition of appropriate knowledge, skills, competencies; development of mental, physical and scientific abilities; equipment of individuals to live in and contribute meaningfully to the development of the society. The importance of education in general and science education in particular in national development cannot be overemphasized. Science education occupies a very high position in Nigeria educational policies.

The Federal Republic of Nigeria (National Policy on Education) (FRN, 2014) stated amongst other goals that: Science education shall emphasize the teaching and learning of science process and principles, and in addition to general education, the study of related sciences and acquisition of practical skills is also necessary. This emphasis could be in response to the rapid advancement in science and technology so that the country would be able to move forward and keep pace with development in other parts of the world. Science and its applied form technology, have contributed to the comfort of man through the production of goods and services in various parts of the world. Science is acknowledged as the bedrock of national development. This implies that any nation who desires to attain national development must make science education a priority (Ebuka, 2014) [4]. The Federal Government of Nigeria acknowledged the importance of science education for all, hence she made provisions for science and technology education at all levels of education.

In Nigeria, the situation is not different.

The government through official policies and actions has demonstrated commitment to the inculcation of scientific literacy among all Nigerians and not only those pursuing scientific careers or science professions but also for those in non-science related courses. One obvious example of government action in this regard is making science subjects compulsory (i.e. a core subject) in our Primary and Junior Secondary Schools and one of such subjects is Chemistry.

Chemistry is one of the branches of science whose study contributes to scientific knowledge. Chemistry in particular, takes up a very significant place in the secondary school curriculum because of its applications in everyday life and the role it plays in enabling students to develop intellectual

and practical skills. Haines in Okeke (2014) [14] suggests that through practical activities in Chemistry, students are able to develop science process skills necessary for solving problems in real life situations. The application of chemical knowledge has improved the life of mankind in the area of medicine, agriculture, transport and food industry (Okere, 2006) [6]. It also enables students to explore the world by understanding the chemical phenomena, procedures and investigative nature.

Chemistry is a core subject in secondary schools in Nigeria. It is a branch of science that deals with the study of chemicals, substances and molecules. For students who are not in sciences; chemistry may be terminal science subject they study but for science-inclined students, chemistry may provide relevant paradigm for their training as scientists, or for a career that involves science. It can equip the learners with the skills and knowledge to become and remain lifelong learners, contributing positively to the society. The nature of the subject itself presents concepts and phenomena that would enable students to apply the methods of scientific observation and evaluation of decision making, distinguish observation from influence, lead healthy lives through knowledge of how their bodies function and can be abused. As a matter of fact, our world is made up of matter, we study chemistry to acquire knowledge about matter.

Chemistry is a core subject for medical sciences, textile technology, agricultural sciences, synthetic industry, printing technology, pharmacy, chemical engineering. Kwan, Lam and Ofoefuna (2011) noted that productive rewarding careers can be built on the knowledge of chemistry. However, some researchers have shown that students' achievement in chemistry is not encouraging. Nnachi (2015) [11] indicated that secondary school students have dwindling science achievement. Reports from the West African Examination Council (WAEC, 2018) [19], show that students' performance in chemistry is getting poorer and poorer each year.

The performance of students in practical work is still worse. Uwadie (2018) in support of the above assertion noted that it was only 48.8% of the candidates who sat for November/December 2017 West African Senior School Certificate Examination (WASSCE) had credit pass in chemistry. The 2018 June/July SSCE results also recorded mass failure by students across the country. In chemistry, 1,156,561 students sat for the examination with only 3,256 representing 0.28% obtaining distinctions. 295, 961 or (24.86%) got credit while 77, 395 or (60.27%) got pass. 98,023 representing (7.48%) failed while 50, 826 or (4.27%) were withheld. By implication, only 25.14% of the students who sat for 2018 SSCE (passed at distinction and credit levels) are qualified for admission for further studies in science courses in universities, colleges of education, polytechnics or other higher institutions. This consistent poor performance by students in chemistry is worrisome.

Chemistry is viewed as a difficult subject at secondary school level and therefore students' achievement in chemistry has always been a topic for discussion among teachers, parents, counsellors and researchers. Chemistry achievement is viewed as a problem internationally (Young, 2009). In more specific terms Ozbey (2007) [18], posits that students fail chemistry because they do not demonstrate good study behaviours. Several factors have been identified as the causes of students' poor achievement in the science subjects, including chemistry. Some of them are ineffective teaching methods and strategies, over-loaded chemistry syllabus, abstract and difficult nature of many chemistry concepts, lack of interest on the part of students, large class size, fear of the subject psychologically, attitude of students towards science, poor motivation of students, poor students' attitude to science and students' laziness, (Onunkwo and Unachukwu, 2010) [17].

Another major factor that affect students' performance in process skills acquisition, as identified by Ikeanumba (2017), is lack of video practical. According to Greenberg (2009), video practical method of learning should be seen as a complementary tool for teaching and learning rather than a substitute to the use of instructional tool, video-taped lesson could be used in conjunction with traditional method to enhance learning and promote students achievement. Video-taped lesson offer students' opportunity to pause, rewind, reply and download lesson content and later review the lessons either in the classrooms or in their homes. However, in support of the above assertion (Marshal, 2012) was of the view that teaching method that includes the use of video and audio, will in effect, reach more students and provide more opportunity for intellectual development and learning.

In the same vein, the benefits of colour, sound and motion attached to videotaped package will be of interest to students who are the target of the study. In order words, students will have positive achievement and attitude to the learning of chemistry. This view is in agreement with Chambers (2009) when he asserts that fun and entertainment are natural ways through which students learn and this could be provided by videotaped instruction. Though video-taped lesson play a vital role in teaching and learning of chemistry, the introduction of teacher's demonstration method has also helped. Since it involves experiments performed by the teacher with the assistance of the learners. This method is used in situations where apparatus and supply of chemicals are limited.

Other factors that might contribute to their poor performance could be traced to inadequate number of teachers, teachers' qualification and an attempt to cover an extensive work load by the teacher within a limited time, thereby leaving behind the necessary skills and strategies required to increase students' performance especially in practical acquisition skills in chemistry. Oluwatayo and Fatabo (2010) [16] identified the use of inappropriate teaching method by teachers as a major cause. The above facts in the students' achievement in chemistry in secondary schools are of concern. If students are not motivated, and their performance in chemistry remains poor, there will be a limit to which they would maximize their potentials in chemistry so as to solve life's problems

True teaching and true learning are more than simply the impartation and regurgitation of information. They are more than isolated mastery of scientific knowledge, principles and facts. Using the constructive perspectives, Malcolm (2015) [19] asserts that the teaching and learning which have life-long implications are activities that develop processes as well as products. He stressed on the activities that are characterized by being experimental which engages the students in hands-on-and minds-on activities.

The findings of Muhammad (2014) [10] and Okpala and Onocha as cited in Offiah and Okonkwo (2011) [12], indicated that achievement of students in chemistry, could

be influenced by some learner characteristics such as gender. Gender is an important variable in educational research and it has continued to be an issue of concern to educators and researchers. Ezirim (2006) [5]; Longe and Adedeji (2003) [8]; Yoloye (2004) [20], have noted in their studies that gender has impact on science education. Gender can be considered to be sexual classification into male and female. Gender issues in the context of education is referred to as the differences, both real and perceived between boys and girls and their relative achievements and opportunities (West Minister Institute of Education, 2006).

Gender-related issues have attracted the attention of many researchers in science education for male and female in secondary schools. Agommush and Nzewi (2003) [1]; Babajide (2010) [2]; Danladi (2003) [3], found that gender has no influence on students' achievement in science. The influence of gender on achievement and in science education is therefore still a controversial issue among science researcher. These contradictive evidences in academic achievement and lack of clear trend on gender influence in the study of science has resulted in the need to carry out a study with a view to determine the effect of video practical method on secondary school male and female chemistry students' academic achievement. Based on these facts, the researcher therefore, considered it crucial to analyze the effects of video practical method on secondary school students' academic achievement in chemistry in Anambra State.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of secondary school students taught chemistry using video practical method and that of those without video practical method using pretest and post test scores?
2. What are the mean achievement scores of male and female secondary school students taught chemistry using video practical method using pretest and post test scores?

Hypotheses

Two null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of secondary school students taught chemistry using video practical method and that of those without video practical method in a chemistry.
2. There is no significant difference in the mean achievement scores of male and female secondary school students taught using video practical method.

Methods

A quasi experimental research design was adopted for this study. Specifically, a pretest-posttest non-equivalent control group design was used. The study was carried out in Orumba South Local Government Area of Anambra State. The population of the study consisted of 808 senior secondary (SS2) chemistry students in sixteen public secondary schools in Orumba South Local Government Area. The sample of this study consisted of 87 SS2 chemistry students drawn from two (2) schools out of the 16 public secondary schools in Orumba South L.G.A. of Aguata Education Zone. First, purposive sampling technique was used to select schools from the 15 co-educational secondary schools in Orumba South L.G.A. The two schools were assigned into experimental and control group by a toss of a coin. To avoid interaction of students from each group, one intact class of chemistry students from each school made up the sample for this study. The experimental sample (N = 35) consisted of 14 males and 21 females while the control sample (N = 52) consisted of 33 males and 19 females. The Chemistry Achievement Test (CAT) containing 40 question items developed by the researcher was validated by three experts from Measurement and Evaluation Unit, Science Education and a chemistry teacher. The scores for CAT obtained from trial testing exercise carried out with 40 students were used to estimate the reliability coefficient of the instrument using Kudder Richardson Formular (KR-20) which yielded a reliability of 0.76. The instruments were administered to the students by their class teachers who were used as research assistants. Before the commencement of treatment, the CAT was administered on the students as pre-test. At the end of treatment period, the items of CAT was reshuffled and then administered as post-test to the students. The data obtained from the pre-test and post-test were used for analysis. The research questions were answered using mean and standard deviation. The hypotheses were tested at 0.05 alpha level, using analysis of co-variance (ANCOVA).

Results

Research question 1

What are the mean achievement scores of secondary school students taught chemistry using video practical method and that of those without video practical method using pre-test and post-test scores?

Table 1: Pretest and Posttest Means Achievement and Standard Deviation Scores of the Experimental and Control Groups on Chemistry Achievement Test (CAT).

Pretest				Posttest		
Groups	**N**	$\bar{X}$	**SD**	$\bar{X}$	**SD**	**Mean gain**
Control	52	25.77	13.69	47.38	9.87	21.61
Experimental	35	31.26	14.29	78.34	6.27	47.08

Data presented in Table 1 show that the control group had a pretest mean and posttest mean achievement scores of 25.77 and 47.38 while those of the experimental group were 31.26 and 78.34 respectively. The pretest standard deviation for control (13.69) and experimental (14.29) groups indicate that the individual scores are widely spread apart from each other.

On the other hand, their posttest standard deviation 9.87 and 6.27 respectively indicate that their scores are not too far from the mean and from each other. The table also reveals that the mean gain achievement score of the experimental group is 47.08 and is remarkably higher than that of the control group which is 21.61.This means that experimental group taught with video practical and demonstration method achieved more than control group taught with conventional method.

Research question 2

What are the mean achievement scores of male and female secondary school students taught chemistry using video practical method using pre-test and post test scores?

Table 2: Pretest and Posttest Mean Achievement and Standard Deviation Scores of Male and Female Chemistry Students in Experimental Group on CAT.

Pretest			Posttest			
Groups	**N**	$\bar{X}$	**SD**	$\bar{X}$	**SD**	**Mean gain**
Male	14	30.71	16.85	76.14	8.65	45.43
Female	21	31.63	12.74	80.29	7.78	48.66

Table 2 reveals that, the male and female students in the experiment group had a pretest mean achievement scores 30.71 and 31.63 respectively while their posttest mean achievement scores were 76.14 and 80.29 respectively. The pretest standard deviation for male (16.85) and female (12.74) indicates that their responses were far from the mean and from each other. On the other hand, their posttest standard deviation 8.65 and 7.78 respectively indicates that their responses were not too far from the mean and from each other. The mean gain achievement score of female students (48.66) is slightly higher than the mean gain achievement score of the male students (45.43). This shows that both male and female students maintain unequal intellectual level even when they were exposed to the same learning environment and structure.

Testing the Null Hypotheses

Null hypothesis 1

There is no significant difference in the mean achievement scores of secondary school students taught chemistry using video practical method and that of those without video practical method.

Table 3: ANCOVA on the mean achievement scores of chemistry students taught with video practical and demonstration and those taught with conventional method.

Source of sum variation	Df type III of squares	mean square	F	sig.
Corrected Model	21114.907[a]	2	10557.454	66.573	.000
Intercept	59212.675	1	59212.678	373.384	.000
PRETEST	5.531	1	5.531	.035	.852
GROUP	20147.007	1	20147.007	127.043	.000
Error	13321.047	84	158.584		
Total	340952.000	87			
Corrected Total	34435.954	86			

R Squared = .613 (Adjusted R Squared = .604) [a]

The result of the 2-ways analysis of covariance from Table 5 shows that the F-value is 127.043 and the P-value is 0.000. Since the P-value is less than 0.05 level of significance at df of 1 and 84, it shows that there is a significant difference between the mean achievement scores of the control and experimental groups in favour of the experimental group with higher mean score. The null hypothesis is therefore rejected.

Null hypothesis 2

There is no significant difference in the mean achievement scores of male and female secondary school students taught chemistry using video practical method.

Table 4: ANCOVA on the mean achievement scores of male and female chemistry students taught with video-taped and demonstration methods.

Source of Sum variation	Df type III of squares	Mean square	F	sig.
Corrected Model	146.716[a]	2	73.358	.970	.390
Intercept	35485.713	1	35485.713	469.338	.000
PRETEST	2.544	1	2.544	.034	.856
GENDER	142.827	1	142.827	1.889	.179
Error	2419.456	32	75.608		
Total	218952.000	35			
Corrected Total	2566.171	34			

a. R Squared = .057 (Adjusted R Squared = -.002)

The result of the 2-ways analysis of covariance from Table 10 indicates that the F-value is 1.889 and the P-value is 0.179. Since the P-value is greater than 0.05 level of significance at df of 1 and 32, it shows that there is no significant difference between the mean achievement scores of male and female chemistry students who were taught with video-taped and demonstration methods. The null hypothesis is therefore upheld.

Summary of the Findings

The findings of this work are summarized as follows:

1. Experimental group taught the chemistry using video practical method out performed control group taught with conventional method.
2. There is a significant difference in the effectiveness of video practical method and conventional method in enhancing secondary school students' achievement in chemistry.
3. The academic achievement scores of male and female chemistry students who were taught the concepts of chemistry using video practical method do not differ significantly.

4. Gender has no influence on students' science process skill acquisition when taught with video practical and demonstration methods.
5. There is no significant difference in the mean score on TSPS of male and female chemistry students when taught with the video practical and demonstration methods.

Conclusion

The study indicated that video practical method of teaching yielded a more viable result on academic achievement among secondary school chemistry students irrespective of their gender. This experimental group taught chemistry with video practical method, had higher mean achievement scores than their counterpart taught with conventional teaching methods. Also a non-significant gender influence on academic achievement was indicated. Therefore, it was concluded that the use of video practical method enhances the secondary school chemistry students' academic achievement better than the use of conventional method.

Implication of the Study

Based on the findings of the present study, the effectiveness of video practical and demonstration methods of teaching on chemistry students' academic achievement and science process skills acquisition was revealed. This suggest the need for science teachers and chemistry teachers in particular to adopt the use of activity-oriented teaching method that is inquiry-based in chemistry teaching and learning at secondary school level to ensure an improvement in the students' academic achievement and science process skills acquisition. This also implies a likelihood of improvement in performance in chemistry and other related science subjects in "WASSCE" if the students are exposed to video practical and demonstration methods.

Gender did not significantly influence the chemistry students' academic achievement and science process skills acquisition in this present study. By implication, video practical and demonstration instructional methods once implemented will discourage gender stereotyping as it provides equal opportunities for both male and female science students and chemistry in particular to interact with the teachers, amongst themselves and the resources. Consequently, the students' academic achievement and their science process skills acquisition will be even for both male and female.

Recommendations

Based on the findings of this study, and their implications, the following recommendations were made:

1. Chemistry teachers and other science teachers should be encouraged to teach their students using video practical teaching method and discourage the use of only conventional method that are not activity-oriented teaching method alone as the former technique enhance better academic achievement of the students. Therefore it is highly recommended that the use of video practical teaching method should be encouraged in all secondary schools in Anambra state and other states in Nigeria.
2. Video practical teaching method should be used by the chemistry and other science teachers at large to enhance gender equality and to discourage gender stereotyping in teaching and learning of science subjects.
3. The science teachers should acquaint themselves with the skills and principles of video practical method of teaching with a view to enhance the students' academic achievement.
4. The chemistry and other science teachers should structure lessons to provide hands-on activities, with a hope to stimulate students' understanding of science as a process of discovery and acquiring scientific knowledge.
5. Government should sponsor teachers to attend workshops and seminars on the appropriate and effective use of the video practical teaching method in the realization of chemistry and other science subjects' better performance among senior secondary school students in Anambra state.
6. The teacher training institute should train their products on the appropriate use of video practical teaching method so as to keep them abreast with the current development in methodology of teaching.

Limitations of the Study

The researcher experienced the following as a limitation in this study:

The samples used in this study were limited to only SS2 chemistry students of public coeducational secondary schools. Privately owned schools, rural schools and single sex schools were left out in this study, and this limited the generalization of the findings. Also, the conclusion reached about the effectiveness of video practical method in this study, is only limited to concepts of chemical reaction and equilibrium in chemistry.

Suggestions for Further Studies

Based on the findings and limitations of this study, the following suggestions for further research work were made:

1. A replication of this study could be carried out in other science subjects like biology, computer and physics.
2. This study can be replicated using private owned and singled sex schools.
3. Similar study on the effects of video practical method can be carried out on different ability levels of chemistry students.
4. It can also be replicated in other educational zone in Anambra state and other states of Nigeria to see if the same result will be obtained.
5. The effects of students' socio-demographic characteristics on their achievement can be investigated.

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