

ISSN: 2664-3812 (ONLINE)

ISSN: 2664-3804 (PRINT)

Journal

JOURNAL OF EDUCATIONAL RESEARCH ON
CHILDREN, PARENTS & TEACHERS



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ISSN ONLINE: 2664-3812

ISSN PRINT: 2664-3804

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REG. NO.: 2019/368041/08 SOUTH AFRICA

The effects of video-taped instructional strategy on the academic achievement and retention of chemistry students in Lagos State

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Abstract

This research investigated the effects of video-taped instructional strategy on the academic achievement and retention of Senior Secondary 2(SS2) chemistry students in Lagos State. The continuous low academic achievement of students in this core science subject has been of major concern to stakeholders in the education sector in Lagos State in particular. The study adopted an experimental design of pretest – posttest factorial design. The population for this study was made up of 4500 chemistry students in Ikorodu and Kosofe LGAs, while the sample comprised 93 SS2 chemistry students selected through multi staged method. The instrument used was Chemistry Achievement Test (CAT). The instrument was validated by experts in Educational Technology and Measurement and Evaluation while the reliability was derived through a test – retest method. Pearson product moment correlation coefficient r was used to arrive at 0.78. Mean and standard deviation were used to answer the research questions, which indicated that students achieved better when taught with video-taped than conventional methods. On the other hand, t -test was used to analyze the hypothesis, which indicated significant difference between students taught with video-taped and conventional method, amongst others. The study also recommended that video-taped instructional strategies should be used regularly in teaching chemistry in senior secondary schools in Lagos State amongst others.

Keywords: Academic. Achievement. Chemistry. Instructional strategy. Video.

Introduction

Instructional strategies have remained the bane of teachers over the years across the globe as most research findings have reported that this may be contributing to the low academic achievement of students, (Abimbade, 2001; Abubakr, 2001; Kozima, 2005). This phenomenon has resulted to the recent emphasis from teaching by the teacher to learning by the learner. Therefore, instruction ought to be learner-centered rather than teacher-centered. The teachers also need to deduce what their students desire to know, how it is important to their life work and how best they can learn. Students generally have different learning styles; hence the teacher is to identify these learning styles and find the most appropriate instructional strategies that will suit the preferred styles in order to promote effective teaching and learning method in the classroom.

Learning activities usually starts at birth and continue through to the classroom. Formally, learning takes place where facilities and personnel are employed with the aim of preparing all the learners to work as well as participate in the society in which they live. In the same vein, the place of science in national development has been emphasized as opined by Shedrack and Robert (2016). Orukotan (2007) averred that science education has introduced a lot of changes in our world today and will continue to do so in the future. Achievement in science education will go a long way in reducing illiteracy and poverty, which are impediments to national development (Nwachukwu, 2008). Science amongst other inventions contributes to the quality of life in such areas as health, agriculture transportation, material and energy production, and industrial development.

The integration of Information and Communications Technology (ICT) into teaching and learning has engendered positive changes in the educational sector. This has served as a substitute to the diverse methods of teaching, learning, acquisition and use of instruction, training and development, instructional aids as well as sharing of resources (Akinboboye, 2016). This has also offered more opportunities for new teaching methods such as student-centered teaching and provided greater opportunity for teacher-to-teacher, student-to-student and teacher-to-student relationship, (Akinboboye, 2016) This has also ensured provision of and broadening access to new resources, services for teachers and students; thereby strengthening the quality and quantity of education delivery as well as improving the efficiency of education administration and management (Fisseha, 2011).

As a science discipline, chemistry is concerned with compounds composed of atoms, i.e. elements, and molecules, which include their composition, structure, properties, behavior and the changes they undergo during a reaction with other compounds, (Reinhardt, 2001) In the scope of its subject, chemistry occupies an intermediate position between physics and biology (Reinhardt, 2001). This is sometimes called the central science because it provides a foundation for understanding both basic and applied scientific disciplines at a fundamental level. Chemistry as a branch of science has attained a unique position in the school curriculum as an essential part of general education for life. Chemistry enables learners to understand what happens around them and the most interesting aspect of chemistry is that it applies to our daily lives. In order words chemistry is a real-life science subject (Fahmy, 2000).

In Nigeria, the inclusion of chemistry in the curriculum of secondary schools and Technical Colleges of Education has been justified for attracting youths to careers with chemistry options and commended as innovative creating wealth of experiences for the educated citizenry (Igwe, 2002). Chemistry curriculum is designed in such a way as to show inter-relationships between the subject (chemistry) and other science subjects (biology and physics) and to satisfy requirements for senior secondary school programme in the National Policy on Education, (Igwe, 2002). Students are required to learn chemistry by understanding, which demands a mastery of reasoning capabilities of students at the formal operational stage, (Fahmy, 2000). The curriculum content is organized around major concepts of energy, periodicity and structure, which subsumed many other chemical concepts. The objectives of Chemistry curriculum as specified in the Senior Secondary School syllable are:

- a. To facilitate transition in the use of scientific concepts and techniques acquired integrated science (now basic science) with chemistry.
- b. To provide basic knowledge in chemistry concepts and principles through efficient selection of contents and sequencing.
- c. To show inter-relationships between chemistry and other science subjects
- d. To show chemistry and its link with the industry, everyday life, hazards and benefits, and
- e. To provide students not proceeding for higher education with adequate foundation for other future careers (Igwe, 2002).

The teaching of chemistry helps to imbibe scientific knowledge and stimulate science-oriented attitude in learners (Odotuyi, 2012). This attitude when directed to the world of work results in the development of the individual, the society and general standard of living of the citizenry. Therefore, the place of chemistry knowledge and skills in economic and industrial development in the Nigerian society cannot be underestimated, (Odotuyi, 2012). Chemistry goes beyond processes in chemical industries to other industries such as fertilizers, petroleum, paper and pulp, iron and steel, cement, coal, glass, electronics and so on, (Odotuyi, 2012). It plays major roles in the vital sectors of the economy, execution of other professions and improvement of quality life. The acquisition of professional qualification in chemistry equips an individual with skills to be self-employed because chemistry involves the use of process skills which are the paths for ways and strategies followed by the chemist in order to arrive at the products of science, (Falilat & Are, 2017).

Despite the central position of chemistry among science subjects and its importance in sustaining sustainable economic growth and development, the academic achievement of Chemistry students in (SSCE) over the years is not encouraging (Baanu, Oyelekan & Olorundare, 2016). The realization of the goals of chemistry to some extent has been impeded because the achievement of students in the subject remains low in Nigeria (Adesoji & Olatunbosun, 2008). The low academic achievement in sciences especially chemistry in (SSCE) attests to the fact that chemistry teaching and learning and the conditions under which they take place need to be re-examined. In recent times such a re-examination focused on assessing teacher-students' interaction patterns and how this can serve as a source for enhancing students' performance in the subject (Odotuyi, 2012).

Teaching and learning processes are very crucial at all levels of educational development. If well planned and directed, they are the keys to success and progress of an individual. Therefore, best methods must be used in order to enhance effective teaching and learning. It is therefore pertinent to employ the use of audiovisual resources to enhance effective teaching and learning (Ode, 2010). Audio-Visual Instructional method refers to the integration of sound and pictures, which are presented in form of slides and video clips and recorded speech and music, which are visually presented to the students by the teacher. Audio-visual aids are those instructional aids which are used in the classroom to encourage teaching learning process, Singh (2005) defined audiovisual aids as any device which by sight and

sound increase the individual's experience beyond that acquired through reading. Audio-Visual aids are those instructional devices which are used in the classroom to encourage learning and make it easier and interesting.

This study leaned on the constructivist theory as the theoretical framework. Constructivist theory implies that learning is a process whereby learners are actively involved in the process of constructing relevant knowledge. In contemporary terms, Bransford, Brown and Cocking (2000) submitted that learning involves constructing new knowledge and understandings based on what is already known and believed. However, Schunk (2001) quoted in Valcke, (2010: 238) explained that constructivism does not propound that learning principles exist and are to be discovered and tested, but rather that learners create their own learning. This perspective that learners 'create' own learning supports the idea that students bring their own created experiences to the learning process but require adequate support in during the learning process (Simons & Bolhuis, 2004). For us to understand the process, it is necessary to be aware of different ways in which each student learns by establishing what the learner already knows and believes. Within this context, education be a form of dialogue at different levels between educator and students (Fransen, 2006; Laurillard, 2002) which can lead to a co-constructivist approach between the students and teacher (Carnell, 2007). It is therefore important to understand the role of knowledge construction during teaching and learning. When deploying video and considering its educational effect, it can be helpful to keep the constructivist perspective clearly in focus to ensure that the student is assisted in taking an active role in constructing the relevant knowledge (Hattie, 2009). Because by its nature, video viewing is often passive, therefore remains a continual challenge on how to activate the learning process of students in order to stimulate them to construct relevant knowledge from what is presented on screen (De Boer, 2013).

Guo *et al.* (2014) opined that several principles are presented give guidelines in the arrangement and presentation of e-learning materials effectively. Accordingly, words should be synchronized with the relevant graphic (i.e., contiguity principle). Also, words should be presented as audio rather than on the screen as text (i.e., modality principle). While visuals should be explained with words or text, and graphics should support rather than distract from the content (i.e. coherent principle). In the same vein, lesson content should be carefully planned and segmented into more manageable sections. It is obvious that this segmentation, also known as chunking, can lead to better understanding and retention. Video content should take into consideration the aspects of human cognition in learning. How much information, in what format and through which channels (audio/visual) can a student acquire and for what specific learning goals? To learn effectively, a student should be made aware of this process and how they learn.

Educational technologists are of the view that video-taped instruction has high potential in teaching and learning situation (Abimbade, 2001; Abubakr, 2001; Kozima, 2005). Video-taped instruction like some other audio-visual aids can multiply and widen the channels of communication between the teacher and the students (Kozima, 2005). It has the qualities of providing a semi-permanent, complete and audiovisual record of events (Agommuoh & Nzewi, 2003). It is a method that has the potentials of increasing the probability that students will learn more, retain better and thus improve performance. Video-taped instruction reduced abstractions as well as boredom among

students in the classroom and laboratory (Adams, 2011). In the same vein, the benefits of colour, sound and motion attached to video-taped package will be of interest to students who are the target of the study (Bada, 2006). Students could receive individual instruction with videotapes at their own pace, and as when they needed it (Mitchell & Surprise, 2007). It is relevant for both homogenous and heterogeneous sets of learners (Ajayi & Dudan, 2000). It is the commonest, cheapest, and easiest to operate among Information Communication Technology (ICT) gadgets and can be afforded by schools for the purpose of teaching and learning processes (Fowoyo, 2006).

Despite the enumerated advantages, video has been criticized as having some shortcomings. It is considered dominant in instructional setting, as learners in most cases remain passive during the period of receiving instruction that is with little or no involvement (Lendha & Stone, 2002). Several studies indicated that multimedia such as video and computer can improve learning and retention of material presented during a class session or individual study period, as compared to "traditional" lectures or study materials that do not use multimedia (Anyanwu, Gambari & Ezenwa, 2013; Gambari & Olumorin, 2013; Anyanwu, 2013; Gambari, Yaki, Gana & Ughovwa, 2014; Mayer, 2001). A study in Greece reported that primary school pupils taught Physical Education using Multimedia Computer-Assisted Instruction (MCAI) performed better than those that used the traditional approach (Siskos, Antoniou, Papaioannou & Lapidis, 2005). In the study, the effects of four video instructional types were examined, that is, Text + Animation (TA), Text + Narration (TN), Text + Animation + Narration (TAN) and Text Only (TO). In another study, Gambari, Ezenwa and Anyanwu (2013) found that students taught geometry with Animation with Text (AT) performed better than those taught with traditional method. Similarly, on Animation with Text (AT) mode, Yen, Lee and Chen (2012) reported that the group using image-based (animation) concept mapping showed higher level than the text-based group in the dimension of understanding and creating. Similarly, Mahmood (2002) revealed that Computer Assisted Instruction (CAI) involving Animation with Text (AT) and Animation with Narration (AN) improved students' achievement in mathematics. However, Koroghlanian (2000) found that participants in the Text treatments achieved the same as participants in the Audio (narration) treatments on both the practice and post-test. In another study, Jolly (2003) reported no significant differences in the performance level of the students in animation-with text as compared to graphics-with-text when exposed to Life Cycle of a Monarch Butterfly in Biology.

Empirical evidences on Animation and Narration (AN) mode of multimedia are inconclusive. For instance, on Narration with Text (AN) mode, Mayrath (2009) found that students who received the voice-only (narration) tutorial performed significantly better on the transfer test than students who received the text-only tutorial. Gambari, Ezenwa and Anyanwu (2013) reported no significant difference between students taught geometry using animation with narration and those taught using Animation with Text (AT). However, those taught using animation with narration performed better than those taught with traditional method.

Ayogu (2000) stated that when videotape is used to compliment instruction, it can:

- i. Reduce abstractions in class lesson;
- ii. Reduce boredom among students and teacher;

- iii. Conserve the teacher's energy;
- iv. Allow moral learning autonomy among students;
- v. Restructure the learning environment;
- vi. Make learning interesting and motivating to students;
- vii. Minimize the problems of large class size;
- viii. Promotes students' participation in classroom;
- ix. Reduce problem of insufficiency learning resources, and materials;
- x. Encourage individualized learning.

It is important to understand different learning preferences within the student population and it can be helpful to allow them to learn at their own pace (Schwartz, 2013). This can enable content to be provided in a variety of formats other than the traditional classroom setting (e.g., video) with the potential to make learning more accessible to students with different learning preferences. A number of different ways in which students actually view video teaching have been identified. Some students watch the entire video in one go without stopping, some watch it again having already viewed it, some select a part of the video and view it multiple times, and some 'zap' through it skipping from one section to another (De Boer, 2013). This feature is referred to by Laurillard (2002) as self-pacing which provides greater learning control. It is important for teachers using video in their teaching to understand the individual learning patterns of students and how these can impact the effectiveness of learning.

Statement of the problem

In recent years, the level of understanding and commitment of chemistry students as reflected in their academic performance in external examinations has not been impressive over the years, particularly in Lagos state. This has triggered perpetual worries to science educators and especially chemistry teachers because the bulk of the blames of this downward trend in achievement of chemistry students in public examinations has been shouldered on either directly or indirectly on the teachers' poor knowledge of the subject, method of subject delivery, non-commitment and poor dedication to duty. This situation worsens especially at this era of information technology where the use of Global System for Mobil Communication (GSM) by secondary school students has eroded deep into the academic interest of the students. This poor achievement in academics has been confirmed by the analyses of results of the performance of candidates in May/June West African Senior Secondary Certificate Examination (WASSCE) in chemistry from 1999-2016 WAEC (2016). Asiem, Bassey, & Essien (2015); West African Examination Council (WAEC) (2016) reported on the performance of students in West African Senior School Certificate Examination (WASSCE) chemistry from 2014-2016. In these reports, the mean performance score in chemistry essay was 35 in 2014; 36 in 2015; 37 in 2016. In Practical, the mean score in 2014 was 29; 22 in 2015 while in 2010 it was 24 (Asiem, Bassey & Essien (2015). These poor achievements in chemistry are reflected in several other years of the students' performance in external examinations such as WAEC as shown below. The effect of this poor achievement has resulted in backwardness in development of

science related courses in higher institutions, high rate of students drop-out, food insecurity, economic meltdown and others (Igwe, 2002).

Performance of Chemistry Students in WAEC in Lagos State

Year	Total Pass (A1-C6)	Mean Score
2002	47	42
2003	36	30
2005	39	32
2007	46	37
2013	44	39
2014	40	35
2015	42	36
2016	47	37

Source: Research and Statistic Unit, WAEC, Lagos 2016

These repeated poor performances of secondary school students in Chemistry have been attributed to various variables, and research works have also been mounted on most of these variables. But lately, the calls for urgent use of other instructional strategies in teaching Chemistry have been persistent. Hence this work is poised to find out if there exist any effect on the use of videotaped instructional strategy on the academic achievement and retention of Chemistry students in Lagos State.

Research questions

The following research question was used for this study:

- What is the mean difference in the academic achievement of chemistry Students taught with videotaped instruction and those taught with conventional method?
- What is the mean difference in the retention ability of chemistry students taught with videotaped instruction and those taught with conventional method?

Research hypotheses

The following hypotheses were tested at 0.05 level of significance

- There is no significant mean difference in the academic achievement score of students taught chemistry with videotaped instruction and those taught using conventional method
- There is no significant mean difference in the retention of students taught chemistry using videotaped instruction and those taught with conventional method

Research design and methodology

The pretest, posttest factorial design i.e. two levels of instructional strategies – video-taped and conventional were adopted for the study. The experimental and control groups were given the pretest before the treatment. Experimental group 1 was exposed to video-taped instructional design while Experimental group 2 was taught using conventional method.

Sample and sampling procedures

The sample for this study consisted of a total of 91 Senior Secondary 2, (SS II) Chemistry Students. The researcher adopted Multi-staged sampling technique to select the sample from the population of 4,500 Chemistry students in Ikorodu and Kosofe Local Government Areas (LGA) in Lagos State. First, a purposive random sampling was adopted to select 4 Senior Secondary Schools (1 private and 1 public schools) each from the 2 LGA in Lagos State. These four schools were purposively sampled based on infrastructure (laboratories, manpower), gender composition (male and female), school type (private and public), and student's enrollment for WASSCE. Secondly, Intact Class method was used to capture the entire students in SS II Chemistry classes from the selected schools. Two schools (one public and one private) were designated experimental and control groups respectively. Thirdly, simple random sampling was used to assign individual learners to the treatment groups.

Instrumentation

The test instrument used in this study was a self-designed Achievement Test known as Chemistry Achievement Test (CAT). The CAT consisted of a 15 multiple choice objective items adopted from the past Senior Secondary School Certificate Examinations of West African Examinations Council (WAEC) and the National Examinations Council (NECO) questions (from 2005 - 2017). The Chemistry Achievement Test (CAT) was based on SS2 curriculum. The CAT was administered as pre-test and posttest to the experimental and control groups.

Validity

The instrument was face and content-validated by experts in the field of Chemistry Education, Educational Technology and Measurement and Evaluation.

Reliability of instrument

The instrument was face and content-validated by experts in the field of Chemistry Education, Educational Technology and Measurement and Evaluation. To test the reliability of the CAT, a random sample of 20 (SSII) students who were part of the research population but not part of the sample for the study were selected. The test was administered on the pilot sample. The data collected was tested using the test-

retest method. The reliability coefficient of the instrument was 0.78 using Pearson Product Moment Correlation.

Data collection procedures

The researcher visited the four Senior Secondary Schools selected for the study in Ikorodu and Kosofe Local Government Areas of Lagos State, where he briefed and sought permission and cooperation of the school's management to conduct the experiment. There -after, intensive teaching commenced in the four (4) selected schools. The schools were used as both the treatment and control groups. The control groups were taught by the subject teacher using the conventional method (chalk and talk teaching process). An Adapted Video-taped lesson was used to teach the students the Periodic table of elements. The classes used were SS II Chemistry Students. The teaching lasted for one week and the Chemistry Achievement Test (CAT) was administered to the two treatment groups (experimental group 1 and experimental group 2). The tests were marked, and the scores were recorded appropriately. The students were given a retention test 14 days after administering the posttest.

Statistical analysis procedure

The data obtained from the schools were subjected to descriptive statistics using mean and standard deviation. The null hypotheses were tested at 0.05 level of significance using t-test.

Research question 1:

What is the mean difference in the Academic Achievement of Chemistry Students taught with videotaped instruction and conventional method?

Table 1
Posttest Mean Achievement Scores of Students using video-taped and conventional method

Instructional Design	N	Post-test Mean	Std. D	Difference of Means
Video-taped method	43	18.40	1.58	8.20
Conventional method	50	10.20	2.49	

The result in table 1 shows the difference between the Mean Achievement Scores of Students who were taught Chemistry with videotaped instruction and those taught using conventional method. The result shows that the students taught with videotaped instructional strategy had a mean achievement score of **18.40** while those taught with conventional strategy had a mean achievement score of **10.20**. The difference between the mean achievement scores ($x = 8.20$), which infers that students performed better when taught Chemistry with Video-Taped Instructional Design than in Conventional Instructional Design.

Research question 2:

What is the mean difference in the Retention of Chemistry students' academic achievement taught with videotaped instruction and conventional method?

Table 2
Retention test Mean Achievement Scores of Students

Instructional Design	N	Mean	Std. D	Mean Difference
Video-taped method	43	17.72	1.58	9.12
Conventional method	50	8.60	2.19	

The result in table 2 shows difference in retention of students taught in Chemistry with videotaped instruction compared to those taught using conventional method. The result shows that the students taught with videotaped instructional strategy had a mean retention score of **17.72** while those taught with conventional strategy had a mean achievement score of **8.60**. The difference between the mean retention scores ($x = 9.12$) infers that students retained knowledge better when taught Chemistry with Video-Taped Instructional Design than in Conventional Instructional Design.

Hypothesis discussion

H₁: There is no significant mean difference in academic Achievement score of Students taught Chemistry with videotaped instruction and those taught using conventional method

Table 3
T-test table showing mean achievement scores of students in both instructional design

Instructional Design	N	Mean	Std. D	df	t	t crit	P	Remark
Video-taped method	43	18.40	1.58	91	18.35	1.987	0.05	Significant
Conventional method	50	10.20	2.49					

Two-tailed: $p < 0.05$

Table 3 shows the difference in achievement scores of students taught using Videotaped and Conventional instructional design. The table shows that there is significant difference in achievement scores of students taught using Videotaped and

Conventional instructional design. (df = 91; t = 18.35; p<0.05). Based on this result, the null hypothesis is not accepted.

H₂ There is no significant mean difference in retention of Chemistry students' academic achievement taught with videotaped instruction and those with conventional method

Table 4 T-test table showing Mean Retention Scores of Students in both Instructional strategies

Instructional strategies	N	Mean	Std. D	Df	t	t crit	P	Remark
Video-taped method	43	17.72	1.58	91	22.73	1.987	0.05	Significant
Conventional method	50	8.60	2.19					

Two-tailed: p<0.05

Table 4 shows difference in retention of students taught in Chemistry with videotaped instruction compared to those taught using conventional method. The table shows that there is significant difference in mean retention scores of students taught using Videotaped and Conventional instructional design. (df = 91; t = 22.73; p<0.05). Based on this result, the null hypothesis is not accepted.

Discussion of findings

The mean achievement post-test score of students in the experimental group was higher than that of the control group. Thus, there was significant difference in their mean achievement score. Students taught with videotaped instruction performed better than those taught with the conventional method. There was also significant difference in mean retention scores between the experimental and control group. The experimental group taught with videotaped design could produce learning contents better than those with conventional instructional design. This result has established that teaching methods were significant factors on students' achievement in Chemistry. The results of the study was consistent with Akinpelu (2003), Ajelabi (2008), Salawu (2009), Abubakar (2001), Agommuoh and Nzewi (2003) and Osokoya (2007) who indicated that students taught using video-taped instruction performed significantly better in achievement than those taught using the conventional method.

Conclusion

Information Communication Technology (ICT) has resurfaced the quality and quantity of Science delivery in educational institutions. In recent times, the performance of students in Chemistry which is a science of nature and utilization of natural substances and creation of artificial ones have not been impressive due to the method of delivery of the subject in conventional strategy. This research presents the video-taped instructional strategy as a panacea on the on-going performance problems. Students taught with the video-taped instructional strategy achieved better than students taught with the conventional/traditional method. Achievement was greatly improved by the

use of video-taped instructional approach in teaching Chemistry. From the above results, it is obvious that Video-taped instructional design is more effective than the conventional strategy. It is more effective for the cognitive and attitude development of the students than the conventional method as there is a significant difference in the achievement score of both groups. Video-taped instructional strategy helps to develop higher order cognitive skills and appeal the student psyche towards learning. It can thus be concluded that the use of animations, sound, and video and audio clips makes the lessons attractive and affective.

Recommendations

The following recommendations are advanced from this study:

- For students' better academic achievement and positive attitude development, Video-taped instructional strategy should be used in teaching of Chemistry
- Multimedia Infrastructure should be provided to schools for teaching of Chemistry in secondary schools
- Chemistry teachers should practice the use of viewing programmes on video-tapes as part of their teaching methods
- Chemistry curricula should be tailored toward Video-taped instructional strategy which moves us toward the constructivist approach of learning in which learner plays an active role in the teaching and learning process
- Authors of Chemistry textbooks and publishers should lay emphasis on the use of video-tape instruction in their textbooks
- Ministries of Education, School Management Boards as well as professional educational bodies should arrange seminars, workshops and conferences on the training of Chemistry teachers on the use of video-taped method in the Nigeria secondary schools.

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Acknowledgements

Management of the Journal of Educational Research on Children, Patents and Techers (JERCPT), wishes to thank colleagues who spent time to review articles appearing in this medium edition of JERCPT. Your contributions through your objective and constructive comments, surely helped in improving the quality of the papers appearing in this volume.

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